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Protection of peri-urban open spaces at the level of regional policy-making: Examples from six European regions

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ABSTRACT

Peri-urbanisation is a dynamic process consisting primarily of the expansion of artificial areas into natural, semi-natural, and agricultural areas. This process reduces peri-urban open spaces, thus it is threatening peri-urban biodiversity and hampers the provision of ecosystem services. In this manuscript, we introduced the concept of peri-urban open spaces and exemplified it on the level of regional policy-making in the following six European case study regions: Basque Country (Spain), Flanders (Belgium), Gorenjska (Slovenia), Hajdú-Bihar (Hungary), Mazovia (Poland), and Saxony-Anhalt (Germany). Our study aimed (1) to analyse land cover changes related to peri-urban open spaces in the case study regions, (2) to identify and classify policy improvements that are useful to protect peri-urban open spaces, and (3) to provide recommendations for regional policy instruments to improve the protection of peri-urban open spaces. We designed a mixed-method approach combining Geographical Information Systems, an explorative questionnaire, and a semi-quantitative survey to fulfil our research aims. Our results showed that peri-urban open spaces are decreasing in all case study regions but with different scale and dynamics over time. Mostly (non-irrigated) arable land was transformed into non-peri-urban open space. Moreover, we identify 15 policy improvements that are suitable to support the protection of peri-urban open spaces at the level of regional policy-making. Our results indicated a potential for improving the regulatory instruments and showed the usefulness of multi-level governance that better address the protection of peri-urban open spaces at regional level. Using our research results, we provided recommendations for regional policy-makers who are willing to pay more attention to the protection of peri-urban open spaces.

1. Introduction

Urbanisation is globally increasing due to population growth and demographic change (Grimm et al., 2008). Along with urbanisation, also peri-urbanisation (PU) is taking place that affects even a greater extent of landscapes and creates different challenges of policy-making. PU continuously increases urban and other artificial land cover in Europe (EEA, 2019). Between 2000 and 2006, more than 1000 km^2 of land in the European Union (EU28) was used for urban expansion indicated by new housing, industry, roads, or recreational purposes. Between the years 2012 and 2018, 539 km^2 of land was taken for these purposes. In a projection until 2030 (baseline 2010–2030) by the European Observation Network for Territorial Development and Cohesion (ESPON), an increase in urban areas is especially foreseen for Poland, Netherlands, United Kingdom, Spain, southern France, and central Italy (EEA, 2016). Currently, highest rates of sealed land with more than 5% of the national terrestrial surface are the Netherlands, Belgium, Germany, and Luxembourg (EC, 2013). Sealing the soil limits the exchange of energy, water and gases, which can have a negative impact on the ecological functions of the soil (Glæsner et al., 2014).

In our manuscript, we are referring to PU as a process of establishing peri-urban landscapes (PULs) – transitional territories that are not yet urban and not fully rural, combining rural with urban pecularities (Spyra et al., 2020), that cannot be addressed from the perspective of the classic urban-rural dichotomy (Simon, 2008). Similarly to the definition of landscape in European Landscape Convention (ELCs), PULs are resulting from “the action and interaction of natural and /or human factors” (Article 1, point a, Council of Europe, 2000). Even if in this

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manuscript, the process of PU has been investigated in the context of European countries, this process is also observed in other geographical zones, such as the Global South (Butsch and Heinkel, 2020).

PU is a process of expansion of artificial areas into untilled (open) areas, accompanied with diverse socio-economic transformations, taking place beyond urban fringes (Zasada et al., 2011). According to the European Environmental Agency (EEA) the most significant drivers of PU are related to the development of (1) construction sites, (2) industrial and commercial sites, (3) mines, quarries and dump sites, (4) housing, services and recreation, and (5) transport infrastructures (EEA, 2019). Many of these developments are fostered by the migration of urban dwellers from cities to peri-urban areas (Zasada et al., 2011) and the intention of people to increase their quality of life by moving into or using amenities of peri-urban areas (Simon, 2008). For example, people assume that peri-urban areas have better air quality, higher personal safety and lower prices of land (Nilsson et al., 2014; Woltjer, 2014). Nevertheless, this constituent of PU is also pertinent for the development of sub-urban, outlying, and peripheral areas at the fringe and outskirt of cities. Overlaps among those processes are the topic of an on-going scientific debate (Žlender, 2020). Furthermore, changing social patterns of cities foster PU (Butt and Fish, 2016). Other important drivers are related to direct or indirect incentives that encourage PU (Nilsson et al., 2014) like foreign investments along with "pro-investment" public policies (Zhao, 2012). These are only a few examples of global socio-economic drivers of PU, which includes as well limited access to dwellings in metropolitan areas (Butt, 2013). Recent research underlines that PU is multifaceted and related to a combination of different driver types like socio-economic, political, or even technological drivers (Plieninger et al., 2016; Shaw et al., 2020).

Using the land cover perspective, PU is indicated by dynamic land cover changes (LCC) mainly from forests, semi-natural areas, and agricultural areas to artificial land (Siedentop and Fina, 2010). Those processes foster the emergence of PULs. Current debates on the delimitation of PULs go beyond classical variables related to land use / land cover and population size or density. For example, Gonçalves et al. (2017) pointed out that delimitations of PULs need to be based on a transdisciplinary process that is linking physical, social, economic and personal aspects (different views of PU governance actors). A similar approach was developed by Žlender (2020) who characterised governance actors in PULs.

We refer in our manuscript to regional policy-making as the governance level addressing the whole extent of PULs. The regional level has the best potential to cover the complexity of PUL, as it includes several properties particular to a regional community in their administrative boundaries. Moreover, strong regional policy-making and planning have the capacity to prevent uncontrolled PU (Nilsson et al., 2014) and stimulate a balanced relationship between social needs, economic activities and the environment as requested in the ELC (Council of Europe, 2000).

The main aim of the study is to analyse peri-urban open spaces (PUOS) that are often neglected in policy-making on regional level. Policy-makers on regional level often focus either on rural or urban oriented actions and ignore or undervalue open spaces (PURPLE, 2017). The transitional character of PULs, related for instance to intensive LCC, hampers the effectiveness of policies addressing pressures on open spaces (Spyra et al., 2020). Therefore, investments in PULs tend to be unsustainable over time, and do not properly take into consideration the real capacities of these spaces to contribute to biodiversity conservation and ecosystem services (ES) provision. Knowledge related to LCC of PUOS and regional policies addressing PUOS comes from diverse research fields and describes diverse examples of PULs. Experiences related to regional policy instruments applicable to PUOS are also not yet well described. Such experiences are "owned" by the regional policy-makers who are directly responsible for the design, implementation, review, and agenda setting of regional policies.

With our paper, we intend contributing to close this knowledge gap with the following research objectives:

(1) to analyse LCC related to PUOS, exemplified in six European regions,
(2) to identify and classify policy improvements that are useful to protect PUOS at the level of regional policy-making,
(3) to provide recommendations for regional policy instruments to better tackle the protection of PUOS based on our results.

1.1. Peri-urban open spaces

New developments in PULs that are taking place at the urban fringe at the edge of build-up areas (Wandl and Magoni, 2017) encourage a more in-depth analysis of non-artificial parts of these areas to understand their dynamics towards transformation and contribution to biodiversity and ecosystem services of PULs. Particularly, PUOS are of high interest as they form places of highest land-use conflicts and pressures. Krasnowiecki and Paul (1961) and Bryant et al. (1982) were probably the pioneers in conceptualising PUOS. Bryant et al. (1982) have introduced the term of city's countryside looking at it as a complex environmental system comprising natural, economic, cultural, social, and political dimensions. Those authors provided considerations related to the need for management, use, and functions of open spaces located in city's countryside. Moreover, several concepts equivalent to the PUOS concept have been described that are related to the conceptualisation of open spaces in the extent of "rural-urban fringes" (e.g. Friedberger, 2000) or acknowledging the urgent need to protect open spaces in metropolitan areas (Krasnowiecki and Paul, 1961).

The term of PUOS is used in the scientific literature in different ways. For example, recent studies like Žlender and Gemin (2020) discussed peri-urban green spaces from the perspective of people's sense of place. Sun and Shao (2020) talked about quantification of visitor satisfaction toward peri-urban green and open spaces, and discussed the challenges related to policy-making of peri-urban green and open spaces. Hersperger et al. (2020) addressed the issue of growth management and its effect on diminishing open spaces in the peri-urban context.

PUOS from a philosophic perspective can be considered as areas of open space and the concept of "open" or "non-open" space seems to be interlinked with how humans perceive landscapes (Lindenmayer, 2009). Humans may think that something that tends to be "open" has the capacity to be "filled". Filling of open spaces is often related to converting them into artificial surfaces like urban fabric, or transportation units. Thus an "open space" is a non-build-up area (e.g. recreational area, forest, farmland), where the "natural" environment is dominant (both biotic and abiotic elements of it) and where the level of anthropogenic intervention still allows ecosystems to function and landscape values to be present (Maruani and Amit-Cohen, 2007).

However, in our research we decided to focus on the understanding of PUOS which can be more useful and practical for policy-makers and allows a delimitation and spatial analysis of PUOS on regional scale. In this respect, we prepared the delimitation of PUOS based on land cover classes, as described in the Method section of this manuscript. Similar approaches were implemented to, e.g., delineate patterns of urban built-up and open spaces (Pauleit and Duhme, 2000).

1.2. Negative effects of peri-urban open spaces diminishment and degradation of ecosystem services and biodiversity

PUOS provide many important services for citizens, for example,

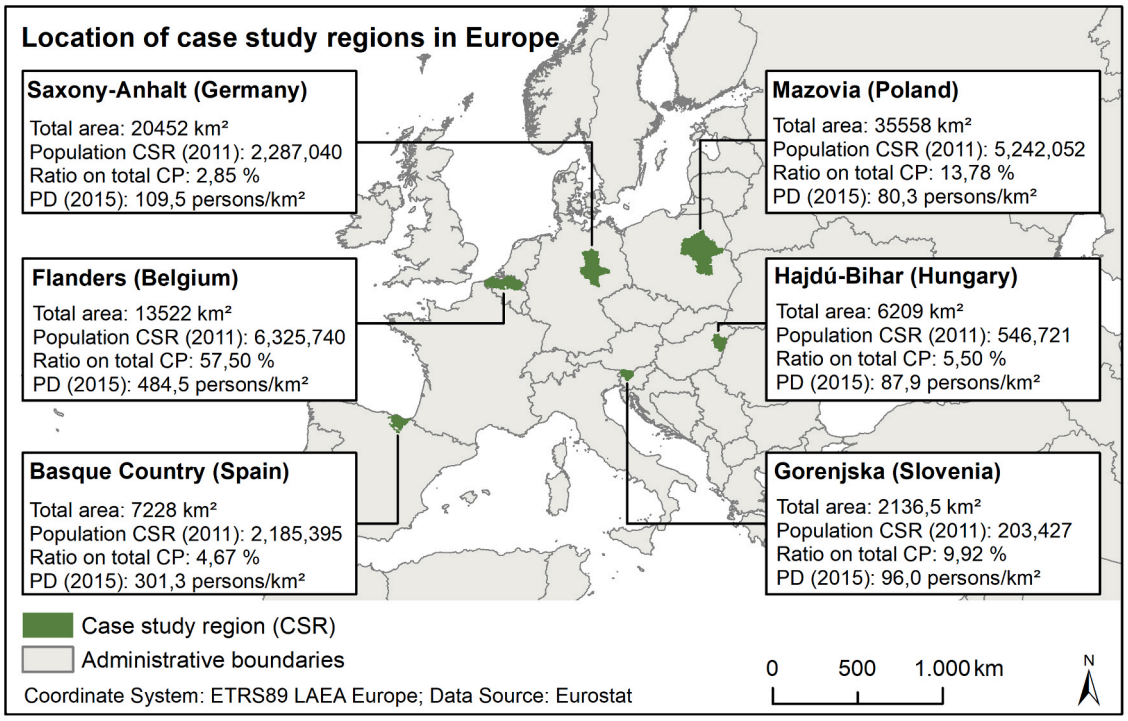

Fig. 1. Location of the case study regions in Europe and characterisation of the case study regions (CSR); explanation of abbreviations: CP = Country Population, PD = Population Density.

fulfilling recreational demands and providing space for leisure activities (Maruani and Amit-Cohen, 2007). Those services contribute to social, environmental, economic, and human health aspects of landscape sustainability (Jennings et al., 2012; Nutsford et al., 2013; Wandl and Magoni, 2017). PU and the associated LCC, land take, and land degradation are significantly affecting biodiversity and causing habitat loss and fragmentation of peri-urban ecosystems, therefore affecting the capacity of PUOS to provide different services and endanger landscape sustainability. For example, in 2015, 30% of the EU's land was highly fragmented due to urban sprawl and land use intensification, which had negative effects on different services provided by PUOS (EEA, 2019).

At the same time, the demand for PUOS services is growing with increasing human population and consumption (Carpenter et al., 2009; Yachi et al., 1999). People are stressed by the noise, heat, and hustle of cities. The reduction in peoples stress levels is often associated with the accessibility to urban green spaces (Maller et al., 2005; White et al., 2013; van den Berg et al., 2010). In order to comply with such needs, policies related to PUOS need to ensure the provision of ecosystem services (Vejre et al., 2010). PUOS provide many urban ecosystem services (ES), e.g. air pollution control, noise reduction, above-ground carbon storage, water and temperature regulation (regulating ES), food (provisioning ES), leisure activities (cultural ES) (Bolund and Hunhammar, 1999; Haase et al., 2012; Maller et al., 2005), and can provide even food in the form of urban gardening (provisioning ES) (Bendt et al., 2013; Spilková and Vágner, 2017). ES contribute with economic and non-monetary values to human benefits, and therefore to human well-being (Haines-Young and Potschin, 2010). Consequently, LCC and soil sealing are affecting key aspects of human life (MEA, 2005), and the way in which global earth systems function, e.g. global climate regulation (Lambin et al., 2001). PU provokes environmental and health risks which are reflected in increasing societal costs (Scalenghe and Marsan, 2009). For example, a study performed by the Flemish government shows that societal costs increase if buildings are more dispersed in the landscape (Department Omgeving, 2019). A study by Dutta (2012) shows that PU increases the costs of permanent crops and pastures due to fragmentation of landscapes, which is problematic for PULs inhabitants. This confirms that PU has negative effects on farming activities. However, there is no conflicts between the protection or management of PUOS and farming.

Landscape fragmentation is mentioned in the literature as being the most serious ecological threat to biodiversity (Brückmann et al., 2010; Forman, 2008; Selva et al., 2011; Qviström, 2017). Many species cannot maintain viable populations in small patches, thus fragmentation leads to local extinction (Krebs, 2008; Piqueray et al., 2011). In addition, loss of habitat decreases species richness and diversity (Bogyó et al., 2015). The reduction of open spaces in PULs or fragmentation of such spaces fosters the development of new edges in PULs. It has significant consequences for landscape functioning, particularly for the protection of natural heritage of PULs (Lindenmayer, 2009). For example, many researchers observe a weed invasion as a direct effect of new edges introduced in the heavily disturbed landscape (Krebs, 2008). Actions, incentives, and regulations are required to protect PUOS in order to halt the loss of biodiversity and to maintain ES.

