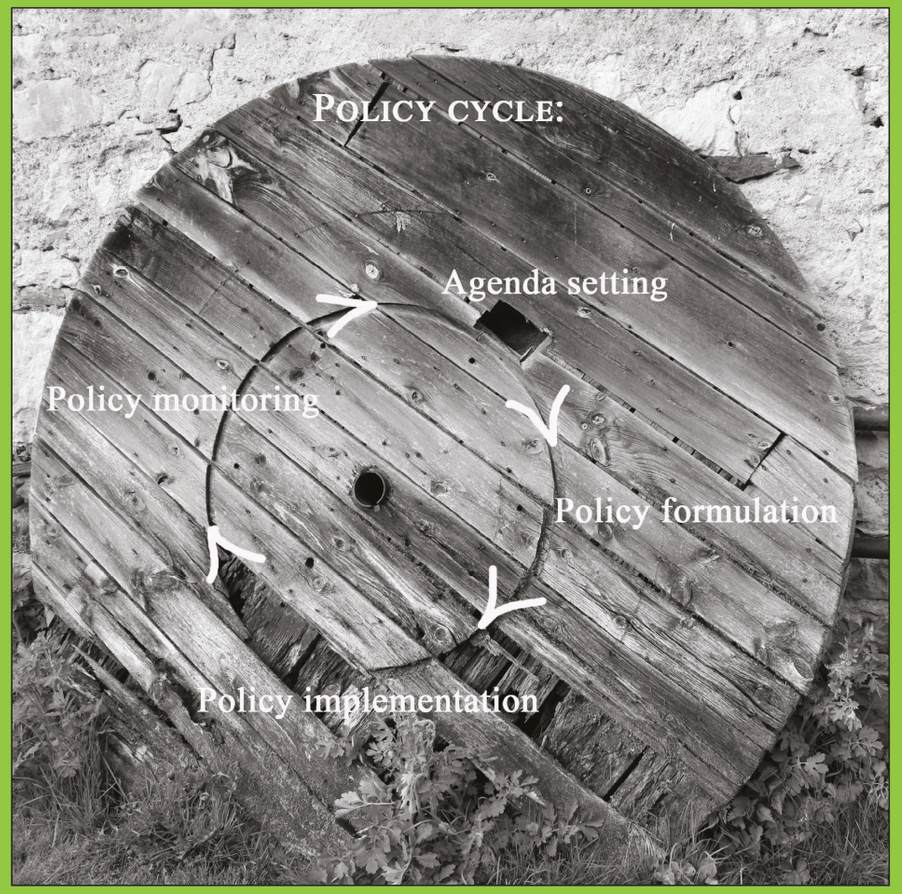
Ing. Eva Semančíková

Landscape policy in the Czech Republic



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Ph.D. Thesis Series, 2019, No.11

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Landscape policy in the Czech Republic

Ph.D. Thesis

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Annotation

This PhD Thesis provides insight into the field of landscape policy in the Czech Republic. It gives an overview of various policy instruments for implementation of the European Landscape Convention. It explores landscape as a policy object, and related policy goals in the spatial planning and environmental policy domains of the Czech Republic.

Declaration [in Czech]

Prohlašuji, že svoji disertační práci jsem vypracovala samostatně pouze s použitím pramenů a literatury uvedených v seznamu citované literatury.

Prohlašuji, že v souladu s § 47b zákona č. 111/1998 Sb. v platném znění souhlasím se zveřejněním své disertační práce, a to v úpravě vzniklé vypuštěním vyznačených částí archivovaných Přírodovědeckou fakultou elektronickou cestou ve veřejně přístupné části databáze STAG provozované Jihočeskou univerzitou v Českých Budějovicích na jejích internetových stránkách, a to se zachováním mého autorského práva k odevzdanému textu této kvalifikační práce. Souhlasím dále s tím, aby toutéž elektronickou cestou byly v souladu s uvedeným ustanovením zákona č. 111/1998 Sb. zveřejněny posudky školitele a oponentů práce i záznam o průběhu a výsledku obhajoby kvalifikační práce. Rovněž souhlasím s porovnáním textu mé kvalifikační práce s databází kvalifikačních prací Theses.cz provozovanou Národním registrem vysokoškolských kvalifikačních prací a systémem na odhalování plagiátů.

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Eva Semančíková

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List of papers and author's contribution

The thesis is based on the following papers:

I. **Semančíková, E.**, Kadlecová, V., Grill, S. (2014): Landscape and Spatial planning in the Czech Republic – Historical development. In: Eds.: Stará, K., et.al., Landscape Transformations. Praha: Czech Technical University in Prague. Conference Proceedings. ISBN 978-80-01-05676-9

Eva Semančíková was responsible for the literature review, wrote the proposal of the manuscript, and wrote final version of the paper.

II. Kadlecova,V., Dramstad, E.W., **Semancikova, E.**, Edwards, R.K,, (2012): Landscape changes and their influence on the heterogeneity of landscape of the South Bohemian Region, the Czech Republic, *International Journal of Sustainable Development & World Ecology*. 19 (6): 546 – 556. DOI: 10.1080/13504509.2012.740512 (IF = 1.213)

Eva Semančíková participated on selection of the study sites, field observations, proposal of the methodology, data digitalization, and revision of the manuscript.

III. **Semančíková, E.**, Dvořáková-Líšková, Z., Holcová, V., 2008. How strategic planning deals with spatial landscape problems? In.: Eds.: Kabrda, J., Bičík, J.. Man in the landscape across frontiers: Landscape and land use change in Central European border regions. Conference Proceedings of the IGU/LUCC Central Europe Conference 2008. ISBN 978-80-86561-80-6

Eva Semančíková was responsible for the content analysis of the documents, wrote the proposal of the manuscript, and wrote final version of the paper.

IV. **Semančíková, E.**, Grădinaru, S.R., Aubrechtová, T., Hersperger, A.M. (2019). Framing fragmentation in strategic policy documents of spatial planning and environmental domains: differences and similarities. *Journal of Environmental Planning and Management*. https://doi.org/10.1080/09640568.2019.1589433, in press (IF = 1.594).

Eva Semančíková was responsible for the content analysis of the documents, wrote the proposal of the manuscript, and wrote final version of the paper.

Contents

Abbreviations, translation of concepts and definitions

In this work I do employ many concepts routinely used in the Czech language, for which several possible translations can be found in English. Therefore, I am referring here to the Czech concept, their abbreviations, and their English translation throughout this study. Translations of professional concepts are taken from official translations of valid legislation. Definition of some concepts are given in Table 1.

AIU	agriculturally intensively used areas	*zemědělsky intenzivně využívaná území*
EIA	Environmental Impact Assessment	*hodnocení vlivů na životní prostředí*
ELC	European Landscape Convention	*Evropská úmluva o krajině*
EPI	Environmental policy integration	*integrace environmentální politiky*
EU	Europe Union	*Evropská unie*
GIS	Geographic information system	*geografické informační systémy*
DPZ	remote sensing	*dálkový průzkum Země*
JPÚ	Simple Land Consolidation	*jednoduché pozemkové úpravy*
KPÚ	The Complex Land Consolidation	*komplexní pozemkové úpravy*
KPZ	Landscape Landmark Zones	krajinné památkové zóny
KSOPK	Concepts and Strategies for Nature and Landscape Conservation	*koncepce a strategie ochrany přírody a krajiny*
LHO	Forest Management Guidelines	*lesní hospodářské osnovy*
LHP	Forest Management Plans	*lesní hospodářské plány*
LUC	land use/ land cover	*krajinné využívání/ pokryv*
MG	marginalized areas	*marginalizovaná území*
MIC	areas with medium intensity of cultivation	*území středně zemědělsky využívaná*
MoA	Ministry of Agriculture	*Ministerstvo zemědělství*
MoE	Ministry of Environment	*Ministerstvo životního prostředí*
MoRD	Ministry of Regional Development	*Ministerstvo pro místní rozvoj*
NGOs	Non-Governmental Organization	*nevládní neziskové organizace*

NPP	National River Basin Management Plans	*národní plány povodí*
NUTS	Nomenclature of Units for Territorial Statistics	*nomenklatura územních statistických jednotek*
OKR	Protection of the landscape character	*ochrana krajinného rázu*
OPRL	Regional Plans of Forest Development	*oblastní plány rozvoje lesů*
PhD	academic degree	*akademický titul*
PO KPZ	Protection plans of Landscape Landmark Zones	*plány ochrany pro krajinné památkové zóny*
POP	District River Basin Management Plans	*plány oblastí povodí*
PP	Management plans of protected areas	*plány péče*
PRK	Region Development Program	*programy rozvoje krajů*
PÚ	Land Consolidation	*pozemkové úpravy*
RP	Regulatory plans	*Regulační plány*
SDP	The Spatial Development Plan	*Politika územního rozvoje*
SEA	Strategic environmental assessment	*Posuzování vlivů koncepcí na životní prostředí*
SPO	Strategic Plans of Municipalities	*Strategické plány obcí*
ÚAP	Planning Analytical Materials	*územně analytické podklady*
ÚP	Plans	*územní plány*
ÚS	Planning Studies	*územní studie*
ÚSES	Structural connectivity	*územní systémy ekologické stability*
ÚSK	Landscape Studies	*územní studie krajiny*
ZCHÚ	Specially Protected Areas	*zvláště chráněná území*
ZÚR	Regional Spatial Plans	*zásady územního rozvoje*

Table 1: Selected key concepts to conceptualize this study.

Landscape	An area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors.	(Council of Europe, 2000)
Landscape policy	An expression by the competent public authorities of general principles, strategies and guidelines that permit the taking of specific measures aimed at the protection, management and planning of landscapes.	-//-
Landscape quality objective	Means, for a specific landscape, the formulation by the competent public authorities of the aspirations of the public with regard to the landscape features of their surroundings.	-//-
Landscape protection	An action, from a perspective of sustainable development, to ensure the regular upkeep of a landscape, so as to guide and harmonize changes which are brought about by social, economic and environmental processes.	-//-
Landscape management	An action, from a perspective of sustainable development, to ensure the regular upkeep of a landscape, so as to guide and harmonize changes which are brought about by social, economic and environmental processes.	-//-
Landscape planning	A strong forward-looking action to enhance, restore or create landscapes.	-//-
Spatial planning	Spatial planning refers to methods used to influence the distribution of future activities in space. It is undertaken with the aims of creating a more rational territorial organization of land uses and the linkages between them, to balance demands for development with the need to protect environment, and to achieve social and economic objectives.	(Directorate-General for Regional and Urban Policy, 1997)

1. Introduction

1.1. Landscape

The mutual interaction between landscape and human has occurred from the ancient history. The landscape has influenced human life (Bruun, 2016), as well as the landscape meaning, importance, and management has been changed as human transformed them (Antrop, 2006). Although the landscape changes were in harmony with nature for centuries (Ložek, 2007), the human impact on landscapes increased, and the spatial scale of landscape changes has broadened throughout the world. The landscape transformation has been driven by both natural and cultural driving factors (Antrop, 2014; Jongman, 2002). Bürgi et al. (2004) and Plieninger et al. (2012) specify that the political/institutional, natural/spatial and cultural driving factors have been the most dominant across Europe. Although we are most aware of their negative impact on landscape functions, the different driving factors and their consequences created new demands on landscape organization and its functions (Antrop and Van Eetvelde, 2005).

The direction of landscape transformation and its continuity are important indicators of landscape quality. Balanced impact of landscape driving factors significantly affects sustainable development (Fanta, 2001). If any of driving factors prevail, landscape can be negatively impacted. Therefore a hierarchical and multi-scale approach is desirable (Antrop, 2014), characterized by interdisciplinarity and transdisciplinarity (Naveh, 2010, 2007; Tress et al., 2001). Nevertheless, implementing these approaches into practice is still problematic (Pinto-Correia et al., 2006). Landscape as a holistic issue is difficult to tackle, scientifically as well as politically. It is because the term landscape has many different meanings and definitions within various disciplines, between different languages, and national laws. The landscapes are understood as 1) defined and restricted territory, 2) legal entity, 3) physical place focused on aesthetic values, 4)

interaction between physical factors and human impact, or 5) as European Landscape Convention (ELC) proposes (Table 1) (Thorén and Jorgensen, 2016).

The different understanding of the term landscape, heterogeneity of driving factors, and variety of consequences point to the fact that landscape is complex, multifunctional, and hierarchical system influenced by variety of natural and cultural factors (Hammer and Siegrist, 2016; Naveh, 2007). Hruška (1945) compared this complexity to human body and landscape components to interconnected organs of human body. Likewise, the human body conditions, the landscape conditions, functions and changes influence our environment and the quality of human life. In other words, the landscape quality influence the quality of life of many people and therefore the landscape can be understood as public good (Turner, 2005). Landscape is a public space and should be treated as a public interest. Therefore, it is necessary to pay attention to past changes as well as to expected landscape transformations that may cause negative consequences either in landscape structure or in its functions influencing ecosystems, biodiversity as well as human well-being. It is a task for landscape policy to deal with these problems and to find balance between physical factors and socio-economic demands. It is a challenge to implement landscape policy and find such policy instruments to prevent or eliminate negative consequences of landscape transitions, while keeping the development sustainable.

1.2. The European Landscape Convention

The ELC is a European policy document that gives guidelines for the holistic landscape approach, and call for political responsibility (Brunn 2016). The ELC shifts the meaning of landscape from just a part of environment to important everyone's quality of life (Dempsey and Wilbrand, 2017). The main goals are concerned with the well-being of all, sustainable development, and the promotion of democracy in landscape policy (Prieur, 2006). It stresses an interdisciplinary approach, monitoring landscape changes, process of systematic landscape planning and landscape integration into different sectoral policies on all hierarchical administrative levels. The main task of the individual states is to legally recognize the term landscape and incorporate it into all areas of state policy from protection through management and landscape planning.

Policies should understand landscape holistically as area that is dynamic and changes over time. Landscape should be an integral part of policies and must be understood not only as a component of the environment or an urban area, and should not separate natural and cultural landscape components. Rather, policies should focus on interconnection of these components, their historical development, driving factors, and public perception. They must pay attention to all landscapes, whether outstanding, routine or degraded. The responsibility of various actors and their collaboration should be assured on all administrative levels.

The ELC also obliges the member states to acknowledge their landscape as important in terms of public interest, as a part of their natural and cultural heritage and as an essential part of life quality. The ELC gives general and specific measures in the Articles 5 and 6 to achieve landscape protection, management, planning, and co-operation on landscape issues. The Article 5 introduces basic definitions (Table 1) and Article 6 deals with specific measures as landscape identification and assessment, landscape quality objectives, implementation as well as landscape awareness, training

and education. The activities that arise from the ELC for different hierarchical administrative levels are summarized in Table 2.

Table 2: Actions for the ELC implementation.

Improving landscape integration in both existing and future spatial planning and sectoral policies	
National level	**1.** Recognize landscape in law **2.** Integrate landscape in all sectoral as well as spatial planning policies
Define landscape strategies ensuring a coherent landscape conception in protection, planning and management	
National / Regional / Local levels All landscape types	**1.** Identify landscapes **2.** Enable public participation when describing landscape characteristics, values and driving factors that have impact on different landscape types **3.** Monitor landscape changes **4.** Define landscape quality objectives / visions **5.** Introduce measures and instruments aimed at landscape protection, management and planning
Public involvement in the process of creating landscape policies, deciding about landscape and raising their awareness of the role of landscape and its values	
Supportive context	**1.** Increase public awareness of landscape values, its importance and changes **2.** Implement procedures for public and institutional participation on defining and implementation of landscape policies **3.** Promote education and training
Mutual sharing of experience and best practice	
International cooperation	**1.** Cooperation

The Council of Europe (2008) gives guidelines to help individual states to implement the ELC and fulfil particularly the Articles 5 and 6 at the national level. Each country should adopt hierarchical landscape policies and create strategies for their implementation. The implementation of landscape policies may be regulatory, i.e. integration of landscape issues into existing or newly prepared spatial or special policies, planning systems and instruments or it may be voluntary, i.e. based on agreements between authorities and stakeholders (Council of Europe, 2008). The ELC stresses that each individual country should provide instruments for protecting, managing and planning the landscape, where the general principles should be provided on the national level. National specific and sectoral strategies are seen as the most important policy instruments for the ELC implementation and integration of landscape issues (Council of Europe, 2008). Strategies from different hierarchical levels should be processed by the rules of the ELC (Figure 1), which will result in better coordinated, spatially and temporally framed approaches to landscape protection, management, and planning. Specified measures should focus on the whole landscape - the mutual physical, functional, symbolic, cultural, historical, and other formal levels. An active public participation should be a part of the landscape policies processing, determining visions, formulation of policies and their implementation.

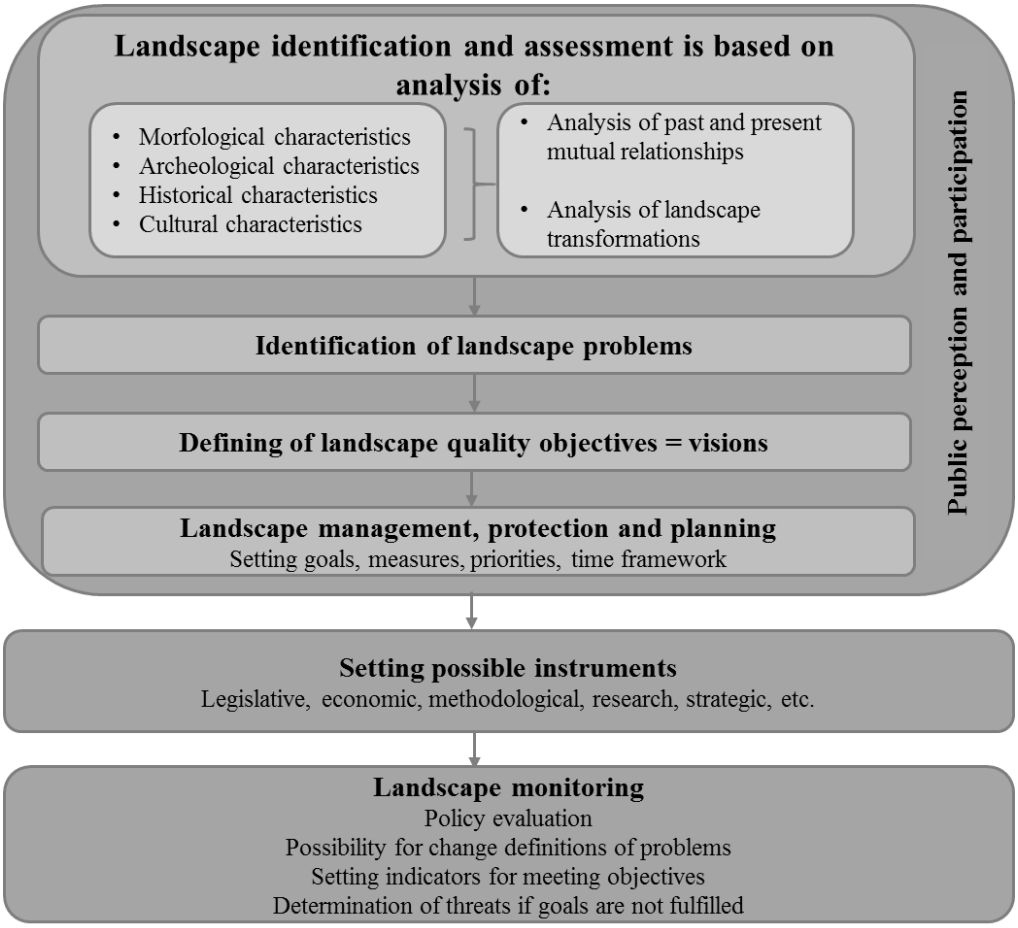


Figure 1: The processing of landscape policies within various hierarchical administrative levels.

1.3. Landscape policy, implementation, and integration

The ELC use the concepts as landscape policy, implementation and integration. To understand these concepts, we should consider policy science. The concept **policy** can be understood very differently and many definition exist, but generally it is understood as a set of decisions or actions to reach policy goals (Veselý and Nekola, 2007). The essential policy elements are policy object, actors, their goals and structures, procedures, and instruments adopted to reach policy goals (Briassoulis, 2004). Policy is multilevel and multi-actors phenomenon (Crabbé and Leroy, 2008). The process of policy making is very complex and to deal with this complexity, the process is simplified into several stages of policy cycle: agenda setting, policy formulation, implementation and monitoring (Potůček et al., 2005). **Agenda setting**, and **policy formulation** are very important for future policy considerations. Any issue must be first, framed as a policy problem to be placed on policy agenda, where policy problems are selected and prioritized. Next, policy formulation is a process of narrowing the consideration of a problem placed on agenda (Peters, 1986). A problem becomes a policy object, which refers its scope, localization, temporal characteristics, environmental, social, economic, etc. features (Briassoulis, 2017). Various policy actors may see the problem from different perspectives. Based on different knowledge and values, the actors may frame or re-frame a problem differently. This fact influence looking for strategies, actions to solve the problem, and formulation of goals. The way how the problem is analyzed, strategies are framed and formulated influence the third stage of policy cycle, i.e. **policy implementation** (Crabbé and Leroy, 2008). In the third stage, appropriate policy instruments to accomplish policy goals are addressed by policy actors (Potůček et al., 2005). The policy decisions are specified by looking for institutional, actors and financial resources, their coordination, structure, specifying procedures, and rules (Crabbé and Leroy, 2008). The fourth stage is **policy monitoring.** Monitoring of policy integrity, coherence, efficiency of

outputs and outcomes. The results of policy monitoring may have additional impact on policy agenda setting, etc.

The ELC suggests that the states ratifying the Convention should implement the Convention by adoption of landscape policies (Figure 2). Landscape policy is defined as "*expression by the competent public authorities of general principles, strategies and guidelines that permit the taking of specific measures aimed at the protection, management and planning of landscapes"* (Council of Europe, 2000). Landscape policy is based the principle of subsidiarity. This means that competent public authorities, either on national, regional, or local levels, should formulate their own strategies, adopt general principles, and guidelines that permit the taking of specific instruments aimed at the protection, management and planning of landscapes. That does not necessarily mean that the states must create new strategies or instruments; they can update the existing ones (Prieur, 2006). The ELC emphasizes several instruments for the ELC implementation:

Strategic instruments. Strategic instruments are important for frame forming of other hierarchically lower strategies. Policy actors usually formulate strategies in written strategic policy documents. Strategic policy documents should pinpoint the policy object, the goals, as well as the responsibility of various hierarchical authorities and institutions for the implementation of appropriate instruments and landscape integration to sectoral policies, within a defined territory and timeframe. In the case of the ELC implementation, the policy object is "landscape", i.e. "*an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors"* (Council of Europe, 2000). The goals should reflect the actions necessary for the ELC implementation (Table 2).

Planning instruments. These are instruments that set out policies for planning or development assessment, management or protection of any area, either it is landscape, urban area, etc. The Council of Europe (2008)

lists several planning instruments available for the ELC implementation: landscape planning; spatial planning; impact and landscape studies; protection of sites and landscapes; other sectoral plans. Planning instruments regarding landscape issues are often related to two domains: landscape planning and spatial planning.

The ELC defines **landscape planning** as *„a strong forward-looking action to enhance, restore or create landscapes"* (Council of Europe, 2000). It is also understood as a planning instrument for nature protection and landscape management (German Federal Agency for Nature Conservation, 2002). **Spatial planning**. This concept has been adopted by the European Commission and represents many planning systems and responsibilities throughout the whole Europe (Nadin et al., 2018). According to Directorate-General for Regional and Urban Policy (1997): *"Spatial planning refers to methods used to influence the distribution of future activities in space. It is undertaken with the aims of creating a more rational territorial organization of land uses and the linkages between them, to balance demands for development with the need to protect environment, and to achieve social and economic objectives"*. The system of spatial planning refers to hierarchical system of planning: national (national planning), regional (regional policy and planning) and municipal (land use planning) (Directorate-General for Regional and Urban Policy, 1997).

Institutional instruments. Institutions responsible for legislation on environment or land use planning are in charge for landscape policy (Prieur, 2006). He also states that the minister in charge of the environment is responsible for landscape policy because landscape is a part of environment and thus ministry in charge for landscape should be a key policy actor in coordination of landscape policy integration to other sectoral policies potentially affecting landscape.

The Council of Europe (2008) mentions also landscape observatories and centers as appropriate actors for the ELC implementation.

Coordinative instruments. National coordinative instruments for implementing the ELC are important in cases where landscape issues are addressed by various authorities (Prieur, 2006).

Legal instruments. Landscape should be a part of existing legislation, either in constitution, any existing piece of legislation on environment or land use planning, or newly created specific law on landscape (Prieur, 2006). The ELC mention also shared charters, and contracts.

Financial instruments. Council of Europe (2018) introduced recommendation, noting that national and/or regional public landscape funds are important instruments for providing consultancy, technical assistance and funding for projects aimed at improving landscape quality. States ratifying the ELC should consider the creation or reinforcement of legally regulated funds, national or regional, assigning them public law status.

Monitoring instruments. The Council of Europe (2008) lists reports on the state of the landscape, and reports on the state of landscape policies.

Communicative instruments. The participation, consultation, and pooling of ideas are optional approaches to communicative landscape issues and should be organized at all administrative levels.

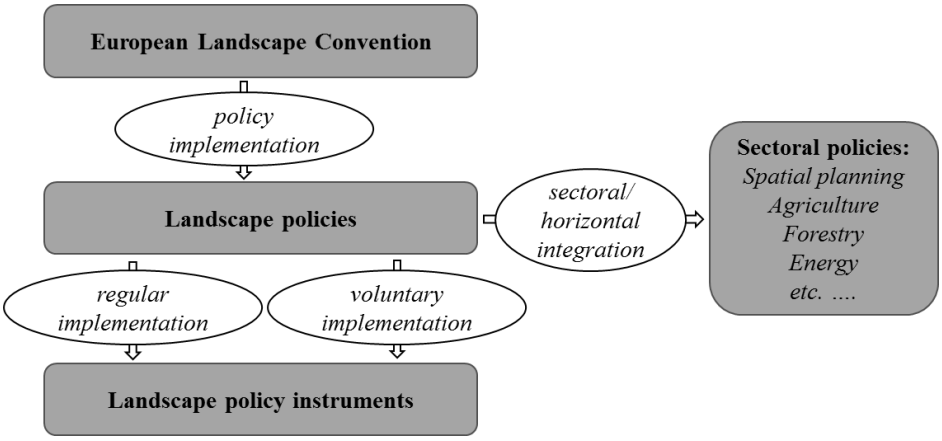


Figure 2: Landscape policy implementation and integration

Nevertheless, the ELC is aware that landscape policies alone are not sufficient to deal with complex landscape problems caused by different driving factors. Therefore, it supports the integration of landscape policy into other sectoral policies (Figure 2), and stress the importance of the spatial and land use policies. This refers to Environmental policy integration (EPI). EPI is an approach to ensure complex and hierarchical integrating of environmental issues into different sectoral policies (Lenschow, 2002; Runhaar et al., 2014). It is a process of governing as well as the policy product (Briassoulis, 2004; Jordan and Lenschow, 2010). It is supposed to indicate opportunities for prevention and reduction of environmental damage as well as any conflicts among different sectoral policies with environmental objectives early in the policy process (European Commission, 2014; Jordan and Lenschow, 2010; Runhaar et al., 2014), and it can help to prioritize environmental issues in different sectoral policies (Nilsson and Persson, 2003).

EPI can be studied from different perspectives. It can be studied horizontally among different sectors at one hierarchical level, or vertically among different hierarchical levels, and internally within one sector or policy (Lafferty and Hovden, 2003; Rouillard et al., 2013). Evaluating EPI is necessary for discovery barriers and further actions for its improvement.

EPI was evaluated in climate change policies (Kivimaa and Mickwitz, 2009; Mickwitz et al., 2010), land use planning (Simeonova and van der Valk, 2016; Termorshuizen et al., 2007), environmental health (Negev, 2016), biodiversity policies (Velázquez Gomar, 2016), etc. Nevertheless, a united definition of EPI and clear method for EPI evaluating are missing. Runhaar (2014) sees the reason in a heterogeneity of policies, i.e. their nature, quality, or structure. The EPI can be evaluated as a process, a product, or an outcome of strategies/plans (Jordan and Lenschow, 2010; Laurian et al., 2010). Hence, clear criteria for EPI evaluation differ according to purpose of policy evaluation. Most often the criteria for EPI evaluation are related to policy objects, goals, measures, actors, actor's networks, structures, procedures and instruments (Briassoulis, 2004). These policy elements must be compatible, non-conflicting, and coordinated to reach policy integration. Regarding landscape, the criteria for EPI can be understood as follows: a **policy object** is landscape that has to be integrated by various sectoral policies. **Goals** relate to landscape protection, management, and planning. The long-term goals must be employed by strategies on all administrative levels. Formal and informal **actors** are people (politicians, decision makers, clerks, landowners, inhabitants, NGOs, etc.) involved or interested in decisions concerning the landscape. Their common interests, communication, collaboration and traditions are key aspects for an effective EPI (Briassoulis, 2004). By **structures**, the multiscale organizational structures are understood that formalize roles and responsibilities for managing, protecting, and planning landscape. **Procedures** are legal processes and obligatory mechanisms for landscape integration (Simeonova and van der Valk, 2009). Finally, several legal, financial, informational, institutional, etc. **instruments** are recognized (Briassoulis, 2004; MoE, 2012). For example, Půček (2009) described four most important policy instruments for spatial development: strategic (strategic documents, spatial planning documentation, etc.); financial (financial programs, EU funds, subsidies); methodological

(consultations, guidelines, etc.); institutional (agencies, authorities of Regional councils, etc.).