1.3. Policy instruments

A policy instrument (PI) represents a specific measure, available for different governments, which is used to implement specific policy objectives (Howlett, 1991). In the context of the European Union and according to the definition provided by the manual of the INTERREG Europe Programme (INTERREG Europe, 2019; p. 38) "a policy instrument is a means for public intervention. It refers to any policy, strategy, or law developed by public authorities and applied on the ground in order to improve a specific territorial situation. In most cases, financial resources are associated with a policy instrument. However, an instrument can also sometimes refer to a strategy or legislative framework with no specific funding".

Scientific literature has described various ways of classifying PI. A popular classification of PI is related to three basic types: (1) sticks, which are highly choice constraining, (2) carrots that are moderately choice constraining, and (3) sermons that consider and facilitate free choices (Bemelmans-Videc et al., 1998; Jordan et al., 2003). Three

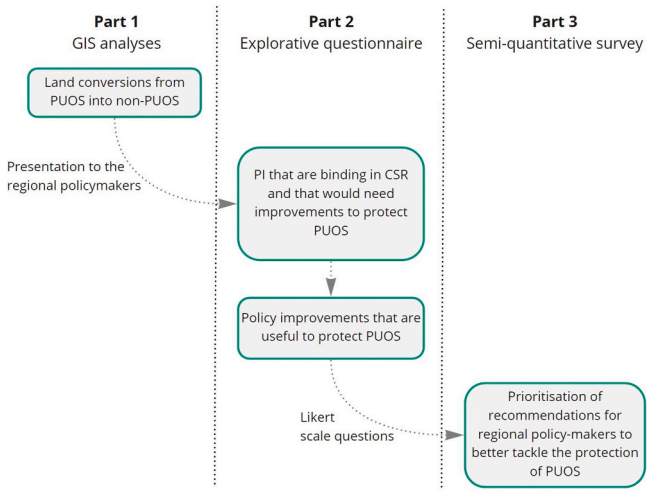

Fig. 2. Methodological framework of the study. PI = Policy Instrument; PUOS = Peri-Urban Open Space; GIS = Geographical Information Systems; CSR = Case Study Region.

general groups of policy instruments, which are often discussed in the literature (Jordan et al., 2011; Ring and Schröter-Schlaack, 2011; Sterner, 2003), are: (1) regulatory instruments that aim to directly control specific aspects related to particular space (e.g., land use zoning), (2) economic instruments, including market-based instruments that are related to economically oriented approaches (e.g., taxes, charges or fees, emission trading schemes), and (3) informational and motivational instruments aiming at raising awareness and educating social actors in order to give them a free choice related to specific issues. This group of instruments is leaning to non-regulatory instruments that is the contrast to traditional command-and-control regulations, and towards voluntary agreements, where governance actors commit themselves to specific actions on a voluntary basis (Zito et al., 2011). Such PI are characteristic for "new modes of governance" (Jordan et al., 2011). Recently, the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) provided a classification of PI that expands the above mentioned three types into four types: (1) Legal and Regulatory Instruments, (2) Rights-Based Instruments and Customary Norms, (3) Economic and Financial Instruments, and (4) Social and Cultural Instruments (IPBES, 2020a).

A combination of different policy instruments is required to foster effective governance and decision-making of PUOS. As stated by the White Paper on European Governance, this could be a combination of various forms of legislation, programmes, guidelines, and use of structural funds (COM, 2001). Such a combination is called a "policy mix" and defined by Ring and Schröter-Schlaack (2011; p. 15) as a "combination of policy instruments which has evolved to influence the quantity and quality of biodiversity conservation and ecosystem service provision in public and private sectors".

2. Case study regions and methods of the study

2.1. Case study regions

The selection of case study regions (CSR) was dependent on the availability of representatives of policy-makers at the stage of preparing an INTERREG Europe project application. The policy-makers had an interest in the protection of PUOS and have been affiliated to specific regions in the European Union (hereafter, "the regional policy-maker"). This approach gave us the opportunity to collect first-hand knowledge and policy experiences related to PUOS in those regions, obtained from local policy-maker and experts. Moreover, the CSR are located in different parts of the European Union, differ in size and population (Fig. 1), as well as vary in the dynamics of PU. That gave us the possibility to cover and analyse different characteristics of European PULs. However, it was not our aim to directly compare the selected regions among them. Regional policy-makers were affiliated to the following regional institutions that are located in our CSR (in brackets): University of the Basque Country (Basque Country, Spain), Flemish Land Agency (Flanders, Belgium), BSC, Business Support Centre, Ltd., Kranj (Gorjenska, Slovenia), Hajdú-Bihar County Government (Hajdú-Bihar, Hungary), Agencja Rozwoju Mazowsza s.a. (Mazovia, Poland), and the Ministry for Regional Development and Transport of Saxony-Anhalt (Saxony-Anhalt, Germany). Each institution was either directly responsible for the PI (Belgium, Hungary and Germany) or was endorsed by those institutions that are responsible for the PI (Poland, Slovenia and Spain).

During implementation of this research, representatives of the CSR became partners in the INTERREG Europe project RENATUR that gave us additional opportunities to further explore aspects of policy-making in those CSR.

2.2. Methods

2.2.1. Methodological framework of the study

Our research was implemented in three parts and was based on a mixed-method approach using in sequence (1) Geographical Information Systems (GIS), (2) an explorative questionnaire, and (3) a semi-quantitative survey (Fig. 2). We performed a GIS-based analysis to show the dynamics of PU and to analyse the need for the protection of PUOS (Part 1 in Fig. 2). Before starting the explorative questionnaire (Part 2 in Fig. 2), the initial results of GIS analyses were shown to the regional policy-makers to better visualise the spatial configuration of PUOS and the reduction of PUOS in their region over time. Later, the semi-quantitative survey was conducted between September 2018 and November 2019 (Part 3 in Fig. 2). The survey contained 15 policy improvements to better protect PUOS at the level of regional policy-making that were mentioned by the regional policy-maker in Part 2.

2.2.2. Delimitation method of peri-urban open spaces

Our delimitation method of PUOS was based on CORINE Land Cover classes (CLC). According to it, PUOS are non-built-up, mainly non-sealed, terrestrial areas located in PUL, while land use is not related to the following land cover classes based on CORINE Level 2: urban fabric (1.1); industrial, commercial and transportation units (1.2); mine, dump and construction sites (1.3) (CLC, 2018). We refer to non-PUOS for the remaining land cover classes.

2.2.3. Part 1: GIS analyses

The LCC in the six CSR were illustrated for the time periods 1990–2000, 2000–2006, 2006–2012 as well as for 2012–2018 and were analysed afterwards. The administrative boundaries were provided by Eurostat (2016 version). CORINE land cover (CLC) and land cover change data (CHA), produced by the European Environmental Agency (EEA), are used together with the respective nomenclature to determine the LCC in each region (for details, see https://land.copernicus.eu/pan-european/corine-land-cover). The five major groups of level 1 are: (1) artificial surfaces, (2) agricultural areas, (3) forests and semi-natural areas, (4) wetlands, and (5) water bodies. Land cover data for the separate time periods were clipped with the administrative boundaries of the respective CSR.

For the visualisation of the changed land cover types, we have created a transition matrix using the tool *intersect* in ArcMap 10.7.1. The tool calculated a geometric intersection of the input features, which in this case were the land cover types detected for the year 1990 and 2018, respectively. Which means that the matrix only includes land cover data from 1990 and 2018, but does not contain data from 2000, 2006 or 2012. The output feature class contains all features or parts of features that overlap in the given feature classes.

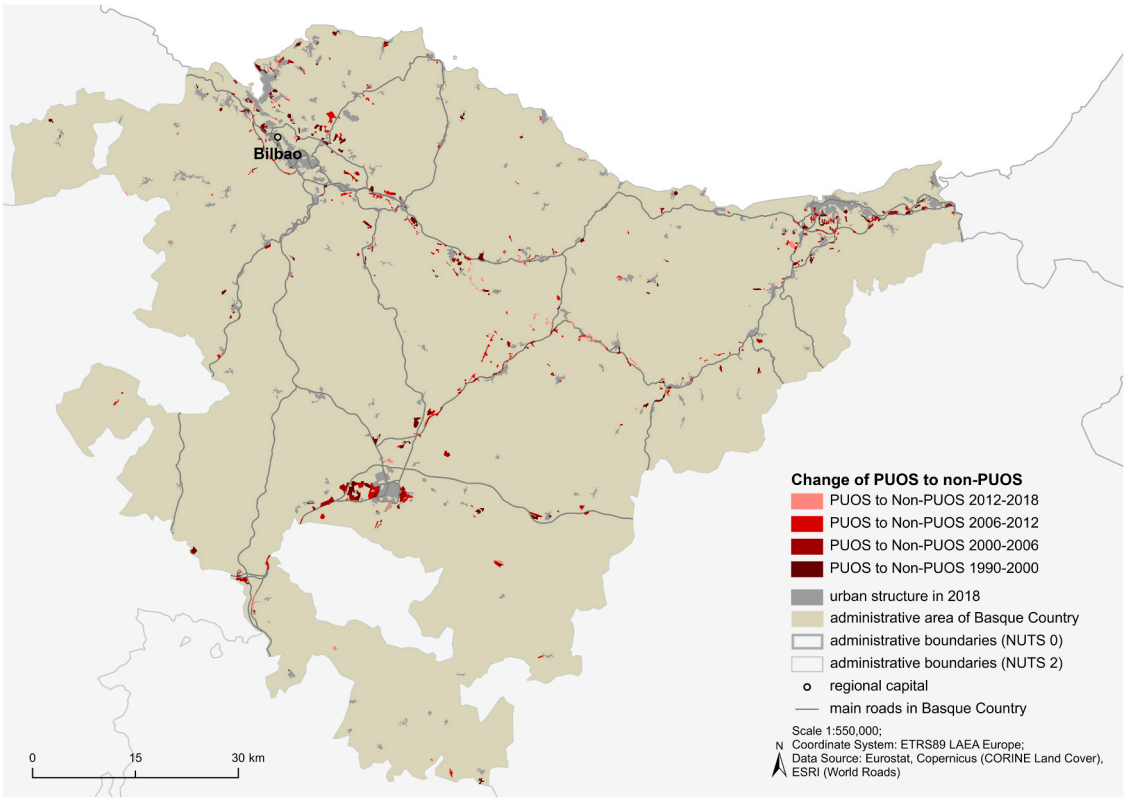

Fig. 3. Land cover changes of peri-urban open spaces to non-peri-urban open spaces in Basque Country (Spain) between 1990 and 2018.

2.2.4. Part 2: explorative questionnaire

This part covers the explorative questionnaire with regional policy-makers affiliated to the respective CSR. They were contacted online between April and May 2018. The regional policy-makers were asked to characterise the PI related to their region, propose changes in the described PI in order to improve the protection of PUOS at the regional level, and the manner in which these changes could be implemented (the list of questions is presented in the Appendix Table 1A).

The explorative questionnaire allowed us to identify (1) PIs that are binding in the CSR and that would need to be improved to better protect PUOS and (2) policy improvements that were useful to protect PUOS at the level of regional policy-making (Part 2 in Fig. 2). Finally, the policy improvements were classified according to IPBES and previous PIs classification. By a "policy improvement", we designated the name of a paradigm, solution or tool that could be implemented at the level of regional policy-making (in our case, to improve the protection of PUOS).

Following input from the "support policy" section of IPBES, our policy improvements can neither be directly classified as a PI (IPBES, 2020a), nor as a policy support tool and methodology[1] (IPBES, 2020b). However, the discussed policy improvements could be usable to support either specific types of PI or a policy support tool and methodology. To show their usefulness for this, we classified the policy improvements according to three criteria: (1) type of applicable PI, (2) family of applicable policy support tools and methodologies and (3) type of policy improvement (Fig. 6). Each of the policy improvement was visualised as a frame. The colour of the frame represents a type of policy improvement. Size of the frame and its location in the matrix express which type of specific policy improvement could feasibly support which family of policy support tools and methodologies, and type of policy instruments. For the preparation of this classification, we checked each policy improvement according to its feasibility to support the types and families described below.

(1) Type of applicable PI: we implemented the approach presented by Barton et al. (2014), and Ring and Schröter-Schlaack (2011). Therefore, three main types of PIs were selected: (a) regulatory instruments (including direct regulations), (b) economic instruments (including economic [dis-]incentives), and (c) informational and motivational instruments (including facilitation of self-regulation).

(2) Family of applicable policy support tools and methodologies: we adopted the detailed approach proposed by IPBES, which addresses the direct issues of nature protection, management and planning and is therefore, close to our topic of PUOS protection (IPBES, 2015, 2020a, b). IPBES distinguishes seven families of tools and methodologies:

F1 Assembling data and knowledge (including monitoring),
F2 Assessment and evaluation,
F3 Public discussion, involvement and participatory process,
F4 Selection and design of policy instruments,
F5 Implementation, outreach and enforcement,
F6 Training and capacity building, and
F7 Social learning, innovation and adaptive governance.

(3) Type of policy improvement: we used the approach presented by Geneletti et al. (2017) proposing three types of policy improvements. The policy improvements are presented here in a cascade, from the most general to the most detailed:

[1] Policy support tool and methodology according to IPBES definition are "approaches and techniques based on science and other knowledge systems that can inform, assist and enhance relevant decisions, policy-making and implementation at local, national, regional and global levels to protect nature, thereby promoting nature's contributions to people and a good quality of life." (IPBES glossary https://ipbes.net/glossary/policy-support-tools)

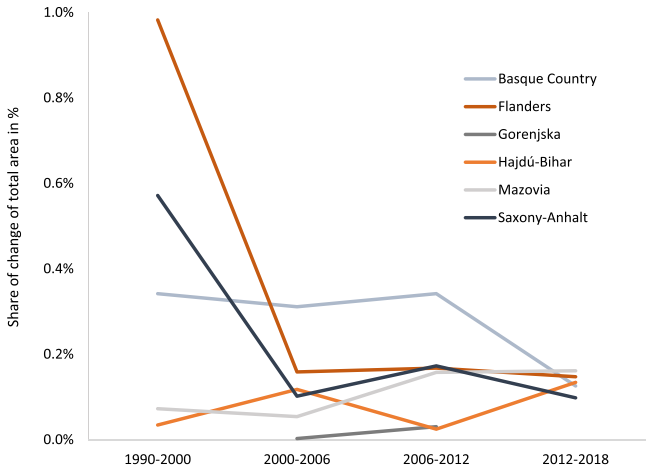

Fig. 4. Change of peri-urban open space (PUOS) to non-PUOS as share of total area of the specific case study regions.

a) Policy paradigms: description of the overall approach, which is (or could be) applicable to policy-making that simultaneously address specific issues (e.g., governance or transport), or existing concepts (e.g., the ES concept),
b) Strategies and solutions: description of policy actions that addresses specific issues (e.g., housing policies), or policy paradigms (e.g., implementation of the ES concept), and
c) Operational methods and tools: description of methods and tools applied to operationalise strategies and solutions (e.g., specific tools aiming to implement land use zoning in a more flexible way), or to assess strategies and solutions (e.g., assessment frameworks).

2.2.5. *Part 3: semi-quantitative survey*

Closed questions in a Likert-scale between 1 and 5 were used for the semi-quantitative survey (1 = "the policy improvement is not relevant at all" and 5 = "the policy improvement is highly relevant"). The survey was filled in online by the regional policy-maker in Google Forms. After that process, several thematic sessions were organised at different international scientific conferences and workshops related to PU and governance between April and October 2019 in order to collect more data. In this case, the survey was conducted (optionally anonymous) paper-based. The full list of thematic sessions is presented in Table A2. In order to complete the sessions, scientific workshops titled "Innovative environmental governance for sustainable peri-urban landscapes" were organised in Halle (Germany, June 2019) and in Ostrava (Czechia, November 2019).

3. Results

3.1. *Part 1: GIS analyses*

Our analyses showed that in all CSR land conversion from PUOS to non-PUOS is taking place but on different scales and with different dynamics (Fig. Appendix 1A, 2A, 3A, 4A, 5A). In general, changes in our CSR occurred primarily close to urban structures (CLC classes 111 and 112), or along main roads. Exemplified in Fig. 3, LCCs in the Basque Country related to changes from POUS to non-PUOS mainly occurred along the roads and in proximity to economic centres such as Bilbao, Donostia - San Sebastian, and in the southern Basque Country around Vitoria-Gasteiz as the administrative capital of the Basque Country. LCC along the road can also be observed for Mazovia (Fig Appendix 4A). In addition, changes from PUOS to non-PUOS are mainly located around Warsaw. Land conversion in Flanders and Saxony-Anhalt were rather scattered over the region. Larger and recently converted plots are located in Flanders in proximity to the seaside. Land conversion in Hajdú-Bihar were only a few but larger plots mainly located around the regional capital Debrecen. LCC in Gorenjska were only marginal.

We observed differences for PUOS transformed into non-PUOS in the CSR in different time spans (Fig. 4). Highest land conversion from PUOS to non-PUOS occurred between 1990 and 2000 in Saxony-Anhalt and Flanders. For all CSR, the share of LCC from PUOS to non-PUOS has been reduced. Lowest land conversion over the time span was observed for Gorenjska.

The share of PUOS that has been converted into non-PUOS in the CSR in the different times spans is shown in Fig. 5. Mostly, (non-irrigated) arable land has been transformed into non-PUOS in Saxony-Anhalt, Hajdú-Bihar, and Mazovia. In the Basque Country and Gorenjska, a major share of converted land use types is related to forest. Between 2000 and 2006, only forest was converted in Gorenjska. In Basque Country, also the share of converted pastures is high. In Flanders, especially the share of heterogeneous agricultural areas is high; mainly reflected by complex cultivation patterns. However, looking at the share of the total amount of the land cover type in the respective CSR between 1990 and 2018, heterogeneous agricultural areas have been converted mainly in Mazovia and Hajdú-Bihar (Table 1). Major reductions were also related to green urban areas, and sport and leisure facilities (level 2, CORINE class 14: artificial, non-agricultural vegetated areas) where the highest reduction is shown in Saxony-Anhalt with 31.49%. In the Basque Country, 17.11% of this land use type (level 2, CORINE class 14) was converted to non-PUOS. Minor reductions have been taken place for the land cover type forest.

3.2. *Part 2: qualitative survey with regional policy-makers*

Six PIs were identified (one per CSR) which address PUOS at the level of regional policy-making:

(1) Basque Country: European Regional Development Found (ERDF) Regional Operational Programme 2014–2020,
(2) Flanders: Section 5 on the Act of Land Development (28 March 2014 – published in Belgian Official Gazette 22 August 2014) concerning re-parcelling by virtue of law with zoning exchange,
(3) Gorenjska: Operational programme for Implementation of Cohesion policy 2014–2020,
(4) Hajdú-Bihar: Regional Development Programme of Hajdú-Bihar County 2014–2020,
(5) Mazovia: Regional Operational Programme of the Mazowieckie Voivodeship 2014–2020 (Regional Operational Program (RPO) Mazovia), and
(6) Saxony-Anhalt: ERDF Operational Program Saxony-Anhalt 2014 – 2020, Priority 4 Preserving and protecting the environment and promoting resource efficiency, Investment priority 6e, objective 11: Reducing the soil, sealing of cities through stimulation of inner urban development, and redevelopment of brownfields.

All questions and answers of the survey with regional policy-makers are presented in the Appendix Table A3 and A4.

By analysing the results of the survey, we identified 15 policy improvements which could be useful to protect PUOS at the level of regional policy-making (Fig. 6): (1) Expanding the awareness of the ecosystem services concept in different governance actors groups; (2) Re-parcelling plots; (3) Changing land use zones designated in plans, specifically applicable for wrongly designated zones; (4) Developing

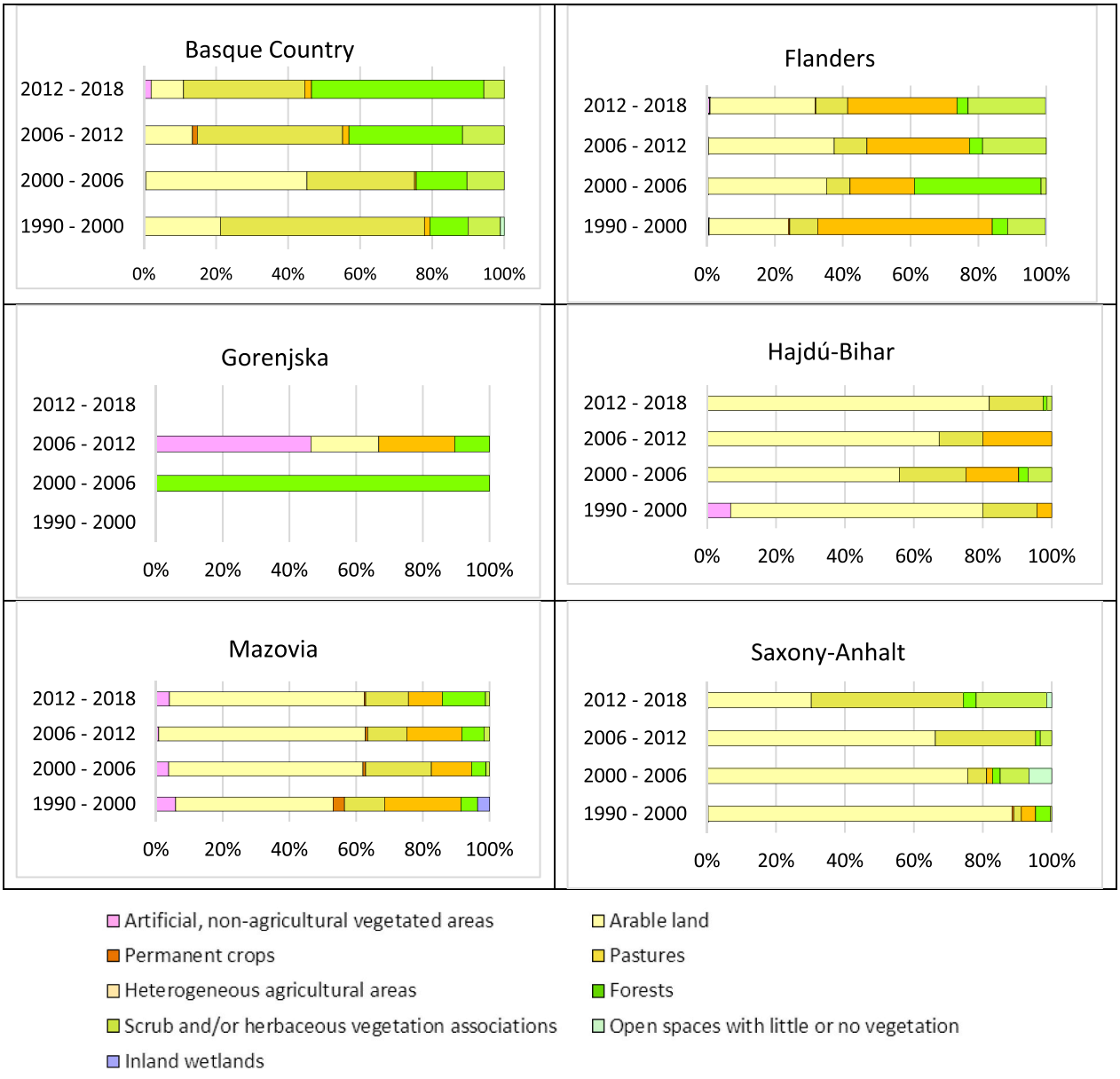

Fig. 5. Share of peri-urban open space (PUOS) converted into non-PUOS in the case study regions.

Table 1
Transition matrix describing the change (%) from peri-urban open space (PUOS) to Non-PUOS in the case study regions from 1990 to 2018. Reduction of the land cover type in the total case study region of > 10% is highlighted in bold.

CORINE Land cover types, level 2	Class	Basque Country	Flanders	Gorenjska	Hajdú-Bihar	Mazovia	Saxony-Anhalt
Artificial, non-agricultural vegetated areas (sport and leisure facilities, green urban areas)	14	**17.11%**	2.22%	**13.58%**	6.29%	**13.13%**	**31.49%**
Arable land	21	6.05%	0.87%	4.66%	0.67%	2.41%	1.84%
Permanent crops (vineyards, fruit trees and berry plantations)	22	2.69%	0.97%		0.96%	1.71%	6.73%
Pastures	23	9.56%	0.93%	2.10%	0.83%	1.15%	1.27%
Heterogeneous agricultural areas (e.g. complex cultivation patterns, agro-forestry areas)	24	1.93%	2.09%	4.84%	9.70%	**16.02%**	5.83%
Forests (broad-leaved, coniferous and mixed forest)	31	0.80%	0.68%	0.19%	0.24%	0.34%	0.56%
Scrub and/or herbaceous vegetation associations (e.g. natural grasslands, moors and heathland)	32	1.89%	3.04%		0.21%	0.75%	0.60%
Open spaces with little or no vegetation	33	0.12%	1.44%	0.02%		1.47%	
Inland wetlands	41		0.13%		0.50%		0.11%
Maritime wetlands	42	3.51%					

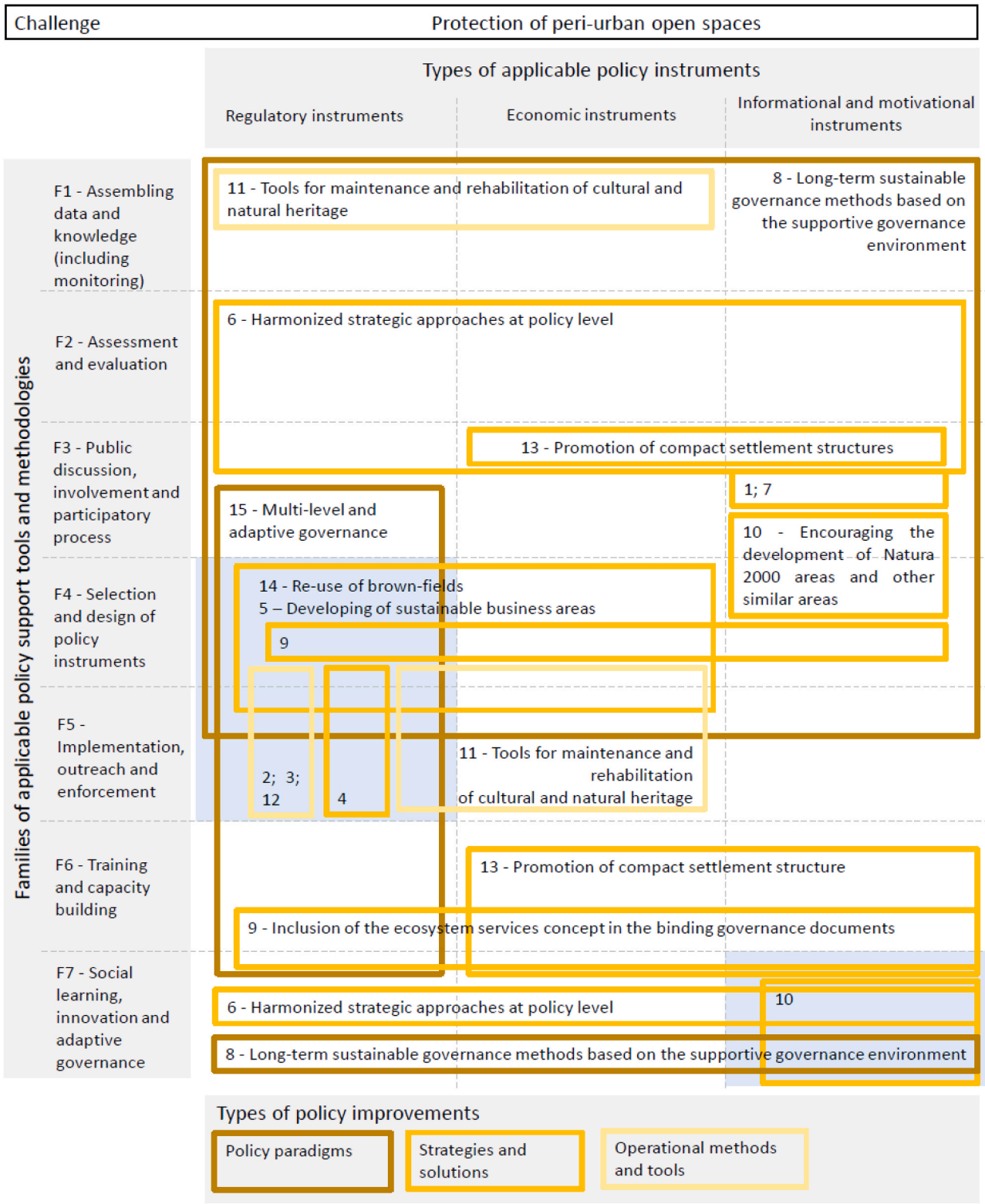

Fig. 6. Classification matrix of the identified policy improvements. Location of a frame with a number and name of a specific policy improvement describes for which category of policy support tools and methodologies (axis y) and for which type of policy instrument (axis x above) it could be supportive (for name of policy improvement, see the numbered list in sub-Section 3.2). Blue squares mark the clusters of policy improvements. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.).

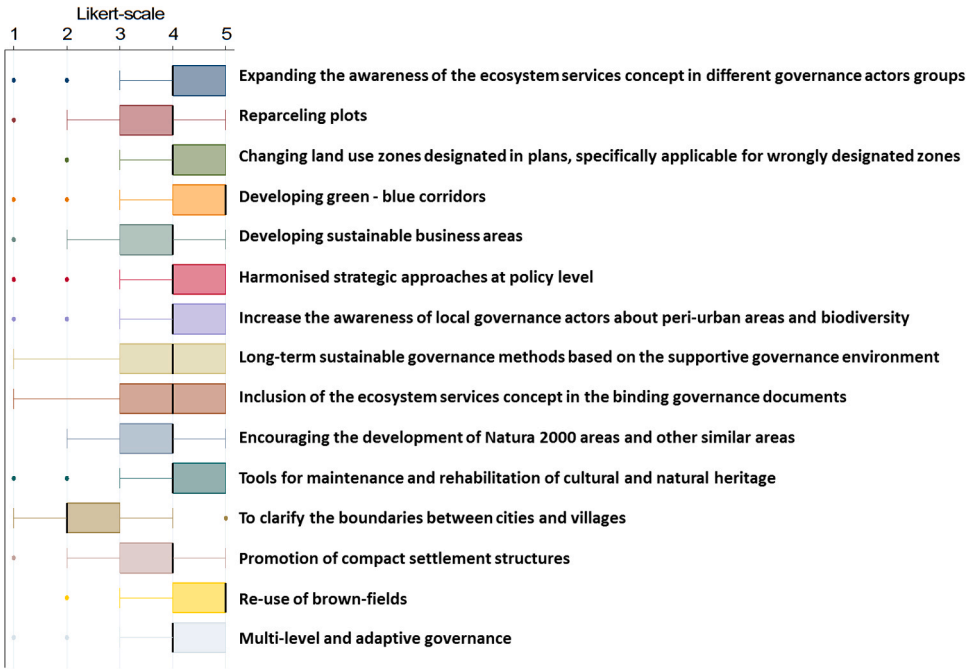

Fig. 7. Frequency distribution of replies for each of the policy improvement. Median values are shown in black and bold. Likert-scale: 1 = "the policy improvement is not relevant at all" and 5 = "the policy improvement is highly relevant".

green - blue corridors; (5) Developing sustainable business areas; (6) Harmonised strategic approaches at policy level; (7) Increase the awareness of local governance actors about peri-urban areas and biodiversity; (8) Long-term sustainable governance methods based on the supportive governance environment; (9) Inclusion of the ecosystem services concept in the binding governance documents; (10) Encouraging the development of Natura 2000 areas and other similar areas; (11) Tools for maintenance and rehabilitation of cultural and natural heritage; (12) To clarify the boundaries between cities and villages; (13) Promotion of compact settlement structures; (14) Re-use of brown-fields; and (15) Multi-level and adaptive governance.