Nevertheless, Roberts et al. (2009) point on the fact that landscape policy integration is so far the weakest point of the ELC implementation. The reasons can differ as several studies concerning environmental policy integration deduce:

- The complex environmental issues are difficult to reduce in any meaningful way to prevent their distortion (Crabbé and Leroy, 2008).
- Policies from different sectors, administrative levels, and spatial scales result in poorly integrated approaches to provide solutions to many environmental and landscape issues (Knüppe and Pahl-Wostl, 2013; Primdahl et al., 2013; Semančíková et al., 2008).
- Weak synergies among goals and measures lead to conflicts between interacting sectoral policies (Nilsson et al., 2012).
- Policy goals are not consistent with policy statements (Reyes-Mendy et al., 2014).
- Environmental and landscape issues are underestimated and are not prioritized in favor of economic interests in spatial planning policies (Belčáková, 2015; Simeonova and van der Valk, 2016; Termorshuizen et al., 2007).
- Different spatial-temporal operating scales of natural and social processes and their different consideration by policy decisions (Görg, 2007).

Therefore, policy analysis, monitoring and evaluation are important (Crabbé and Leroy, 2008; Faludi, 2000; von Haaren, 2002) for more control, policy improvement, providing information for authorities, and integrating landscape and related issues into different spatial planning and sectoral policies in coordinated way (Behn, 2003; Council of Europe, 2000).

1.4. Examples of policy instruments for the ELC implementation adopted in several European countries

So far, 38 members of the Council of Europe have ratified the ELC and Iceland and Malta signed the convention. The countries that have neither signed nor ratified the Convention are Germany, Austria, Estonia, Albania, Liechtenstein, Monaco, and Russian Federation. Nevertheless, Germany has a long history of landscape planning instruments, landscape planning was established there already in 1980s (von Haaren et al., 2006).

The approaches to the ELC implementation vary throughout Europe based on different enthusiasm, governance structure, as well as different available policy instruments (Déjeant-Pons, 2006). Some countries build on their long-standing traditions of the landscape policy instruments and innovated them, while other countries still have to define new instruments (Council of Europe, 2008; De Montis, 2014). In some countries, the key role on the ELC implementation is vested on national level, while in some other countries the regional authorities took their opportunity (Dempsey and Wilbrand, 2017). The overview of different approaches and instruments to the ELC implementation is given further on. The overview of the Czech instruments is given in chapter 1.1.

1.4.1 Strategic instruments

Increasing interest about landscape issues and the ELC implementation is reflected in strategic policy documents throughout many European countries. Some countries adopted or prepare directly national policy strategies concerning the ELC such as Sweden (Swedish National Heritage Board, 2011), Ireland (Government of Ireland, 2015), Scotland (Scottish Natural Heritage, 2005), Armenia (Alaverdyan, 2016), Latvia (Granta, 2016), and Hungary (MoA, 2017). The Swiss Landscape concept was adopted in 1997, yet already in sense of the ELC that was adopted 7 years later. This document ensured landscape integration in spatial

planning and is aimed to achieve sustainable landscape development, and promote cooperation between landscape users and conservationists. This document is a predecessor of the Concept 2020 – Guiding principles for nature and landscape (SAEFL, 2003) and later for Landscape Strategy FOEN.

Similarly to Switzerland, the Netherlands adopted several national strategic policy documents concerning landscape (Baas et al., 2011). He mentioned the Land Use Planning Memorandum, Nota Ruimte, and Landscape Agenda (Agenda Landschap). This document introduced plans of different ministries until the year 2020 regarding preservation and development of landscape values within Netherlands. One of the last strategic instruments is the Planning policy for conservation and sustainable development of 20 national landscapes that received also the National Landscape Award. Lithuania ratified the ELC in 2002. Since then, they adopted the National Landscape Policy, the Government measures of its realization, and the National Landscape Management Plan.

On the other hand, some countries have not adopted a specific national landscape policy document yet. They have a wide range of sectoral policy documents instead addressing landscape and more or less also the ELC, for example Poland (Majchrowska, 2011), Bulgaria (Hardalova, 2015), Cyprus (Hadjisavva-Adam, 2015), Sweden (Gren, 2015), Slovenia (Hladnik, 2016), and Finland (Mikkonen, 2016).

On regional and local levels, we can find also several documents concerning landscape strategies. These are for example: National Landscape strategy of Andorra (Rovira and Moles, 2011), National Landscape strategy of Andorra – Action 2016 – 2020 (Rovira and Moles, 2016), A Landscape Strategy for Lancashire (Lancashire County Council, 2000), Landscape Strategy and European Landscape Convention and Action Plan 2009 – 2019 (Peak District National Park Authority, 2009). In Great Britain, many landscape strategies give guidelines, for landscape

management and protection, based on the Landscape Character Assessment studies that have a long history of use.

1.4.2 Planning instruments

Planning instruments are most useful in dealing with landscape protection, management, and planning. In several European countries, we can observe hierarchical landscape planning systems on national, regional and local levels. It is the case of Germany, the Netherlands, France, and Switzerland (Table 3 and Table 4). On the other hand some countries have a history of spatial planning and they rather prefer landscape issues being directly integrated into spatial planning processes, as in England, Latvia, and Slovenia (Granta, 2016; Hladnik, 2016; Sala et al., 2015). Nevertheless, environmental policies have a rather small change to influence spatial planning policies in some European states, for example the Czech Republic and Lithuania (Nadin et al., 2018).

The landscape planning documents are mostly voluntary. When finished, they have to be/ can be integrated into spatial or territorial, resp. urban planning documents (Sala et al., 2015). For example, in Germany or in the Netherlands, the landscape plans are voluntary, but once approved, they must be adhered to. On the other hand, French landscape planning documents have no legal weight. In Switzerland, regions can elaborate landscape master plans while municipalities can elaborate their own landscape development plans. However, the previous plans must be implemented by local planning plans; the later come just as a recommendation.

Some countries do not have special landscape planning documents, but landscape issues are directly integrated into spatial planning systems, just as in England. Here, the landscape is integrated in Core Strategies that are part of Local Development Framework plans. The Core Strategies set the long-term visions and goals, and include results of the landscape character assessment, information about the necessity to develop green infrastructure, management strategies and plans, etc.

Table 3: Landscape planning documents.

State	National level	Regional level	Local level
Germany	Landscape program*	Landscape structure plan*	Landscape** plans
The Netherlands	Landscape Agenda	Landscape Development Plan Landscape Quality Plan	
			Village Surroundings Plans
France		Landscape Charters Landscape plans	
Switzerland	The Swiss Landscape Concept Concept 2020 Landscape Strategy FOEN	Landscape master plans	Landscape development plan

** These planning documents have different names in individual federal states; ** Except Berlin, Bremen, Hamburg, North Rhine-Westphalia, and Thuringia* (von Haaren et al., 2006).

Table 4: Spatial planning documents.

State	National level	Regional level	Local level
Germany	Federal state regional planning program*	Regional plan	Land use plan
The Netherlands	Land Use Planning Memorandum Nota Ruimte		Zoning plan
France		Territorial Coherence Plan	Local urban development plan
England	National Planning Policy Framework		Local Development Framework plans with Core Strategy
Switzerland	Spatial Concept	Canton strategies Canton master plans	Local planning plans

** These planning documents have different names in individual federal states* (von Haaren et al., 2006).

1.4.3 Institutional instruments

European countries introduce a variety of institutional arrangements concerning landscape (Jones and Stenseke, 2011). Most institutions represent three-scale territorial hierarchy, national, regional, and local. On regional and local levels, the landscape planning is up to the regional authorities or local municipalities. On the national level, somewhere a single ministry is responsible for landscape issues (Italy, Spain, Switzerland), in other countries several ministries are in charge, namely in Armenia, Bulgaria, Croatia, France, Poland, the Netherlands, and Slovakia (Alaverdyan, 2016; De Montis, 2014; Hardalova, 2015; Majchrowska, 2011; Miklós and Izakovičová, 2016). In most cases, the national authorities are responsible for the ELC implementation. The regional authorities are empowered to deal with some landscape issues (De Montis, 2014). For example, in France, the Regional Directions of Environment are supposed to elaborate Landscape Atlases and run the Landscape Photographic Observatories. Similar arrangement exists in Italy and Switzerland. Federal states or states with regional authorities are responsible for implementation in the regions (for example Belgium, Spain, the Netherlands, and the United Kingdom). In England, landscape planning and fulfilment of the national strategies is the responsibility of the Federal office of Environment, Department for Environment, Food and Rural Affairs (DEFRA), and the Natural England, and English Heritage run the agenda. In Germany, the Federal Nature Protection Agency is in charge.

Nevertheless, not only the governmental organizations are active in the ELC implementation. Veen (2014) stated that the Netherlands government decided to end their national policy and financial support for landscapes and the responsibility for landscape was delegated to regional authorities. In response, the non-governmental and non-profit organization Service net was established in 2012 to protect the landscape and support sustainable development in 20 most valuable cultural landscapes in

Netherlands (Veen, 2014). Another NGO organization preserving the Dutch landscapes is the Landschapsbeheer Netherland.

In Norway, the Norwegian university of Life Science established The Centre for Landscape Democracy in 2014. The mission of this Centre is to lead, and provide a conceptual framework landscape research and practices associated with democracy, and public engagement.

1.4.4 Coordinative instruments

Some European countries set up a new coordinative committees or charge a special agency to do this (Prieur, 2006). In France, The Ministry of Ecology, Sustainable Development, and Energy of France established the National Council for Landscape in 2000 (De Montis, 2014; Prieur, 2006). In Poland, the National Secretariat of the European Landscape Convention was established in 2010 (Opechowska, 2014). The Switzerland empowered the Federal Office for Environment to establish a landscape protection department to deal with the task of the ELC implementation. The Interdepartmental Commission for Coordination of Implementing the ELC was established in Armenia (Alaverdyan, 2016). A Swedish coordinating group for the ELC implementation was established among the 8 State Agencies in years 2010-2014. In England, a working group named 'Landscape Advisory Group' was formed to implement the ELC in 2014 with DEFRA support. Moreover, the Natural England, English Heritage, Department of Culture, Media and Sport, and the government agencies and administrations of Scotland, Wales and Northern Ireland did the same (Sala et al., 2015).

On the other hand, some countries leave the implementation on regional authorities, as in Spain (Elorrieta and Sánchez-Aguilera, 2011) or in the Netherlands (Baas et al., 2011). As already mentioned above, the Servicenet operates in the Netherlands, which is a network of local and regional institutions, organizations, and volunteers caring about the National Landscapes. There is an independent board named Foundation for

National Landscapes, which coordinates cooperation and knowhow exchange, a website for professionals, the organization to run symposia and seminars, dealing with product development and quality assurance (Veen, 2014). In the case of Spain, the role of coordinating the ELC implementation is up to the Landscape Observatory in Catalonia, operating since 2005. It is the advisory body for the Government of Catalonia and the center of landscape and landscape policy studies and monitoring. In Andorra, the coordinative body is the National Landscape committee, focusing on fulfilling the National Landscape Strategy of Andorra and communication with local authorities and stakeholders.

1.4.5 Legal instruments

The most countries has included landscape in a multitude of laws concerning environment, cultural heritage, planning and/or agriculture, while only few nations have a specific law dealing with landscape (Jones and Stenseke, 2011). This is the case of Catalonia (Law on Landscape protection, Management and Planning), and France (Law on Landscape) (De Montis, 2014). Jones and Stenseke (2011) also point out the fact that only Croatia, Cyprus and Wallonia in Belgium have formally adopted the definition of the ELC in law. Croatia ratified the ELC by the Act on the Ratification of the European Landscape Convention, Official Gazette 12/02 setting guidelines for the implementation of the ELC now (Dumbovic-Bilusic, 2015).

1.4.6 Financial instruments

The ELC implementation depends very much on financial support and the budget cuts (Amaro Alves, 2015; Baas et al., 2011). Different approaches are evident in financial support of the ELC implementation. Somewhere the money flow from the national budget or national funds. In Switzerland, the Swiss Landscape Fund supports landscape policies and landscape planning for over 25 years (Sala et al., 2015). On the other hand, for

example in the Netherlands, the landscape plans and studies must be financed from municipal, regional or non-governmental funds. In the Netherlands, the national landscape subsidies were redirected in 2009. Instead of paying landscape planning studies and documentations, they stimulated the implementation and integration of Landscape Development Plans by offering compensation for the appointment of a landscape coordinator. As Baas et al. (2011) noted such support of a coordinator effectively increased the successful realizing the Landscape Development Plans. In fact, this also meant increasing necessity of co-financing by other parties, including the regional and local authorities. This slowed down a lot of new Landscape Development Plans. Baas et al. (2011) added that the Landscape Development Plans has to solve compensations for 'red' developments, i.e. detrimental to landscape and 'green' values. The money from compensatory actions are frequently the source of financing Landscape Development Plans. These plans have to include a calendar of execution and the projected costs to make it easier for municipalities to plan finances in their annual budget for landscape actions (Sala et al., 2015). In England, the Heritage Lottery Fund is the main financial source for the landscape projects.

1.4.7 Monitoring instruments

These represent studies that aim do inform about landscape processes, services, and values enabling to intercommunicate landscape issues. The overview of some landscape studies worked out in accordance with the ELC see in the Table 5.

1.4.8 Communicative instruments

Many states adopted legal provisions for public participation in planning legislation. However, many states failed to do it still (Jones and Stenseke, 2011). Some states have already a long tradition of participation and wide base of active public support. For example, Baas et al. (2011) noted that in

the Netherlands, a thirty-four organizations cooperated to formulate the Landscape Manifesto just to stress the importance of landscape. They also noted that the public participation is supportive when the Landscape Development Plans are well prepared. The United Kingdom supports a wide range of consultations, public inquires, stakeholder partnerships, and involvement of community groups (Jones and Stenseke, 2011). Some states legislatively support public participation when preparing landscape plans or spatial plans (Germany, the Netherlands, and England).

Among variety of communicating instruments, we can also include several national Landscape awards granted to the ELC and landscape observatories.

Table 5: Landscape studies concerning the ELC.

State	Study	References
Poland	Red Book of Landscapes of Poland	(Majchrowska, 2011)
England	The National Character Area spatial framework	(Gray, 2014)
Scotland	Natural heritage zones: A national assessment of Scotland's landscapes	http://www.snh.gov.uk/docs/B464892.pdf
England	Landscape Character Assessment Guide for England and Scotland Landscape character map of England ELC – A Framework for Implementation	(Sala et al., 2015)
Spain	The Landscape Catalogues of Catalonia Landscape Catalogue of Andorra	http://www.catpaisatge.net/eng/catalegs.php
France	Landscape atlas	(Sala et al., 2015)
Switzerland	State and development of the Swiss landscape The Swiss Landscape Monitoring program LABES	http://www.sib.admin.ch/en/documentation/publications-addressing-biodiversity/2010/state-and-development-of-the-swiss-landscape/index.html (Kienast et al., 2015)
Lithuania	National Landscape Management Plan Landscape Guidelines for Roads and landscape Lithuanian Landscape types and its spatial characteristics identification study	(Bezaras, 2015)
Croatia	Landscape, Factor of Spatial Development	(Dumbovic-Bilusic et al., 2017)

1.5. Policy instruments addressing landscape in the Czech Republic

We have a multi-level governance system in the Czech Republic, where the success of partial polices depends strongly on their relationship to hierarchically higher policies. A variety of hierarchical sectoral policies aim at landscape issues in the Czech Republic as a response to negative landscape transformations and resulting consequences. They focus on different landscape components, spatial scales, administrative hierarchical levels and they have different binding status. We can follow different sectoral policy instruments focusing on landscape. This chapter gives an overview of the most important instruments addressing landscape, because the ELC implementation in the Czech Republic is characterized by integration of landscape issues into existing instruments addressing landscape rather than adopting new ones. See also Table 6 and Table 7.

1.5.1 Strategic instruments

In the Czech Republic, we have no special landscape strategy for the ELC implementation. Nevertheless, we have adopted several strategies that integrate landscape as policy object and propose goals (**Paper III** and **IV)**. Nevertheless, none of the environmental or spatial planning strategic policy documents fully use the terminology of the ELC, neither integrate landscape as the ELC suggests (Semančíková, 2016). Also, their legal binging statuses differ. Most of the national strategic policy documents are just guidelines (Veselý and Nekola, 2007), while the spatial planning documents are legally binding. The Table 6 gives an overview of the most important national strategic policy documents concerning landscape issues. The most important strategic policy documents on regional levels are the Regional Spatial Plans (*Zásady územního rozvoje, ZÚR*), Region Development Programs (*Programy rozvoje krajů, PRK*), Strategies for Nature and Landscape Conservation (*Koncepce a strategie ochrany*

přírody a krajiny, KSOPK).

On local level, the optional Strategic Plans of Municipalities (*Strategické plány obcí, SPO*) can be worked out. Nevertheless, optional special sectoral strategies are subject to adoption by regional or local authorities depending on their needs.

Table 6: Overview of national policy instruments regarding landscape issues

Government
▪ National Program of Reforms 2016 ▪ Strategic Framework Czech Republic 2030
Ministry of Environment (MoE)
❖ Act no. 114/1992 Coll., on Nature and Landscape Protection ❖ Act no. 254/2001 Coll., the on Water ❖ Act no. 334/1992 Coll., on the Conservation of Agricultural Land Resources
▪ National Environmental Policy 2012 - 2020 ▪ National Climate Change Adaptation Strategy ▪ National Strategy of Biological Diversity ▪ National Program of Nature and Landscape Protection ▪ Concept of Flood Protection Solutions ▪ Concept of Environmental Security 2015 - 2020
• Operational Program Environment 2014 – 2020 • LIFE program • National Program Environment • Landscape Management Program • Program for promoting the restoration of natural landscape functions
Ministry of Agriculture (MoA)
❖ Act no. 139/2002 Coll., on the Land Consolidation and Land Offices ❖ Act no. 289/1995 Coll., on Forests ❖ Act No. 334/1992 Coll., on Protection of Agricultural Land
▪ Strategy of Agricultural Resort until 2030 ▪ National Forest Program for the period until 2013 ▪ Concept of water management policy until 2015 ▪ General Plan for the protected area for surface water storage ▪ National River Basin Management Plans ▪ National Strategic Plan for Rural Development for the period 2007 - 2013
• Direct payments (GREENING) • Rural Development Program 2014 - 2020
Ministry of Culture
❖ Act no. 20/1987 Coll., on state monument care
▪ National Cultural Policy from 2015-2020 ▪ Concept of Monument Preservation 2011 - 2016
• Program of care for Rural Monument Reserves and Landscape Landmark Zones
Ministry of Regional Development
❖ Act no. 183/2006 Coll., the Building Act
▪ Strategy of the Regional Development ▪ Policy of Architecture and Building Culture ▪ National Planning Policy

❖ Legislative instruments, ▪ Strategic instruments, • Financial instruments

1.5.2 Planning instruments

We have several planning instruments dealing with landscape or its parts in the Czech Republic. They can be divided by domains, scale validity, and administrative level. Their overview is in the Table 7 and they are more described further.

The most important planning instrument for dealing with landscape issues in the Czech Republic is the spatial planning (*Územní plánování*) processed in accord with the Act No. 183/2006 Coll. (the Parliament of the Czech Republic, 2006). It focuses on the area arrangement and co-ordinates activities linked to construction and land development. It should also protect and develop natural, cultural, and civilizational values of all areas. Landscape must be protected as substantial component of human well-being. The spatial planning in the Czech Republic is hierarchically organized on national, regional, and local levels, where the responsibility is vested to relevant Municipal Offices with extended power, Regional Offices, the Departments of Regional Development and Defense. The planning tools are the non-statutory planning instruments - the Spatial Planning Policy of the Czech Republic, the spatial planning documents, and the planning permission (the Parliament of the Czech Republic, 2006).

The spatial planning documents represents the most important outputs of spatial planning process in the Czech Republic. They have a great potential to deal with landscape issues, nevertheless there are big differences in landscape issues integration on local level (Nedvědová, 2017). The spatial planning documents are adopted hierarchically on regional level (Regional spatial plans) and local level (Land use plans). The Decree No. 500/2006 Coll. (MoRD, 2006) specifies their content. The plans cannot contain details belonging by the content to hierarchically lower spatial planning documentations and they must integrate the goals from the hierarchically higher spatial planning documentations.

Regional Spatial Plans (*Zásady územního rozvoje, ZÚR*) are obligatory and legally binding for hierarchically lower documents and they

must comply with the Spatial Planning Policy. The ZÚR focus on framing of efficient and economic spatial arrangement of the region´s territory, and they delimit the areas or corridors of regional importance.

The documentation of ZÚR specify structural connectivity (*Územní systémy ekologické stability, ÚSES*), set landscape quality objectives including conditions for their achieving or preservation, and specify conditions for protection and development of natural and cultural values within entire region. The graphical supplements of ZÚR include maps of landscape types according to the defined landscape quality objectives. Uncoordinated methodologies for mapping landscape types and specifying landscape quality objectives in ZÚR are perceived as a disadvantage of the current practice.

Land use Plans (*Územní plány, ÚP*) must comply with the hierarchically higher Spatial Planning Policy and Regional Development Principles. Again, they are legal binding and obligatory. All municipalities must adopt them before the end of 2020. They specify basic concept for spatial development of entire municipality and its values. They should focus on spatial, urban and landscape design, as well as public infrastructure. ÚP delimit built-up areas as well as other areas and corridors, especially areas with potential for next development, areas designated for redevelopment or renewal, areas for actions of public interest, areas to be maintained as spatial reserves, and they enable land utilization. Local building authorities at municipal level have responsibility for land use planning.

The ÚP must reflect landscape through the Green Spaces Sharing System, Landscape Arrangement system (including structural connectivity, landscape permeability, erosion and flood control measures, recreation, mining, etc.). The plan also must determine the possible and unacceptable use limits of delineated areas of a municipality as well as conditions for landscape character protection. The disadvantage is that no uniform methodology exist for concept of landscape arrangement and the attention

is paid mostly to structural connectivity and landscape character assessment (Nedvědová, 2017). The ÚP is not able to solve quality of individual landscape components.

Regulatory plans (*Regulační plány, RP*) are the most detailed types of land use planning documentation. They are elaborated for designated areas of a municipality. Mostly they focus on localization and spatial arrangement of buildings, resp. protecting of values and character of defined areas. However, these plans are not obligatory.

Management plans of protected areas (*Plány péče, PP*) are expertise and strategic documents governed by the Act no. 114/1992 Coll. (the Czech National Council, 1992). They focus on protection and development of natural conditions, as well as natural processes regulation of development of and human activities in Specially Protected Areas, such as national parks, protected landscape areas, national nature reserves, nature reserves, national natural monuments, local natural monuments and their protective zones. The PPs are set up by Ministry of the Environment (through Nature Conservation Agency) for national parks, protected landscape areas; and by the Administrations of the Protected Landscape Areas for the rest Specially Protected Areas, usually for a period of ten to fifteen years. These plans are mandatory for other types of planning documents (i.e. forest, water or land use plans). However, the Management plans of protected areas are not legally binding for physical and juridical persons (Frank Bold, 2009).

Protection plans of Landscape Monument Zones (*Plány ochrany pro krajinné památkové zóny, PO KPZ*) are voluntary and can be prepared to stipulate cultural values in KPZ by the Act 20/1987 Coll. (the Czech National Council, 1987). So far, we have in all 25 KPZ in the Czech Republic and no protection plan for them. The superior document for PO KPZ is a Regulation Plan, if approved.

Table 7: Overview of planning instruments for different sectors.

Planning instruments	Scale	Admin level	Responsible authority	Spatial Focus
Environmental domain				
Management plans of protected areas	N	regional local	Nature Conservation Agency Administrative bodies of Protected Landscape areas Administrative bodies of National Park	natural values in nature protected areas
Structural connectivity	A	national regional local	Regional Office Municipality with extended power	biocentres, biocorridors
Cultural protection domain				
Protection plans of Landscape Monument Zones	N	regional local	Regional Office Municipality with extended power	cultural values in Landscape Monument Zones
Forestry domain				
Regional Plans of Forest Development	N	national regional	Forest Management Institute	forests
Forest Management Plans	A	local	forests owners	
Water management domain				
National River Basin Management Plans	N	national	Ministry of Agriculture Ministry of Environment River Boards, state enterprises	quality and quantity of ground /surface water and water ecosystems
River Basin District Management Plans	N	regional	River Boards, state enterprises	

Planning instruments	Scale	Admin level	Responsible authority	Spatial Focus
Rural development / agricultural domain				
Land Consolidation	A	local	State Land Office	agricultural land
Spatial planning domain				
Regional Spatial Plans	A	regional	Regional Building Authorities	area-wide
Land use Plans	A	local	Municipal Board Building Authorities of Municipal Office of entire Municipality with extended power	area-wide
Planning Analytical Materials	A	regional local	-//-	area-wide within region or municipality
Landscape studies	A	local	-//-	area-wide within municipality

Note: A – administrative scale, N – natural scale

Land Consolidation (*Pozemkové úpravy, PÚ*) represents planning instruments within rural development/ agricultural domain. It primarily focuses on functional organization of land lots to ensure their accessibility and settle the property ownership rights. A part of land consolidation process is the plan of Common Facilities that helps to improve environmental conditions in the area. The plan of Common Facilities often includes measures for flood and erosion control, establishment of structural connectivity, and the increasing landscape accessibility from the human point of view (Podhrázská et al., 2015).

The Act No. 139/2002 Coll. (the Parliament of the Czech Republic, 2002) and the Decree No. 13/2014 Coll. (MoA, 2014) specify two basic forms of land consolidation. The Complex Land Consolidation (Komplexní pozemkové úpravy, KPÚ) and Simple Land Consolidation (Jednoduché

Pozemkové úpravy, JPÚ). Each of these forms are processed differently and are used for different purposes. The responsible authority is the State Land Office (*Státní pozemkový úřad, SPÚ*), which has to completely organize the process of land consolidation since its initiation, funding, administrative procedures order and decisions (Kaulich, 2013).

Regional Plans of Forest Development (*Oblastní plány rozvoje lesů, OPRL*) provide methodological support for state forest policy, according to the Act No. 289/1995 Coll. (the Parliament of the Czech Republic, 1995). They set a framework of management directives for forest management, and for adoption of forest management plans and guidelines. Their aim is to provide sustainable forest management and to minimize conflicts between public and private interests in sense of finding proportion among different forest functions in various socio-economic and natural regional conditions.

The OPRL are provided for totally 41 natural forest areas defined by specific forest habitats within specific geological, phytogeographical, orographic, and climatic conditions. The OPRL are prepared for a period of twenty years. The contractor is the Forest Management Institute (*Ústav pro hospodářskou úpravu lesa, ÚHÚL*) and the expenses for their elaboration are paid by the state.

Forest Management Plans (*Lesní hospodářské plány, LHP*) represent the operational inventory of forest state and set the framework for their management directives for the individual types of forest development. They determine timber harvesting limits, and the minimum proportion of ameliorating and bolstering tree species. These plans bring the economic goals and visions into accord with the Act No. 289/1995 Coll. (the Parliament of the Czech Republic, 1995). The LHPs are the owners' instrument for management of their property. They are obligatory for all forest owners who own forest exceeding the area of 50 ha. Those forest owners who own forest which does not exceed the area of 50 ha are

obligated to prepare **Forest Management Guidelines** (*Lesní hospodářské osnovy, LHO*). Both plans, LHP and LHO, are in effect for 10 years and the costs for preparing LHP are paid by the forest owner.

River Basin Management Plans represent National River Basin Management Plans (*Národní plány povodí, NPP*) and District River Basin Management Plans (*Plány oblastí povodí, POP*). Both these types of plans focus on protecting and improving ground and surface water, together with related water ecosystems. They provide a description of the water basin characteristics, a description of human influence, water status evaluation and definition of goals and measures (MoE and MoA, 2011). However, in practice, the goals and measures of adopted POP focus on constructions related to water bodies (Mackovič, 2012) and they do not focus on landscape and its management in water basin. These river basin management plans are binding for spatial planning and other policy decisions according to the Act No. 254/2001 Coll. (the Parliament of the Czech Republic, 2001).