Even though most of the names of policy improvements are self-explanatory, we provide further explanation for policy improvement no. 2 and no. 3. "Re-parcelling plots" (policy improvement no. 2) is a tool that allows to exchange the properties assigned to parcels and to reorganise the smaller parcels into a bigger one. "Changing land use zones designated in plans that are specifically applicable to wrongly designated zones" (policy improvement no.3) is a tool which allows to change the designated usage of a specific part of land which is outdated into a more sustainable usage. Policy improvements no. 2 and 3 were proposed by the regional policy-maker from Flanders and correspond to several tools from the toolbox described in the Flemish Parliament Act of Land Development (Flemish Land Agency, 2014).

According to Fig. 6, each of the 15 policy improvements can be considered as at least one of the three types of policy instruments. Our classification shows two larger clusters of policy improvements (indicated in light blue in Fig. 6). Nine of the policy improvements (no. 2, 3, 4, 5, 9, 11, 12, 14 and 15) have the potential to be applicable for regulatory PI and could support the selection, design of new PI (family 4), as well as the implementation, outreach and enforcement of existing PI (family 5). Five of the policy improvements (no. 6, 8, 9, 10, 13) have the potential to be applicable for informational and motivational PI and could support social learning, innovation, and adaptive governance (family 7).

3.3. Part 3: semi-quantitative survey

This section presents the main results from the semi-quantitative survey conducted during the last part of the study. The collected data show that the majority of the identified policy improvements is predominantly considered to be "relevant" or "highly relevant" (Fig. 7). In particular, according to the frequency distribution, the policy improvement no. 12 "To clarify boundaries between cities and villages" emerged as the least relevant one, with 21.9% of the experts defining it as "not relevant at all". The policy improvements no. 4 "Developing green-blue corridors", no. 14 "Re-use of brown-fields", and no. "15 Multi-level and adaptive governance" were considered as most relevant with respectively the 59.76–52.44% - 48.78% of experts responding "5 = highly relevant" for these policy improvements.

4. Discussion

4.1. Land cover changes related to PUOS

Our delimitation approach of PUOS allows to reflect on LCC related to PUOS that are one of the most significant consequences of PU and that often stimulate policy and planning changes (Nuissl and Siedentop, 2021; Shaw et al., 2020). Moreover, this approach matches with the classification by Walz and Stein (2014) who separated the land cover classes according to hemeroby levels. Hemeroby shows the degree of human influence on land. In Walz and Stein (2014), discontinuous urban fabric, mineral extraction sites and dumpsites are polyhermerobic areas with very strong human impact. Continuous urban fabric, industrial or commercial units, road and rail networks, and associated land are metahemerobic areas with excessively strong human impact. Our definition has also similarities to the land take indicator by EEA (2019) because it is also based on CORINE data. The land take indicator includes areas that we have defined as non-PUOS but also "green urban areas" and "sport and leisure facilities" which we have classified as

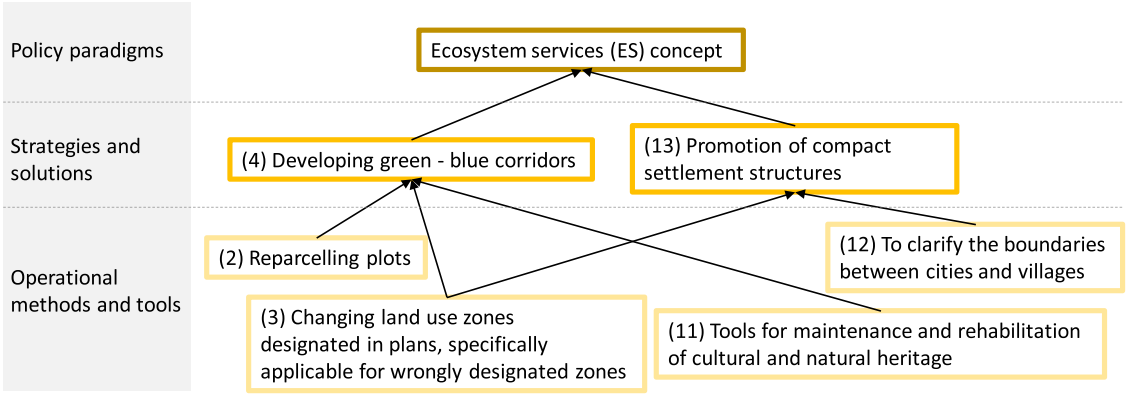

Fig. 8. Cascade figure showing the relations between different types of policy improvements identified in our study using the ecosystem services concept as example.

PUOS. This approach to PUOS delimitation can also be transferred to Functional Urban Area (FUA) data provided by Eurostat. In this case, areas that are not related to artificial surfaces can be described as PUOS. However, FUA data do not cover the whole extent of our case study regions and, therefore, we did not use this approach.

Aside from the specific approach that was implemented in our research, several other studies identified LCC as main component of the PU in the European context (Lennert et al., 2020, Shaw et al., 2020, Tavares et al., 2019). Similar to this fact, land conversion from PUOS to non-PUOS was observed for all CSR in our study, even though only marginal changes were visible on regional scale in Gorenjska. The LCC maps showed monocentric as well as polycentric patterns of PU. In monocentric patterns, LCC of PUOS to non-PUOS are clustered close to the dominating city in the CSR. In a polycentric pattern, LCC of PUOS to non-PUOS are clustered around main cities and along existing infrastructures (transportation infrastructures and already urbanised areas; for further reading, e.g. ESPON, 2005). For Mazovia, the monocentric PU patterns were obvious since the region and the country is centralised towards the capital city of Warsaw. PU pressure occurs in the fringes of the capital city. Grochowski et al. (2013) confirmed that the municipalities along the main transportation roads to Warsaw experience the highest level of urbanisation pressure. Mainly agricultural area was converted for housing and service. Population growth was caused by migration because Poland changed during the 1990s from an industry-oriented to a service-oriented economy where the national headquarters moved to Warsaw as capital (Grochowski et al., 2013; Nilsson et al., 2014). LCC in Mazovia – as well as in Hajdú-Bihar - could have been also related to the transition from socialist planning to market-oriented economy (Cegielska et al., 2018).

As seen in Fig. 1, Flanders and the Basque Country have the highest population densities among the CSR besides Mazovia. Population growth is a major pressure on PUOS (Fertner et al., 2016; Poelmans and Van Rompaey, 2009). However, patterns of LCC related to PUOS are different since changes in Flanders are rather scattered, while in the Basque Country development is oriented along the main transportation network, concentrated close to the main cities and also limited by the hilly and forested landscape. Land use in the Basque Country changed in the 1990s after an economic crisis in which the industry and the service sector evolved considerably in this region. Different scientific and technological centres have been strengthened. Rural areas have been transformed to small cities that are interconnected by large-scale infrastructure (Palacios-Agundez et al., 2013). In addition, development has taken place around Vitoria-Gasteiz as it is the administrative capital of the Basque Country (Aguado-Moralejo et al., 2013). Flanders has been densely populated already for a long time, which led to continuous growth of urban centres like Ghent and Antwerp and a growing infrastructural network between the scattered centres leading to further fragmentation of the landscape (Antrop, 2004). LCC of PUOS to non-PUOS are distributed in a highly polycentric way or even equally distributed in this CSR that might be also related to the plain landscape where development can spread into all directions. In Saxony-Anhalt, the largest change from PUOS to non-PUOS can be observed between 1990 and 2000. The German reunification (1990) could be one of the reasons for this development that caused an increasing demand for housing and infrastructure especially near urban centres (Prieler et al., 1996). Nevertheless, the LCC of PUOS to non-PUOS remained polycentric in this CSR. For Gorenjska, literature could not reveal the reasons behind the slow development but the local policy-maker from this region reported that the financial crisis in 2012–2013 (COM, 2020) could have caused a loss of markets and lack of regional investments. Our own observations, confirmed by discussions with local policy-makers, lead to the conclusion that PU in Gorenjska region takes place mainly along transport infrastructural line from Austria to Ljubljana (the capital of Slovenia). This fact has the negative influence on the protection of local PUOS. Moreover, the policy-makers from Gorenjska informed us that the LCC related to PUOS might be observed more in detail on local scale e.g. in communes Bohinij and Škofja Loka. They further mentioned that in those communes POUS are endangered mainly due to intensive tourism activities (e.g. new parking places for tourists, new commercial infrastructures aiming to serve tourists, increasing yearly number of PUOS visitors). Nevertheless, such detailed scale was out of the scope of this research.

The share of the LCC from PUOS to non-PUOS has shown that mainly (non-irrigated) arable land was affected in our CSR, which is in line with the findings of the EEA where mainly agricultural areas were affected by land conversion (EEA, 2019; García-Martín et al., 2021). However, looking at the total share of this land cover type per region, considerable reductions were only seen in the Basque Country. The analysis of the reduction per PUOS of the total land cover per CSR has shown that mainly green urban areas, sport and leisure facilities, and heterogeneous agricultural areas (mainly complex cultivation patterns) were affected by land conversion. Even though green urban area, and sport and leisure facilities belong to artificial surfaces, they are of great value for human health and well-being (Braubach et al., 2017).

4.2. *Recommendations for the regional policies to better protect PUOS*

Landscape protection, as defined in ELC, encompasses "(…) actions to conserve and maintain the significant or characteristic features of a landscape (…)" (Article 1, point d, Council of Europe (2000)) as the measures to preserve the "open" character of PUOS. Even if PUOS are not always protected areas as such, several authors addressed the problem of effective nature conservation outside protected areas (Sepp et al., 1999), particularly in rapidly urbanising areas (Xun et al., 2017) and they see it as important issue to stop, e.g., the extinction of species outside protected areas (Boakes et al., 2019). Furthermore, as shown in

our results, transformation of PUOS into non-PUOS is still taking place in CSR. To stop or at least to slow down this unsustainable process, we assert that a better protection of PUOS is needed. Thus, we focus on PUOS "protection" because we argue that a stronger term than "management" of PUOS is needed.

Looking beyond definitions and theories, reality of policy-making is much more complex (Colebath, 2006). We have realised that the results of part 2 and 3 of our study do not conform directly to the existing classifications of either policy instruments, or policy support tools and methodologies. Nevertheless, we argue that it is possible to show the usefulness of the policy improvements to different types of policy instruments, and policy support tools and methodologies. Based on this, it will be possible to provide useful recommendations on how to improve the protection of PUOS at the level of regional policy-making.

The potential to use the policy improvements in governance practices is illustrated in a cascade figure (Fig. 8), which shows the relation between identified policy paradigms, strategies and solutions, and operational methods and tools using the example of the ES concept paradigm.

Our results indicate a large potential for improving the regulatory instruments, which can better address PUOS protection because the largest group of policy improvements was classified as usable for these types of policy instruments (Fig. 6). This finding is in line with Wästfelt and Zhang (2018) who confirmed a positive influence of regulatory instruments into the protection of PUOS related to agriculture. On the other hand, regulatory instruments can also foster PU and reducing PUOS as demonstrated by Christensen (2019) for housing decentralisation in China.

Concerning the "families of applicable policy support tools and methodologies", we identified four of these families with the largest amount of assigned policy improvements. Two clusters can be created from these four families. The first cluster contains F3 (Public discussion, involvement and participatory process) and F7 (Social learning, innovation and adaptive governance). This indicates the need for a more effective dissemination of the PUOS concept and, related to this concept, implications for landscape sustainability and well-being of region inhabitants to wider groups of governance actors. This could be used as backbone supporting adaptive governance concerning to PUOS. Another cluster is composed from F4 (Selection and design of policy instruments) and F5 (Implementation, outreach and enforcement). This shows the potential for careful improvements of the design and implementation phases of policy-making (Perrin et al., 2018), particularly in the context of agro-environmental balance and regeneration in PULs (Cattivelli, 2020).

Important for our recommendations is the policy improvement no. 15 related to multi-level and adaptive governance for the protection of PUOS that was highly ranked by the respondents. Implementation of this policy improvement offers the shift into intersecting and flexible jurisdictions, characteristic for multi-level governance (Hooghe and Marks, 2003), which conforms well to the transitional character of PULs and PUOS (Spyra et al., 2020). This can lead policy-making of PUOS into non-hierarchical, horizontal and polycentric directions. In addition, it can foster the move from the "command and control" type of governance towards the situation where the policy-makers and the governing bodies are rather setting the objectives and supporting the resources acquisition (Peters and Pierre, 2001). In such a system, the role of negotiations among governance actors becomes more important. Literature studies show growing interest in approaches of multi-level governance. Even if it is difficult to find articles that directly address multi-level governance in PULs, some thoughts that originally are related to multi-level governance in metropolitan contexts could be also adopted to aspects of PUOS protection. For example, the implementation of multi-level governance could increase the resilience of PULs and PUOS (Frey and Ramírez, 2018), or could contribute to the required shift in framing PUOS as socio-ecological rather than socio-economical spaces. This as such could highlight ecological aspects for circular and regenerative economy (Frank and Marsden, 2016). Nevertheless, the successful implementation of multi-level governance in the context of PULs and PUOS requires well-designed and planned inter-municipal cooperation (Leck and Simon, 2018). A recognition of barriers on a local scale and coordination across all levels of governance is needed to overcome obstacles that could be disturbing in the multi-level governance of PUOS (Juhola, 2016).

The impact of the thematic policies should be taken into account in order to increase the efficiency of PUOS protection policies (Jann and Wegrich, 2007). For instance, the respondents especially appreciated the policy improvements no. 1, 4, 9, and 10. Policy improvement no. 4 "Green-blue corridors" is among the highest rated in our study. All these policy improvements relate to ecological approaches towards policy-making. This could indicate that nature protection policies could strongly support the protection of PUOS. This aspect is pertinent, even if our results show that mostly agricultural areas as PUOS were transformed into non-PUOS. This is because agricultural areas are both recognised as important part of PULs (Zasada, 2011) and as important land use type for ES and biodiversity (Pérez-Campaña and Valenzuela-Montes, 2015). To be effective, approaches of nature conservation and biodiversity protection need to address agricultural areas in a wider spatial context, meaning agricultural areas and adjoining territories like PULs (Calvache et al., 2015). The requested protection of biodiversity supports the protection of arable land. Both, i.e. reduction of arable land and loss of biodiversity, are strictly related to the dynamics of PU and both could be limited by implementing policy improvement on the regional level. Addressing this topic has a significant importance because PU will result in a significant loss of very productive cropland, particularly in the agrarian economies of the Global South (Bren d'Amour et al., 2016).