In the Czech Republic, we have the three NPPs for the main river basins Labe, Odra, and Dunaj. The Ministry of Agriculture and the Ministry of Environment in cooperation with the River Boards, state enterprises, and relevant Regional Offices are the responsible authorities for establishment of NPPs (Frank Bold, 2017). The POPs are managed by the relevant River Boards, state enterprises, in cooperation with Regional Offices, and relevant Water Authorities (Frank Bold, 2017). Regional councils according to their local administrative power approve these plans. Altogether, there are ten POPs in the Czech Republic.

1.5.3 Institutional instruments

Landscape, its protection, management and planning, is historically divided among many public authorities in the Czech Republic, hierarchically at the national, regional and local levels. The Ministry of Environment is the most

important institution responsible for landscape policy, the ELC implementation and coordination of landscape policy integration to sectoral policies. Next important national policy authorities are: the Government of the Czech Republic, Ministry of Agriculture, and Ministry for Regional Development, the Ministry of Culture, and Ministry of Defense. The Regional Offices and Municipal Offices with extended powers take their responsibility at the regional and local levels.

Some authorities rank landscape further among departmental sectors. For example, the Ministry of Environment rank landscape as follows: General Nature and Landscape Protection, Special Territorial Nature and Landscape Protection, Species Protection and Implementation of International Commitments, Geology; Water Protection; Air protection; Environmental Hazards and Environmental Damages; Energy and climate protection. The Ministry of Agriculture has sectors concerning on: Water and flood management; Soil and land consolidation; Forest management; or Countryside.

1.5.4 Coordinative instruments

In 2006, The Interdisciplinary Consultation Committee was established by the Ministry of Environment to coordinate the ELC implementation on the level of ministries. Nevertheless, the Committee failed to work for 3 years and it was re-established a new in 2014. Now, it consists of representatives from 5 ministries (Tóbiková, 2016). Just the same year 2014, the *Government Council for Sustainable Development* (as Government Advisory Board) formed *Committee for Landscape, Water, and Biodiversity*. State representatives, academicians, professionals, and NGOs compose this Committee. One of its working groups should deal with landscape issues.

1.5.5 Legal instruments

The national legislative instruments are the most important for legal

binding decisions on landscape protection, management, and planning.

Different Acts have an impact on landscape (Table 6). The Act no. 183/2006 partly implemented the concepts used by the ELC and describe a landscape as "*the substantial component of the environment of the inhabitants´ life and the basis of their identity*". Nevertheless, only the Act no. 114/1992 Coll., on nature and landscape conservation (the Czech National Council, 1992) defines the concept landscape and sets a framework for general and spatial landscape protection. For more description of various Acts and Decrees relating to landscape in the Czech Republic see Kučera et. al. (2014).

The Act no. 114/1992 Coll. defines landscape as "*a part of the Earth's surface, with a characteristic relief, formed by a complex of functionally integrated ecosystems and elements of civilization"*(§3, Act no. 114/1992 Coll.). Nature and landscape conservation is understood „*to mean the hereinafter specified care for wild animals and their communities, minerals, rock, paleontological finds and geological formations, ecological systems and landscape units as well as for the appearance and accessibility of the landscape, carried out by the State and by natural and legal persons*". Nature and landscape conservation is ensured by general and spatial conservation. The Act stresses the most important activities in landscape protection:

1. Establishment of structural connectivity (*územní systémy ekologické stability, ÚSES*);
2. Conservation of wood species growing outside of forests and protection of significant landscape components;
3. Influence of water management to maintain natural conditions for life in water and wetland ecosystems;
4. Protection of the landscape character (*ochrana krajinného rázu, OKR*);
5. Restoration and establishment of new and valuable natural ecosystems;

6. Protection and use of landscape for ecologically appropriate forms of economic utilization, tourism, and recreation;
7. Participation in setting and approval of forestry plans, in process of spatial planning, and in conservation of land resources.
8. Establishment of network of Specially Protected Areas (*zvláště chráněná území, ZCHÚ*).
9. NATURA 2000.
10. In relation to the note 7, the ACT also formulates intentions to carry on landscape policy integration.

1.5.6 Financial instruments

Various types of financial instruments exist in the Czech Republic. These can be positively motivating as all kinds of subsidies or negatively motivating as sanctions or penalties. Some important, positively motivating, financial instruments are in Table 6. These can be divided on European or national programs. Programs supported from European funds are three: Operational Program Environment 2014 – 2020 (*MoE*), Rural Development Program 2014 – 2020 (*MoA*), and LIFE program (*MoE*). Programs supported from national funds are: National Program Environment (*State environmental fund of the Czech Republic*), Landscape Management Program (*Nature Conservation Agency of the Czech Republic*), Program for promoting the restoration of natural landscape functions (*Nature Conservation Agency of the Czech Republic*), GREENING (*MoA*), Program of care for Rural Monument Reserves and Landscape Landmark Zones (*Ministry of Culture*).

1.5.7 Monitoring instruments

In the Czech Republic, we have large amount of various data and studies describing the landscape state and development or its components. These studies can be specified as obligatory based on legal requirements or as products of the scientific research. In this study I describe the important, obligatory monitoring instruments.

The obligatory studies represent the non-statutory planning materials that are part of the spatial planning process. According to the Act 183/2006 Coll. (the Parliament of the Czech Republic, 2006) we do recognize:

Planning Analytical Materials (*Územně analytické podklady, ÚAP*) as obligatory but not binding for the above described planning documents, although they are necessary for the ZÚR and ÚP assignment. They describe the state and development of entire region or a municipality with extended power. They give overview and classification of values, use limitations, and analysis of sustainable development of an area. ÚAP maps has text and graphical outputs, and are the most frequently used maps within the Czech administration (Burian et al., 2016). The Decree No. 500/2006 Coll. (MoRD, 2006) provides listing of ÚAP differently for ZÚR (totally 37 phenomenon) and ÚP (totally 119 phenomenon). Nevertheless, the ÚAP are considered as limits for spatial development and their interpretation for purposes of spatial planning is minor.

Planning Studies (*Územní studie, ÚS*) are voluntary and prepared to show options or solutions for selected problems concerning land use or spatial arrangement within the selected area. Mostly they are local, but on regional level they could be worked out if more information on certain topic are necessary (about recreation or tourism).

Landscape Studies (*Územní studie krajiny, ÚSK*) are relatively new type of ÚS (since 2015). They are worked out for the whole territory of the Municipality with extended power and they are supposed to be a source of landscape information for the Concept of Landscape Arrangement. One of the main outcomes of these studies should be a formulation of landscape vision and engagement of public participation.

Another very important obligatory instruments are the environmental assessment studies. In the Czech Republic, we have adopted

the Environmental Impact Assessment (EIA), and Strategic Environmental Assessment (SEA). These are mandatory when preparing various types of development projects (EIA) and policy documents (SEA).

1.5.8 Communicative instruments

In the Czech Republic, we have many communicative instruments regarding the ELC such as workshops, conferences, awards, participative strategies, etc. National institutions such as Ministries, but also the universities, Academy of Science, different NGOs have their own ways to communicate landscape issues on national, regional or local levels. These instruments are (more or less) persistent.

On the national level, the Landscape Award was established. Nevertheless, it was awarded only twice, in 2010 and 2012.

Regarding public participation, the public in the Czech Republic have just limited chance to participate on any level of spatial planning process. They can only raise objections or protest to already processed planning document. The only possibility for real participation can be the preparation of the ÚSK on local level which is the non-statutory planning material for spatial planning documentation. The legal bases for true public participation in spatial planning still need a major overhaul and improvement.

2. The study aims

Based on the overview of policy instruments it is evident that we have a variety of sectoral policy instruments dealing with the landscape issues in the Czech Republic. On the other hand, we have no coherent complex instrument dealing with landscape. We have no true landscape planning and no true landscape strategy for implementing the ELC in spite that these has been called for by our scientists since a long time ago (Boucníková and Fanta, 2005; Hruška, 1945; Klika, 1946; Míchal, 1976; Salašová, 2014). The Czech Republic did decide to implement the ELC and integrate landscape into already existed policies long time ago. The question then arises, how do the existing policies really integrate the landscape issues? Many scientific studies provide evidence of low prioritization of environmental and landscape issues in various policy documents (Belčáková, 2015; Kučová et al., 2013; Salašová, 2014; Simeonova and van der Valk, 2016; Termorshuizen et al., 2007). Kučová (2013) even states that the effective cooperation between nature protection, spatial planning, and protection of cultural monuments in the Czech Republic is missing altogether. Therefore, the evaluation of landscape policy and landscape policy integration into a planning process is necessary, as supported also by Roe (2013) and Scott (Scott, 2011).

Two requirements arising from the ELC are the pillars of this PhD thesis: 1) the landscape integration into spatial planning, and 2) the landscape and landscape policy monitoring. The overall aim of this study is to evaluate landscape as a policy object and its goals in spatial planning and environmetal domains in the Czech Republic strategic policies. Special focus is given to evaluation of strategic policies implemented through strategic policy documents (Veselý and Nekola, 2007). The national strategic spatial planning and environmental documents were evaluated, because they give framework to lower strategic policies and they are perceived by the ELC as the most important in relation to landscape policy

integration, even if landscape policy integration must be stressed in all stages of policy making. The strategies also may have power to frame ideas, prioritize them, and set them into action (Healey, 2009). I consider them to be an important start point for effective landscape policy implementation and integration. The main questions of this study are: (1) What are the historic roots of having no effective landscape planning instruments?; (2) How does landscape change under varying agricultural management?; (3) What policy objects are connected to landscape in strategic policy documents?; (4) How is fragmentation as an urgent landscape problem framed in strategic policy documents in spatial planning and environmental domains? What are the differences and similarities?

To meet the overall aim, several partial objectives were defined:

1. To describe the historical and current state of landscape planning in the Czech Republic and its relation to spatial planning. (**Paper I**)
2. To monitor historic changes in landscape structure to identify the trends of landscape transformation in areas with varying agricultural management and to determine the impact of land use change on the resulting landscape heterogeneity. (**Paper II**)
3. To evaluate policy objects connected to landscape and their integration in national strategic policy documents. (**Paper III**)
4. To evaluate framing of fragmentation in strategic policy documents of spatial planning and environmental domains (**Paper IV**)

3. Methods

This chapter is divided into two subchapters concerning the methods for monitoring landscape changes and evaluating the strategic policy documents. This division comes from the thematic focus of the articles in this PhD thesis.

3.1. Monitoring of landscape changes

Monitoring of landscape changes is important for observing the landscape state over long periods of time and examination of the effects of human intervention. In present days, all kinds of GIS and DPZ technologies are used to monitor landscape, based on available data, scale, and thematic purposes. Several types of satellite data, historical maps, orthophoto maps or varying digital data are used. This research is quantitative, and several indicators were developed to evaluate structural and functional landscape changes.

We evaluated LUC changes in 15 brook basins, situated in South Bohemian Region (NUTS 3, CZ031) in the Czech Republic **(Paper II)**. We selected the brook basins based on the next characteristics: paved surfaces has to be less than 5% of the total brook basin area, total area of each basin does not exceed 3 km^2, and forest cover is less than 30%. We divided the brook basins into three landscape categories according to different agriculture management: 1) Agriculturally intensively used areas (AIU); 2) Medium intensively cultivated areas (MIC); 3) Marginalized areas (MG).

Next, the LUC was derived from ortho-rectified Military Aerial Photographs from 1940, 1960, and 1990, and orthophotomaps from 2010 (VGHMUr, 51816 Dobruška, Czech Republic). These time spans were chosen for existence of aerial photographs and because they represent historical breaks in land use related to political changes. The first year represents the traditional form of agricultural management based on personal ownership, while the second and third years represent the

landscape mirror of the transfer from small scale management to large industrial agricultural management and the introduction of municipal ownership, later agricultural cooperatives. On the other hand, the year 2010 represents the landscape mirror of land use development after the communist regime collapse in 1989 followed by restitution of private ownership and development of free market economy driven forms of land use (Boucníková and Fanta, 2005).

We classified LUC as Cultivated land; Non-cultivated land; Woodland; Linear vegetation; and Built-up areas. For evaluating the landscape structure changes, a set of indicators was proposed: the relative length of edges, average size of landscape elements, relative occurrence of landscape elements, diversity of land use types (Sklenička and Lhota, 2002), and index of LUC heterogeneity (Fjellstad et al., 2001).

3.2. Evaluation of strategic policy documents

Assessing of strategic policy documents is complicated, because they are elaborated very differently, for different purposes and they are not measurable. Hence, evaluating strategic policy documents is mostly a question of qualitative research based on qualitative methods.

For the purposes of processing **Papers III** and **IV** the content of strategic policy documents was analyzed using thematic frame analysis (Ritchie and Lewis, 2003). The analyses were done in time periods of 2007-2008 and 2015-2016. The strategic policy documents focused on environmental and landscape issues, and were all in force when the content analysis were conducted. In the first period, we evaluated a wider set of sectoral national strategic policy documents while in the second period we focused on strategic documents in environmental and spatial planning policy domains.

In the first period (**Paper III**), we searched the documents for sentences and paragraphs regarding next policy objects that represents spatial landscape problems: landscape fragmentation, and landscape

abandonment, changes of landscape character, non-cultivated areas, brownfields, and landscape sealing. These policy objects were categorized according to literature review and reading the policy documents. We labeled and coded these categories in the documents. Next, the coded data were sorted into separate spreadsheets regarding four categories of problem importance:

- First category: data deal with the problem, support different ways of tackling it and suggest possible solutions to the problem. This category was given a score of 3.
- Second category: data discuss the problem and only support tackling the problem. This category was given a score of 2.
- Third category: discuss the problem only generally and neither tackle the problem nor give possible solutions. This category was given a score of 1.
- Fourth category: data do not deal with the problem at all. This category was given a score of 0.

Finally, the documents were evaluated according to quantity of the policy objects resented, and according to the importance they were tackled.

In the second period (**Paper IV**), we analyzed the documents by means of the thematic frame analysis, even if we focused only on landscape fragmentation as one of the most critical spatial landscape problem (MoE, 2012). The main aim was to understand the differences and similarities in how fragmentation is framed in the spatial planning and environmental policy domains. A content analysis was conducted using thematic framework analysis (Ritchie and Lewis, 2003). We searched the documents for sentences and paragraphs regarding the concepts associated with fragmentation and the key fragmentation aspects (Semančíková et al., 2019). Next, the data were labeled and coded in terms of three key fragmentation aspects: 1) biological organization, 2) land cover, and 3)

connectivity. These data formed the basis for addressing the three frames: species-oriented frame, pattern-oriented frame, or ecosystem services frame. We quantified the presence of the frames in the two policy domains and we also assessed the quality of the framing, by evaluation of framing elements (i.e. knowledge and values).

Next, we searched for proposed solutions, derived as goals and measures proposed in each document, with these solutions assigned to one of three types - mitigation, avoidance, compensation (Iuell et al., 2003).

4. Results and discussion

4.1. Historical and current state of landscape planning in the Czech Republic and its relation to spatial planning

In the Czech Republic, the current state of landscape as well as the public interest on its planning are deeply rooted in history (**Paper I**). Landscape protection, spatial planning, and landscape planning activities can be traced from the beginning of the last century, some even earlier. Valuable natural isolated parts of landscapes started to be protected by law already in the first half of the 19th century. Similarly, the first regulations regarding municipalities and their surroundings were adopted already in the19th century. These activities put bases for nature protection and spatial planning as separated disciplines and they did not cooperate until the World War II.

Later, attempts to integrate nature protection with spatial planning emerged and landscape planning was seen as important (Hruška, 1945; Klika, 1946). In addition, a draft of an Act on landscape and urban planning was formulated in the former Czechoslovak Socialistic Republic after the World War II. Nevertheless, the Act was not adopted and landscape planning, based on ecological and biological findings was overlooked by policy decisions makers.

After the World War II, Prof. Klika proposed a methodology of biological planning and he already focused some principles that came into forefront in planning just recently, yet they are still not common. These are for example: precautionary principle, protection of landscape aesthetic values, substitution measures, or landscape planning based on defined landscape types and landscape character areas. This research had also institutional background since 1950's (working section "Biology of landscape", the National Institute for District Planning - TERPLAN, the Institute for the Landscape protection and management of the

Czechoslovak Academy of Sciences). Nevertheless, landscape planning was low importance in practice. I see three reasons, why the landscape planning did not gain common acceptance. First, at the time, the two separate disciplines on spatial planning and nature protection existed. The scientific community opinion was not in accord, if landscape planning should be understood as equivalent to spatial planning, or if it is an independent activity that should not be interchanged with spatial planning. Second, it had no legislative support because the Act on landscape and urban planning was not adopted. Third, the spatial and environmental policies were subordinated to the economic growth oriented national policy. At the time, the spatial planning did concentrate on economic and technological needs and stressed the built-up areas only (Kolář et al., 1979). It focused on determining the territorial technological potential, and it was considered an instrument for territorial economic development. Officially, the landscape planning did not exist, although some examples of landscape planning can be found. For example, Fanta (1974) introduced a study where the goals for landscape protection and management were proposed for different landscape functions within the described landscape types of the National Park of Giant Mountains.

In 1980's, some new methods based on bio-ecological approaches to landscape planning were introduced. For example, it was: 1) a landscape-ecological planning method, widely known as LANDEP, based on defining landscape potential for optimal land use allocation; 2) a methodology for a hierarchical, long-term biological landscape planning was proposed; and 3) a method for establishing structural connectivity (*územní systémy ekologické stability, ÚSES*). The last approach, of interconnected network of biocentres and bio-corridors, was supported by the Act No. 114/1992 on Nature and Landscape Conservation (Mackovčin, 2000). This evolved into the obvious measure for general landscape protection in the Czech Republic. Due to its legal binding status, it became the obligatory part of spatial planning.

Since 1990's, the actual spatial planning is based on spatial determination of functional and physical development of all areas. (Maier, 2001). The landscape was understood as just a limit of a build-up area development (Salašová, 2014). The situation of landscape planning became promising with ratification of the European landscape convention and adoption of the new Building Act no. 183/2006. The Act no. 183/2006 partly implemented the ELC understanding a landscape as "the substantial component of the environment of the inhabitants' life and the basis of their identity". The Act aims spatial planning to focus on build-up areas as well as surrounding landscape (Maier and Peltan, 2015). Nevertheless, although this is innovative in the Czech spatial planning law, understanding landscape just as surrounding of a build-up area is insufficient because the ELC focus landscape in urban, peri-urban, rural and natural areas. The Act also lacks a landscape definition and do not adopt landscape planning as an instrument for landscape protection or management. Kučera et al. (2014) conclude that this law still stress urban development as a key target of spatial planning and landscape is still understood as just a reserve for the urban development.

4.2. Trends of landscape transformation in areas with varying agricultural intensity

The policy decisions have had impact on land use/cover changes (Plieninger et al., 2016) either they were influenced by the rigid centrally planned economy between 1950s – 1980s, or by the free market economy since 1990s (Bičík et al., 2001). This is most evident on development of arable land in the Czech Republic. Although the forest and urban areas increased, and the total amount of agriculture land decreased since the beginning of the 20th century (Bičík et al., 2001), the percentages of arable land vary according to the Czech Republic policy changes (Boucníková and Kučera, 2005). The percentage of arable land increased during 1950s – 1990s (from 71,85% in the year 1950, to 75,2 % in the year 1989).

However, in years following the abolition of the communist regime in 1989 it has been decreasing continuously. In 2015, from the total agricultural land we had only 70,5% of land arable. Nevertheless, this land use/cover changes differ regionally (see Figure 3) (Boucníková and Kučera, 2005; Meyer et al., 2000).

We did monitor local differences of land use/cover changes in small water basins in Southern Bohemia, which were categorized as agriculturally intensively used areas (AIU), marginalized areas (MG) and areas with medium intensity of cultivation (MIC) (**Paper II**). The changes in cultivated land, non-cultivated land, woodland, linear vegetation and build-up areas were evaluated for the selected years of 1940, 1960, 1990, and 2010.

The landscape changes were noticeable within the specified time segments and they remarkably differ in our three categories of selected water basins. The total changes observed during the period 1940 – 2010 were:

1) Continuous increase of cultivated land area in the AIU in disadvantage of non-cultivated areas, and linear vegetation;

2) The cultivated land area was gradually decreasing in the water basins categorized as MG, mostly in advantage of permanent grasslands or forests;

3) The linear vegetation increased in all categories of water basins. The riparian vegetation increased in MG areas, and road alleys increased in MIC and AIU areas.

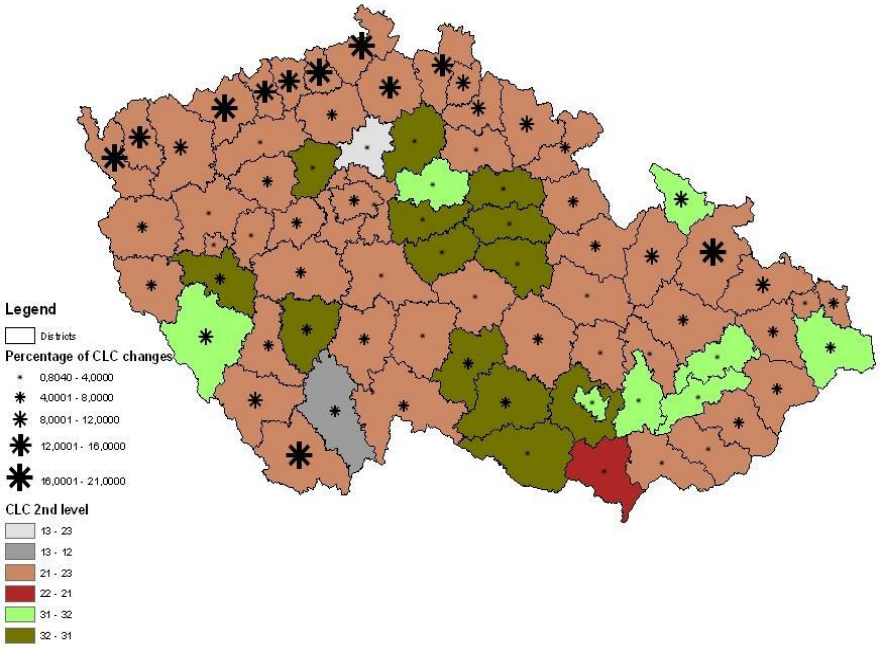
Further, the analysis of landscape structure showed that even if diversity of land cover remained constant, the length of edges decreased, and average size of landscape elements increased. This results point on decreasing heterogeneity and increasing homogenization of landscapes in all categories of water basins, although most in AIU. The national long-term land use monitoring show continuous decline of arable land in the Czech Republic (Czech Statistical Office, 2016). While the changes in MG

confirm the national trend, the increase of cultivated land area in the AIU is not in line with the trend evident on the national level.

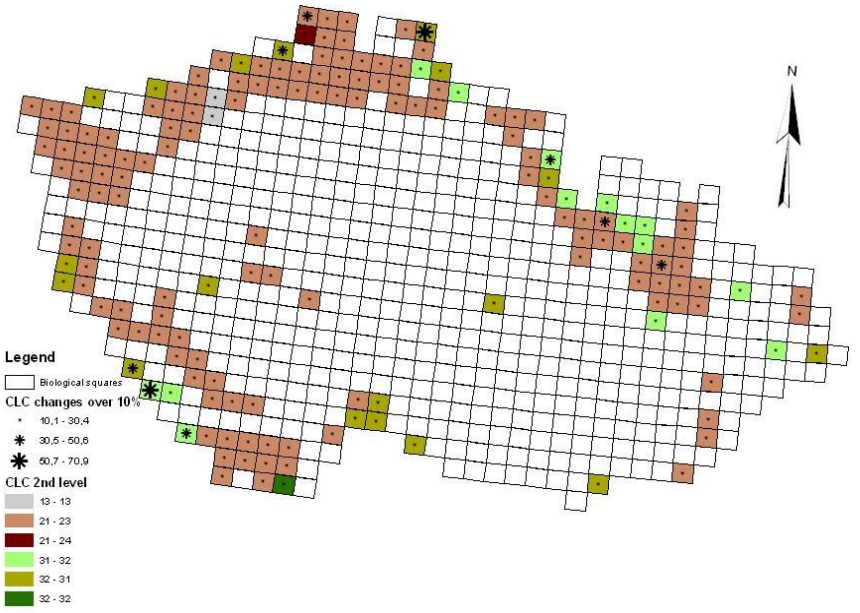
Processes of landscape homogenization occur throughout the whole of Europe, having several negative consequences (Jongman, 2002). These consequences are species-, and scale- specific (Dorresteijn et al., 2015; Liu et al., 2018). Thus, we have to be aware about regional differences in landscape transformations. Hence, the monitoring of landscape transformation on national, regional, and local levels is necessary with identifying their corresponding driving factors, their intensity, the changing land cover categories and ecosystem functions.

Figure 3: Distribution of prevailing land cover changes and percentage of changes that occur: a) in districts and b) square grid (Those squares where changes exceeded 10% are depicted).

a)



b)



(Boucníková and Kučera, 2005)

4.3. Evaluation of policy objects connected to landscape, their integration in national strategic policy documents; and evaluation of framing of fragmentation in strategic policy documents of spatial planning and environmental domains

The landscape transformation is a dynamic process that is significantly driven by policy decisions on local as well as on national level (Belčáková, 2015; Bičík et al., 2001). This confirms many studies from many Central and East European countries (Plieninger et al., 2016). Therefore, hierarchical policy is necessary to direct landscape issues and related problems in optimal way (Boucníková and Fanta, 2005). After joining the EU, the Czech Republic adopted several strategic policy documents aiming to improve environment. These documents differed in quality and focus because a methodology for their writing was missing (Veselý and Nekola, 2007). New strategic policy documents have been adapted since 2012 in the Czech Republic on the national as well as regional levels. Thus, evaluating the policy objects connected to landscape, framing of policy objects, policy goals; and their integration into various policy domains is desirable.

In the **Paper III**, we evaluated policy objects connected to landscape, and their integration in national strategic policy documents. The policy objects represented spatial landscape problems, i.e. landscape fragmentation, landscape abandonment, landscape character changes, uncultivated areas, brownfields, and landscape sealing. The results indicated that most of the studied strategic policy documents concentrated on brownfield and landscape sealing. The rest spatial landscape problems got attention by less than 50% of the studied documents. The Spatial Development Plan (SDP), as a legal binding document for spatial planning on regional and local levels did not tackle the spatial problems sufficiently. We discovered, that the studied documents were different quality and the integration of landscape related issues was low. The problems were described mostly only generally without formulating any goals/measures.

This was also the case of landscape fragmentation. Half of the Czech Republic is highly fragmented compared to other European regions, and further increase of fragmented landscape (about 11%) is expected by 2040 (CENIA, 2013; EEA, 2011). Thus, in the next study (**Paper IV**), we focused on fragmentation as a policy object connected to landscape.

Fragmentation is a typical example of complex environmental issue occurring at various spatial and temporal scales in different urgency. There are variety of causes behind the process of fragmentation that vary in physical and functional consequences, which are closely associated with various biotic implications, especially in terms of connectivity. This gives broad potential for interpretation of fragmentation (Fischer and Lindenmayer, 2007; Mitchell et al., 2015) and it is a challenge for policy to find its appropriate solutions (Laurance, 2008; Saunders et al., 1991). The concept of fragmentation is often used as an umbrella for human-derived processes negatively altering landscapes (Lindenmayer and Fischer, 2007) and its consequences has been often mistaken for habitat loss. These approaches give false interpretations. Fragmentation is a physical process of breaking apart of either habitat or different vegetation types per se, where the remaining patches vary in configuration and their connectivity is altered (Fahrig, 2003; Hadley and Betts, 2016). The consequences may be either negative or positive if assessed from the perspective of a single species (either animal or plant species), species assemblage or humans (Fahrig, 2017; Mitchell et al., 2015).

To find solutions to negative consequences of fragmentation, it has to be framed as a policy problem. The way how it is framed will influence the solutions, choice of appropriate instruments as well as responsibilities. We identified three frames in the studied documents. These were: species-oriented frame, pattern-oriented frame, and ecosystem services frame. We quantified the presence of the frames, assessed the quality of framing, and assessed types of solutions proposed in the spatial planning and environmental policy domains.

The results show differences and similarities in how fragmentation is framed and the types of proposed solutions to deal with fragmentation in the strategic documents within the spatial planning- and environmental-policy domains. The results also show that strategic documents tend to handle the complexity of the fragmentation problem by using general statements and formulating general goals. This conclusion is supported by 1) the fact that pattern-oriented frame and mitigation solutions are the most prominent, and 2) the low quality in framing fragmentation in most of the studied documents. General statements signals a low awareness of environmental policies and a tendency to use vague concepts, which are easily accepted by people with different backgrounds, including politicians, scientists, as well as practitioners (Turnhout et al., 2008; Van Der Windt and Swart, 2008). The formulation of general statements addressing fragmentation indicates low quality of framing fragmentation, especially within the spatial planning documents. Nevertheless, differences between policy domains in framing environmental issues have been identified in Europe (Niţă et al., 2015).

We conclude that better framing of fragmentation is necessary. The fragmentation and related concepts must be well-defined and transdisciplinary communication among scientists, politicians and practitioners must exist. Also, spatial planning documents, as legal binding documents, must improve the quality of framing fragmentation, find a balance between the species, human-species and human-perspectives, and address more avoidance and compensation solutions, because protection of valuable non-fragmented habitats and connectivity restoration are important for mitigating and adapting to fragmentation, and should be prioritized (Donaldson et al., 2017; Jaeger and Madrinan, 2011).

5. Conclusions and Follow up

Policy builds a bridge between science and practice. Thus, we have to be aware of the bridge quality. That is why this PhD thesis refers to implementation of the European Landscape Convention, and monitoring of landscape changes as well as landscape policy. The study links landscape research with policy and explains what the implementation and integration of the European Landscape Convention (ELC) means; and what are the policy instruments for the implementation of the ELC in various European countries as well as in the Czech Republic. The **Papers I-IV** focus on: historical and current state of landscape planning in the Czech Republic and its relation to spatial planning (**I**), monitoring trends of landscape transformation in areas with varying agricultural intensity (**II**), evaluation of policy objects connected to landscape and their integration in national strategic policy documents (**III**), and framing of fragmentation in strategic policy documents of spatial planning and environmental domains (**IV**).

Landscape policy has not been established as a separate policy domain in the Czech Republic, as for example spatial planning, agriculture or forestry, etc. has been. Historically, we have had no special hierarchical landscape instruments for dealing with the landscape as in some European countries, for example in Germany, France, Spain or Switzerland. Rather, landscape as policy object and landscape goals are part of various sectoral policies, and thus we have specific sectoral instruments to landscape management, protection and planning.

The approaches to solve landscape problems arose from the policy development in our country in the past. Solutions of landscape problems were primarily limited to individual environmental components, protection-based policies for specific landscapes, and land use based policies in urban areas. Because of historic development, we have had a broad spectrum of uncoordinated sectoral approaches to environmental issues, and no concentrated system of multilevel landscape instruments.

Specific landscape policies and landscape planning did not come into forefront for a long time.

Nevertheless, the Czech Republic has decided to implement the ELC and integrate landscape into already existing network of policy instruments.

This has some advantages, as well as disadvantages. The advantages are in existence of broad range of multilevel policy instruments, which work well. One of the good examples is the system of spatial planning instruments. Thus, if we want to integrate landscape protection, management and planning approaches as suggested by the ELC, we have the option to build on well-rooted policy instruments.

On the other hand, although the situation of landscape policy integration has improved during recent years, the disadvantages still prevail. The existing systems are somewhat conservative. This is evident from the long period since the ELC ratification by the Czech Republic to its implementing by strategic and legislative instruments and by planning instruments later as well. The instruments are sectoral and work side by side next to each other instead of all together. Each sector formulates its own biased policies, covering different scales and having different spatial focus. It is a result of missing visions about future landscapes; low landscape awareness; low policy awareness of scientific outcomes; insufficient landscape policy integration; missing coordination on several hierarchical levels; and missing landscape policy monitoring.

It is a future challenge to monitor and evaluate landscape policy hierarchically on national, regional and local levels. It is a challenge to interconnect the so far sectoral approaches and integrate landscape into a wide range of policies in all stages of the policy cycle.

We need to formulate the **SMART landscape policy** based on the European Landscape Convention, that will **Specify** present and future landscape quality objectives based on landscape monitoring; that will propose **Measurable** goals and measures; that will be **Attainable**

delegating responsibility for landscape policy coordination; will be **Realistic** while being spatial specific and implementing strategic, procedural, structural, coordinative, and communicative instruments; and will be **Timed** proposing time frames and priorities.

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Research Articles

Paper I

Landscape and Spatial planning in the Czech Republic – Historical development

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Abstract

The need for landscape planning was initiated by large changes in land use, which not only led to a deterioration of the environment from the environmental point of view, but also in terms of the quality of human life. Planning is a very important activity for sustainable land use at this time, when the economic and social pressure on the landscape is so great that it often poses a threat to landscape functions and services. We have historically grounded spatial planning and nature conservation in the Czech Republic that should deal with landscape. However, there are doubts about whether a separated hierarchical landscape planning should be established. Such landscape planning that would interconnect a care of landscapes in areas that 1) do not have significant natural values to be protected by statute and 2) are not in built-up areas of towns and villages that are approached by spatial planning.

This article is a historical literature review and provides a comprehensive view of the development of needs of landscape planning in the Czech Republic. We investigate how the landscape was linked to spatial planning from the very beginnings. And we describe the historical and current status of landscape planning in the Czech Republic, including its hierarchical structure.

Keywords:

landscape, landscape planning, spatial planning, history

1. Introduction

Humans are part of functional components of ecosystems from ancient history. First, they were part of natural ecosystems, which they later, whether consciously or unconsciously, began to transform into cultural ecosystems, cultural landscapes. Humans transformed landscapes primarily for the purposes of colonization, subsistence and raw material sourcing. These changes were in balance with nature for centuries (Ložek, 1970). Although there were occasional devastations of some localities, overall, it was only a local matter (Vulterin, 1970). The problem occurred with the development of technologies, where land use changes affected landscape functions and exceeded local dimensions.

Sometimes even well-intentioned land use changes and interventions in ecosystems had far-reaching impacts on the environment and people started to realize that these changes have a great impact on the quality of their lives. Example of such changes in the Czech Republic may be the expansion of fish farming in the 16th century. Many ponds were established and subsequently landfilled for the purposes of development of agricultural land. From the 16th century to the year 1982, more than 1500 sq. km of ponds disappeared only in the Czech Republic. This resulted in changes in microclimate, which were strengthened by regulations of water streams. Water streams were reduced by one half only in the first 30 years of the 19th century (Havrlant, Buzek, 1985). Changes in the water regime, decrease of groundwater levels, reducing the fertility of floodplain meadows and fields, acceleration of water runoff, but also aesthetic degradation of landscape values (Jeřábek 1907 in Bureš, 1970) were other unintended impacts "of these well-meaning" land use changes.

Industrial development, uncontrolled urban sprawl, logging and changes in forest species composition and agricultural industrialization had resulted in significant negative changes in landscape and environmental quality of the 19th century. Beside these socio-economic factors, also political development had impact on landscapes as well [1].

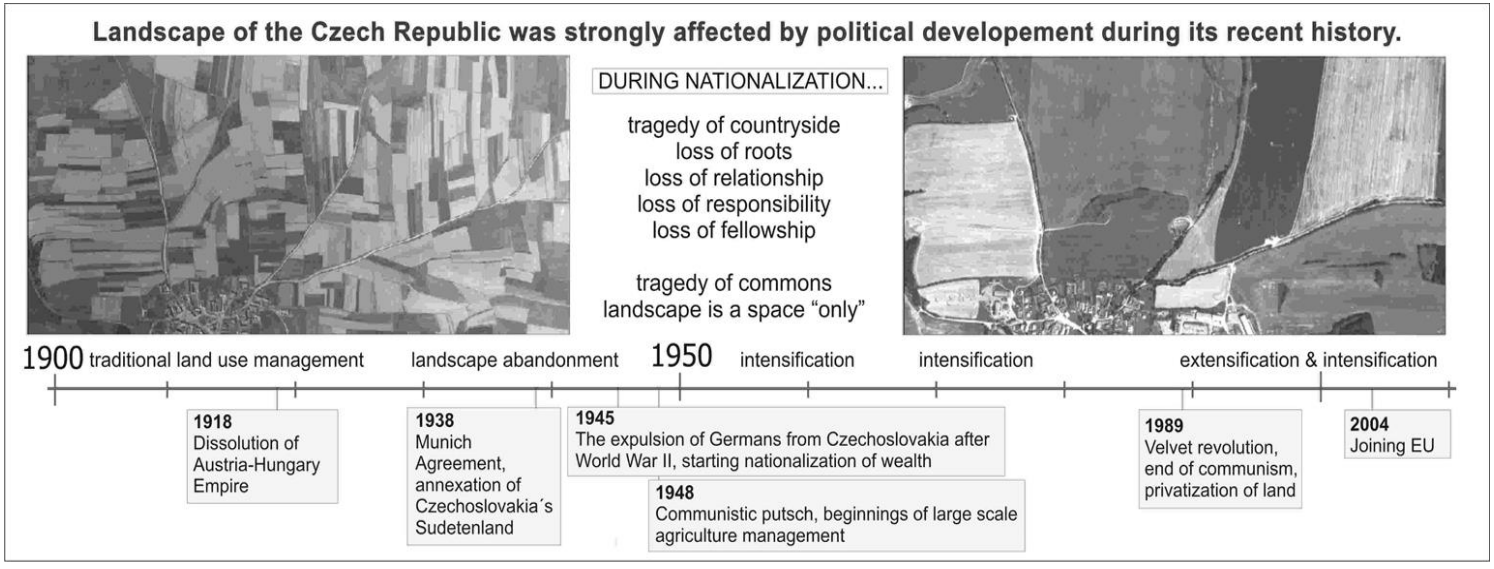

Fig. 1: Development of Czech Cultural Landscape.

Problems of contemporary Czech landscapes have evolved mostly as a result of previous landscape managements and utilization, but at the same time new problems and threats still arise. State Environmental Policy (2012 - 2020) indicates that the main risks to the state of the environment in the Czech Republic are landscape changes that are associated with the development of transportation infrastructure, increasing traffic, intensive farming in rural areas, but also consumer behavior of households. According to Semančíková et al. (2008a), among major landscape problems in terms of space occupation belongs landscape sealing, landscape fragmentation, landscape abandonment, brownfields creation, marginalization of agricultural land and rural areas, non-re-cultivated landscapes and negative changes in landscape character. Therefore, landscape, as a mosaic of functionally interconnected ecosystems and space of conflicts of diverse interests at the same time, requires an objective and careful planning. We have historically anchored spatial planning in the Czech Republic. The aim of spatial planning is to create conditions for construction and sustainable development of a designated area, consisting of balanced conditions for a favorable environment for economic development and cohesion for community residents and area that meets the needs of the present generation without compromising the conditions of life of future generations (Act. no. 183/2006 Coll.).

With an attempt to solve landscape problems and with a ratification of the European Landscape Convention by the Czech Republic, there are increasingly emerging debates about the need of landscape planning at several hierarchical levels. Many discussions are led on the theme of existence or absence of landscape planning in the current system of spatial planning in the Czech Republic and the ability of spatial planning to solve complex landscape problems (Mackovič, 2012; Kucera, et. al. 2014). These discussions are not new and we already encountered with them several times in the history (Hruška, 1946; Klika 1948; Míchal, 1976; Vaníček, Zachar, 1981).

In this article, we decided to look at how landscape was linked to spatial planning from the very beginning. The aim of this paper is to describe the historical and current status of the landscape planning in the Czech Republic and to focus on the development of hierarchical planning.

2. Landscape planning before 1989

2.1. *The period before 1945*

Till the 19th century the uncontrolled land use was unrestrained and it culminated during the Industrial Revolution. Although at the end of the 19th century, there were laws on the planning of municipalities and their surroundings, targeted landscape planning did not exist before that time and so the gap between short-term needs of Man and long-term processes of environment gradually deepened. The planning and implementing of landscape management was done on the basis of subjective feeling that had led to chaotic land utilization regardless of its biological and ecological balance (Hruška, 1945). Since 1830s the perception of landscape had started to change and the first steps towards landscape planning were made (Jůva, Zachar, 1981). Efforts to protect some isolated parts of natural landscape resulted in establishment of the first nature reserves in Europe ever - Žofínský (1838) a Boubínský virgin forest (1858). In the late 19th century, Association for beauty and homeland protection was established and an idea of linking beautification activities with conservation activities originated from this association (Klika, 1946; Bureš, 1970). But it was mainly land conservation activity (Nepomucký, Salašová, 1996) and it took into account only the protection of natural and historic monuments.

This connection, however, made considerably more difficult answering legislative measures for the nature protection (Klika, 1946). Still, in the period 1918 - 1938 there was devoted considerable attention to the protection of nature. And although there was no law established, 138

protected areas were created, covering the area of 155 sq km. After 1945, nature protection received a law support and became an independent science.

A botanist - prof. Jaromír Klika came first with the need to respect nature protection in technical plans and works and the need for cooperation between technicians and biologist in 1938 (Bureš, 1970). Klika (1946) mentioned the need of planning that has appropriately streamlined all interventions in the region so that the technical interventions do not interfere with the aesthetic character of the region, and that nature is protected from destruction. This new approach to the landscape influenced urban planning, which was focused only on organizing materials and technical interventions (Mikuškovic, 1948).

In the period between the two world wars, characterized by the industrial development and increase in population, landscape planning changed and its importance grew. Urbanization was perceived as a main cause of landscape and environmental problems. Because of this, the attention was diverted from urban planning to human activity in landscape and to environment for the first time (Mikuškovic, 1948). The residential formations (villages, towns) started to be perceived as one of landscape unit components next to vegetation, watercourses, climatic conditions, etc. Landscape started to be perceived as living organism, where functions and relationships between individual components need to be studied (Hruška, 1945).

During the inter-war period, the emphasis was placed on the need for landscape planning that would ensure the remedy of some landscape problems and would help to restore landscape harmony (Hruška, 1945). Although the landscape hierarchical planning did not existed in Czechoslovakia yet, the necessity of focusing on complex landscape, rather than on individual residential formations was already emphasized in planning (Hruška, 1945).

2.2. Period of 1945 – 1960s

After the World War II, there was a turn in the view of nature conservation. Protected area conservation from active landscape management began to be distinguished (Klika 1946). Greater emphases were placed on the consideration of the ecological balance in the landscape planning (Klika, 1946).

Due to the increasing demands for planning in landscape scales a concept of planning methodology and a draft of law on landscape (spatial) and urban (local) planning was compiled in the Czechoslovak Socialistic Republic (CSSR) (Hruška, 1946). Due to this draft, 4 types of plans on 3 hierarchical levels were introduced for the first time [2].

National level	National planning – planning of cultural, social and economic factors
Regional level	Spatial planning – an executive method of national plan in certain landscape unit
	Expert planning – economic planning, technical planning (urban, transport, water management, etc.), landscape planning.
Local level	Local planning – master plans for regulation of economic relations, detailed plans for specifications of parcels and developed areas

Fig. 2: Hierarchical levels and types of plans.

The term landscape planning was understood in two different ways in that draft. Firstly, it was understood as a part of spatial planning or even considered to be the same. It was mostly a planning of technical components in certain administrative region or area. Secondly, it was understood as a landscape planning that was aimed at biological harmonization of landscape. Together with technical and economic planning it ranked among expert planning and was supposed to have synthetic – spatial task on regional or even municipal level (Hruška, 1946).

Shortly after the World War II, working section "Biology of landscape" was established (1953) (Kopecký, Muranský, 1960), the National Institute for District Planning - TERPLAN (1954), and later the Institute for the Landscape protection and management of the Czechoslovak Academy of Sciences was founded. Biology of landscape was defined as a science and should address a comprehensive study of the landscape. The first scientific methodologies for biological planning (landscape planning) were set up (Klika, 1948; Kopecký, Muranský, 1960).

Klika (1946, 1948) described in his works the first approach to planning of landscape, he called it biological planning. This approach was based on directing of all cultural interventions into the landscape so that the destruction of nature in landscapes was avoided and the landscape was protected for its aesthetic value. Biological planning should carried out analysis before the technical intervention, and then decide whether action can or cannot be done. If it could be done, it should be determined how the landscape, biologically and aesthetically, has to be restored after completion of the work. Klika (1948) first defined the landscape type and landscape character. Landscape type was defined as the actual landscape unit, composed of landscapes with similar morphology, vegetation cover, human activities, water, and aesthetic value. Aesthetic value is evaluated in terms of quality (how landscape is aesthetic) and quantity (diversity of the landscape, the richness of form). The landscape character was a subunit of the landscape type and it was distinguished as a "minor deviations from the normal" landscape type. It should be divided into smaller units.

The methodological guidance for planning the landscape was the publication ‘Planning with nature’ (Klika 1948). Author established objectives and principles for biological planning and he described the biological planning on the background of landscape types. Planning process is composed from three steps: analysis, synthesis and use of work for landscape planning. However, although Klika (1946) emphasis on the analysis of vegetation cover, aesthetics and natural values such as

geological features, water pollution, climate and soil properties, he only sketch the vegetative cover to be consistent with the site conditions and should led to the landscape recovery and should increase its aesthetic value in synthesis.

This methodology further elaborated Kopecký, Muranský (1960). They didn't work with different landscape types, but with districts and municipalities. Their definition wasn't based on natural conditions of landscapes, but on the basis of production-economic areas, as the Act 84/1958 on Town and country planning defined it. Within districts they defined landscape units primarily according to the altitude, and then they defined geomorphological characteristics, biotic and abiotic landscape features. Analysis of landscape elements was carried out from three aspects: 1) quantitative representation of landscape features in the landscape units, 2) in terms of spatial arrangement, and 3) in terms of the qualitative composition. Planning process was based on analysis and synthesis again. Biologically unfavorable phenomena had to be described and then a remedy had to be drawn and explained. Biological planning should solve the vegetation cover, climatic conditions, the retention capacity of the landscape, erosion resistance and stability of the soil, the questions of a species compositions of forests and grassland plants communities, their areal and spatial representation, the reclamation of infertile soils, areas devastated by mining coal and minerals. The task of "biology of landscape in spatial planning" should by evaluation the current biological situation of landscapes, an analysis of positive and negative impact factors, and proposal of appropriate measurements. Biological planning should be concerned on removing of current conflicts in the landscape, but also on the designing of preventive measures in relation to the planned economic-production purposes.

But further development of planning and landscape planning was linked to political development of the country during 1945 – 1989. The attention was focused on national economic development, development of

industry and important industrial regions. Mining and metallurgical industry began to form new faces of the Czech rural areas. Surface mines were quarried across the hills, abandoned mines were flooded, and cities were destroyed by mining activities (Semotanová, 2014).

The aim of agriculture was to guarantee self-sufficiency in food supply; forestry was focused on increase of wood production. These tasks were to be accomplished by intensification of agricultural and forest land utilization, by increasing the soil fertility using melioration, by converting meadows and pastures into arable land and by forbidding the conversion of arable land for non-agricultural purposes (Jůva, Zachar, 1981). It was a period of indiscriminate exploitation and devastation of the landscape regardless of natural conditions with large impacts to the environment.

The content of the nature conservation and landscape protection came from the national economic development plan (Jůva, Zachar, 1981) and so biological (landscape) planning has been relegated to the background (Nepomucký, Salašová, 1996). As Battný (1970) stated at the end of the 1960s and 1970s, there were practical experiments on comprehensive planning, linking spatial and landscape planning, but these experiments were always interrupted by external reasons and haven't been realized. Spatial planning came into prominence, which was based on the Act No. 280/1949 on Town and Country Planning and Municipality Development and Act No. 84/1958 on Town and Country Planning [3]. Authorized institutions responsible for providing plans, according to Act No. 84/1958, were regional authorities for district plans and plans of housing estates, district authorities for developing plans. This spatial planning was concerned mainly for planning investment projects in the cities and municipalities and it was based on economic and technical needs. Although spatial planning had the greatest influence on changes in the landscape (Růžička, 1971), spatial planning documentation dealt mainly with problems of built-up areas (Kolář, et al. 1979).

The former environmental policy addressed only a protection of the environment or individual components of the environment (water, air, soil, forests) and active approach to environmental planning and landscape lacked at all (Madar, 1972).

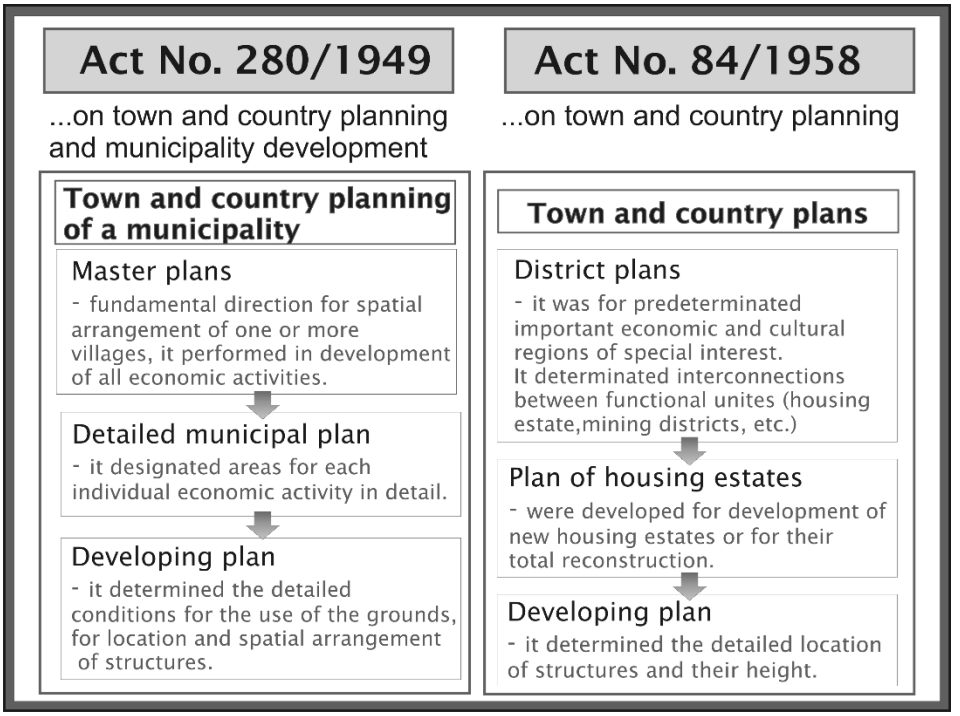

Fig. 3: Acts on town and country planning.

2.3. Period between 1970s and 1980s

Since 1970, scientists had started to speak about the need for landscape planning based on ecological and biological findings (Růžička, 1971; Vaníček, Zachar, 1981). Researchers understood landscape planning as equivalent to spatial planning. And as Vaníček and Zachar (1981) remarked, these activities should complement each other and should not be interchanged.

New methods of bio-ecological approaches to landscape planning were introduced, for example: 1) Landscape-ecological planning method - LANDEP (Růžička, Miklós, 1982) that however, originated in the former Czechoslovakia at the Institute of Landscape biology of Slovak Academy of Sciences and in future Czech Republic was not applied. The aim of this methodology was to emphasize the ecological potential in determining the fitness of a given tract of land for a land use. 2) The methodology for biological landscape planning was further developed. And Battný (1970) proposed a hierarchical structure of long-term biological landscape planning for the entire territory of the former Czechoslovakia. Unfortunately it remained only theory. 3) The method of territorial systems of ecological stability (USES) came into existence (Buček, Lacina, 1984; Buček, et.al., 1986; Low, et al. 1988), which was subsequently applied in the Act No. 114/1992 on Nature and Landscape Conservation. USES has been defined and created on three hierarchical levels - local, regional and non-regional.

It was also worked on collecting of ecological materials that should be used as a basis for landscape planning and spatial planning. For example TERPLAN created so called ‘Automated information system (AIS)‘ that should serve data for the needs of spatial planning. A register of landscape ecology was a part of the AIS and it contained significant landscape elements (Valtr, 1983).

But at that time, the environment and landscape conservation was based on the national economic plan that was implemented into reality by the spatial planning [4] pursuant to Act No. 50/1976 on Town and Country Planning and Building Code (Building Act). Totally 9 types of planning documentations were distinguished. Institutionally, regional authorities acquired the big territory plans and settlement plans. A building zone plans were acquired by district authorities. This law, unlike the above-mentioned previous laws, aimed to ensure the consistency of the natural, historical and cultural values, with respect to environmental care and protection of its

components - soil, water, and air. The aim of spatial planning by the Act No. 50/1976 should also be a definition of protected areas conservation, if were not set up by other legislation. But it was only a theory that did not get to practice (Vaníček, Zachar, 1981). Spatial planning did not cover the whole range of issues of environmental care, because from the perspective of a protected areas and landscape conservation it focused solely on determining the territorial technical assumptions, for example, definition of sanitary protection zones or locating of houses (Valtr, 1983).

Kubíček (1983) wrote that the spatial planning was again understood mainly as an instrument to guarantee capital constructions in landscape in 1970's and 1980's. Nature and landscape conservation was overshadowed by economic development and was reduced only to species protection and establishing natural reserves. There was no landscape planning to speak about. Míchal (1976) stated that the landscape and natural features of area were perceived only as land outside developed areas and were overlooked in spatial plans. Development of spatial plans on ecological principals were processed non-systematically, only in 1) protected areas, 2) in areas where it was required by big technical works, which had significantly affected the environment (dams, highways), 3) in areas where there has been so extensive damage to the landscape, that it got to the forefront of the governmental bodies, 4) in places where a person had been interested in landscape and environment (Míchal, 1976).

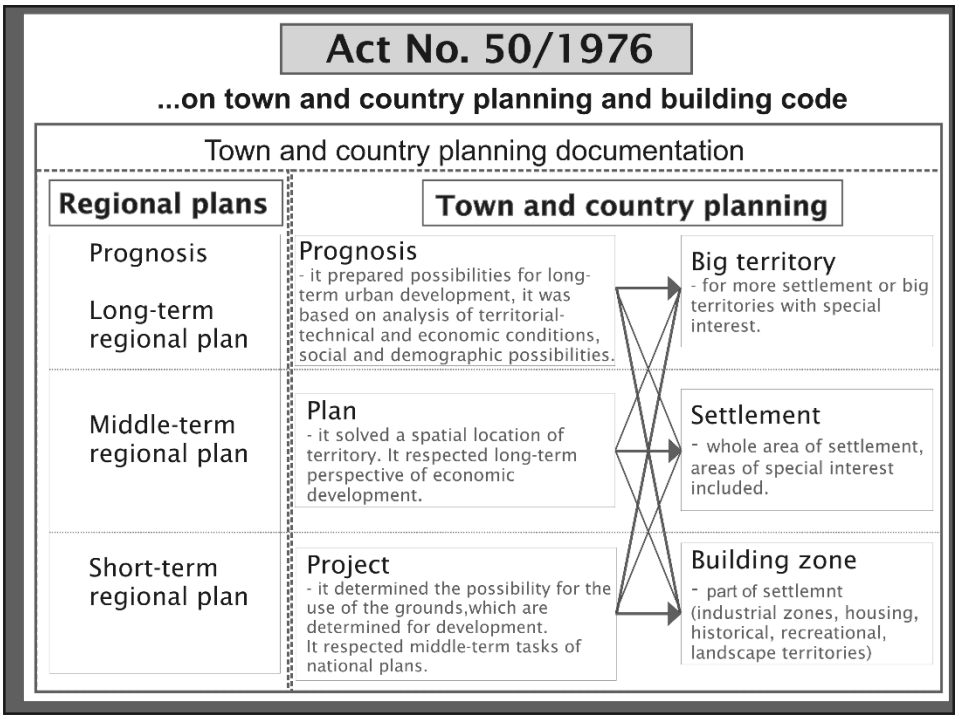

Fig. 4: Act on town and country planning.

3. Landscape planning since 1989

3.1. The period of 1989 - 2000

Following the political overturn, the period after the year 1989 was characterized by the abolishment of central planning system and central economic management (Maier, 2000). Following public administration reform, the former hierarchical planning structure collapsed during the first half of 1990s. National strategic level, and then regional level completely disappeared in the field of spatial planning. Planning was generally understood as a heritage of communist regime. Spatial planning survived only because there was a need for spatial planning documentation necessary for obtaining grants from Development and regenerative programs (Maier, 2001).

In 1990 the regional committees were abolished and their competences were delegated to district authorities. It was intended to restore the structure of regional offices in two years, but finally it took more than 10 years because the Czech and Slovak republic split in 1992.

In 1996, the Czech Republic applied for membership in European Union. The audit of regional policy and public administration standards carried by European Commission concluded that there was neither comprehensive regional policy in place nor any necessary authorities on regional level that would be able to deal with this issue (Postránecký, 2004). Consequently, the 14 higher self-governing territorial units were established in 2001 as a part of preparation for joining European Union. Later, in 2003, district authorities were abolished and their powers were delegated back to regions or district municipalities. According to Maier, (2001), the planning became regulative in 1990s; it was converted from planning of ideal conditions to planning with strictly defined limits and regulators of physical development and functional determination of area. Municipalities were responsible for spatial planning on local level. Planning on regional level has almost disappeared as the regional authorities responsible for it were abolished. As Maier (2001) wrote, since 1996 the disparity between regions has started to increase. Projects of overlapping local importance have started to emerge and there was also increase in demand for land utilization. Absence of national spatial development policy led to many landscape problems such as uncontrolled urban sprawl, increasing fragmentation or conflicts with environmental quality. Because of this, there was again a need for hierarchical planning. In relation to planned entry to the European Union, the system of strategies was set up as a foundation for further planning.