It is important to mention that policy-making concerning the protection of PUOS needs to acknowledge not only the aspects of the physical development of PULs but also socio-economic changes and different flows (including also the ecological ones) that take place between urban and rural landscapes (Dávila et al., 1999).

An interesting policy improvement that was highly rated by our respondents is the re-use of brownfields (no. 14), as an example of infill development and as an approach towards the protection of PUOS. In the CSR Saxony-Anhalt, the land development law (LEntwG LSA, 2015) at paragraph 10 stipulates that the operating mining company should have sufficient financial reserves to pay for the consequential costs of mining. This includes the redevelopment of former mining landscapes. Incentives to encourage new investments into brownfields rather than into PUOS reduce the pressure on existing PULs, thus supporting the protection of PUOS (Smith, 2010). In addition, Genske (2003) identified - based on a study by Grimski, Doetsch and Rüpke (1998) - that the remediation of a brownfield in the region of Dresden was financially better than the land conversion from a green area to industrial area.

In that sense, strategies of "land recycling" need to be developed to demolish unusable buildings and to redevelop sealed surfaces (Genske, 2003). The Urban Redevelopment Programme of Germany also set standards for the design of open spaces even though these standards are often implemented at the minimum level (Mathey and Rink, 2020). Funding for demolition is often not available (Bernt, 2009) even though building companies should be more obliged to restore sealed wasteland to its near-natural state. This financial and organisational burden could demotivate investors and encourage them to think twice about soil sealing. However, it is often the burden of the government, or at a public-private partnership approach, to finance the remediation (Genske, 2003).

On the other hand, clarification of boundaries between cities and villages (policy improvement no. 12) is not seen as a valuable improvement by our survey respondents, despite on-going considerations concerning to foundations and evolution of rural planning (Scott et al. 2019). There are different approaches distinguishing between urban and rural areas, thus allowing to delimitate boundaries between

them. One of the most well-known is the one adopted by the Organisation for Economic Co-operation and Development (OECD, 2018). Dependence of the urban-rural boundary delimitation on the used methodology could point out that urban-rural boundary might be understood as being "fluid/flexible". That fact could influence policy making related to PUOS protection. Nevertheless, in the context of our study, jurisdictional overlaps between different administrative bodies (e.g. communes) seems not to hamper much the protection of PUOS. Despite that, it is important to acknowledge that the issue of cooperation between municipalities remains an important factor for sustainable governance for the whole extent of PULs (Nuhu, 2019) and for the multi-level governance as such. It could result in significant governance gaps, if the issue of cooperation between municipalities is not addressed in peri-urban policy-making.

An important aspect is how to avoid the possible risks related to the protection of PUOS. Preventing new investments in PULs could lead to the reduction of commercial investments that potentially provide new employment opportunities in the region and could lead to the loss of competitiveness of the region on the national, or international scale (Turok, 2004). This is in particular pertinent for developing regions and countries where "pro-investment" is still the main asset for decision-makers and for some citizens. Therefore, there might occur a trade-off between the need of PUOS protection and the necessity and political pressure for regional development.

Even if infill development has been promoted for some time as one of the tools for protecting open spaces (Dieleman and Wegener, 2004; Wolff and Haase, 2019), there is still rather limited knowledge on what kind of practical results this policy tool could bring in the context of PU (Kamal and Proma, 2017) and how effectively it could directly protect PUOS. On the other hand, in the wider context of PULs in Flanders, densification of existing clusters of commercial and housing investments in PULs is used as a policy tool to prevent new investments in PUOS (Vermeiren et al., 2018). As described above, specific incentives for densification of urban brownfields are planned in Saxony-Anhalt. Concerning to the risks related to infill development, it has to be mentioned that this tool could (not necessarily must) go hand in hand with, the process of gentrification that is questionable from the perspective of landscapes sustainability (Rose, 2004). Moreover, health risks could emerge in urban areas where infill development is implemented at the expense of urban open spaces, that represent spots of nature in the city (Haase et al., 2018). Such spots of nature provide for urban inhabitants a minimum access to greenery (Chiroma et al., 2018) and, therefore, to several important ES for health and well-being (Prahalad et al., 2019). Nature-based solutions could contribute to solve this problem (Bush and Doyon, 2019).

Our study does not provide direct answers related to governance / policy actors who would need to be involved in the process of a better protection of PUOS. Nevertheless, based on the results, we could acknowledge that families F3 and F6 and the policy improvements that fit to those families could support process of selecting pertinent governance actors for the protection of PUOS. Other studies pointed out the transition character of PULs and the variety of governance actors involved in policy-making and planning (Spyra et al., 2020). For this reason, and due to often conflicting interests of peri-urban governance actors, policy-making should not be implemented in the closed cycles of "elite" policy-makers. Rather extensive feedback loops that are able to inspire new policies or the redefinition of the existing policies are necessary (Howard, 2005). Effective policy-making concerning PUOS will require a larger consultation involving several experts. In this situation, a wider social engagement is required from policy-makers like in similar processes of policy-making (Janssen and Helbig, 2018).

4.3. Pros and cons of the research methods

The main achievements of this study are related to the identification of possible policy improvements that can be implemented for the protection of PUOS. In particular, the classification matrix of policy improvements (Fig. 6) can be converted into a practical tool for policy-makers that are interested in developing more efficient policies towards the protection of PUOS. Moreover, this matrix could be used to classify other types of policy improvements that focus on different policy challenges. The combination of GIS analyses and surveys allowed us to get a richer picture of the dynamics in the context of PUOS from an interdisciplinary perspective (natural and social sciences; qualitative and quantitative approaches). The comparison of LCC concerning PUOS in different regions of Europe provided an overview and confirmed that this is an emerging topic and needs to be investigated in different socio-economic and spatial contexts. This comparison was possible due to the use of CORINE data. The CORINE Land Cover database has the advantage of being both coherent and comparable in all EU countries (Buttner et al., 2004). Nevertheless, some uncertainties are related to the CORINE data set regarding spatial resolution being higher than 25 ha. This could lead to possible misclassifications related to smaller patches. In addition, the LCC observed constant change over time in CSR.

In the transition matrix (Table 3), the percentage change revealed the magnitude of the LCC detected in the CSR. The findings represent relevant information for further analyses of affected land cover types and related intensities. From the point of view of Part 2 of the study methods, a very challenging constraint dealt with the availability of data in line with its tenets and purposes. Due to the specificity of the topic and the lack of relevant and pertinent (secondary) data to be consulted for our analysis, an explorative approach was chosen. In addition, there might be some uncertainties related to data gathered by the survey that have caused limited reproducibility and robustness. The results of the semi-quantitative survey could be biased due to potential misunderstandings of the respondents regarding the specific names of policy improvements, even though these names were explained before the survey and any related question or doubt raised by respondents was answered and/or clarified.

5. Conclusion

Our concept of PUOS and non-PUOS is useful for highlighting LCC related to diminishing open spaces in PULs, thus enabling a better understanding of the impact of land take on the sustainability of PULs. This definition overlaps with the hemeroby concept that characterises land cover classes belonging to non-PUOS as areas of strong, very strong or excessively strong human impact.

LCC related to PUOS showed a different dynamic and spatial pattern in CSR. Nevertheless, the process of PUOS diminishing remains a policy and planning problem, which still needs to be addressed. The basis for such study needs to be juxtaposed with the careful delimitation of PULs, distinguishing between PUL as a larger territory and peri-urban areas that can be also located inside PUL.

Our study showed the potential for improving regulatory instruments to better address PUOS protection at the regional level. Furthermore, multi-level governance as a policy paradigm is appreciated to address PUOS protection despite its recent criticism. The clarification of boundaries between villages and cities was not considered to be important for the protection of PUOS by our respondents even if PUOS can stretch over several administrative boundaries between urban and rural landscapes. It is important to harmonise different thematic policies that are related to PU to improve the protection of PUOS at the

level of regional policy-making. Furthermore, there is a need to take into account the different flows and dynamics at different levels of policy-making between urban and rural landscapes. Policies that address the protection of the natural environment can take a leading role in such "policy bundles". In general, policy improvements need to be targeted towards more flexible and adaptive policies that are result-oriented and not only focus on theoretical solutions.

CRediT authorship contribution statement

Marcin Spyra: Conceptualization, Supervision, Methodology, Writing – original draft, Writing – review and editing, Investigation, Visualisation, Project administration. **Janina Kleemann**: Writing – original draft, Writing – review and editing, Methodology, Formal analysis, Investigation. **Nica Claudia Calò**: Writing – original draft, Writing – review and editing, Formal analysis, Investigation. **Alina Schürmann**: Writing – review and editing, Formal analysis, Visualization. **Christine Fürst**: Supervision, Funding acquisition.

Declaration of Interest Statement

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Appendix A

See Figs. 1A–5A.
See Table 1A–4A.

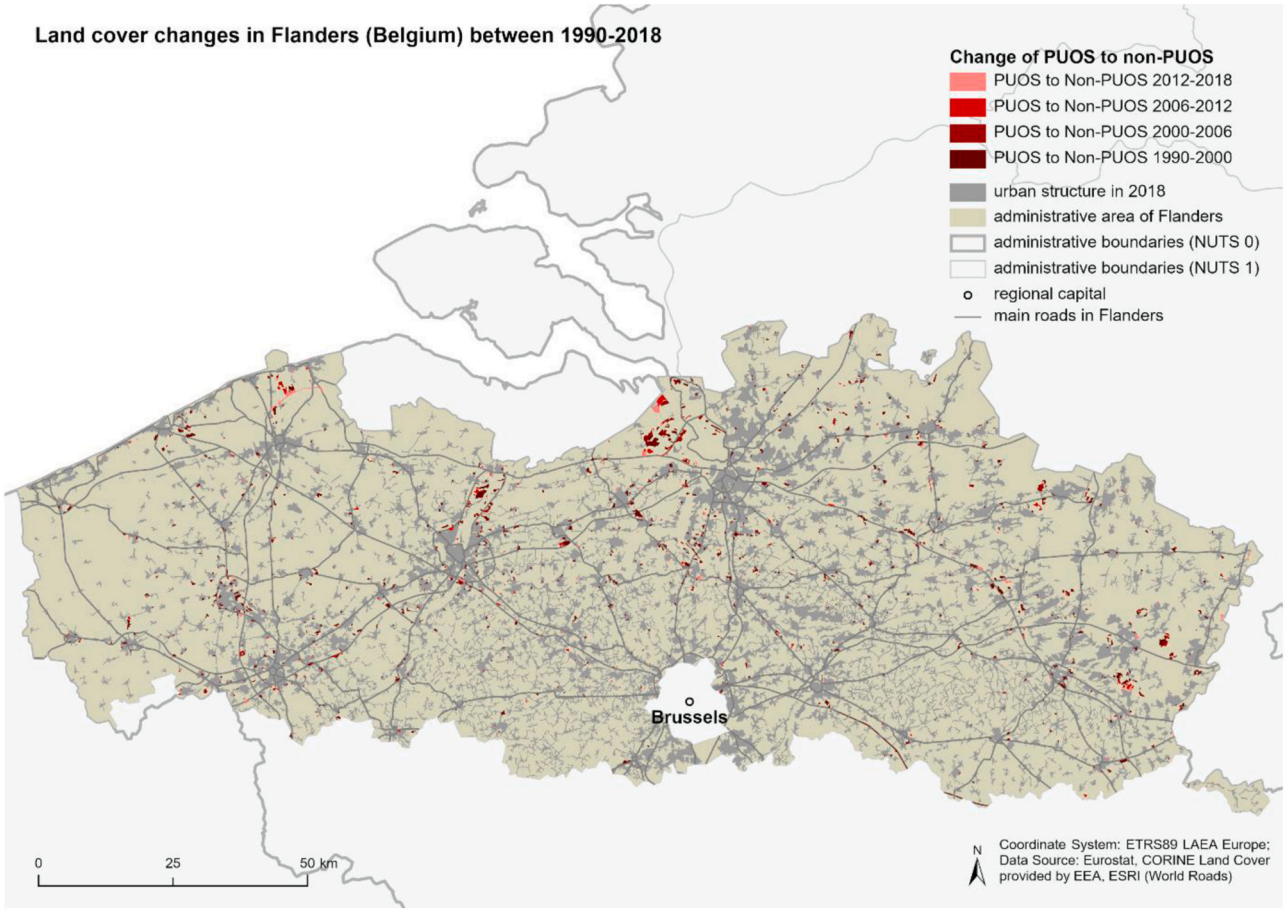

Fig. 1A. Land cover changes of PUOS to non-PUOS in Flanders (Belgium) between 1990 and 2018.

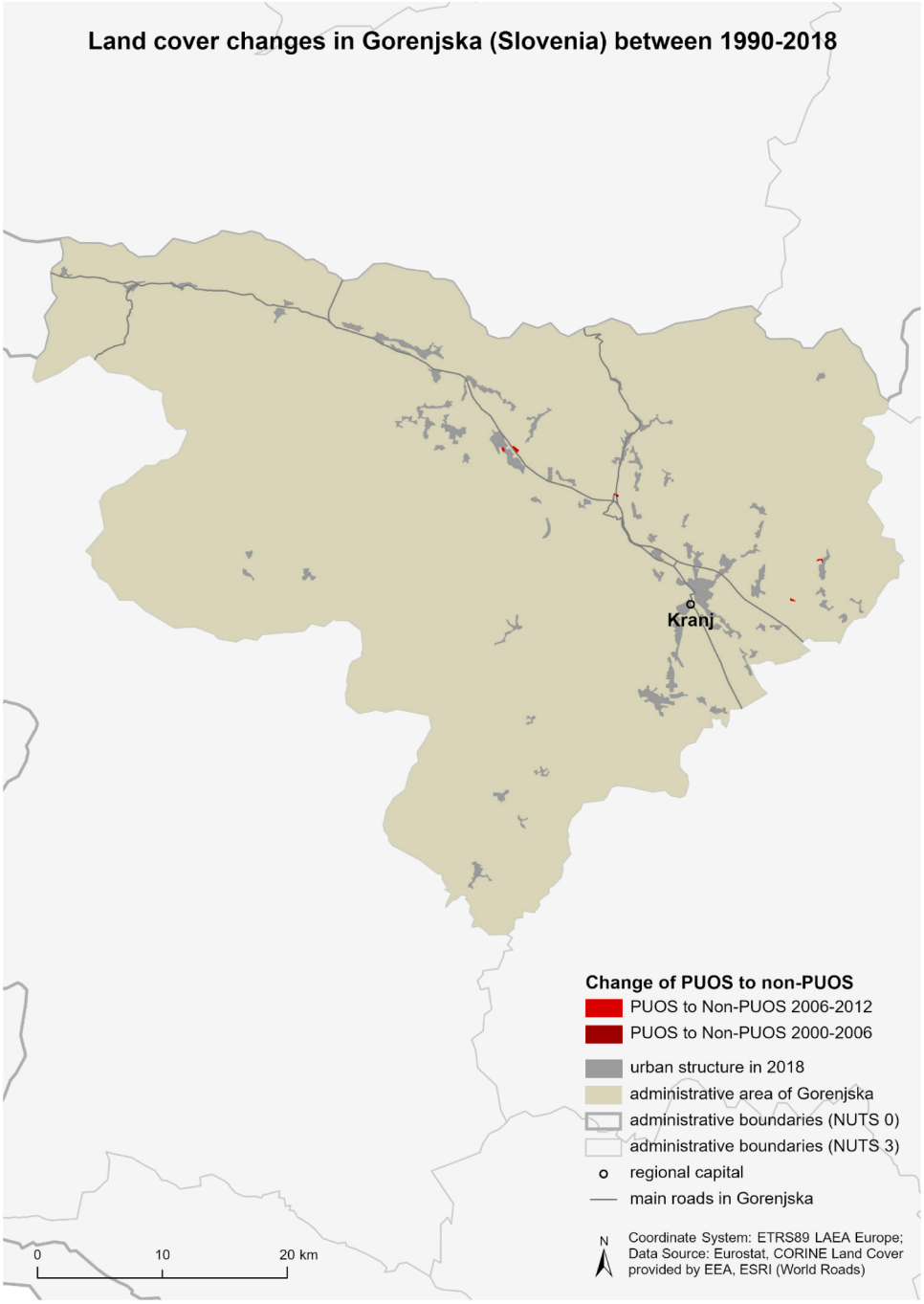

Fig. 2A. Land cover changes of PUOS to non-PUOS in Gorenjska (Slovenia) between 1990 and 2018.