Although the planning underwent many changes on political level after the fall of communist regime, the historical approach towards landscape planning that had been formed since 1950s still persisted. Even at the beginning of 1990s, the terms of landscape planning or landscape

plan had not been included in law yet. The landscape planning was again understood only as a part of spatial planning (Bulíř, 1992). When drawing up spatial plans, the landscape was still understood only as a developed area of a residential formation (Kyselka, 2003). The issues of preservation of monuments or active environmental protection were not included in the spatial planning of 1990s (Maier, 2001). In spatial plans, environment and landscape were represented just as outer limits for municipality development. In planning documentation they were mentioned only on a list of limits for area utilization as development plans of territorial systems of ecological stability, specifications of current specially protected areas, protected deposit areas, protected natural curative sources, groundwater and surface water protection and delineation of flood plains. Landscape planning that would be based on biological and ecological principles to sustain landscape functions and services were not included in the spatial planning. None of other new approaches to landscape planning as EIA, SEA or landscape character protection was included in process of spatial planning or relevant legislation (Salašová, 2006).

3.2. Period after the year 2000

The last landmark period in hierarchical landscape planning system has started after the Czech Republic joined the European Union. As mentioned earlier, the need for hierarchical structure of planning has emerged again and new national strategies were set up to determine the scope of work with landscape. These activities were conditioned by obligations arising under European legislation and international conventions. In 2002, the Czech Republic ratified the European Landscape Convention and committed itself to include the landscape to all its policies. The need for landscape planning became a topic again as the landscape planning should become a part of implementation of this Convention (Kyselka, 2003; Low, 2003; Salašová, 2003; Boucníková, Fanta, 2005; Vorel, 2006; Salašová, Štěpán 2007).

In 2006, a working group was established under the Ministry of Environment that should prepare a methodology of the Strategic landscape Plan. However, the ministry stopped the works and the methodology didn't come into practice. Similarly, ‚Method of landscape plan', drawn up and published by Stejskalová, Novotný (2008), isn't widely used in practice.

Due to the Building Act No. 183/2006 on Spatial planning and Building, local, regional and national levels of planning were linked together again in spatial planning [5]. This law, for the first time in history, aims spatial planning to protect the landscape as the important component of the environment of the inhabitant's life and basis of their identity. And it ensures the protection of the non-developed area. In several respects, it adheres to the philosophy of the European Landscape Convention (Kučera et. al. 2014) and allows solving the landscape problem. In hierarchical structure of spatial planning landscape management is arranged mainly by defining territorial systems of ecological stability, landscape character protection and by the concept of arrangement of landscape, which is not methodologically anchored so far.

The period of last 10 years was characterized by restoration of national and regional planning level. In addition to the hierarchical spatial planning, where the coherence and documents respecting upper levels have been guaranteed by the Act No. 183/2006, a hierarchical strategic planning on national, regional and local levels have been formed, where respecting documents of higher levels is not binding (Půček, 2009). The strategic and tactical documents came into existence at the national level that have had both direct and indirect impact on the landscape in terms of its quality and space (Semančíková et al., 2008a, 2008b). In aspect of dealing with landscape issues there are still some weak points in this newly formed hierarchical landscape planning system.

Semančíková et al. (2008a, 2008b) analyzed the connection between existing national strategic long-term and tactical mid-term documents (see the table and scheme) issued by Ministry of Environment,

Ministry of Agriculture and Ministry for regional development. It resulted from the analysis that references to the landscape issues are very often formal. And although hierarchical structure of planning was created, approaches of individual ministries to landscape issues and its planning are not well coordinated. They are not united and have not sufficient tools to engage the public, local and regional authorities (Kučera, et.al. 2014; Mackovič, 2012; Semančíková et al. 2008a, 2008b).

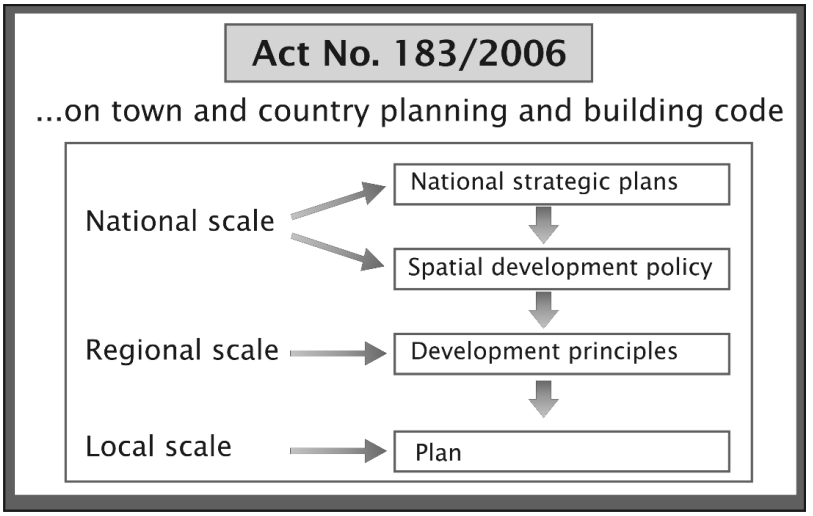

Fig. 5: Act on town and country planning.

The first important documents of a comprehensive approach in addressing environmental and landscape issues were State Environmental Policy of the Czech Republic 2004 - 2010 and National Nature and Landscape Conservation Program 2004 - 2010 (Semančíková et al. 2008a, 2008b).

"Spatial development policy of the Czech Republic" is a national tactical document that should provide a framework for spatial planning and feasibly transfer landscape problem solutions into space. This document was supposed to implement the goals of national strategies and target these goals to spatial documentations of lower levels. It should have contributed

to protection, better management and improvement of landscapes by introducing spatial arrangements; especially better organisation of various cross-sectorial policies interactions with regard to their impact on area. However, spatial development policy neglects the development of the landscape, and this development cannot be adequately incorporated into the planning process of the lower levels, as well as into sectorial policies. Policies relating to economics, agriculture, infrastructure and urban development, culture, the environment and social development, all of which have a direct or indirect influence on the development of landscapes. In addition, various documentations of hierarchical levels of spatial planning are not followed each neither in form or content (Mackovič, 2012). Consequently, this shortcoming causes many faults in planning, management and land use.

4. Conclusion

The need for landscape planning always arouse as a response to changes in quality of environment and its impact on quality of life of local inhabitants. Growing urbanization and development of settlements during the pre-war and post-war period were initially seen as the main driving factors of landscape changes that led to a need of planning. Planning of settlements and landscapes in which these settlements expanded and changed its character. Hence the philosophy of linking landscape planning with spatial planning. However, with resultant excessive exploitation of the landscape in favor of industrial development and economic growth in the second half of 20th century these needs for landscape planning and dealing with landscape issues were increasingly growing. These needs found a foothold in the ever-deeper scientific knowledge about the individual components of the environment, but also in understanding the importance of the landscape as a whole.

As also shown, the needs of landscape planning, its hierarchical structure, its existence, but also methodological approaches have been closely linked with the political development of the country from the beginning. Whether it were periods of wars, totalitarian regime of the second half of the last century, the political turn to democracy and a market economy, or joining the European Union. Landscape planning as a discipline and as a science began to develop in the Czech Republic after World War 2. Based on historical overview of the progress of planning in the Czech Republic we can say that neither purely political, purely scientific nor purely market-oriented attitude was suitable on its own. These approaches must be applied in parallel. As mentioned in Rookwood (1995), effective planning should be based on scientific findings and pragmatic political approach. We can learn some valuable lessons from this historical development.

The planning system was strongly directive in the period after the World War II to 1990. This was called top-down approach. Hierarchy of planning was very well elaborated on several levels, including the division of competencies for creating planning documents. Nevertheless, for landscape planning and dealing with the landscape issues this approach was set inappropriately. During the communism, the top priorities were economic and industrial growth and that overwhelmed everything else. The impact on quality of environment was not taken into account. Even the spatial planning that was supposed to incorporate the care of landscape did not cover this part of space. And according to the earlier legislation landscape could not been sufficiently addressed.

After 1990 the situation changed. The whole system of hierarchical planning had disintegrated. The management and planning on national level was abolished and it almost disappeared on the regional level as well. The bottom-up approach in planning became prevalent. But this approach also had a negative impact on landscape planning and related problem solving. Spatial planning that had to be responsible for landscape care and

management was strongly influenced by market economy. Within the scope of spatial planning was only the urban area of municipalities and setting of the limits for utilization of some landscape areas. Attempts for restoring hierarchical structure of landscape planning were unsuccessful as there was no political support in this matter.

A certain change in addressing landscape issues has occurred with the commencement of hierarchical strategic planning and ratification of the European Landscape Convention. The term landscape and references of the needs to address landscape issues have emerged in the form of long-term visions and goals in some policy documents and legislation. For the first time in history, the term landscape appeared in the Act on Spatial Planning and Construction, no. 183/2006. And spatial planning should deal with landscape issues at national, regional and local level.

However, the term landscape planning does not still exist in the Czech legislation and policy documents and question whether spatial planning can address the issues of landscape enough and whether it can substitute a hierarchical system of landscape planning, still remains.

And instead of proposing some measures and designing for the whole hierarchical landscape planning system, we ask questions at the end of this historical overview:

1) Can spatial planning effectively incorporate functional landscape planning? If yes, under what conditions it can be possible?

2) Setting long-term visions and objectives in the policy documents is all we need to plan landscape?

3) Can we solve the landscape issues only through approach from position of individual disciplines?

4) How can we coordinate the bottom-up efforts to tackle the landscape issues?

5) And how can we come up with a comprehensive solution to landscape issues?

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Paper II

Landscape changes and their influence on the heterogeneity of landscape of the South Bohemian Region, the Czech Republic

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Abstract

Landscapes reflect both historic and current cultural and socio-economic activities of human societies. Accordingly, as human societies change, the landscape changes as well. Agriculture is the main driver of landscape changes in the Czech Republic. Therefore, it is necessary to devote special attention to agricultural practices and define simple but effective steps to improve landscape mosaics towards a sustainable development. In this study, regional information about historic changes in landscape structure was studied to (1) identify the trends in land use/cover development since 1940 to 2010 and (2) determine the impact of land use change on the resulting heterogeneity of the landscape. The overall purpose was to find areas of compromise which would allow strengthening of landscape structure and thus stabilize its functions. We specified trends of land use/cover development in 15 catchments with varying agriculture intensity. We digitalized aerial photographs from 1940, 1960, and 1990 and orthophotomaps from 2010. Then, we used a heterogeneity index to define landscape heterogeneity in all catchments and time horizons. The results of our research confirmed increasing tillage effort in intensively cultivated areas, support of secondary succession processes in marginalized areas, and overall increase in forest area. Our study found that simplification and homogenization of the landscape mosaic took place in all studied areas, with the steepest decline found in areas with high agriculture intensity. However, linear vegetation proved to be a suitable starting point for a targeted effort to increase heterogeneity and thus seemed to be crucial for sustainable development of landscape functions in agroecosystems.

Keywords:

agricultural landscape; heterogeneity; historical changes; landscape functions; management

1. Introduction

Landscape character is the result of interactions between natural and human factors (European Landscape Convention 2000). Further, the mosaic of ecosystems in a landscape is amended both by its internal dynamics (succession) and by historical human management. The territory of Central Europe consists mainly of cultural landscapes cultivated and shaped by humans (Reidsma et al. 2006), where natural processes of secondary succession are currently taking place in many regions (Cramer et al. 2008). Areas of 'untouched' nature with the original ecosystem dynamics are still present, but, with only a few exceptions, these are restricted to fragmented incoherent territories. These areas command special protection status in the Czech Republic (Ministry of the Environment of the Czech Republic, Act No. 114/1992 Coll.). Unlike these protected areas, open landscapes, which prevail in most of the region, are not mentioned in the nature protection law and so their dynamics are determined by human actions.

One of the more widely distributed forms of human land use is agriculture. Arable land, along with grassland, is becoming one of the largest terrestrial biomes in the world, currently representing almost 40% of the total land cover (Foley et al. 2005). However, agriculture is not constant. In fact, agriculture is an important driver of change in the landscapes of the Czech Republic and throughout Central Europe (Foley et al. 2005; Gabriel et al. 2010). This is also related to changes in agricultural practice, especially agricultural technology in the second half of the twentieth century (Benton et al. 2003). Economic and technological incentives increased agricultural production and resulted in an unprecedented intensification of agriculture, which was associated with decreased diversity and quality of agricultural ecosystems. As an example, intensified cultivation and loss of the fallow phase resulted in large farm units having the same intense management for long, continuous periods (Robinson and Sutherland 2002).

Since the introduction of the Common Agricultural Policy in the European Union in 1957, increased agricultural production with an accompanying loss of mixed farming took place in rural areas over a large part of Europe (Verhulst et al. 2004). The overall result of long-term intensive agricultural activities is manifold. Aside from the degradation of the quality of land resources and related components of the environment, landscape heterogeneity also changed (Pretty et al. 2000). Typically, the changes include loss of elements of the historic landscape structure of agroecosystems in time and space and their continuous change into more homogeneous areas (Benton et al. 2003).

Landscape changes resulting from human activities in agriculture came into focus during the first occurrences of major environmental problems such as flooding, erosion, and soil degradation (Burel and Baudry 2003). It was then realized that more intensive agricultural production caused considerable environmental damage to the involved and adjacent ecosystems (Skinner et al. 1997; Caplat et al. 2006). One such effect was degradation of the landscape mosaic, which ultimately may promote the occurrence of generalist and invasive species and also affect the rate of species extinction and species exchange in degraded habitats (Perkins et al. 2011).

In general, landscape homogenization reduces successful recolonization of remote and thus less accessible areas (Sih et al. 2000). In contrast, areas with greater heterogeneity of ecosystem mosaics present organisms with the opportunity to move into locations with the most suitable conditions (Oliver et al. 2010). Furthermore, heterogeneous landscapes can also dampen the effects of weather fluctuations associated with emerging climate changes at both long and short scales. Many authors refer to the importance of landscape heterogeneity for the biological capability and self-regulation of ecosystem functions (see e.g. Cerda et al. 2010; Oliver et al. 2010; Ryan et al. 2010; Fischer et al. 2011; Kaffashi and Yavari 2011). Cultural landscapes, however, are managed with a clear

objective – to maximize the yield of agricultural practices while at the same time minimizing the costs (Foley et al. 2005). The negative impact of agriculture on agrobiodiversity has been reported by many authors (Robinson and Sutherland 2002; Rundlöf et al. 2008; Oliver et al. 2010; Ch et al. 2011). Soil under an intensive agricultural regime is also exposed to increased strain. Temme and Verburg (2011) describe how this usually leads to undesirable changes in biophysical properties, such as the soil clay content, water deficit in the growing season, the presence of impermeable layers within the soil profile, and salinity or restrictions due to local excess of water (soils with water restrictions). Other ecosystem functions commonly negatively affected when landscape heterogeneity is reduced are decreasing habitat and corridor functions, wind barrier function, soil-stabilizing and erosion protection functions, and loss of cultural heritage (Dover and Sparks 2000; De Blois et al. 2001; Gabriel et al. 2010).

To fully comprehend the current state of a landscape it is also necessary to understand its history (Marcucci 2000; Bürgi et al. 2004; Brierley 2010). A detailed description of the changes in land use in the Czech Republic is fortunately already available. Bicik et al. (2001) described the fundamental changes to the Czech Republic landscape and the main controlling landscape factors in what is now the Czech Republic over the past 150 years. Other studies, such as Lipský (1995), Boucníková and Kuˇcera (2006), and Bianchi et al. (2007), described historic changes in land use. Generally, the change from a traditional form of agriculture to a more technology-dependent and intensive production in the Czech Republic began in the 1950s. From 1950 to 1989, there was also the transfer of privately held agricultural land into municipal ownership and later the introduction of state agricultural cooperatives. This land tenure, however, collapsed in the early 1990s, when most agricultural cooperatives ceased to exist and land was returned to its original owners. This process thus resulted in a lot of land left fallow and, as an alternative, lease-based cooperatives began to emerge. However, the original linkage to land

established through ownership was irretrievably broken after this almost 40-year-long period (Lipský 1995).

A key question is how landscape changes influence landscape function as a whole and what consequences they bring for individual ecosystems embedded within the landscape mosaic. The aim of this study was to use regional landscape information about historic changes in landscape structure to (1) identify the trends in landscape change in areas with varying agricultural intensity and (2) determine the impact of land use change on the resulting heterogeneity of the landscape. The overall purpose was to find areas of compromise, which would allow restoration and strengthening of landscape structure and thus aid in stabilizing its functions towards sustainable development of agroecosystems.

2. Methods

2.1. Description of study sites

The study was conducted in 15 catchments with a total area of 1184.6 ha, situated in South Bohemia (NUTS 3, CZ031), Czech Republic (Figure 1). Since the study was focused on investigating the processes occurring in cultural landscapes that are neither protected nor settled, several parameters were taken into account when choosing the study areas:

1) Paved surfaces had to cover less than 5% of the catchment area, represented mainly by local roads, handling areas, and small settlements, with no continuous residential buildings.
2) Each individual catchment had to meet certain basic geomorphologic requirements such as average slope of land (1–10%), similar catchment area (up to 3 km2), and forest covering less than 30% of the area.
3) Active farming had to have been performed to a similar areal extent (more than 75% of the total area) in all catchment areas in the past.

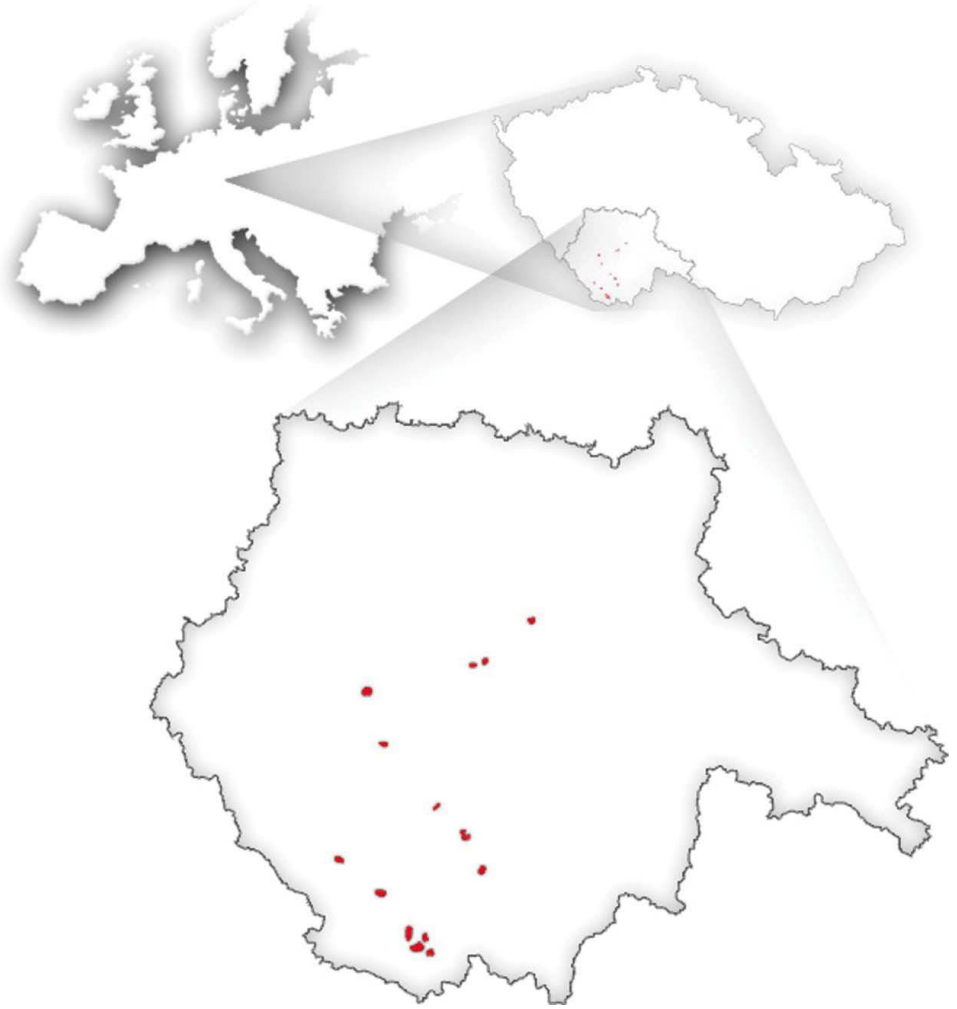

Figure 1. South Bohemian Region (NUTS 3, CZ031), the Czech Republic.

A total of 15 study sites were selected. The amount of cultivated land ranges from 65% to 92% of the total catchment area in all study sites, which greatly exceeds the global average of 40%. This is because all the selected locations are located in the agriculturally highly productive areas of South Bohemia. Current land use/land cover (LUC) was recorded during field mapping, and this formed the basis for dividing the catchments into three basic landscape categories according to varying agriculture intensity.

1) Agriculturally intensively used (AIU) areas with conventional tillage plots. Arable land is the dominant land use in these areas, and there is only a minimum of small groves, and semi-natural vegetation is present.
2) Medium intensively cultivated (MIC) areas. They are dominated by a mosaic of arable lands, permanent grasslands, or orchards.
3) These catchments consist of marginalized (MG) areas that are managed rather extensively. They are located at the base of the Šumava mountain range in areas previously used for grazing. Currently, these catchments contain a large proportion of permanent grassland; these are harvested for hay or serve as temporary or permanent pasture. In addition, there is a spontaneous development of wetland vegetation and vegetation along the edge of watercourses on these sites.

A summary of the characteristics of the study sites is given in Table 1.

Table 1. Basic characteristics of the study sites.

Landscape category	No. of catchments	Mean area of catchment (ha)	Total area (ha)
AIU	5	67.8 ± 19.5	338.8
MIC	5	52.9 ± 16.1	264.9
MG	5	116.2 ± 54.6	580.9

2.2. Overall evaluation of landscape changes and interpretation of their driving forces

The indicators of landscape structure were derived using military aerial photographs from 1940, 1960, and 1990 as well as orthophotomaps from 2010. Aerial photographs from the 1940s were a very good data source for this type of analysis as they capture the area in a period of agricultural prosperity. These landscapes were therefore expected to contain high

landscape diversity. The aerial photographs from the 1950s and 1980s show the landscape during and after the collectivization process, while the most recent orthophotomaps capture the current state.

Military aerial photographs had to be orthorectified into the desired coordinate system, the Czech national coordinate system (S-JTSK), a prerequisite for their further use in geographic information systems (GIS). Metadata characteristics of the used map layers are described in Table 2.

Table 2. Metadata describing the used map layers in 1940, 1960, 1990, and 2010.

Year	Cell size (m)	Pixel depth (bit)	Producer
1940	0.6 × 0.6	8	VGHU Dobruška, Czech Republic
1960	0.4 × 0.4	8	VGHU Dobruška, Czech Republic
1990	0.7 × 0.7	8	VGHU Dobruška, Czech Republic
2010	2 × 2	8	Gefos, Budweis, Czech Republic

To evaluate LUC changes, LUC was classified as belonging to five main LUC classes. The aerial photographs and orthophotomaps captured the landscape directly and produced data with limitations mainly related to their interpretation, which depends on the resolution and overall quality of the pictures. Because of trouble with distinguishing between permanent grasslands and arable lands on black and white maps, two general categories were determined; cultivated land and non-cultivated land. These catogories were separated based on the shape of the borders; cultivated land had straight lines, whereas non-cultivated land had winding borders.

The LUC classes used in these analyses were:

1) Cultivated land: arable land, cultivated permanent grassland used for haymaking or grazing, orchards
2) Non-cultivated land: previous permanent grasslands in succession and changed into shrub land vegetation, dispersed trees
3) Woodland: forest formation, non-forest patchy trees

4) Linear vegetation: riparian vegetation (4a), road alleys (4b), and hedgerows and field belts (4c), where a unit's width does not exceed 30% of its length (Supuka et al. 2000).
5) Built-up areas: paved and unpaved roads and residential, industrial, and other built-up areas

The LUC classes were identified and digitized as individual polygons for each year independently using ArcInfo (ESRI, ArcGis Desktop 10, Redlands, CA, USA). Minimum mapable units were determined at 0.001 ha. Areas with altered or unaltered landscape cover were determined by superimposition of several layers. Current status was obtained by field investigation during spring and summer 2010 and following digitalization of field data.

2.3. LUC changes analysis

Landscape characteristics according to Sklenicka and Lhota (2002) were recorded on the basis of the aerial photographs. The calculations of basic characteristics of LUC classes and their changes were performed in ArcInfo using Patch Analyst 4. The characteristics recorded were:

- *Relative length of edges* (km/ha): total length of boundaries among different types of LUC classes and divided by the field area.
- *Average size of landscape elements (ha):* average area of different LUC polygons. • Relative frequency of landscape elements (ha−1): total number of LUC polygons divided by total area.
- *Diversity of land use types*: the number of different LUC classes in an area.
- *Index of LUC heterogeneity (HIx):* Evaluation of landscape heterogeneity using the Fjellstad et al. (2001) methodology. This gives, in contrast to the commonly used Shannon's index, information about the spatial variability of the landscape.

HIx documents the occurrence of identical LUC classes, when comparing points in a defined grid (Fjellstad et al. 2001), while the Shannon index is only about the landscape content, i.e., of LUC classes present in the mosaics and their number (see Magurran 1988; Fjellstad et al. 2001). In extremely heterogeneous landscapes, where no two adjacent land use types are identical, HIx equals 1. In the case of a totally homogeneous landscape, where all the points fall into the same class of LUC, HIx equals 0.

For the purpose of this study, HIx was calculated using LUC maps for each different area and all four time periods. A point matrix (100 × 100) was interwoven into the area of interest, i.e. each catchment. Each point in the matrix had a clearly defined number of adjacent points, usually 8 but less if located on the edge of the catchment area. The heterogeneity index is calculated according to the following equation:

$$HIx = 1 - \frac{\sum_{i=1_{i \neq j}}^{n} \sum_{j=1}^{n} w_{ij} \cdot c_{ij}}{\sum_{i=n_{i \neq j}}^{n} \sum_{j=1}^{n} w_{ij}},$$

where w_{ij} is binary; it equals 1 if i and j are merely on the same LUC, otherwise it equals 0. Also, c_{ij} equals 1 if i and j are identical types of land cover, otherwise it equals 0.

3. Results

3.1. *Changes in area of different landscape categories*

Detailed results of the changes in the size of each LUC class are presented in Table 3.

3.1.1. Time interval 1940 – 1960

AIU areas were rather intensively used during both the war and postwar period (1940–1960). There was a significant increase in newly cultivated land (+3.6%) as well as increases in linear vegetation length (+0.4%) and forest area (+0.7%). These increases occurred at the expense of non-cultivated land (−4.4%). During this same period, economic activity was partially reduced in MIC areas, caused by the outflow of population from the Sudetenland, resulting in a small decrease in the amount of cultivated land. Changes in landscape structure included increased linear vegetation structures, especially linear vegetation in abandoned fields (+0.3%), and scattered vegetation and forest (2.2%).

The studied localities in MG areas are within the area of the Sudetenland. The large outflow of the German population following the end of World War II resulted in a significant depletion of land belonging to the cultivated land class (−8.6%) in favor of forest and scattered vegetation (+9.2%). Paradoxically, non-cultivated land also decreased during this period (−0.4%), most likely due to spontaneous vegetation development on these lands. Riparian vegetation nearly tripled its area (0.3%), while linear vegetation, especially along road alleys (+0.6%), increased in area.

3.1.2. Time interval 1960–1990

During the period of collectivization (1960–1990), there was a paradoxical decrease of cultivated land area (−1.8%) in the AIU LUC resulting from large-scale drainage digging. This caused the temporary removal of the affected arable land from the cultivated land class mainly into the non-

cultivated class. This was only a short-term effect, but clearly visible. Orchards were abandoned as a result of collectivization of property, commonly being converted to scattered forest vegetation units (+0.4%) and linear vegetation (+0.4%).

Resettlement of the Sudetenland and collectivization of agricultural land resulted in an increase in the area of cultivated land (+5.6%) in MIC areas at the expense of linear field belt vegetation (−0.6%) and non-cultivated vegetation land (−3.8%). The amounts of riparian vegetation (+0.2%) and road alleys (+0.3%) slightly increased during this period.

Between 1960 and 1990, areas in the MG landscape continued to be under the influence of secondary succession and extensive land management. Classes of riparian vegetation significantly increased in area (+1.5%), as did the non-cultivated land (+2.7%).

3.1.3. Time interval 1990–2010

The intensive use of agricultural land in AIU areas continued even after the fall of communism (1989). There was a renewed increase in field size (+0.9%) at the expense of non-cultivated land (−1.8%). The agricultural intensification after 1990 did not have any negative effect on the linear vegetation in the subcategory of road alleys (+0.7%) and surprisingly even hedgerows and field belts vegetation increased slightly (+0.1%).

In the MIC areas, the change in the political regime after the fall of communism (1989) brought a return to the original mixed farming. Again there was a renewal of orchards, the linear vegetation in all categories significantly strengthened (+3.1%) and forest area increased (+4.6%).

Forest area also significantly increased (+5.3%) in the MG areas during this most recent period. This change was caused mainly by the transfer of land from the 4a category of riparian vegetation (−1.2%) as they had exceeded the set ratio of width to length (width <30% of length). Also, other sub-classes of vegetation developed to the extent where they were partially transferred into the forest unit. Cultivated land is currently

represented only by a unit of permanent grassland, used mainly for grazing cattle, and only with a minimum of arable land (field mapping).

Table 3. Changes in area of the different LUC classes (%) in the period 1940–2010 in landscape categories with varying intensity of agriculture.

	1940	1960	1990	2010	1940 - 2010
AIU area					
1 – cultivated land	89.78	93.39	91.54	92.41	3.6
2 – non-cultivated land	6.65	2.24	2.86	1.11	-5.5
3 – forests	1.59	2.25	3.06	3.3	1.7
4 – linear vegetation	0.47	0.85	1.24	1.99	1.5
4a – riparian vegetation	0	0.03	0.21	0.22	0.2
4b – road alleys	0.13	0.29	0.85	1.53	1.4
4c – hedgerows, field belts	0.33	0.53	0.18	0.23	-0.1
5 – built-up areas	1.52	1.26	1.29	1.19	-0.3
MIC area					
1 – cultivated landscapes	81.46	78.93	83.37	80.35	-1.1
2 – non-cultivated landscapes	4.87	4.84	1.03	1.06	-3.8
3 – forests	10.54	12.71	12.48	14.03	3.5
4 – linear vegetation	1.33	2.01	1.9	3.31	2.0
4a – riparian vegetation	0	0	0.23	0.66	0.7
4b – road alleys	0.28	0.62	0.89	1.61	1.3
4c – hedgerows, field belts	1.05	1.38	0.78	1.04	0.0
5 – built-up areas	1.8	1.51	1.22	1.25	-0.5
MG area					
1 – cultivated landscapes	77.57	68.81	67.32	65.13	-12.5
2 – non-cultivated landscapes	5.22	4.8	7.54	4.69	-0.5
3 – forests	14.39	23.58	21.24	26.45	12.0
4 – linear vegetation	1.15	2.04	3.02	2.41	1.2
4a – riparian vegetation	0.18	0.5	1.97	0.79	0.6
4b – road alleys	0.14	0.75	0.38	0.49	0.3
4c – hedgerows, field belts	0.83	0.78	0.67	1.13	0.3
5 – built-up areas	1.66	0.77	0.88	1.33	-0.3

Note: AIU, agriculturally intensively used; MIC, medium intensively cultivated; MG, marginalized.

3.2. Indentifying trends in landscape changes between 1940 and 2010

Comparing the initial state of the area (1940) with the state in 2010, it is clear that a continuous increase of cultivated land area (+3.6%) occurs in AIU areas. This happens mainly at the expense of non-cultivated areas (−5.5%) and hedgerows and field belt category (−0.1%). The cultivated land area is gradually decreasing in the MIC (−1.1%) and particularly the MG areas (−12.5%). Nowadays the vast majority of cultivated land in the MG area is represented by permanent grassland as was seen during field mapping. Non-cultivated areas are declining compared to the original values of 1940 in all categories, but especially in AIU (−5.5%) and MIC (−3.8%) areas. In MG, however, the decrease in non-cultivated land was less than 1% between 1940 and 2010.

The area of forest land has changed in the opposite direction to the area of cultivated land. Forest area has been gradually increasing in all catchments, the most in the MG category (+12.0%), less in MIC (+3.5%) area, and the least in AIU (+1.75%) area. Linear vegetation increased somewhat in almost all subclasses, with the exception of the hedgerows and field belts. Hedgerows and field belts decreased in AIU compared to 1940 (−0.3%) and remained at the original size in MIC areas, while it increased slightly (+0.3%) in MG areas. The subclasses of road alleys and riparian vegetation have increased in all studied landscape categories. There was an especially marked rise in riparian vegetation in MG areas, resulting in part of them being transferred into the forest subunit (Table 3). Even so, the extent of riparian vegetation increased by +0.6% compared to the original size in the MG category and by +0.7% in the MIC area. Small increases were also recorded in AIU (0.2%) area. The area of road alleys increased, especially in the AIU (+1.4%) and MIC (+1.3%) categories, while to a lesser extent in MG (0.3%) category. The extent of built-up areas even slightly decreased, by tenths of a percentage, in all defined landscape categories.

3.3. Parameters of landscape spatial structure

Diversity in general remained constant in all three different landscape categories, as all LUC classes were found in all time periods (Table 4). Length of edges decreased in all landscape categories, however, being almost twice as much in AIU as in both MIC and MG categories. Both heterogeneity and frequency of landscape elements also showed a decline in all categories, with the most in AIU category. Average size of landscape elements increased in all categories.

Table 4. The changes of observed landscape parameters in the period 1940–2010 in defined landscape categories with varying intensity of agriculture.

	1940	1960	1990	2010	1940 - 2010
AIU area					
Diversity of land use	5	5	5	5	0
Relative length of edges (km/ha)	0.8	0.32	0.28	0.23	-0.57
Average size of landscape elements (ha)	0.44 ± 0.70	1.99 ± 5.18	3.05 ± 5.90	3.66 ± 8.50	+3.22
Frequency of landscape elements (ha^{-1})	2.23	0.43	0,33	0.28	-1.95
HIx	0.27	0.22	0.15	0.14	-0.13
MIC area					
Diversity of land use	5	5	5	5	0
Relative length of edges (km/ha)	0.64	0.41	0.31	0.3	-0.33
Average size of landscape elements (ha)	0.65 ± 1.5	1.58 ± 3.4	2.28 ± 4.61	2.55 ± 5.49	+1.9
Frequency of landscape elements (ha^{-1})	1.54	0.63	0.44	0.39	-1.15
HIx	0.40	0.42	0.24	0.35	-0.05
MG area					
Diversity of land use	5	5	5	5	0
Relative length of edges (km/ha)	0.49	0.39	0.30	0.26	-0.23
Average size of landscape elements (ha)	1.2 ± 3.5	1.84 ± 4.9	2.71 ± 6.76	3.61 ± 9.08	+2.41
Frequency of landscape elements (ha-1)	0.83	0.54	0.37	0.28	-0.55
HIx	0.43	0.46	0.39	0.34	-0.09

Note: AIU, agriculturally intensively used; HIx, index of LUC heterogeneity; MG, marginalized; MIC, medium intensively cultivated.

4. Discussion

4.1. Changes in area of different landscape categories

The quality of agricultural ecosystems in the Czech Republic was evaluated to be at 13–18% of their original natural values, i.e. values in the middle of the EU25 average (Reidsma et al. 2006). This national average incorporates considerable regional differences, however. Local stakeholders and their activities have to be adapted to these differences when aiming for revitalization of landscape structure and functions. According to the results of this study, cultivated land in AIU represents more than 92% of the catchment area. The field investigation showed that the vast majority of these cultivated areas are used for arable crops, which causes concern in relation to the abovedescribed negative effects regarding quality and function. In such large and continuous areas used for production, farming intensity strongly influences ecosystem services, especially (agro-) biodiversity (Dramstad and Fjellstad 2011), the overall quality of agro-ecosystems (Reidsma et al. 2006), and spatial characteristics of the agricultural landscape. The landscape parameters (Table 4) also show that these surfaces are continuous and homogeneous.

In contrast to what was found in the AIU areas, the majority of cultivated land in MG areas consists of permanent grassland used mainly as pastures. In these areas, considered less suitable for intensive and efficient agricultural production (described as less favorable areas (LFAs)), the trend is very different from that in AIU areas. The phenomena of marginalization and abandonment of former agricultural land are well described in the literature (e.g. Verhulst et al. 2004; Cramer et al. 2008; Kleijn et al. 2011). The process of conversion of arable land to pasture or grassland for hay production may also have positive environmental effects, e.g. on soil quality (Bicik et al. 2001). However, from a spatial perspective, many effects resemble those of intensification, in particular the result of enlarging the grain of the landscape structures and increasing

homogenization of landscapes (Kleijn et al. 2011). The impact on landscape features is not nearly as crucial when arable land dominates, however. From the results obtained in this study, we can therefore assume that, even though the size of landscape elements increases in MG areas to a similar extent as in the AIU areas (Table 4), important functions of the landscape, such as anti-erosion potential or landscape permeability, have increased in the grassland areas in contrast to what has happened in intensively used arable areas (García-Ruiz and Lana-Renault 2011).

Increasing forest areas is desirable in many regions of Central Europe, especially because of anticipated climatic changes (Dury et al. 2011) and the carbon sequestration ability of forests (Cienciala et al. 2008; Schlup et al. 2008). Forest is intentionally grown on land with high slopes, as well as on shallow or hydromorphic soils (Mc Roberts et al. 2009). Further, especially in the MG areas, they have formed spontaneously without management via secondary succession. Increasing the forest proportion has several benefits. Most of all, they represent places of condensation and promote water infiltration into soil, functions which are desirable mainly within AIU areas. However, it is important what will be the quality and naturalness of the new forest if it will have any benefits for biodiversity (Milad et al. 2011; Radovic et al. 2011).

The increase in linear vegetation seen in our study catchments should contribute to strengthening the heterogeneity in these cultural landscapes (van Geert et al. 2010; Lentini et al. 2011). By these structures, it has been documented that hedgerows and hedgerow networks in particular may fulfill a range of landscape functions (Forman and Baudry 1984; Park 1988; Burel 1996; Dover and Sparks 2000; Hinsley and Bellamy 2000; Maudsley 2000). Within our study sites, it is particularly interesting that the subclass riparian vegetation remained almost unchanged for more than a century, no matter what the landscape as a whole has undergone in the past. A very positive finding was that their size has increased in the last period of the study (1990–2010). However, this trend

is unfortunately not observed in AIU areas. Still, we can state based on our findings that riparian vegetation is an element with a stable presence in these landscapes.

A similar trend was also observed in road alleys, another subclass of linear vegetation, and partly in the hedgerows and field belts subclass. In fact, some development of linear vegetation, especially road alleys, occurred even in intensively cultivated areas.

Although linear vegetation can act as biological corridors for pollen dispersal and habitat, as well as providing refuge and barrier function in cultural landscapes (Baudry et al. 2000; Ghazavi et al. 2008; Geert et al. 2010), linear elements in Central and Western Europe have been constantly disappearing. The main threats to these landscape elements were described by Baudry et al. (2000). These include reduction in the number of farms leading to abandonment of agricultural areas and to a gradual transfer of the linear vegetation to the succession stages of forest, which was also confirmed in our study. This change may also have positive effects, e.g., on biodiversity, of course. Another common and less environmentally beneficial trajectory was removal of linear vegetation due to increasing size of farms. A larger farm size tended to lead to an increase in the size of fields. This was mainly achieved by the complete removal of hedgerows and field belts, and the merging of neighboring fields. Additionally, increased intensity of cultivationmanagement could lead to decreased density and the quality of the surrounding vegetation (Baudry et al. 2000). Both described trajectories were identified in our study. In MG areas, riparian vegetation developed to such an extent that it was categorized as a subunit of floodplain forest, while there was a gradual reduction in the hedgerows and field belts category in AIU areas.

4.2. Changes in parameters of landscape structure

Diversity of land use, as measured on this scale, remained unchanged for the whole observed period. In general, all defined LUC classes were

represented in all time periods, but their frequency and parameters changed (see Table 4). A bit surprisingly, the trends of changes are identical for all parameters and in all categories of land use intensity. However, there is a significant difference in the extent of these changes. As could be expected, the most marked decrease in the *relative length of the edges* was noted in AIU areas, where the total length of boundaries among different types of land use decreased by more than 70% between 1940 and 2010. A similar decline also occurred in other areas – by 49% in MIC area and 42% in MG area. As described above, shortening the length of the edges is generally associated with enlarging the grain of landscape mosaics. This corresponds to the increase of another parameter – *the average size of landscape elements*. As expected, the largest increase was recorded again in AIU area. The extent was larger than anticipated, however, as the average size of LUC polygons in general increased more than eight times. The change in landscape structure was pronounced also in the other categories; almost fourfold in MIC and threefold in MG. *Frequency of landscape elements*, on the other hand, decreased in all three landscape categories. The total number of landscape elements present in the defined catchment decreased by 87% in AIU, 74% in MIC, and 66% in MG, implying a significant degree of homogenization of the environment. The *heterogeneity index* further emphasizes this change, as it fell from already low levels in 1940 (0.27) to 0.14 in AIU, thereby documenting a further reduction in the spatial variability of this intensively used landscape. The occurrence of identical types of land use in neighboring areas also increased in MG and MIC, by 21% and 12.5%, respectively.

4.3. Ecosystem consequences of LUC changes

The size of LUC classes, their spatial arrangement, and management also affect the energy balance of the landscape and thus its water dynamics, accumulation and water holding functions as well as their resistance to erosion (Zuazo et al. 2006; Cerda et al. 2010; Ryan et al. 2010; García-Ruiz

and Lana-Renault 2011). In addition, changes in landscape structure may affect the interaction among local climate, soil properties, and vegetation. Ultimately, these parameters affect the catchment runoff response, including the quality and quantity of runoff water (Bari et al. 2005). Compared to forested land, the character of runoff has pronounced maxima in the forest-free areas. In addition, maximum flow in non-forested areas appears in a shorter time after maximum precipitation, a very important factor in the emergence of local and regional floods (Ryan et al. 2010).

It is well documented that a heterogeneous landscape is essential to the survival of several species of animals and plants in agricultural landscapes (Roy et al. 2003; Ashton et al. 2009; Fraterrigo et al. 2009; Oliver et al. 2010), through the provision of habitat in these landscapes (Verhulst et al. 2004; Smart et al. 2006; Rundlöf et al. 2008; Ch et al. 2011 and others). For species that have more than one generation per year, a heterogeneous landscape may provide microclimatic conditions necessary for their individual developmental stages (Roy and Thomas 2003). Many groups of invertebrates can achieve short-term thermoregulation simply by moving among microhabitats or landscape components when these are accessible in the present area (Ashton et al. 2009). Roslin et al. (2009) showed that the loss of habitats with different microclimates caused a dramatic decline in populations of the beetle Onthophagus gibbulus. Thus, a heterogeneous environment is necessary for maintaining and enhancing local biodiversity at all levels (Olden et al. 2004; Smart et al. 2006). In addition, as shown by Oliver et al. (2010), it reduces the variability in population dynamics of represented species, and thus increases the probability of survival in a fragmented cultural landscape.

It is difficult to consider the exact extent to which the detrimental loss of structure and heterogeneity of landscape occur. Ewers et al. (2010) concluded that this was a hardly achievable task because it always depends on the specific object of exploration. Different species communities differ in their ecological requirements and therefore react differently to different

management regimes (Gabriel et al. 2010). An indisputable fact remains, however, that unlike the populations exposed to only one type of environment, heterogeneous landscapes provide organisms with the possibility to move into the most suitable conditions at any one point in time (Olden et al. 2004). In the long run, heterogeneous landscapes thereby allow a population to avoid environmental influences causing increased mortality or reduced fertility, whether these occur along a timescale of minutes, hours, days, or years (Oliver et al. 2010).

The overall spatial organization of landscape elements is an important quality parameter with respect to the spatial organization of the landscape (Temme and Verburg 2011). Landscape heterogeneity is important for the biological capability and ability of self-regulation of ecosystem functions, as elements of landscape structure affect a wide range of landscape environmental attributes such as connectivity and permeability (Smith and Hellmann 2002; Samways 2006; Fahrig 2007; Roslin et al. 2009; Jackson and Sax 2010). Landscape permeability is important mainly because of the dynamics of many species occurring in the cultural landscape, where survival of populations depends on the mutual relationship between extinction of occupied habitats and the rate of recolonization (Hanski 1994). Degradation of landscape mosaics accelerated by agriculture may promote the occurrence of a smaller number of highly competitive generalist species rather than communities rich in species. Landscape homogenization may also reduce the success of recolonization of remote and less accessible areas (Sih et al. 2000) and thus further increase the consequences of degradation of landscape elements. For this reason, it is necessary to pay special attention to efforts to strengthen the environmental connectivity and define simple but effective steps to improve the state of natural and semi-natural ecosystems in agricultural landscape mosaics.

4.4. Trends of development in areas with varying degrees of agricultural dominance

Reduction of arable land and its transfer to permanent grasslands in the MIC and MG areas is probably mainly due to the EU subsidy policy system. Clearly, the decline of arable land in favor of permanent grassland, forest units, and linear vegetation has some advantages, at least from an ecological perspective. As stated by Cramer et al. (2008), abandonment of agricultural land may result in their subsequent development and potentially a gradual return to a state close to natural which can be considered desirable from certain perspectives. Based on the results of our study, the introduction of less intensive farming methods can lead to the restoration and strengthening of landscape structure. Somewhat surprisingly, there has been development of linear vegetation in recent decades even in intensively used agricultural areas. This is definitely a positive finding, since linear elements present the only option for restoring connectivity in the current fragmented cultural landscape. Linear structures are key features for increasing and maintaining biodiversity in agricultural landscapes (Hinsley and Bellamy 2000; Maudsley 2000). This result is an important finding when it comes to the development of landscape spatial components in general and deserves further attention. It may be that, even in periods of and areas with intensive agriculture, these linear elements may be allowed to remain. Understanding more about why this is happening may enable the provision of further recommendations as to how this landscape element can be used in landscape planning and management. Linear elements may be a landscape element filling a number of functions as discussed above. At the same time, our results indicate that focusing on linear vegetation also may generate less conflict than other possible options.

Based on the results of this study, it is clear that a significant increase of landscape grain has happened, resulting in more homogeneous landscapes. However, new structures can develop in homogeneous

landscapes. The newly emerged landscape structure may not be the same as the original condition; but it may in fact be even more differentiated and valuable (Jackson and Sax 2010). It would mainly imply to 'give nature a free hand' and leave a strip of some meters along small streams causing spontaneous development of permanent vegetation. Alternatively, this development could of course be supported by planting regionally specific or ecologically important species. As a matter of fact, these two alternatives should be the subject of further studies, aiming to assess the resulting species assemblages and accompanying costs over time, as well as an evaluation of the actual results.

5. Conclusions

The spatial arrangement of landscape elements affects the basic functional characteristics of cultural landscapes and ultimately has a major impact on ecosystem functions of landscapes containing large agricultural units. Modern agriculture is successful in increasing crop production; on the other hand, it causes serious environmental problems. Current agricultural practices should seriously consider how a short-term increase in crop production can lead to a long-term loss of ecosystem services as a potential cost. Undoubtedly, such a loss will also eventually affect agriculture itself. Changes in the landscape categories studied in our catchment areas showed the following trends:

1) *Increased area of intensively cultivated areas in AIU* – there was a steady increase in cultivated land and decrease in non-cultivated areas and only a small increase in forest area, with a loss of linear vegetation in the fields.
2) *The abandonment of MG with the resulting occurrence of secondary succession processes leading to forest* – reduced size of cultivated areas, significant increase in forest area, with the increase in size of

linear landscape structures resulting these to be placed into the forest unit.

3) *Overall increase in forest area* – the extent depending on the intensity of the exploitation.
4) *Increases in linear vegetation units, especially in the subcategories road alleys and riparian vegetation* – slight but gradual increase. This is valid for riparian vegetation in MG areas, and for road alleys in MIC and AIU areas.

Many studies show that a heterogeneous landscape increases the stability of species and the success of their survival in contemporary fragmented cultural landscapes. However, negative changes and their impacts on the structure of the landscape and quality of its ecosystems continue in spite of all of the available information, including published scientific studies, creation of metrics, indicators, and other tools for knowledge enhancement, assessment, and communication and understanding of the dynamics of the landscape. These negative changes include:

1) *Simplifying of the landscape mosaic* – increasing the area of landscape elements, reducing the frequency of landscape elements. This trend was not only dramatic in AIU areas but also significant in the MG and MIC areas.
2) *Homogenization of the landscape* – reducing heterogeneity of landscape elements. The steepest decline was observed in AIU areas, leading to an almost totally homogeneous landscape, where all the neighboring points fall into the same category of land use. A significant but less dramatic decrease was observed in MG areas. In the MIC areas, HIx values remained close to the value of 1940; this was also the only studied area showing an upward trend for this parameter.

3) *Reducing the permeability of the landscape in AIU* – decrease in the relative length of the edges, reducing HIx. A dramatic decline was observed in AIU areas, where arable land with suppressed linear vegetation is the predominant type of land cover. In MG areas, where the dominant type of land cover is forest or grassland, permeability is not considered to be a problem.

These negative impacts occur in spite of indications of increasing public awareness of the importance of wellfunctioning landscapes and the existence of the European Landscape Convention. Therefore, other actions must be taken to reverse these trends.

Final decisions about what is to happen in a landscape lie mostly in the hands of farmers and landowners; it is therefore essential that they understand the concept of multifunctional landscapes and take care of the landscape structure as a part of their management. Taking appropriate care of the landscape structure will enhance ekosystém services such as reduced risk of soil erosion and flooding. Further, increased connectivity will support the dispersal of species and enhance biodiversity. The results of our research suggest that it is not necessarily very difficult or expensive to invest in the restoration of landscape structure when it is required. We argue that there is a need to farm in a more sustainable manner not only in protected areas but also in ordinary landscapes. We could start by giving the landscape space to breathe.

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Paper III

How does strategic planning deal with spatial landscape problems?

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Abstract

The purpose of this study was to examine the relevance of spatial landscape problems in national strategic planning. In our work, we distinguish six spatial problems: Landscape fragmentation, Landscape sealing, Landscape abandonment, Brownfields, Marginalization of agricultural land and rural areas, Non-recultivated landscapes. Although all these problems were mentioned in studied documents, most of them did not deal with these problems sufficiently. The results of this study could be useful to planners and politics when improving national strategic plans that deal with landscape and establishing such landscape policy that would form a framework for other sector strategies and tactical plans.

1. Introduction

Sustainable development is a present European trend going along many political documents. Sustainable development covers not only environmentally sound economic development which preserves present resources for use by future generations, but also includes a balanced spatial development, what means reconciling the social and economic claims for spatial development with an area's ecological and cultural functions (ESDP). From this point of view, the landscape has a very important role. It is a background for ecological, environmental and social processes as well as for economic activities.

The Czech Republic ratified the European Landscape Convention (ELC) in 2003 and pledged itself to integrate the problem of landscapes into its regional and national planning policies and in its cultural, environmental, agricultural, social, and economic policies, as well as in other policies with possible direct or indirect impact on landscapes (ELC). ELC defines landscape as area perceived by people, the character of which is the result of the action and interaction of natural and/or human factors. It is area composed by mosaic of natural ecosystems, and ecosystems influenced by people (Millennium Ecosystem Assessment). This ecosystem approach considers people as an integral part of landscape, but on the other hand, according to Antrop (2006) landscape is mostly considered as a common value of the whole society.

Landscape can be endangered in terms of quality of ecosystems, and space where the ecosystems are realized (Scheme 1). Landscape quality can be threatened by degradation of its components, functions, threat of landscape services and degradation of landscape diversity. The problems of spatial landscape degradation can be fragmentation, landscape sealing, and changes of landscape character, landscape abandonment, and non-recultivated areas. All the problems are result of activity of many factors (drivers) (Scheme 1) that can be divided into two main categories: primary

and secondary divers. Primary drivers influence landscape directly and secondary drivers influence landscape indirectly and operate more diffusely, by altering one or more direct drivers (http://www.greenfacts.org /ecosystems/millennium-assessment-2/4-factors-changes.htm). Important direct drivers are climate change and land use in the Czech Republic. Secondary drivers are demographic factors, economic factors, technology, political factors and cultural factors. Landscape changes, caused by primary and secondary factors, can be seen in temporal and spatial scales. An impact of these changes can be long-term or short-term, but also local or global. Combination of all these factors creates different landscapes that vary in qualities and thus influence the quality of life of its inhabitants, either urban or rural

It is necessary to protect valuable parts of the landscape to preserve it for future generations. For the remaining portions, it will be necessary to give them new spatial order, new identity, and define new borders of landscape integrity with regard to present state, aesthetic values, and ecological possibilities (Fanta 2001). For this to happen, there must be a national framework of policies and priorities, based on a sound understanding of the environment, and of human interactions with it (Phillips 1999).

Systematical spatial planning can be used as a tool for landscape protection or management. Spatial planning refers to the methods used by the public sector to influence the distribution of people and activities in spaces of various scales (http://en.wikipedia.org/wiki/Spatial_planning). Any systematic control process can be hierarchically structured into three levels. Spatial planning includes all levels of land use planning including urban planning, regional planning and national spatial plans (http://en. wikipedia.org /wiki/Spatial_planning). The aim of such planning is to simplify complex planning problems, in this case spatial problems that have many different objectives, covering different scales (Boyland 2003).

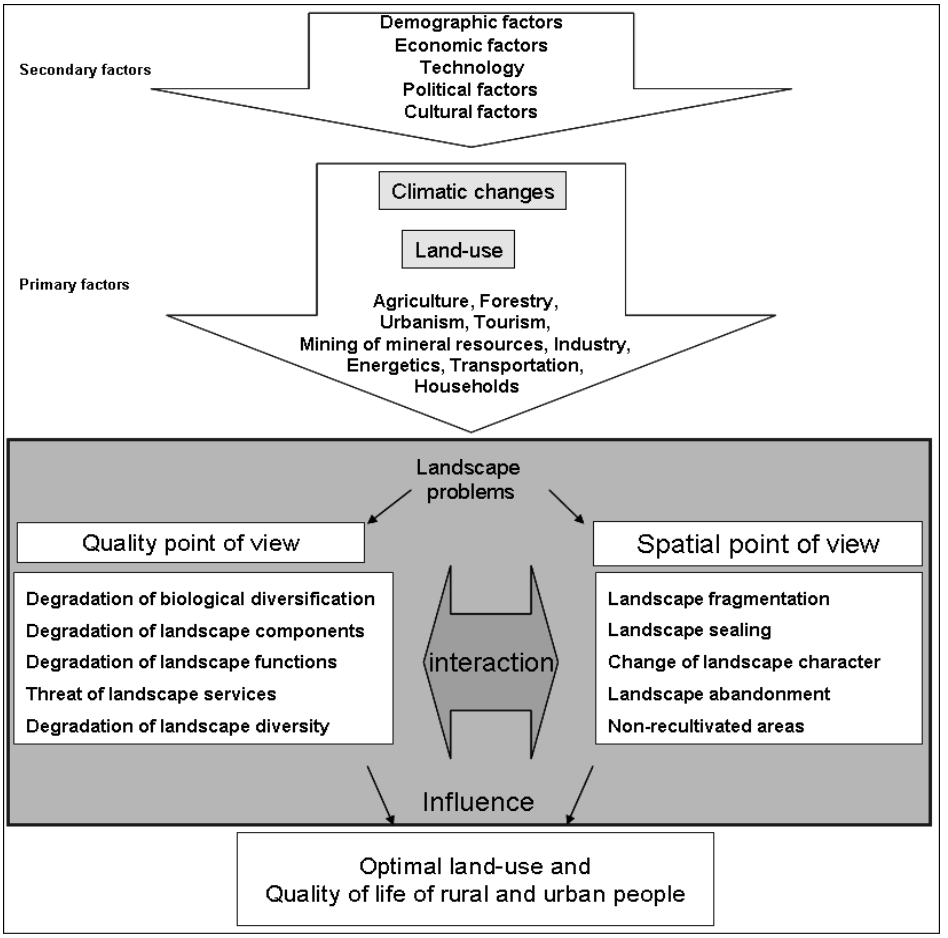
This means to break the problems into strategic, tactical and operational levels.

Strategic level is long-term, large scale planning and has broad aims (Kesseler 2002). Tactical level is planning for middle-scale and time horizons. It implements the strategic goals and objectives and it schedules how and when objectives will be met (Boyland 2003, Reada, Lenderking 2004). Broad scale of tools and measurements for organization, planning, monitoring, control, research, etc. belong to tactical planning (Boucnikova et al. 2006). Operational level is on the lowest level and it is short-term planning. It puts the strategic and tactical goals into practice.

Hierarchical spatial planning is missing in the Czech Republic (Boucnikova et al. 2006, Damborsky 2007). From the existing national documents, the Regional Development Plan and Spatial Development Plan are the nearest to spatial planning (Damborsky 2007). The Regional Development Plan is the strategic document and Spatial Development Plan is the tactical document that gives framework to consensual development and assessing of the area of the Czech Republic.

The aim of this study was to clarify views on landscape spatial problems in national strategic plans. In this paper, we have analysed strategic national plans dealing with landscape. We set up the most important spatial problems concerning Czech landscapes and defined the importance of these problems for decision making. We suppose that the national strategies attend to the spatial problems and thus provide a framework for tactical and operational planning.

Scheme 1: Landscape problems.