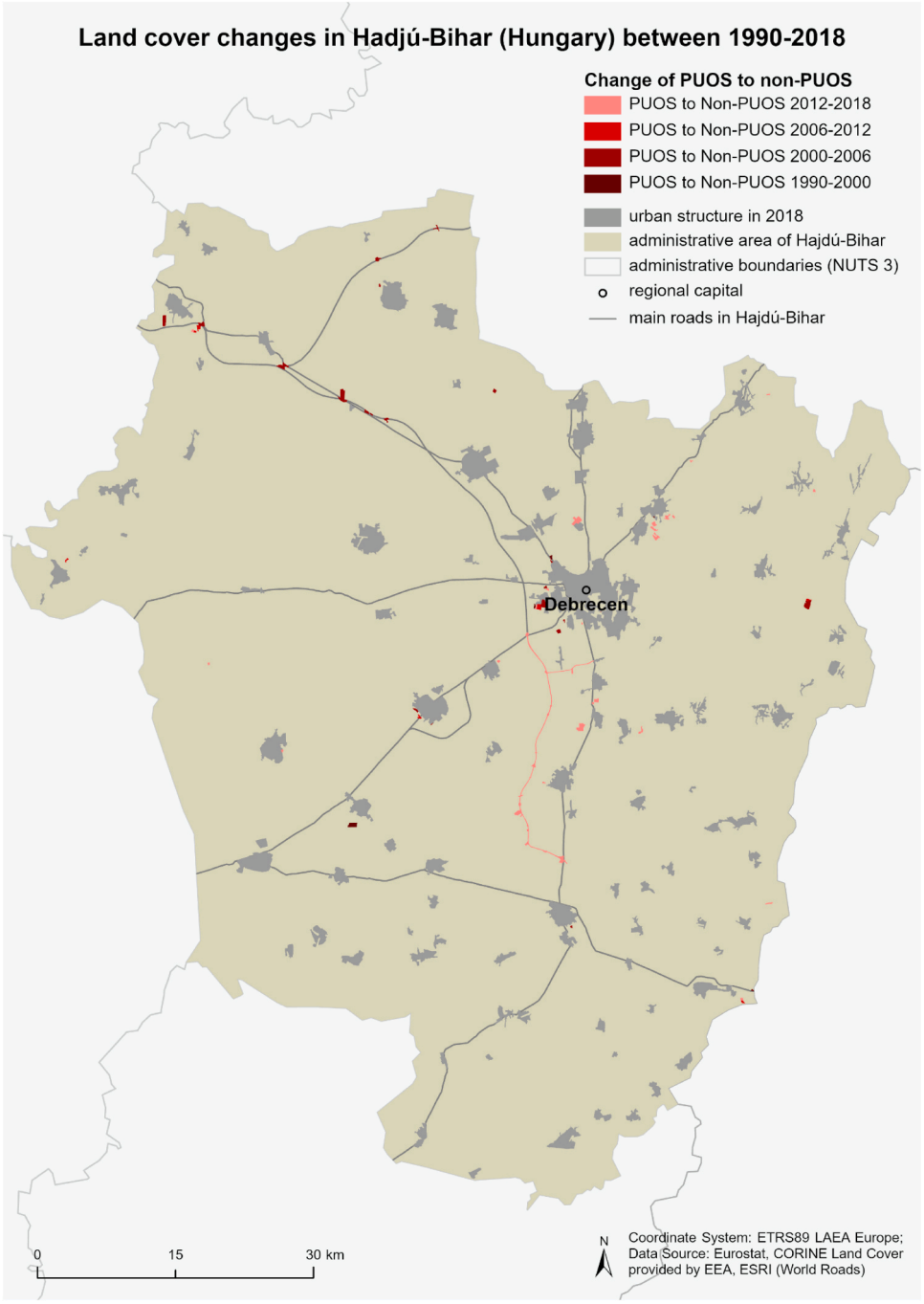

Fig. 3A. Land cover changes of PUOS to non-PUOS in Hadjú-Bihar (Hungary) between 1990 and 2018.

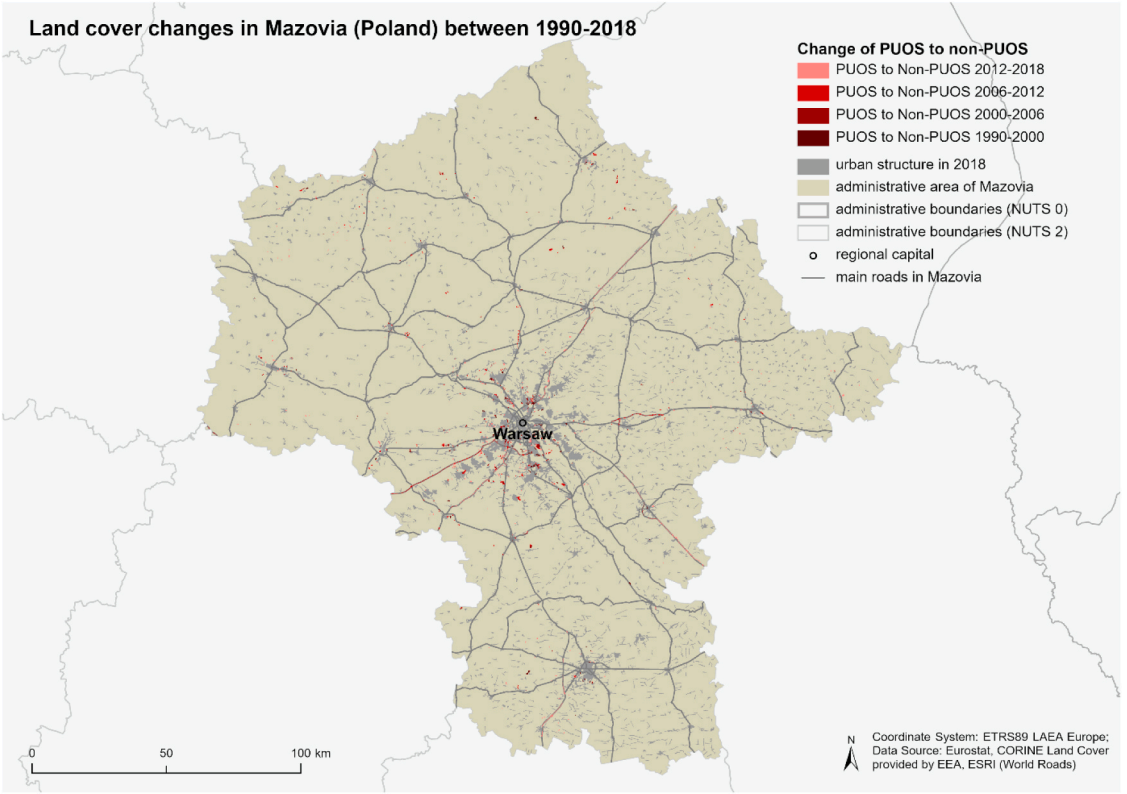

Fig. 4A. Land cover changes of PUOS to non-PUOS in Mazovia (Poland) between 1990 and 2018.

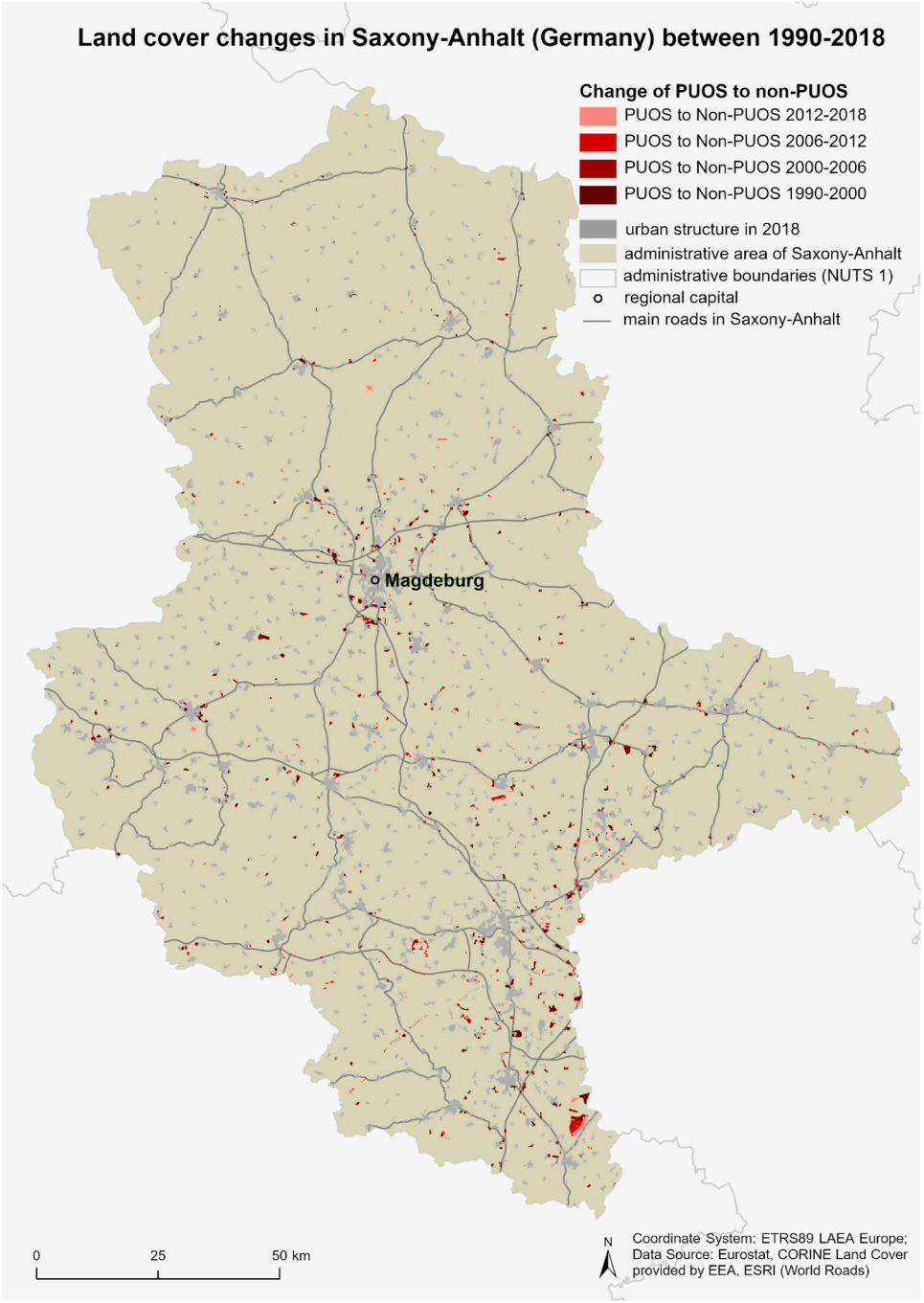

Fig. 5A. Land cover changes of PUOS to non-PUOS in Saxony-Anhalt (Germany) between 1990 and 2018.

Table 1A
Questions of explorative questionnaire.

Name of the case study
Geographical location (country)
Name of the region
Name of the organisation responsible for the regional governance
Name of the policy instrument
Please describe the main features of this policy instrument (e.g. objective, characteristics, priority or measure concerned) and the reason(s) why it should be improved?
Is this policy instrument related to the national or regional Structural Funds operational programme (ERDF/ESF)?
How do you envisage the improvement of this policy instrument (e.g. through new projects supported, through improved governance, through structural change)?
What is the geographical coverage of this policy instrument?1/ local; 2/ regional; 3/ national; 4/ cross-border; 5/ transnational
What is the state of play of the issue addressed by this policy instrument in the territory? What needs to be improved in the territorial situation?

Table 2A
List of thematic sessions for the semi-quantitative survey of potential governance approaches to improve the protection of PUOS.

No.	Place and time	Title of the session	Name of the conference
1	Bern, Switzerland, April 2019	Governance of natural heritage in peri-urban open spaces	Open Science Meeting of the Global Land Programme
2	Milano, Italy, July 2019	Towards visionary peri-urban landscapes? Environmental governance mixes for sustainable peri-urbanisation	International Association of Landscape Ecology World Congress
3	Lublin, Poland, September 2019	Towards the better understanding of land-use conflicts in rural, remote and peripheral areas	Regional Studies Conference of Central and Eastern Europe
4	Hanover, Germany, October 2019	"Governance approaches for ecosystem services in urban and peri-urban open spaces"	Ecosystem Services Partnership World Conference

Table 3A
Flanders, Belgium.