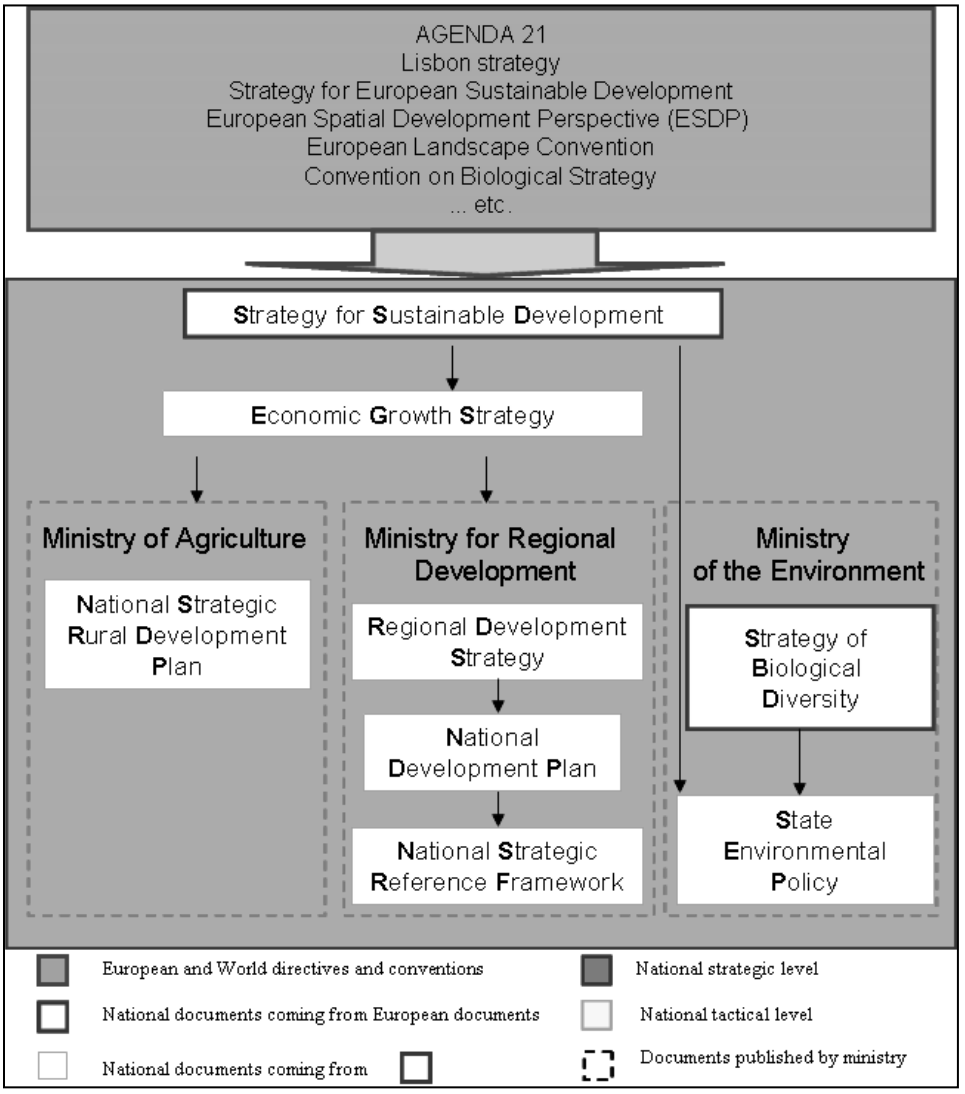
2. Methodology

2.1. Analysis of strategic documents

To analyze national planning documents, first we had to carry out a survey of existing strategic documents dealing with landscape and we had to establish their hierarchy (Scheme 2). The eight documents studied were published by Ministry of Agriculture (MA), Ministry of Environment (ME) and Ministry for Regional Development (MRD). Most of the strategies

were designed for the period 2007-2013. Only State Environmental Policy (SEP) was designed for the period 2004-2013 and Economic Growth Strategy (EGS) for the period 2005-2013. We chose the Spatial Development Plan as an example of tactical planning because it is nearest to national spatial plan that is missing in the Czech Republic.

Scheme 2: Scheme of studied strategic documents and their hierarchy.



Note: Bold capitals signify an abbreviation of the name of each document.

To analyze these eight documents according to spatial landscape problems, we defined five spatial problems (chapter 2.2). The choice of these problems was based on our own expertise after having studied a variety of scientific and political documents.

Each document was analyzed and the importance attached to the spatial problems was assessed. Finally, the documents were divided into four main categories according to their relevance to the problems and each category was scored.

☺☺ - First category deals with the problem, supports different ways of tackling it and suggests possible solutions to the problem. This category was given a score of 3.

☺ - Second category discusses the problem and only supports tackling the problem. This category was given a score of 2.

☹ - Third category discusses the problem only generally and neither tackles the problem nor gives possible solutions. This category was given a score of 1.

☹☹- Fourth category does not deal with the problem at all. This category was given a score of 0.

Giving scores allowed us to compare the documents. A document, which tackled all the problems in category ☺☺ reached 100% in evaluation. On the contrary, a document that did not tackle any problem and was always in category ☹☹, got 0% in evaluation.

Similarly, we were able to assess the importance attached to spatial problems. If all documents suggested possible solutions to the problem in category ☺☺, the problem reached 100%.

To ensure objectivity when dividing documents into categories, we exactly copied the texts where the documents mentioned the problems and then three people judged the documents. First, we judged them individually and then together.

2.2. Definition of problems for purposes of this study

Landscape fragmentation. Landscape fragmentation is a process of breaking-up continuous landscape into smaller and smaller patches that are gradually losing their function as living spaces for existence of viable populations. This results in degrading of habitats, changing of landscape processes, increasing isolation and creating migration barriers.

Landscape sealing. The pressure on appropriation of agricultural land is still growing, especially in the centres of economic boom. This results in appropriation of agricultural land in favour of chaotic commercial development along highways and on the outskirts of settlements or the development of suburban towns in close distance to larger cities with no regard to long-term landscape development, landscape functions and facilities.

Change of landscape character. Landscape character represents a substantial value of preserved natural and cultural heritage. It is outlined by specific features and attributes of landscape. The change in typical landscape features and attributes leads to cultural-aesthetical and visual landscape pollution, that is, the change or degradation of landscape character. This may result either in destruction of typical landscapes or may bring their uniformity.

2.3. Marginalization of agricultural land and rural areas

In some areas of the Czech Republic, agriculture has gradually become unsustainable. There has been a drop in number of job opportunities in agriculture, while marginalization of agricultural land and rural areas has occurred. Both abandonment of rural areas by inhabitants and increasing area of non-cultivated agricultural land participate in acceleration of soil erosion in particular areas, invasion of non-indigenous plant species, overgrowth with shrubs and woods and other adverse effects.

***Brownfields*.** Brownfields are just another negative feature of landscape abandonment. Lots and premises in urban brownfields are areas which had lost their original purpose and represent a substantial part of the built-up area in many of our cities. Not only do they have negative economic effects, but they also have an adverse effect on their wider surroundings (http://www.brownfields.cz/e107/ news.php).

Non-recultivated landscapes. A non-recultivated landscape means a landscape that was transformed by man with the purpose of its exploitation. Owing to exploitation of mineral resources, infrastructure development, industrial and agricultural production there was a huge devastation of many, small to large-scale areas of original landscape. Examples are old mines, depleted mines, settling basins, ***rubble*** slopes, landfills, polluted streams with no original vegetation, barrens, military areas, etc.

3. Results

The aim of our study was not to evaluate the rightness of proposed solutions of the spatial landscape problems, but we wanted to find out the importance of the problems for national strategic plans and one tactical plan that would deal with landscape as a pillar of sustainable development.

3.1. Treatment of problems

3.1.1 Landscape fragmentation

Landscape fragmentation is alluded to as issue in all studied documents. Traffic routes were considered to be the main cause of landscape fragmentation.

Category ☺☺: dealing with the problem in detail (SEP, SBD)

The objects of above documents agreed in priority of preventing landscape fragmentation, the need of gradual facilitation of existing thoroughfares with system of outlets for wild animals as well as with creation of passages and corridors when building a new thoroughfare. SBD deals in detail with removal/bypassing of artificial migration barriers in streams by constructing fish ladders.

Category ☺: mentioning the problem (SSD, RDS, EGS)

In SSD, the arrangements for preventing landscape fragmentation are mentioned in terms of general aim to implement new methods of landscape capacity and vulnerability assessment and protection of landscape character values, especially with regard to reducing landscape fragmentation and ensuring the possibility of migration through landscape for wild animals. RDS emphasizes the importance of preventing an integral landscape from fragmentation but does not deal with it in more detail. EGS proposes to minimalize the influence of throughways and traffic as factors being responsible for increased fragmentation.

3.1.2 Landscape sealing

Spontaneous development in landscape that was not yet built-up is considered to be an adverse effect in half of the studied documents. They emphasize especially the necessity of cutting down the number of new land appropriations and increasing the effectiveness of use of already built-up areas.

Category ☺☺: dealing with the problem in detail (SEP, RDS, SBD, EGS)

SEP suggests increasing the effectiveness of taxation for land appropriation with regard to its biodiversity as an economic device for wide-area protection of land, e.g. adjustment of charges for reclassification of agricultural land from Agricultural Land Fund (ZPF). SPR encourages national strategic planning, focused on restriction of spontaneous landscape development in urban and suburban areas in particular. SBD supports

strategic development document processing at all levels, and furthermore, the acceleration in realization of complex land improvement. EGS recommends solving the problem by escalating taxation and differentiating taxes according to the type of investment activity; it also recommends creating a relation between the appropriation of land and regeneration of the area.

Category ☺: mentioning the problem (SSD)

Among the aims of SSD, there is also an introduction of more efficient steps for restricting land appropriation, which includes safeguarding the financial and organizational system implementation of these arrangements. SSD does not deal with the problem mentioned in more detail.

3.1.3 Landscape character

In the documents studied, the issue of changes in landscape character was mentioned rather marginally.

Category ☺☺: dealing with the problem in detail (SBD, SEP)

Both documents put emphasis on support and protection of landscape character and its individual elements (solitary trees, green strips along roads, wetlands and small water reservoirs...). SBD emphasizes the necessity of reduction of disturbances in landscape character of mountains by construction of vertical buildings.

Category ☺: mentioning the problem (SSD, EGS)

These documents mention arrangements for ensuring support and protection of landscape character and its elements. According to EGS, the solution for protection of rural character of landscape can be found in agro-environmental arrangements.

3.1.4 Brownfields

Brownfields are mentioned in most of the studied documents. They agreed that it is necessary for revitalizing of brownfields to have priority over development in un-built areas.

Category ☺☺: dealing with the problem in detail (SSD, NSRF, RDS, NDP, EGS, SDP)

According to SSD, the possible solution is implementing the system of devices and methods that would enable priority use of brownfields for construction development over similar development on greenfields; NSRF consider the revitalization of city centers to be a part of brownfields´ issue. According to EGS, by optimalizing the Regeneration of industrial zones support Program and by adding increased revenue from appropriation of Agricultural Land Fund (ALF) to investment prospects of villages/towns, more intensive support for revitalization of brownfields can be achieved.

Category ☺: mentioning the problem (SEP, SBD)

Brownfields are mentioned in these documents as well as the urgency of effective use of built-up areas and reinforcement of devices enabling restoration of old industrial zones. They do not deal with the issue of brownfields in more detail.

3.1.5 Marginalization of agricultural land and rural areas

The documents studied deal with the question of Marginalization of agricultural land and rural areas only marginally. It is presented similarly in the tactical document of Rural development Program of the CR.

Category ☺: mentioning the problem (SBD, NSRF, NSRDP, RDS, NDP, EGS)

In studied documents, the solution to the problem of marginalization of rural areas consists mainly of making the way of living

of rural population more attractive by supporting specialized produces and by supporting the non-production functions of agriculture. The impacts on landscape and environment are not, with the exception of SBD, mentioned. SBD emphasize the urgency of supporting such devices of sustainable development in rural areas that would have positive environmental impact.

3.1.6 Non-recultivated landscapes

Category ☺☺: dealing with the problem in detail (SEP, SBD)

Within the scope of non-recultivated landscape, these documents deal especially with recultivation and revitalization in areas disturbed by mining, with special attention to reducing the area of landscape damaged by mining of mineral resources and burdened with mining waste. SBD emphasizes the importance of setting out an ecosystem approach towards the monitoring of spontaneous processes in non-recultivated areas, and further on a long-term research and monitoring of these areas with the aim of defining the best ways of re-incorporating these areas back into landscape.

3.2. Evaluation of Problems

Strategic documents consider all defined spatial landscape problems in their visions and goals, but also support solutions to improve the present state of landscape. Nevertheless, only three of the problems are considered by the documents from more than 50%. Most attention is dedicated to the problem of brownfields. Least attention is addressed to the problem of landscape character changes and non-recultivated areas.

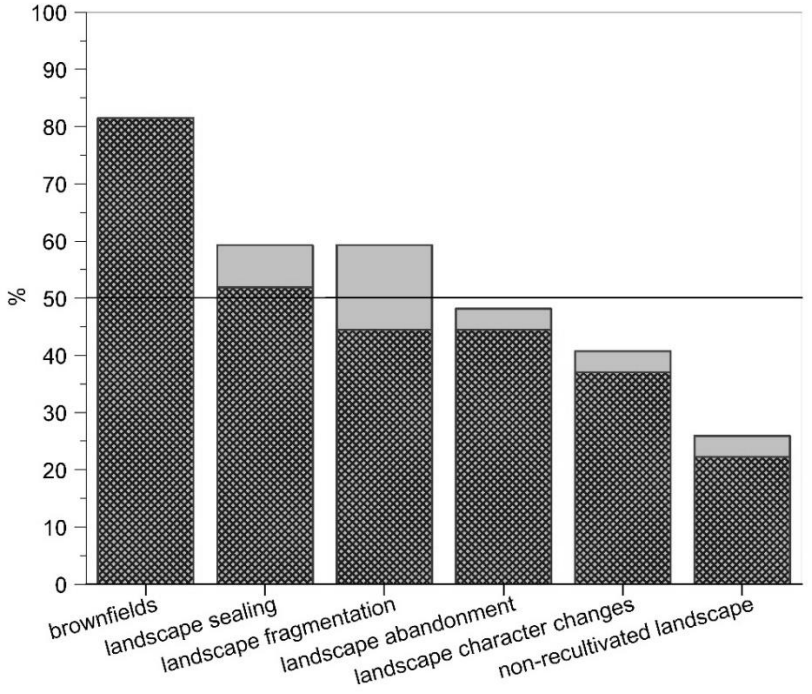
It is evident that on one hand, it is easy to identify some problems and mention them in strategic goals but on the other hand, it is difficult to set up the possible ways of tackling certain problems. Landscape fragmentation, landscape sealing, and landscape abandonment are the examples of problems that are easily identified but difficult to solve. Solid

color in graph 1 shows number of scores the problems could reach in all categories (see chapter 2.1). The pattern shows the number of scores the problems could reach in first two categories. The difference is percentage of problem that is not tackled by the strategic documents.

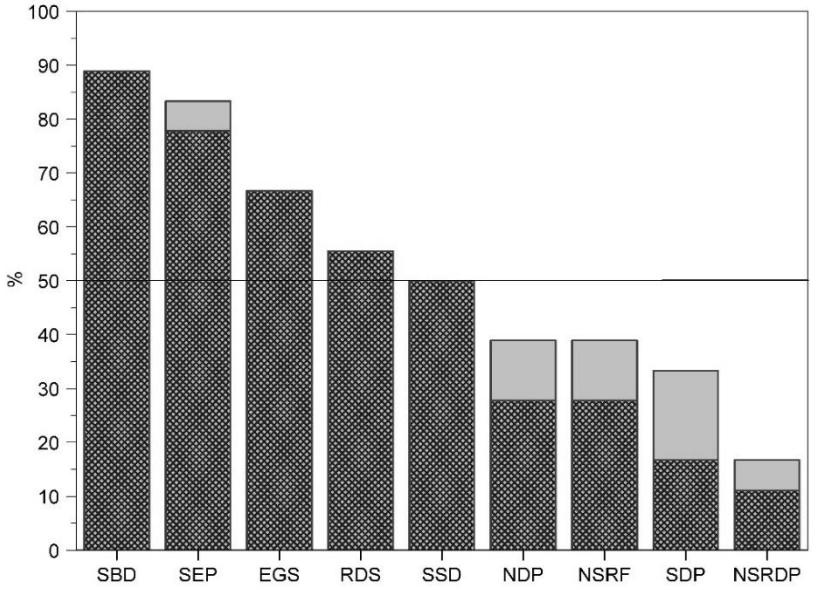
3.3. *Evaluation of Documents*

With regard to the analysis of the documents, we came to a conclusion that most of the strategic plans do not deal sufficiently with the issue of landscape as a framework for all ecological, environmental and social processes, and economic activities (graph 2). Only in two cases are more than 80% of the studied documents related to spatial problems (graph 2). They are the Strategy of Biological Diversity (SBD) and the State Environmental Policy (SEP) drawn up by Ministry of Environment. Only half of the documents deal with the problems more than 50%, support different ways of tackling the problems and suggest possible solutions. In the rest of the documents, these problems are only mentioned. Supporting and solving the problem is not covered sufficiently. This pattern is evident in SEP, NDP, SDP, NSRF and NSRDP. The described differences are shown in graph 2. The solid color shows the total score from all four categories. The pattern shows the score from the first ☺☺ and second ☺ category. The differences are problems that are mentioned, but not solved.

Graph 1: Importance of landscape spatial problems.



Graph 2: Studied documents.



Strategy of Sustainable Development (SSD) is on the highest hierarchical level between the strategic documents (scheme 2). It is based on equal splitting among economic, social and environmental pillars. All other documents should link their aims to SSD and adapt the goals of SSD into themselves, or develop the goals further. Graph 2 shows that SBD, SEP, EGS and RDS further develops the aims set up by SSD and supports different ways of tackling the problems. On the other hand four of the studied documents are not linked to the SSD or they do that inadequately. Even the Spatial Development Plan (SDP), as a tactical document and tool for land use planning, does not tackle the spatial problems sufficiently (graph 2). Only 33% of the document is related to these problems. And only 17% out of those 33% are related to tackling the problem. Only the problem of brownfields is supported to be solved in defined regions. The rest of the problems are just mentioned very broadly, on the level of strategic planning.

4. Discussion and conclusions

The European Landscape Convention aims to promote the protection, management and planning of European landscapes and to organize European co-operation on landscape issues. It is the first international treaty to be exclusively concerned with the protection, management and enhancement of European landscapes. The Convention applies to the Parties' entire territory and covers natural, rural, urban and sub-urban areas. It deals with ordinary or degraded landscapes as well as those that can be considered outstanding. The Guiding Principles for sustainable spatial development of the European continent take especially into account the issue of landscape and consider that "spatial development policy can contribute to protecting, managing and enhancing landscapes by adopting appropriate measures, in particular by organizing better interactions between various sector policies with regard to their territorial impacts."

To date, landscape has not received as much attention from environmental policy makers as has nature conservation, pollution control and abatement, and land use (Phillips 1999). This study has proved that this is still the problem. Current policies do not cover landscape spatial problems sufficiently. The SBD and SEP are the most comprehensive in tackling the spatial landscape problems but the rest of the documents are poor.

As a tactical document, the SDP should be more specific in defining measurements for spatial landscape problems. It is a document that should contribute to protection, management and landscape improvement by adopting specific spatial measurements. But this document neglects solving of the majority of spatial problems. In this form, the document cannot be sufficiently implemented by land use planning and by various sector policies that have direct or indirect impacts on land use.

Damborsky (2007) indicated that a missing spatial plan can be compensated by integrating two documents: Regional Development Strategy (RDS) and Spatial Development Plan. Based on our research, we came to the conclusion that this is impossible. Present RDS and SDP do not tackle landscape problems as it would be necessary. And it is evident, that there is not any adequate relation between these two documents and the rest of national strategic documents. The result of this is the insufficient landscape planning and management in many areas of the Czech Republic.

Generally, the issue of landscape space is mentioned in the studied documents. But most of the policies cover only some of the spatial landscape problems. As the comparison of strategic and tactical documents shows, the link between strategic and tactical spatial planning is very poor or even missing.

One of the possible solutions could be establishment of national Landscape Policy that would give a strategic framework for dealing with landscapes, and it should be integrated in all sector policies. It should also be a foundation for creation of a national spatial plan.

Acknowledgements:

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Paper IV

Framing fragmentation in strategic policy documents in spatial planning and environmental domains: differences and similarities

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Abstract

Fragmentation is a complex issue and the way it is framed will impact policy decisions. The Czech Republic has adopted several strategic policy documents in spatial planning and environmental domains that address fragmentation. However, these documents differ in how they frame fragmentation. Our goal was to evaluate the differences in 1) framing the problem of fragmentation and 2) suggested solutions. We performed a content analysis of the strategic policy documents by coding text using the key fragmentation aspects – biological organization, land cover, and connectivity. Next, we categorized data either to species-oriented, pattern-oriented, or ecosystem service frames and suggested criteria to evaluate the quality of the framing. This method was useful to show the divergences in the framing of fragmentation as a problem between two policy domains. The results show that the pattern oriented frame and mitigation solutions are the most prominent aspects, and also fragmentation is not well framed.

Keywords: habitat fragmentation, landscape fragmentation, problem framing, policy domain, planning

1. Introduction

Fragmentation is a hierarchically nested and cross-cutting landscape process occurring at various spatial and temporal scales. Many biological and ecological studies focus on the fragmentation process, because it is seen as the chief threat to biodiversity, ecosystem functions and services (Resasco et al., 2017). Fragmentation is a typical example of a complex environmental issue that allows for many perspectives and interpretations (see reviews of Fahrig, 2003; Hadley and Betts, 2016; Haila 2002; Lindenmayer and Fischer, 2007; Mitchell et al., 2015). It has been misused as an umbrella term for human-derived processes negatively altering landscapes (Lindenmayer and Fischer, 2007). In fact, the concept has been applied so broadly (Haila 2002) that the term is now often used as an axiom with no clear definition (Hadley and Betts, 2016).

The concept of "fragmentation" is derived from the Latin word "fragmentum", which means a broken piece, remnant or fragment. It is a physical process of breaking apart land cover patches per se (of either habitat or different vegetation types), where the remaining patches vary in configuration and their connectivity is altered (Fahrig, 2003; Hadley and Betts, 2016). The process of fragmentation has to be differentiated from habitat loss because the consequences are different (Fahrig, 2003; Fischer and Lindenmayer, 2007; Hadley and Betts, 2016; Lindenmayer and Fischer, 2007). The consequences may be either negative or positive if assessed from the perspective of a single species (either animal or plant species), species assemblage or humans (Fahrig, 2017; Mitchell et al., 2015). Clearly, both the broad use of the term fragmentation to refer to various processes altering landscapes, as well as its use to refer to habitat loss, are false interpretations.

In the public policy realm, fragmentation has to be framed as a policy problem to ensure effective, strategic and long-term planned solutions to its consequences (Bennet and Saunders, 2010; Jaeger and Madrinan, 2011; Secretariat of the CBD, 2005). Problem framing entails

the process of telling a story about the environmental conditions that might cause a problem, what should be done about it, and determine the responsibility of various actors (Karlsson-Vinkhuyzen et al., 2017; Nisbet, 2009). The way public institutions frame fragmentation further influences decisions about its integration into the policy agenda, the selection of policy instruments to address it (e.g. adoption of legislation, allocation of financial tools), as well as the setting of solutions and responsibilities (Ebbin, 2011; Haug et al., 2010; Loomis and Helfand 2003).

Institutions from various policy domains frame policy problems differently, because they adhere to different values, have other interests and work with different types of information, which may finally influence their perspective about fragmentation. As a consequence, institutions provide various formal frames that can be identified in the written policy documents they adopt (Moschitz, 2018). Solutions to address fragmentation may differ according to how fragmentation is framed as a problem by the various institutions. Thus, it is important to know how policy documents frame fragmentation as a problem.

Spatial planning and environmental policies are the most appropriate for addressing fragmentation, because they may directly define and support practices to prevent fragmentation, improve connectivity of fragmented land cover, and identify areas that should be protected against fragmentation (Kettunen et al., 2007). Strategic spatial planning and environmental policy documents are of interest, because they provide the frames for policies on lower levels (Loorbach, 2010), formulate statements and define strategic policy solutions for the prevention of unexpected and undesirable future events (Daugbjerg et al., 2009; Veselý and Nekola, 2007). To address the pressing effects of fragmentation with policies, they should propose region-specific solutions (Haila 2002), which are adapted to the magnitude of fragmentation (McIntyre and Hobbs, 1999), focus on the protection of non-fragmented areas, connectivity restoration and fragmentation monitoring (Jaeger and Madrinan, 2011). So far, the

importance of framing fragmentation in strategic policy documents for the formulation of appropriate solutions has been poorly explored.

The Czech Republic is suitable for studying how fragmentation has been framed in policy documents. Since the country joined the EU in 2004, increasing attention has been paid to the process of fragmentation in the context of European environmental policy. Several strategic environmental and spatial planning policy documents were adopted at the national and regional levels in order to define the problem and propose solutions to the various environmental issues directly linked to fragmentation (Semančíková, Dvořáková-Líšková, and Holcová 2008). Despite policy integration advancements, fragmentation remains an important issue, as half of the country's total area is highly fragmented compared to other European regions, i.e. the effective mesh density in most Czech NUTS 3 regions is above 20 meshes per 1000 km2 (EEA, 2011). A further decline of 11% in the so far non-fragmented areas is expected by 2040 (CENIA, 2013).

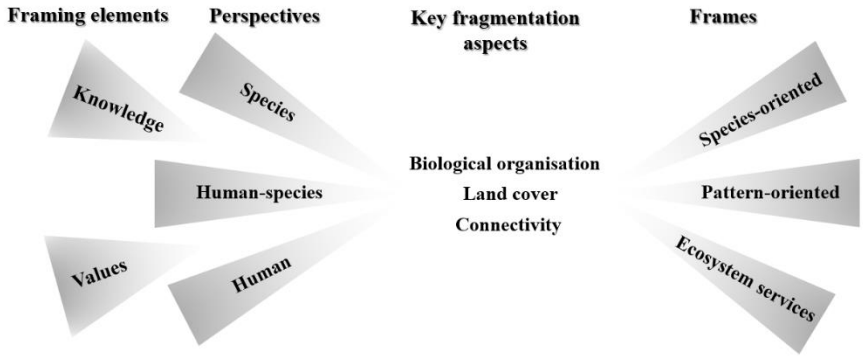

Figure 1. The key fragmentation aspects viewed from different perspectives refer to different knowledge, values and results to different frames.

The aim of this study was to determine how these strategic environmental and spatial planning documents frame fragmentation, using the Czech Republic as an example. We thus addressed the following questions:

- What are the differences and similarities in framing fragmentation in the strategic documents within the spatial planning and environmental policy domains?
- What types of solutions are promoted by the spatial planning and environmental policy domains?

To answer these questions, we used content analysis of policy documents adopted within the two policy domains. In the next section, we present a theoretical framework for assessing fragmentation framing; in section two we present the methodology used in the analysis; the results are given in section three; in section four we discuss the challenges of framing fragmentation; and section five provides some final conclusions.

1.1 Theoretical framework for assessing fragmentation-framing

In the text below, we propose a theoretical framework for assessing frames by building on previous studies by Lindenmayer and Fischer (2007), Fischer and Lindenmayer (2007), and Mitchell *et al.* (2015). We propose three different frames of fragmentation: a species-oriented frame, a pattern-oriented frame and an ecosystem-service frame (Figure 1). These three frames represent a unique combination of 1) knowledge and values, 2) perspective on humans and/or species, and 3) focus on fragmentation aspects (Figure 1). The various frames emerge depending on the amount and type of knowledge and values, and seeing the key fragmentation aspects from different perspectives.

The knowledge and values represent framing elements that influence the various perspectives on fragmentation aspects (Figure 1). These two elements were proposed by Knaggård (2015) as key ingredients

of problem framing and are used here to address the quality of framing. Knowledge, i.e. knowledge about the state of the problem and identification of its causes, is seen as the most important element for framing (Bardwell, 1991; Knaggård, 2015) and for decision makers to decide on solutions (Michaels, 2009). In the context of framing fragmentation as a policy problem, knowledge comes from scientific research or personal or institutional experience about, for example, the type, magnitude and causes of fragmentation and its consequences.

Values are linked to explanations regarding why we should care about a problem, what is threatened, what should be protected, and who is responsible for formulating solutions (Knaggård, 2015). Therefore, values are associated with motivations for action. In the context of framing fragmentation, values refer to the consequences related to various fragmentation aspects, to statements about what should be done to deal with the consequences, and the actors responsible for solutions (either people or institutions).

Values can be either eco-centric or anthropocentric (Karlsson-Vinkhuyzen et al., 2017); together with available knowledge, they are closely related to various perspectives about the fragmentation aspects which give rise to the various frames (Figure 1). Eco-centric values derive from species or human-species perspectives. The species perspective is determined from how non-human species perceive their environment, and is based on scientific knowledge related to metapopulational theory. Meanwhile, the human-species perspective is based on human suggestions about species needs, and it is based on scientific knowledge related to island/biogeographic theory. Anthropocentric values derive from a purely human-centered perspective, which focuses solely on human needs. Therefore, this perspective is closely related to the ecosystem services concept.