Geographical location (country)	Belgium
Name of the region	Flanders
Name of the organisation responsible for the regional governance	Flemish Land Agency
Name of the policy instrument	Section 5 on the Act of Land Development (28 March 2014 – published in Belgian Official Gazette 22 August 2014) concerning reparcelling by virtue of law with zoning exchange
Please describe the main features of this policy instrument (e.g. objective, characteristics, priority or measure concerned) and the reason(s) why it should be improved	the actual rules in the Act of Land Development foresees different public consultations, procedure rules (different steps, plans of real estate exchange, spatial implementation plans, advisory bodies) defined in Section 5 of the Act, that aren't flexible, but are time consuming. To improve this, a new smother approach is needed in implementation of the policy instrument. In a shorter time period Flemish Land Agency (VLM) needs to develop effective solutions, to reorganise PUAs and keep them open, to exchange zoning, to adapt to climate change, to develop green-blue corridors, to develop sustainable business areas on the scarce space etc. This could be implemented through the exchange of land property and land use and reparcelling plots in PUAs combined with an exchange of designated uses determined in zoning plans (= Flemish destination plans). This can be realised by refurbishing the current legislation (make procedures shorter, easier, more flexible), to apply the system of accountable tradeable development rights and integrate it into Section 5 of the addressed policy instrument. With these rights VLM will have the possibility to negotiate with all involved land users and real estate owners to reach a short time span solutions concerning to the reparceling with zoning exchange. The project should lead to the right policy recommendations for a more efficient implementation in exchange of real estate and for renewed, more sustainable land use zoning.
Is this policy instrument related to the national or regional Structural Funds operational programme (ERDF/ESF)?	no
How do you envisage the improvement of this policy instrument (e.g. through new projects supported, through improved governance, through structural change)?	VLM wants to formulate an answer for a more efficient use of the limited space. The objective is related to a smarter and more balanced functional use of PUOS by accelerating the exchange of use in the context of supported by law reparceling operation. VLM wants to implement the participative governance approaches (including all members of the stakeholders group) to increase the awareness of the peri-urban open spaces for the natural heritage. VLM also aims to solve challenges in peri-urban poorly-based legal zoning plans, e.g. wrong designed land use zones according to their potential to adopt to climate change Specifically saying through multi-stakeholder participatory governance approaches VLM wants to provide change related to: – Introducing mechanisms/tools for a smooth facilitation of zoning exchange (change destination of space e.g. into more green/blue zones; green = destination is nature, blue = create flooding areas to mitigate to climate change). Change wrong designated areas into others e.g. to avoid floods, to adapt to climate change) and to motivate private governance actors to support the need of spatial interventions – Introducing a methodology for valuing the real estate for users and owners (e.g. for a smooth exchange of property values) so private governance actors are supportive of the policy intentions – Developing the action plan for phase 2 2 case study areas, are defined in RENATUR to experiment with the improved tools during the Phase 2.
What is the geographical coverage of this policy instrument? 1/ local; 2/ regional; 3/ national; 4/ cross-border; 5/ transnational	regional

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Table 3A (*continued*)

What is the state of play of the issue addressed by this policy instrument in the territory? What needs to be improved in the territorial situation?	The realisation of more green, green-blue infrastructure and the improvement of the environment through the more efficient use of the limited space is an ongoing challenge in peri-urban area in Flanders. The objective is to have a better and more balanced use of peri-urban areas and to create a more livable peri-urban and urban environment. This approach is only possible if we support status quo between built-up and open spaces by mains of land policies and legal instruments.Sometimes governments have to deal with conflicting or competing objectives at different planning levels, for example owners of land in peri-urban areas want to have building permits and to build houses in flooding areas (due to climate change). Right tools (to exchange property, to value the real estate, etc.) need to solve several regulatory obstacles (e.g. land use zoning) and conflicting interests (e.g. area to build or to store water during heavy rainfall). These obstacles must be eliminated through the tool reparcelling by law what is further integrated into the procedure for drawing up spatial implementation. Through bridging the gap between the technical expertise concerning reparceling by law (= land readjustment) and spatial planning practice (=zoning) for the implementation of these spatial plans into practice, the conflicts will be solved. Also, the project will deliver better balanced land-use zoning to adapt to climate change and other pressures on scarce land resources. To realise that VLM needs to exchange land property and land use by developing a system of tradeable rights (= valuing real estate). The project will subsequently lead to implementation issues which are to be tackled in shifting spatial governance context in the involved peri-urban areas in Flanders and especially in the peri-urban area of the Province Antwerp where the battle for peri-urban open spaces is the most significant and relates to housing, agriculture, recreation, business development.
Saxony-Anhalt, Germany.	
Geographical location (country)	**Germany**
Name of the region	Saxony-Anhalt
Name of the organisation responsible for the regional governance	Ministry for Regional Development and Transport of Saxony-Anhalt
Name of the policy instrument	ERDF OP Saxony-Anhalt 2014 – 2020, Priority 4 Preserving and protecting the environment and promoting resource efficiency, Investment priority 6e, Specific objective 11: Reducing the soil sealing of cities through stimulation of inner urban development and redevelopment of brownfields
Please describe the main features of this policy instrument (e.g. objective, characteristics, priority or measure concerned) and the reason(s) why it should be improved	Overall aim of specific objective 11, ERDF OP Saxony-Anhalt 2014 – 2020, is the reduction of soil sealing with the main focus of cities. With the compensation of urban deficits new land occupation should be avoid. Thus, the focus is on promotion of inner urban development and revitalisation of brownfields. The population density of Saxony-Anhalt is 109 persons per km^2, whereas the average of Germany is about 231 persons per km^2. At first glance, the threat of urban sprawl in Saxony-Anhalt seems to be negligible. Nevertheless, land-use conflicts are also noticeably increasing. Functions like housing, commercial use, agriculture, energy production, exploitation of raw materials as well as the required infrastructure compete for land.Especially peri-urban areas of bigger cities in Saxon-Anhalt are affected by an intensive urban pressure. It can be assumed, that also smaller cities with a good education infrastructure and affordable housing will benefit from the crowding-out processes of bigger cities in the future. Migration for education, immigration and rural-urban migration will increase the population of these cities and their adjacent areas.To view the problem of soil sealing in its entirety, a more holistic approach is necessary. Certainly, inner urban development and revitalisation of brownfields are important instruments, but to avoid urban sprawl and increasing land-use, an early setting of political and planning co-operation beyond administrative borders are needed.
Is this policy instrument related to the national or regional Structural Funds operational programme (ERDF/ESF)?	yes
How do you envisage the improvement of this policy instrument (e.g. through new projects supported, through improved governance, through structural change)?	The specific objective 11 of the ERDF OP of Saxony-Anhalt 2014 – 2020 targets the reduction of soil sealing. The programme focuses on inner urban development, which means promotion of densification and compact settlement structures as well as re-use of brownfields. For the reduction of soil sealing and protection of open spaces a sustainable and holistic approach, also in the wider context of peri-urban functional areas, is needed. For a successful reduction of land-use the functional interdependency of the main cities with the urban hinterland should take into account.Furthermore, the ERDF OP is one of the most important funding sources for regional development. In connection with the revision of the Regional Development Plan of Saxony-Anhalt in the next years, there is the opportunity to coordinate and combine the planning objectives directly to the funding objectives. The exchange within the partnership will contribute to collect new ideas for planning instruments at local and regional level and governance structures in the context of dealing with land-use conflicts and preservation of peri-urban open spaces. At regional level the partner will cooperate with different key actors of the study region and planning system to get a better understanding of local problems, existing cooperation between cities and their urban hinterland and current obstacles that hinder the reduction of soil sealing and the long-term protection of open space.
What is the geographical coverage of this policy instrument? 1/ local; 2/ regional; 3/ national; 4/ cross-border; 5/ transnational	regional
What is the state of play of the issue addressed by this policy instrument in the territory? What needs to be improved in the territorial situation?	Currently the policy instrument is focused on the inner-city development and revitalisation of brownfields, whereas the functional areas around the cities are neglected. For a sustainable and long-term development of cities and their urban hinterland strategic approaches and government structures beyond administrative borders are needed, especially in the context of the protection of peri-urban open spaces.Growing population and low interest rates as well as missing alternative financial investments foster the construction activities and investments in "concrete gold", whereas the open space has no well-financed lobby.As a consequence, planning instruments and the sensitisation of key actors and population must be particularly strong to protect peri-urban open spaces. To strengthen the peri-urban open spaces, different planning levels and interests must be brought to together. With the help of legal planning instruments and appropriate governance structure in connection with a better understanding

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Table 3A (*continued*)

	of the functions and importance of open spaces, negative impacts on the peri-urban open spaces can be mitigated.
Hajdú-Bihar, Hungary	
Geographical location (country)	**Hungary**
Name of the region	Hajdú-Bihar
Name of the organisation responsible for the regional governance	Hajdú-Bihar County Government
Name of the policy instrument	Regional Development Programme of Hajdú-Bihar County 2014–2020
Please describe the main features of this policy instrument (e.g. objective, characteristics, priority or measure concerned) and the reason(s) why it should be improved	The Regional Development Programme of Hajdú-Bihar County for 2014–2020 integrates the strategic goals of the county at both sectoral and territorial levels. The objectives of the programme include 8 priorities; within this project we plan to address Priority 1: Sustainable environment focusing on Measure 1.2: Conservation of natural and landscape values of the county. Due to the significant loss of biodiversity and the decrease of natural areas the importance of landscapes clearly strengthens. There is a strong need to create an adequate ecological perspective concerning both policy makers and the wider community. The policy instrument encourages the development of Nature 2000 and other natural areas applying an integrated landscape management approach with specific focus on biodiversity and the sustainability of ecosystems. It is also an essential objective to ensure an attracting and safe livelihood for citizens considering climate adaptation.The main aim of the policy instrument is clear, but an improved structural background is required with an appropriate approach, enhanced capacity and the potential to integrate enhanced governance of ecosystem services to conserve biodiversity. New methodologies to efficiently implement the preservation and maintenance tasks are also needed.
Is this policy instrument related to the national or regional Structural Funds operational programme (ERDF/ESF)?	no
How do you envisage the improvement of this policy instrument (e.g. through new projects supported, through improved governance, through structural change)?	We plan to improve the selected policy instrument through improved governance (as type 2 suggested by Interreg Europe). Based on new aspects, fresh ideas and solutions originating from lessons learnt at/from other partners, we try to find applicable and long-term sustainable methods in the management/governance of peri-urban open spaces when creating and enhance a supportive governmental/policy environment. We also plan to develop/gain an appropriate methodology to monitor and evaluate the efficiency and sustainability of the above-mentioned solutions within the county.Implementing the project in Hajdú-Bihar County will have a potential impact on different sectors; the proper design and interpretation of respective potential brought by the ecosystem services to social and economic assets enable to achieve and generate added value in the form of strengthened and enhanced institutional and territorial capacity. There is a strong need for the integrated and harmonised development of respective peri-urban areas with potential through the preservation of natural heritage.
What is the geographical coverage of this policy instrument? 1/ local; 2/ regional; 3/ national; 4/ cross-border; 5/ transnational	regional
What is the state of play of the issue addressed by this policy instrument in the territory? What needs to be improved in the territorial situation?	The natural and landscape values of the county are diverse and colourful. There are ecological networks of special importance; natural areas, ecological corridors, protected landscape areas mean significant natural resources. Besides, agricultural and other economic production activities are also essential for the quality life of citizens; to preserve natural values, brownfield investments are preferred instead of greenfield ones, but huge peri-urban areas have been selected to serve as the location for new industrial parks.Considering the significance of ecological objectives, there is a strong need to focus on the governance of ecosystem services to conserve biodiversity; the peri-urban ecosystems of Hajdú-Bihar county can provide different services related to reducing the impacts of climate change, air/water purification, waste management, food security serving environmental and social purposes at the same time. The county needs a better coordination of natural, social, cultural and institutional resources and capacities built on appropriate participatory processes; moreover, it is important to find proper answer on how to help policy makers to integrate knowledge into decision making process.
Mazovia, Poland	
Geographical location (country)	Poland
Name of the region	Mazovia
Name of the organisation responsible for the regional governance	The Office of the Marshal of the Mazowieckie, Voivodeship in Warsaw
Name of the policy instrument	Regional Operational Programme Of The Mazowieckie Voivodeship 2014–2020 (RPO Mazovia)
Please describe the main features of this policy instrument (e.g. objective, characteristics, priority or measure concerned) and the reason(s) why it should be improved	RPO Mazovia 2014–2020 is a programme implemented at the regional level in support of the implementation of cohesion policy from the European Union funds for the years 2014–2020. Within the framework of the programme it is possible to obtain co-financing for the projects supported by the European Regional Development Fund (ERDF) and the projects for human resources, supported by the European Social Fund (ESF). High quality of life has been selected as a one of four Smart Specialisations of Mazovia. It refers to one of the aims of RIS Mazovia and statues the areas with the greatest development potential.Mazovia, as the only voivodeship in Poland, has been classified as a "transition region" – a more developed one in relation to other regions of the country, primarily due to the influence of Warsaw. However, it still has a number of areas struggling with serious structural problems. Currently in RPO Mazovia there is a lack of proper governance approaches to address the issues related to the protection of natural heritage of peri-urban open spaces. ROP Mazovia is primarily focused on urban renewal programmes. Participation in the project should contribute to creation of mechanisms and patterns of management of peri-urban areas and should result in a change in the strategic focus of the policy instrument for the new programming period.
Is this policy instrument related to the national or regional Structural Funds operational programme (ERDF/ESF)?	yes
How do you envisage the improvement of this policy instrument (e.g. through new projects supported, through improved governance, through structural change)?	The improvement of RPO Mazovia 2014–2020 is envisaged through a new project that will ensure the support to the regional programme by dedicated research and series of

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Table 3A (*continued*)

	participatory activities in order to create a mechanism for protection of natural heritage of peri-urban open spaces (PUOS). Peri-urban areas (PUAs) in Mazovia emerge in the vicinity of the biggest cities, such as Warsaw, and also around sub-regional urban centres and smaller towns. Many activities undertaken in PUAs are endangering the spatial cohesion and fostering local environmental conflicts. Therefore, the project will promote methods to deal with the integrated management of similar kinds of areas located in other regions in Europe. These methods will include tools for maintenance and rehabilitation of closely linked natural and cultural heritage and landscape in the peri-urban zone, in a manner similar to the urban renewal programmes. Governance tools will be described and proposed to include in the ROP Mazovia and in other policy instruments. One of the major advantages of the project, due to its participatory approach, will be the envisaged strengthening of the territorial aspect related to the influence of ROP Mazovia on local communities.
What is the geographical coverage of this policy instrument? 1/ local; 2/ regional; 3/ national; 4/ cross-border; 5/ transnational	regional
What is the state of play of the issue addressed by this policy instrument in the territory? What needs to be improved in the territorial situation?	The territorial situation in the peri-urban areas of Mazovia is typical for the zone of environmental conflicts between the traditional small-scale and big-scale farming, individual and collective housing, industrial and commercial investments, development of new transport networks, natural and cultural environment. Typical problems in peri-urban open spaces (PUOS) include: penetration of new housing into the nature protection areas, overlapping of conservation and cultural protection, adjoining old industrial areas within the cities. Some examples of challenges are: penetration of housing constructions into the Kampinoski National Park buffer zone, degradation of natural systems typical for small-scale agriculture in the region (watercourses, margins, woodlands, shrubs) or related to the heritage of the Central Vistula Valley.This is accompanied by the problem of the perception of city-village boundaries, the emergence of identity and social conflicts. Investors and developers endanger the natural heritage of PUOS by fostering conflicts with their inhabitants and users and by damaging the quality of air and soil. It occurs both in the Warsaw agglomeration and in the sub regional area (NUTS3). Also attempts to interfere in the heritage of the Vistula River, as the last wild river in Europe almost entirely covered by the Natura 2000 programme, brings conflicts between investors and environmentalists. The aim of actions to be implemented in the ROP Mazovia should be therefore to preserve the natural landscape, to protect the system of ecological linkages, to restore spatial order, to clarify the boundaries between the city and the village, and - where possible – to introduce solutions that will prevent environmental conflicts. All this is possible thanks to broad participation and creation of social awareness and business responsibility of local stakeholders (e.g. authorities and managers).
Kranj, Slovenia	
Geographical location (country)	Slovenia
Name of the region	Kranj
Name of the organisation responsible for the regional governance	Government Office for Development and European Cohesion Policy, Cohesion Policy Department
Name of the policy instrument	Operational programme for Implementation of Cohesion policy 2014–2020
Please describe the main features of this policy instrument (e.g. objective, characteristics, priority or measure concerned) and the reason(s) why it should be improved	The National operational programme for 2014–2020 integrates the strategic goals of the Slovenia at both sectoral and territorial levels. The project will address priority 9: "Social inclusion and reducing the risk of poverty" with sub priority: 9.7."Investment in the framework of the strategy of local development, led by community_ Community led development". The specific goal within the priority is "Better economic and social inclusion of society in the areas of Local action groups"; with measure: "protection and improvement of environment (including natural heritage and landscape)", which is the strategic topic.Due to the significant loss of biodiversity and the decrease of natural areas, the importance of open spaces in PUAs of the major cities is an important development challenge. Additionally, biodiversity in urban settlements and PUAs should become the value (among diverse stakeholders) and its value for development of the areas should be increased and recognised from the planning, biodiversity, working places, climate change points of view. Especially we see that protection of the biodiversity in peri-urban open spaces can contribute to the preservation of the Natura 2000 areas, which are already overcrowded with visitors.
Is this policy instrument related to the national or regional Structural Funds operational programme (ERDF/ESF)?	yes
How do you envisage the improvement of this policy instrument (e.g. through new projects supported, through improved governance, through structural change)?	We plan to improve the selected policy instrument. We will build on exchange of ideas; practices and we will upgrade the approaches for settlements and peri-urban areas having in mind the needs of the natural heritage protection. There is a strong need for strategic and harmonised development of peri-urban settlements and peri-urban areas with the main emphasis on preservation of biodiversity, new approaches in planning. We will improve the policy through new projects developed, improved governance and we will prepare the proposal for policy changes (in the context of the coming programming period 2021–2027).
What is the geographical coverage of this policy instrument? 1/ local; 2/ regional; 3/ national; 4/ cross-border; 5/ transnational	national
What is the state of play of the issue addressed by this policy instrument in the territory? What needs to be improved in the territorial situation?	The natural and landscape values of the region Gorenjska Region, as well as the whole country, are very diverse. In the region we have almost 50% of Natura 2000. Moreover the land cover of the region is characterised by over 60% of forests.Thus peri-urban areas peri-urban open spaces and new emerging peri-urban settlements are becoming important from the point of biodiversity protection, quality life of local citizens, and overlay saying the future sustainable development of the region.Peri-urban open spaces (PUAs) in Gorenjska Region can become green lung of the area and will empower citizens and visitors with knowledge about biodiversity. Additionally, it will contribute to the decreasing the amount of visitors in Natura 2000, using PUAs settlements as the recreational and other purposes (e.g. educational). Also green areas will contribute to protection of fertile land - in the surroundings of the settlements (prevent - spreading of settlements on the fertile land). Additionally new open spaces will be

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Table 3A (*continued*)

	the added value for visitors from bigger cities in the region and they will serve as green lungs of the region.To tackle that challenges we need to have harmonised strategic approaches and solutions, especially from the point of policy level and decision making processes. So far biodiversity in settlements were not tackled at all by policy level, there is also lack of understanding of importance of the approaches, possibilities.
Basque Country, Spain	
Geographical location (country)	**Spain**
Name of the region	Basque Country
Name of the organisation responsible for the regional governance	Directorate for Economy and Planification, REGIONAL GOVERNMENT OF PAIS VASCO
Name of the policy instrument	Basque Country ERDF Regional Operational Programme 2014–2020
Please describe the main features of this policy instrument (e.g. objective, characteristics, priority or measure concerned) and the reason(s) why it should be improved	among the six investment priorities of addressed policy instrument (BC-ERDF) is Priority 06: Preserving & protecting the environment, and promoting resource efficiency, Specific Objective 6.4.1: promote management, protection and maintenance of natural habitats and their biodiversity (BD), in particular in protected ones). We assume that the BD has to be managed in the relation to the whole region and special focus has to be on peri-urban open spaces (PUOS) of bigger cities. Thus, there is a need for a new and innovative way of holistic governance which introduces the ES concept and BD through a good design of Green Infrastructure (GI). The aim of the revision of Bilbao Metropolitan Partial Territorial Plan (BMPTP) is to address those issues. The BMPTP is binding for the planning of the 35 town-holds that are included in the Bilbao Metropolitan area (nearly a million inhabitants, 2000 inhab/km2), characterised with continuous pressure on PUOS due to rapid urbanisation and intensive growth of industrial sites. The BMPTP represents the guiding document to define measures to be implemented with funding out of the operational programme (BC-ERDF). Improvement of BMPTP, as an result of RENATUR implementation, will cause a significant improvement of the selection of measures in the BC-ERDF and thus improve the governance of the operational programme.Thus, the measures developed in RENATUR will be very much in accordance with the BC-ERDF, in the investment priority is P.I.6.4. (IP6d).
Is this policy instrument related to the national or regional Structural Funds operational programme (ERDF/ESF)?	yes
How do you envisage the improvement of this policy instrument (e.g. through new projects supported, through improved governance, through structural change)?	The current revision of the Regional Planning Guidelines (DOT, the general reference framework for all the territorial policy instruments) incorporates new guidelines in relation to biodiversity, ES and GI. Thus, there is a need to develop a new methodology to incorporate these new aspects in the territorial management and improve the addressed BC-ERDF.Through the BMPTP revision, in the frame of early setting of political and planning, an improved policy instrument suitable to protect natural heritage of PUOS will be created. This policy will support to improve the regional governance of PUOS and will help to tackle better the pressure on PUOS to maintain and improve the regional natural heritage (BD, ES, improve natural ecosystems connectivity, citizens perception of natural heritage) through the better introduction of GI concept in regional policy instruments. All will improve the governance of the BC-ERDF. For example: Natural heritage could be taken into account in an innovative way when developing plans in the territory, in this way recognising the ES that these open spaces provide to the local citizens. Moreover, the new governance will open a new scope of opportunities in relation to growth and jobs related to the improvement of the natural heritage.There is not much experience on the inclusion of these new structures in the planning so the collaboration with other European partners is essential, and it will help us to address new ideas and design new instruments.
What is the geographical coverage of this policy instrument? 1/ local; 2/ regional; 3/ national; 4/ cross-border; 5/ transnational	regional
What is the state of play of the issue addressed by this policy instrument in the territory? What needs to be improved in the territorial situation?	The Region of Pais Vasco has highly populated sites where there has been a high impact on natural heritage. The new DOTs will improve the natural heritage situation having included now the ES and GI. Thus, there is currently a need to address the new opportunity of governance. Nevertheless, there is a lack of knowledge on how to include the ES and GI in the plans, so the RENATUR project is an innovative way of doing it.The opportunity to work at the scale of the BMPTP is a good way to start to improve the policy instrument. When the BMPTP approved in 2006 there was another economical situation (economical crisis started 2008). Under that BMPTP, the PUOS were facing a high pressure for urbanisation and industrial sites. The new environmental legislation approved since then, such as the Environ Impact Assess (Decreto 211/2012 Basque Government & Ley 21/2013 at State Level), in relation to Landscape conservation (Decreto 90/2014 of Protection, and landscape management), and the initial approval of the DOT, has led to the revision of the BMPTP. These changes will also affect in the near future other regional partial territorial plans.Currently the importance of the natural heritage and ES into citizens' well-being is wildly recognised and request the effective introduction of GI in the regional planning in order to improve the quality of life of the local citizens. This affects not only the future planning of town-holds that are the institutions that really develop the BMPTP at local level, but also all the Pais Vasco Region partial territorial plans and their town-holds.The increment in habitat fragmentation and urbanisation, plus the loss of BD and ES has led to the loss of citizen's wellbeing. The revision of the BMPTP under the new methodology, developed in this project RENATUR, will be the beginning for the recognition of the contribution of natural heritage through its ES and BD to human well-being and, the improvement of the regional territorial situation.

Table 4A
analysis of answers from the qualitative survey with the regional policy makers.

	Policy instruments focus on PUOS				
Country	**Region**	**NOW - How the PI is discussing protection of PUOS?**	**FUTURE - What kind of changes related to better protection of PUOS are proposed?**	**FUTURE - How can the proposed changes be implemented?**	**Proposed policy improvements**
Spain	Basque Country	Under that existing PI, the PUOS were facing a high pressure for **urbanisation and industrial site**The increment in habitat fragmentation and **urbanisation**, plus the loss of BD and **ES** has led to the **loss of citizeńs wellbeing.**The BMPTP is binding for the planning of the 35 town-holds that are included in the Bilbao Metropolitan area (nearly a million inhabitants, 2000 inhab/km2), characterised with continuous pressure on PUOS due to **rapid urbanisation and intensive growth of industrial sites.**	This policy will support to improve the regional governance of PUOS and will help to tackle better the **pressure on PUOS** to maintain and improve the regional natural heritage (**BD**, **ES**, improve natural ecosystems connectivity, citizens perception of natural heritage) through the better introduction of GI concept in regional policy instruments.It should be recognised that peri-urban open spaces provide **ecosystem services** for the citizens	Revision and improvement of Bilbao Metropolitan Partial Territorial Plan (BMPTP) including new guidelines in relation to **biodiversity, ES** and GINatural heritage could be taken into account in an **innovative** way when developing plans in the territory. The whole area has to be managed as a whole with special focus on PUOs of bigger cities.Good design of **Green Infrastructures (GI)**	**1) Expanding the awareness of ES concept in different governance actors groups**
Belgium		Sometimes governments have to deal with conflicting or competing objectives at different planning levels, for example owners of land in **peri-urban areas** want to have building permits and to build houses in flooding areas (due to **climate change**)The project will subsequently lead to implementation issues which are to be tackled in shifting spatial governance context in the involved peri-urban areas in Flanders and especially in the peri-urban area of the Province Antwerp where the battle for **peri-urban open spaces** is the most significant and relates to housing, agriculture, recreation, business development.	In a shorter time period Flemish Land Agency (VLM) needs to develop effective solutions, to reorganise PUAs and keep them open, to **exchange zoning**, to adapt to **climate change**, to **develop green-blue corridor**s, to develop **sustainable business area**s on the scarce space etc. Change wrong destination areas into others e.g. to avoid floods, to adapt to **climate change**) and to motivate private governance actors to support the need of spatial intervention. The objective is to have a better and **more balanced use** of **peri-urban areas** and to create a more livable peri-urban and urban environment.	This approach is only possible if we support status quo between **built-up** and **open space**s by mains of land policies and legal instruments. Obstacles must be eliminated through the tool **reparcelling** by law what is further integrated into the procedure for drawing up spatial implementation. Objectives could be implemented through the exchange of land property and land use and **reparcelling plots** in PUAs combined with an exchange of designated uses determined in **zoning plans** (= Flemish destination plans).	**1) Reparcelling plots;2) Changing land use zones designated in plans, specifically applicable for wrongly designated zones;3) Developing green - blue corridors and sustainable business areas**
Slovenia	**Gorenjska**	Due to the significant **loss of biodiversity** and the **decrease of natural areas**, the importance of open spaces in PUAs of the major cities is an important development challenge. Also green areas will contribute to **protection of fertile land** - in the surroundings of the settlements (prevent - spreading of settlements on the fertile land).	**Biodiversity** in urban settlements and PUAs should become the value (among diverse stakeholders) and its value for development of the areas should be increased and recognised from the planning, biodiversity, working places, climate change points of view. Peri-urban open spaces (PUAs) in Gorenjska Region can become **green lung** of the area and will empower citizens and visitors with **knowledge about biodiversity**. Additionally it will contribute to the decreasing the amount of visitors in Natura 2000, using PUAs settlements as the recreational and other purposes (e.g. educational)	There is a strong need for strategic and harmonised development of peri-urban settlements and peri-urban areas with the main emphasis on **preservation of biodiversity**, new approaches in planning. To tackle that challenges we need to have **harmonised strategic approaches** and solutions, especially from the point of policy level and decision making processes. So far biodiversity in settlements were not tackled at all by policy level, there is also **lack of understanding** of importance of the approaches, possibilities.	**1) Harmonised strategic approaches at policy level;2) Increase the awareness of local governance actors about PU and biodiversity**
Hungary	**Hadju-Bihar**	Due to the significant **loss of biodiversity** and the decrease of natural areas the importance of landscapes clearly strengthens. Brownfield investments are preferred instead of greenfield ones, but huge periurban areas have been selected to serve as the location for **new industrial parks**the peri-urban ecosystems of Hajdú-Bihar county can provide different **services** related to reducing the impacts of **climate change**, air/ water purification, waste	The policy instrument **encourages the development of Nature 2000** and other natural areas applying an integrated landscape management approach with specific focus on **biodiversity** and the sustainability of ecosystems. It is also an essential objective to ensure an attracting and safe livelihood for citizens considering **climate adaptation.** Considering the significance of ecological	Based on new aspects, fresh ideas and solutions originating from lessons learnt at/from other partners, we try to find applicable and **long-term sustainable methods** in the management/ governance of periurban open spaces when creating and enhance a supportive governmental/policy environment.	**1) Long-term sustainable governance methods based on the supportive and governance environment;2) Inclusion of the ecosystem services concept in the binding governance documents;3) Encouraging the development of Natura 2000 areas and other similar areas**

(*continued on next page*)

Table 4A (*continued*)

Country	Policy instruments focus on PUOS				
	Region	NOW - How the PI is discussing protection of PUOS?	FUTURE - What kind of changes related to better protection of PUOS are proposed?	FUTURE - How can the proposed changes be implemented?	Proposed policy improvements
		management, food security serving environmental and social purposes at the same time	objectives, there is a strong need to focus on the governance of **ecosystem services** to conserve **biodiversity**		
Poland	**Mazovia**	Currently in RPO Mazovia there is a lack of proper governance approaches to address the issues related to the protection of natural heritage of **peri-urban open spaces**. Many activities undertaken in PUAs are endangering the spatial cohesion and fostering local environmantal conflicts. The territorial situation in the peri-urban areas of Mazovia is typical for the zone of environmantal conflicts between the traditional small-scale and big-scale farming, individual and collective housing, industrial and commercial investments, development of new transport networks, natural and cultural environment. Investors and developers endanger the natural heritage of PUOS by fostering conflicts with their inhabitants and users and by damaging the **quality of air and soil.**	The aim of actions to be implemented in the ROP Mazovia should be therefore to **preserve the natural landscape, to protect the system of ecological linkages**, to restore spatial order, **to clarify the boundaries between the city and the village**, and - where possible – to introduce solutions that will prevent environmental conflicts.	The project will promote methods to deal with the integrated management of similar kinds of areas located in other regions in Europe. These methods will include **tools for maintenance** and **rehabilitation** of closely linked natural and cultural heritage and landscape in the peri-urban zone,	**1) Tools for maintenance and rehabilitation of cultural and natural heritage;2) To clarify the boundaries between cities and villages;**
Germany	**Saxony-Anhalt**	Functions like **housing, commercial use**, agriculture, energy production, exploitation of raw materials as well as the required infrastructure compete for land.Especially peri-urban areas of bigger cities in Saxon-Anhalt are affected by an **intensive urban pressure**Growing population (enhanced by **migration**) and low interest rates as well as missing alternative financial investments foster the construction activities and investments in “concrete gold”, whereas the open space has no well-financed lobby.	The programme focuses on inner urban development, which means **promotion of densification** and **compact settlement structures** as well as **re-use of brown-fields**. At regional level the partner will cooperate with different key actors of the study region and planning system to get a better understanding of local problems, existing cooperation between cities and their urban hinterland and current obstacles that hinder the reduction of **soil sealing** and the long-term protection of open space.	For the **reduction of soil sealing** and protection of open spaces a sustainable and holistic approach, also in the wider context of peri-urban functional areas, is needed. For a successful reduction of land-use the **functional interdependency** of the main cities with the urban hinterland should take into account.To strengthen the peri-open spaces, **different planning levels and interests must be brought together**. With the help of **legal planning instruments** and appropriate governance structure in connection with a better understanding of the functions and importance of open spaces, negative impacts on the PUOs can be mitigated	**1) Promotion of densification and compact settlement structures;2) Re-use of brown-fields;3) Multi-level and adaptive governance**

Abbrevations: BD - biodiversity, ES - ecosystem services, GI - green infrastructure, PU - peri-urbanisation, PUOS - peri-urban open spaces,

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