Biological organization, land cover, and connectivity are the key aspects influenced by fragmentation (Lindenmayer and Fischer 2007;

Fischer and Lindenmayer 2007); how these aspects are presented depends on the knowledge, values and perspectives of different people or institutions. Biological organization refers to a single species, a species assemblage or humans (Lindenmayer and Fischer, 2007; Mitchell et al., 2015). Their dispersal, abundance, richness, or even extinction events, are influenced by the size, connectivity and also the quality of land cover patches (Deák et al., 2018; Donaldson, Wilson, and Maclean 2017). We distinguish two types of land cover: 1) "habitat" which is an area of suitable living conditions and resources for a single species, and has to be differentiated from 2) vegetation types delineated based on the composition of either native or human-modified vegetation (Hadley and Betts, 2016). For the purposes of this paper, we call this latter type "human-designated patches of land cover". If fragmentation is understood as being the process of breaking apart patches of land cover per se, independent of their loss, then the former type of land cover "habitat" refers to the concept of habitat fragmentation, while the latter "human-designated patches of land cover" refers to the concept of landscape fragmentation, i.e. the human perception of fragmentation and degradation of natural or semi-natural areas (Di Giulio, Holderegger, and Tobias 2009). It is important to distinguish between habitat fragmentation and fragmentation of human-designated patches of land cover, because some species may survive in patches of native or human-modified vegetation (Lindenmayer and Fischer, 2007). The connectivity aspect refers to linkages between patches of the same or similar land cover, which may be isolated due to fragmentation. A larger degree of connectedness, both for structural and functional connectivity, increases the movement of biological organizations and counteracts biodiversity loss (Baguette and Van Dyck, 2007; Lindenmayer and Fischer, 2007). Structural connectivity entails information on the spatial configuration of human-designated patches of land cover across a landscape and facilitates movement of species assemblage or humans. Nevertheless, the perception of a landscape is strongly species specific;

thus we cannot provide an ultimate score for landscape fragmentation, which would be valid for all species. The level of fragmentation in a certain landscape should be evaluated on the level of different taxa or species given their strongly differing habitat preferences. Thus, functional connectivity is important, as it refers to the real movement of a single species within a habitat (Uezu, Metzger, and Vielliard 2005) and is generally considered to be more important than structural connectivity, because it incorporates information on how organism behavior is affected by changes in landscape structure.

Different frames arise based on the knowledge, values and perspectives of the particular people or institutions involved as well as the fragmentation aspects of the habitat in question (Figure 1). The species-oriented frame is based on population biology and corresponds to knowledge regarding a species perspective of the fragmented patches of habitat cover, which provide them with resources and living conditions (Lindenmayer and Fischer, 2007). This frame corresponds to the functional connectivity of habitat patches and the real movement of animal or plant species in both space and time (Auffret, Plue, and Cousins 2015; Zetterberg, Mörtberg, and Balfors 2010). Values, i.e. why we should care and what is threatened, are focused on the single species, habitat degradation, their sub-division, isolation, or functional connectivity. Second, the pattern-oriented frame is based on landscape ecology and corresponds to knowledge in terms of an interrelated human-species perspective on species assemblage needs in fragmented landscapes. This frame corresponds to human-designated patches of native vegetation and structural connectivity. Values would focus on the spatial pattern of patches of native vegetation and their connectivity under the assumption that increased connectedness improves the living conditions for the species assemblage. The final frame, as its name suggests, is based on ecosystem services, i.e. the benefits that humans gain from the natural environment. In the context of fragmentation, this frame focuses on patches of human-

modified vegetation, and their connectivity by infrastructure (Mitchell et al., 2015). The aim would be to improve ecosystem services as well as human well-being and human movement through the landscape. Concepts and statements associated with the three frames are summarized in Table 1, while examples are given in chapter 2.3.

Table 8: Frames and their associated concepts.

	Species-oriented frame	Pattern-oriented frame	Ecosystem services frame
Perspective:	Species	Human-species	Human
Key fragmentation aspects:			
• Biological organization	Single species	Species assemblage	Human
• Land cover	Habitat fragmentation, i.e. fragmentation of patches of habitat	Landscape fragmentation, i.e. fragmentation of human-designated patches of land cover (native vegetation cover)	Landscape fragmentation, i.e. fragmentation of human-designated patches of land cover (human-modified vegetation cover)
• Connectivity	Functional, i.e. connectivity of habitats to facilitate movement of single species	Structural, i.e. connectivity of patches of native vegetation cover to facilitate movement of species assemblage	Connectivity to facilitate movement of humans

2. Methods

The methods section is divided into four subsections: 2.1. the selection of strategic policy documents, 2.2. the content analysis of the documents, 2.3. methods to assess the differences and similarities in framing fragmentation (Question 1), and 2.4. methods to assess the types of solutions in environmental and spatial planning policy domains (Question 2).

2.1 Selection of strategic documents in environmental and spatial planning policy domains

To analyze the differences and similarities in how fragmentation is framed in strategic documents within the spatial planning and environmental policy domains, we searched for strategic documents that were in force when the analysis was conducted (i.e. 2014-2015) and which addressed fragmentation. A total of 11 strategic documents were selected for analysis of the fragmentation frames, representing policy documents issued by institutions in the environmental (three documents) and spatial planning policy domains (eight documents). The documents were adopted between 2005 and 2015 (Figure 2) and represented all available national strategic documents in both policy domains and half of the Regional Development Plans (RDPs). The seven RDPs were randomly chosen out of the 14 RDPs in the Czech Republic.

The environmental policy domain documents (further referred to as environmental documents) are the National Environmental Policy (NEP), the National Strategy on Biological Diversity (NSBD), and the National Program for Nature and Landscape Protection (NPNLP). They are the most important environmental policy documents adopted at the national level in the Czech Republic and describe environmental quality, identify threats and provide solutions. The documents are mandatory, meaning that they

are not legally binding but should be considered in the process of sectoral planning.

The documents in the spatial planning policy domain (further referred to as spatial planning documents) included the National Planning Policy (NPP) (MoRD, 2015) and Regional Development Plans (RDPs). The NPP is the most important spatial planning document in the Czech Republic. In contrast to the mandatory environmental documents, the NPP provides legally binding guidelines for the RDPs, i.e. the RDPs have to be consistent with the NPP (the Parliament of the Czech Republic 2006). The RDPs create the preconditions for regional sustainable development, specify and develop the objectives and tasks given in the NPP, determine strategies and coordinate the planning activities of municipalities on the local level. The spatial planning documents are legally binding for municipalities and land owners according to Act 183/2006 Coll. (the Parliament of the Czech Republic 2006). Figure 2 shows the studied documents as well as their interrelationships.

2.2 Content analysis

In order to understand the differences and similarities in how fragmentation is framed in the spatial planning and environmental policy domains, a content analysis was conducted using thematic framework analysis (Ritchie and Lewis, 2003). First, we searched the documents for sentences and paragraphs (called data) regarding the concepts associated with fragmentation and the key fragmentation aspects (Table 1). Second, the data were labeled and coded in terms of the three key fragmentation aspects: 1) biological organization, 2) land cover, and 3) connectivity. These data formed the basis for addressing our research questions.

2.3 Assessing differences and similarities in framing fragmentation

We compared the coded data with the statements in Table 1, and assessed their perspective in order to identify the frames and assess their presence in the two policy domains. For example, data addressing habitat fragmentation (often focusing on wetlands or water streams) or the functional connectivity of habitats to facilitate species movement represented a species perspective and were categorized into the species-oriented frame. Data addressing structural connectivity, i.e. connectivity of human-designated patches of native vegetation cover, and data formulated as "movement of species assemblage", or data generally formulated as "landscape fragmentation" represented the human-species perspective and were categorized into the pattern-oriented frame. Data addressing the connectivity of human-designated patches of land cover to facilitate recreation and human movement provided a human perspective and were categorized into the ecosystem services frame.

The presence of the frames in the two policy domains were quantified and standardized similarly as Kusmanoff et al. (2016). For example, we found 54 data in the environmental policy domain, of which 22 were assigned to the species-oriented frame, 29 to the pattern-oriented frame, and three to the ecosystem services frame. These were then standardized by calculating their percentages, i.e. (22/54)*100 (i.e. 40,7%), (29/54)*100 (i.e. 53,7%), and (3/54)*100 (i.e. 5,6%), respectively, giving a total sum of 100% within each policy domain.

Next, we assessed the quality of the framing, i.e. how well the documents frame fragmentation in the two policy domains. To do this, operational definitions of knowledge and value were developed based on four and two criteria, respectively (Table 2). The data were then categorized regarding knowledge, value, and their operational criteria and the fulfilled criteria were counted up. Finally, the differences between the

two policy domains were compared. The quality of framing was assessed as high if all the criteria were fulfilled.

2.4 Assessing the type of solutions proposed by the spatial planning and environmental policy domains

The data were searched for proposed solutions, derived as goals and measures proposed in each document, with these solutions assigned to one of three types - mitigation, avoidance, compensation (Iuell et al., 2003). Mitigation refers to reducing fragmentation to acceptable levels, implying adoption and implementation of certain solutions (e.g. construction of wildlife passages) that help to enhance the movement of species and/or humans. Data generally referring to "minimize fragmentation" were categorized as mitigation. Avoidance concerns the protection of a habitat or human-designated patches of land cover to prevent fragmentation, thereby increasing the sustainability of any functions. Compensation refers to establishing functional or structural connected habitats or patches of native vegetation cover to replace lost connections (Table 2). In the Czech Republic, for example, functional connectivity is addressed in the studied documents by a functional network of significant migration areas, long distance migration corridors, and migration routes for large mammals, i.e. deer, bear, lynx, or moose (Anděl , Mináriková, and Andreas 2010), while structural connectivity is presented in the studied documents as the Territorial System of Ecological Stability (TSES) which addresses spatial connected networks of human-designated patches of native vegetation cover understood as important for ecological stability (Kubeš, 1996; Mackovčin, 2000). We categorized the solutions addressing TSES as compensation solutions even if the designated patches of native vegetation cover are protected against building development, but not against transportation infrastructure. The preference for the different types of solutions in the two policy domains were assessed by calculating the percentage of each type of solution within the two policy domains.

Table 9: Framing elements and criteria operationalizing them.

Knowledge	Information about the state of the problem is seen as the most important element of framing.
Context	Explanation of the problem of fragmentation and contextual description of land cover patches that are fragmented, as well as the state and development of fragmentation.
Definition	Providing definition of the concept "fragmentation".
Causes	Address the causes of fragmentation.
Localization	Spatially explicit information about magnitude of fragmentation.
Values	Values are linked to explanations regarding why we should care about a problem, what is threatened, what should be protected and also who is responsible for solutions.
Consequences	Address what or who is threatened by fragmentation, as well as why we should care about it.
Responsibility	Institutions, people, etc. responsible for addressing a problem with fragmentation.

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3. Results

3.1 Differences and similarities in framing fragmentation in the strategic documents within the spatial planning- and environmental- policy domains

3.1.1. Frames in the two policy domains

The eleven studied documents within the spatial planning- and environmental- policy domains employ all the three frames, with the greatest being the pattern-oriented frame in both domains (Figure 3). The ecosystem services frame was the second most important frame in the spatial planning policy domain, while the species-oriented frame is marginal. This order is reversed in the environmental policy domain.

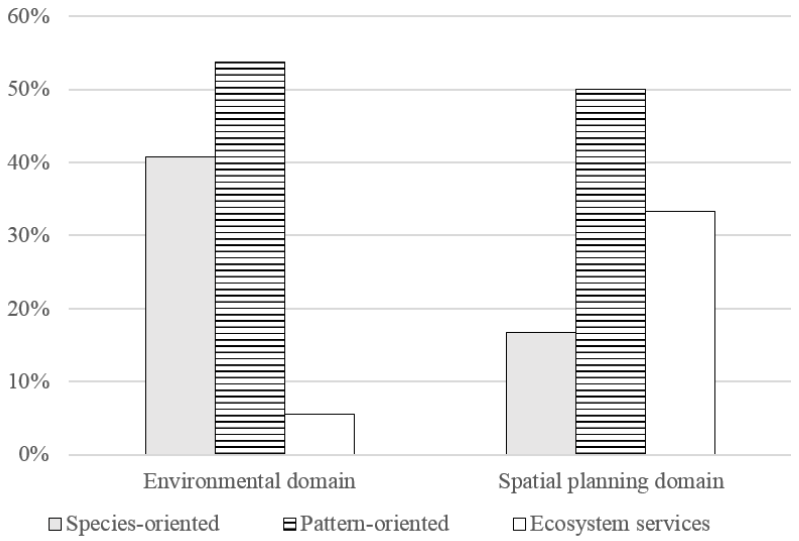

Figure 3. Percentage of the data categorized into the three frames in each policy domain.

3.1.2. Quality of framing

Fragmentation is not well framed in the majority of the studied documents, since many documents address only very few of the outlined knowledge and values operational criteria (Table 3). While the environmental documents address four to five of the six operational criteria, most of the spatial planning documents address, on average, only three of them. The documents in both policy domains refer to criteria causes, consequences and responsibility, but none of the studied documents addresses any information about localization (Table 3).

3.1.2.1. Context. The criterion context is often a part of the introduction sections of the studied documents. All the documents within the environmental policy domain contain an introduction where they provide the context of environmental problems in the Czech Republic and address fragmentation. For example, the National Environmental Policy regards fragmentation as the most serious environmental problem that has to be dealt with in the Czech Republic. On the other hand, most of the studied spatial planning documents do not address the criterion context, but directly formulate solutions.

3.1.2.2. Definition. Only two of the studied documents (National Program for Nature and Landscape Protection, National Strategy on Biological Diversity) address the criterion definition and frame fragmentation as a negative process resulting in the loss of land-cover patches and affecting population viability. The first document defines fragmentation as "a process of dissection of habitat or human-designated patches of land cover, but leading also to loss of these patches", while the second document defines fragmentation as "a process of dissection of continuous landscape by insurmountable barriers that results in low connectivity and isolation of populations that consequently become less viable".

3.1.2.3. Causes. The possible causes of fragmentation are identified in all documents (Table 3). In the introductions, the environmental

documents frame the problem of fragmentation as a complex problem with a broad range of causes, including transport infrastructure, urbanization, water management structures, power plants, tourism, fencing, and agriculture and forestry intensification, all of which have negative impacts. However, the proposed solutions to deal with these causes are connected with transport infrastructure (roads, highways), water management structures (weirs), and urbanization (see below). Urbanization is addressed within the pattern-oriented and ecosystem services frames within both policy domains. Nevertheless, the two policy domains differ in their preference for solutions connected with transport infrastructure and water management structures. While the environmental documents address both transport infrastructure, and water management structures by species- and pattern- oriented frames, the spatial planning documents address transport infrastructure by all the three frames and water management structures only by species-oriented frame.

3.1.2.4. Consequences. The documents within both policy domains do not frame the "consequences" of fragmentation as species- or habitat-specific, but only as general statements. The documents refer to consequences either directly as "what the consequences are" (environmental domain only) or through formulation of solutions (both domains). For example, within the species-oriented frame, the environmental documents refer generally to habitat degradation, decreasing functional connectivity of fragmented habitats, and negative alterations to species populations, or specifically to pollinators, water species, fishes, birds, or big mammals, while the spatial planning documents refer only generally to decreasing functional connectivity of water streams and negative effects on the movement of big mammals due to transportation infrastructure. The pattern-oriented frame in the environmental documents refers generally to landscape fragmentation and its negative impact on landscape ecological stability, or mortality of species assemblage, while spatial planning documents address in general

"landscape fragmentation", or movement of species assemblages, or humans. On the other hand, the ecosystem services frame in the spatial planning domain is specific regarding short-term recreation services and connectivity to facilitate movement of humans through traffic networks, while the environmental documents address human well-being in this frame.

3.1.2.5. Responsibility. The responsibility criterion varies between the two policy domains. The environmental documents ascribe responsibility to sectoral policies or institutions, and stress the significance of spatial planning on dealing with fragmentation, even if they are not specific in terms of solutions. On the other hand, the spatial planning documents delegate responsibility to regional and local spatial planning authorities according to the Act 183/2006 Coll.

3.2 Solutions in the environmental and spatial planning policy domains

The two policy domains do not differ in terms of the types of proposed solutions. Mitigation solutions are the most prominent in both the environmental and spatial planning domains (76 and 68%, respectively), while compensation and avoidance solutions are addressed only seldomly (Figure 4). The mitigation solutions are formulated often to target improvement of functional connectivity of streams, improvement of structural connectivity to facilitate movement of humans by construction of missing links in road networks/ movement of species assemblages through barriers represented by traffic infrastructure, or the mitigation solutions are formulated as general statements to "mitigate or minimize" habitat or landscape fragmentation. The compensation solutions address establishment of either functional or structural connectivity in which the latter prevails. For example, the environmental documents formulate solutions addressing functional connectivity as "within the spatial planning process, protect areas where significant migration areas, long distance

migration corridors, and migration routes for large mammals are planned to be established". The solutions addressing structural connectivity are formulated by most of the documents as "establish the TSES". The spatial planning documents also formulated solutions to connect patches of land cover, i.e. green belts around urbanized areas to facilitate human movement.

Avoidance is the least preferred solution in both domains (Figure 4). Two avoidance solutions are identified in the environmental documents. The first addresses the necessity of protecting existing habitats and migration corridors that sustain functional connectivity for big mammals, a solution which overlaps with the compensation solution, while the second solution addresses the necessity of protecting natural areas against fragmentation when building traffic infrastructure. While the first solution is not offered within the spatial planning policy domain, the latter solution is integrated into one RDP. The other avoidance solutions within the spatial planning policy domain address protection of human-designated patches of land cover near urban areas to sustain human well-being and movement.

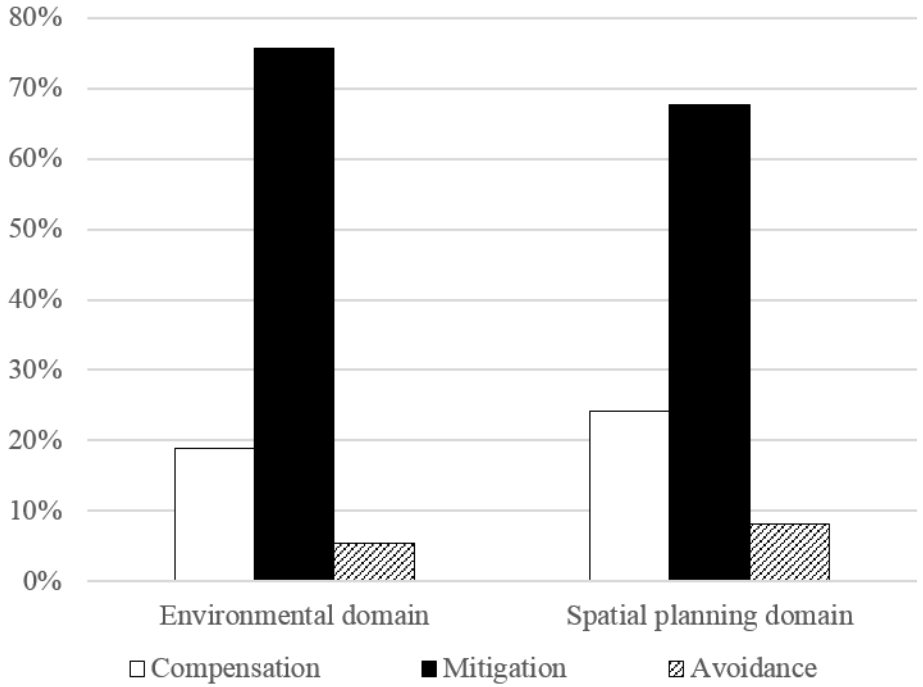

Figure 4. Percentage of the data categorized as types of solutions per each policy domain.

4. Discussion

Framing fragmentation as a policy problem is desirable (Anděl et al., 2009), although it is a challenge, because complex issues such as fragmentation are hard to grasp by policies considering that policies are influenced and shaped by different knowledge and values, not only by scientific research (Pullin et al., 2009; Veselý and Nekola, 2007). Our study shows differences and similarities in how fragmentation is framed and the types of proposed solutions to deal with fragmentation in the strategic documents within the spatial planning- and environmental- policy domains. Both policy domains employ species-oriented, pattern-oriented, and ecosystem services frames and mention mitigation, compensation and avoidance solutions. However, the domains differ in the prevalence of the frames, their quality, and preferred solutions.

4.1 *Differences* and similarities in framing fragmentation

We observed a dominance of the pattern-oriented frame in the strategic policy documents in both policy domains in the Czech Republic. There may be several reasons for this similarity in how fragmentation is framed. First, most of the studied policy documents address structural connectivity, i.e. connectivity of human-designated patches of native vegetation, rather than the functional connectivity of habitats. This is likely due to the fact that planning of structural connectivity, presented in the Czech Republic under the TSES concept, has a long tradition in policy and legislation (Kubeš, 1996), being supported by the Act on Nature and Landscape Protection, No. 114/1992 (the Czech National Council 1992), and the Act on Spatial Planning, No. 183/2006 (the Parliament of the Czech Republic 2006). The situation in Slovakia is very similar to that in the Czech Republic, where structural connectivity is also supported by legislation (Izakovičová and Świąder 2017), or for example, in the Netherlands (Van Der Windt and

Swart 2008). Functional connectivity is supported by legislation, for example, in England, Northern Ireland, Scotland and Wales (Kettunen et al., 2007). Nevertheless, low support for functional connectivity is evident in many other European strategies and spatial planning documents (Brajanoska et al., 2009; Grădinaru and Hersperger, 2018). Second, the emphasis on the pattern-oriented frame may be due to the general formulation of statements addressing fragmentation, which is evident in both policy domains. In this case, most of the data are framed generally as "minimize fragmentation", i.e. they are neither species- nor habitat-specific. Turnhout, Hisschemöller, and Eijsackers (2008) pointed out that using general statements signals a low awareness of environmental policies and a tendency to use vague concepts. Vague concepts are easily accepted because they are flexible so to be used by people with different backgrounds, including politicians, scientists, as well as practitioners (Van Der Windt and Swart 2008). Third, the species-oriented frame needs to be supported by scientific knowledge about species-specific demands on habitat patches, their size, quality and connectivity, either in space and time (Auffret, Plue, and Cousins 2015; Uezu, Metzger, and Vielliard 2005; Zetterberg, Mörtberg, and Balfors 2010) and this information has to be well framed for policy and management purposes. The low support for functional connectivity in policy documents points to its challenging integration in policy documents, because scientists need to better address the importance of different land-cover patches for movement of single species, and develop better mathematical models for assessing functional connectivity (Zetterberg, Mörtberg, and Balfors 2010). Policy documents have to find balance between all the studied frames (i.e. both the functional and structural connectivity) in context of the whole landscape with respect to specific animal and plant species that may prioritize either structural or functional connectivity (Auffret, Plue, and Cousins 2015; Uezu, Metzger, and Vielliard 2005; Zetterberg, Mörtberg, and Balfors 2010).

The fact that the species-oriented frame is employed more by the environmental policy domain while the ecosystem services frame is a more common feature of the spatial planning policy domain can be explained by the interest orientation of the policy institutions within these policy domains. This difference could reflect a focus on different values, respectively eco-centric ones in the case of the environmental domain and an anthropocentric values in the case of the spatial planning domain. While the environmental documents focus on environmental quality and species needs, for example their viability, abundance, diversity, movement facilities, etc., the spatial planning documents focus on human needs and prioritize human well-being, for example infrastructure development, housing, recreation, etc.

Our assessment of the quality of framing shows differences between the spatial planning and environmental policy domains, in which the spatial planning documents fulfill only a few of the operational criteria of the framing elements. The above-described tendency to formulate general statements addressing fragmentation lends credence to the view that the problem of fragmentation is not well framed, especially within the spatial planning documents. The spatial planning documents do not describe the context, do not provide any definition of fragmentation, nor provide information about the local magnitude of fragmentation. They reduce the complexity of the problem of fragmentation by noting only a few causes, and neglect species-specific consequences and solutions. This missing of operational criteria in the strategic policy documents signals a low institutional knowledge about fragmentation. The low quality of the frames, together with using general formulations, means that fragmentation is understood as something like an axiom, which might be counterproductive when looking for solutions. Nevertheless, differences between policy domains in framing environmental issues have been identified in Europe. For example, Niţă et al. (2015) highlighted the differences in the use of landscape concepts by Romanian and Swiss

experts in conducting Environmental Impact Assessments. Good environmental framing has to be supported by well-defined concepts, communications between scientists and non-scientists, as well as relevant knowledge and values (Van Der Windt and Swart 2008).

4.2 *Unbalanced proposal for mitigation, avoidance and compensation solutions to fragmentation*

Protection of valuable non-fragmented habitats and connectivity restoration are important for mitigating and adapting to fragmentation (Donaldson, Wilson, and Maclean 2017). Thus, we expected a balance between all the three solution types - avoidance, compensation and mitigation. However, mitigation is the most common type of solution in the strategic policy documents in both the spatial planning and environmental policy domains, while the compensation, and especially avoidance, solutions are under-represented. This bias towards mitigation solutions may be due to a) a focus of solutions on the movement of biological organizations through insurmountable barriers created by human activities that cause fragmentation, and b) the formulation of general solutions, for example "minimize fragmentation". Moreover, this focus on mitigation can be interpreted as a result of policy makers seeing fragmentation of habitats and landscapes as a somewhat obvious consequence of infrastructure development (e.g. of roads). Thus, policy documents focus on mitigation solutions that will remedy the negative consequences. Avoidance and compensation solutions are important as they focus on the protection and establishment of valuable non-fragmented structural or functional patches of native vegetation or habitats, and should thus be prioritized (Jaeger and Madrinan, 2011) within a policy document. However, these solutions are rarely formulated in policy documents, likely because of their possible conflict with human demands on land (Donaldson, Wilson, and Maclean 2017), and that the establishment and management of new patches are quite time, land and cost demanding. Thus, support of avoidance and

compensation solutions may be a challenge for spatial planning. To support these solutions, policy institutions have to better frame fragmentation and be specific in formulating solutions within strategic policy documents.

Although the presence of remedy solutions in the Czech strategic documents is a positive trend that denotes an increasing interest in fragmentation, as compared to previous decades (Semančíková, Dvořáková-Líšková, and Holcová 2008), the documents do not address limits for fragmentation (e.g. maximal acceptable thresholds). Thus, we do not know which landscapes are overly fragmented and what is acceptable from the strategies, although the European Environmental Agency provides an indicator for assessing landscape fragmentation at the NUTS level. For example, in Germany, the German Federal Environmental Agency monitors fragmentation and defines limits for fragmentation that are used in landscape planning (Jaeger et al. 2008). On the other hand, although indicators for assessing landscape fragmentation are recognized between experts, their use for landscape planning and environmental impact assessment is still rather challenging (Jaeger et al. 2008; Niţă et al. 2015).

Our study shows that institutions from both policy domains frame fragmentation as a negative environmental policy problem, which is framed from various perspectives and focuses on different aspects. Nevertheless, the quality of framing is crucial for formulating species-specific and spatially explicit solutions.

5. Conclusions

Our study shows that fragmentation is a broad and complex issue related to a variety of driving factors, consequences, and solutions. Fragmentation is framed as a policy issue within both the spatial planning and environmental policy domains. However, considerable gaps are evident in relation to the framing of fragmentation within the policy domains. The results show that strategic documents tend to handle the complexity of the fragmentation

problem by using general statements and formulating general goals. This conclusion is supported by 1) the fact that pattern-oriented frame and mitigation solutions are the most prominent, and 2) the low quality in framing fragmentation in most of the studied documents. We expect similar results to be found in other countries, as the experts involved in policy making can have different backgrounds and knowledge of landscape concepts. Based on our results, we recommend better framing of fragmentation in strategic policy documents, based on well-defined concepts and transdisciplinary communication among scientists, politicians and practitioners. Policy documents must better address the knowledge and values for improving the quality of framing fragmentation. Providing a definition of fragmentation, a contextual description of the state and development of fragmentation, spatially explicit information about the magnitude of fragmentation, causes related to its consequences, and information about responsible institutions, authorities, etc. should help to formulate specific and spatially explicit solutions. For example, the European Union, through Agri-Environmental schemes, provides subsidies supporting the maintenance of landscape features, conservation of high-value habitats and establishment of small semi-natural habitats (e.g. road verges, hedgerows) that can effectively mitigate the negative consequences of fragmentation. In this case, a clear framing could assure the successful implementation of avoidance and mitigation solutions as well as clarify the specific conditions for offering compensation measures. Furthermore, spatial planning documents, as legal binding documents, need to greatly improve the quality of framing fragmentation, find a balance between the species, human-species and human-perspectives, and address more avoidance and compensation solutions.

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