Europe:
the paradox of landscape change

A case-study based contribution to the understanding of landscape transitions

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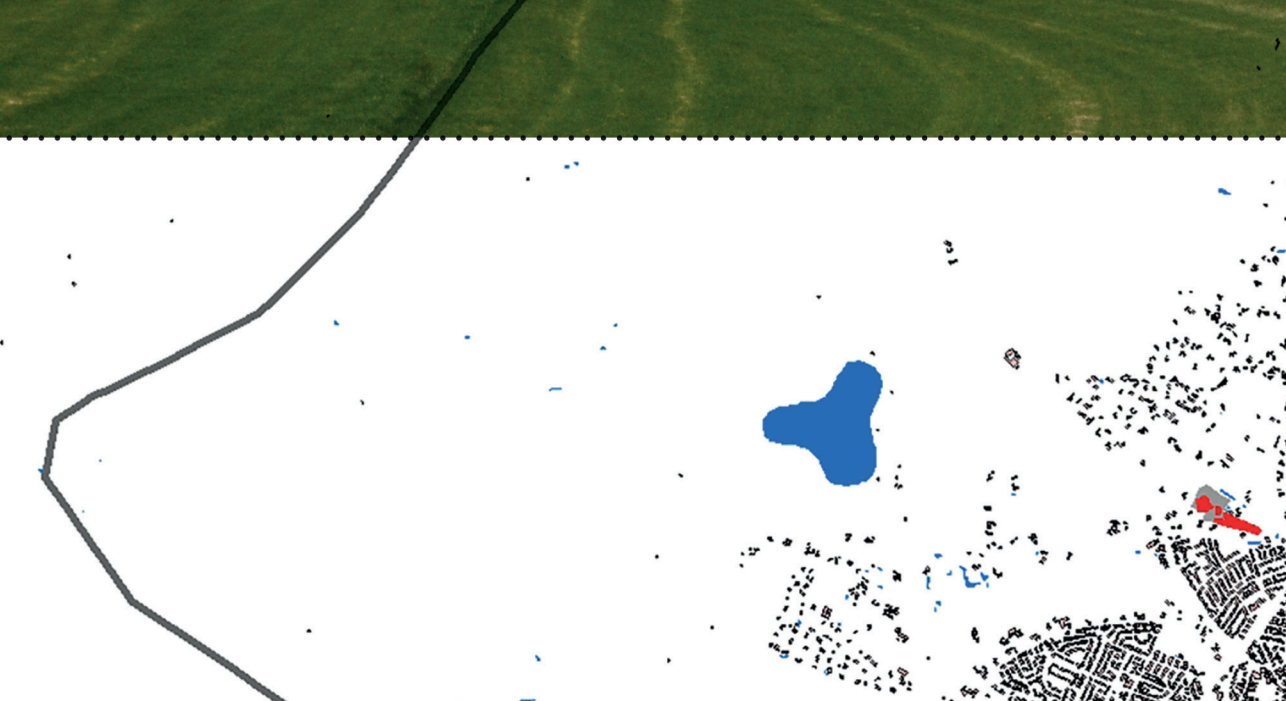
Contents



Chapter 1 General introduction

1.1 Introduction

This thesis explores the processes of change in European rural landscapes. Landscapes have evolved over the millennia as a result of human influence on the physical environment. Europe has a wide variety of landscapes that can alter within a relatively short distance, and which often form part of the national cultural identity of a European country. The landscape is widely appreciated, and some iconic landscapes are even part of the Worlds' Cultural Heritage. Currently, market forces, policies and societal developments that are not directly related to landscape, determine to a large extent the activities that shape the future of it. Landscape management, structure and pattern have changed radically over time. This results in an interesting paradox and forms the basic context of this thesis.

Changing landscape – changing rural population

The European countryside has undergone significant changes over the past centuries. The industrial- and agricultural modernisation of land use has changed almost all aspects of the landscape: the choice of crops, the scale of farming, landscape structure, soil management, and intensity of land use have all changed tremendously. For most farmers, the present-day landscape of Western Europe provides very good conditions for agricultural production.

Changes in landscape and farming have also resulted in a change in rural demographics. The rural population, which previously comprised of mostly farmers, now includes a large proportion of rural residents, employed in diverse sectors that are totally disconnected from farming. Alongside this, industrialisation and reduced employment opportunities in agriculture and forestry have driven an increase in urbanisation. In some regions, this has caused a depopulation of rural areas, and associated problems in maintaining services in the countryside. In parts of Western Europe, this has been followed by 'counter-urbanisation' with urban dwellers settling in the rural areas, introducing new farm functionality and raising the prices for land and farms (OECD 2006; Primdahl et al. 2009). In remote regions in Scandinavia, Southern- and Eastern Europe, economically unproductive farm areas are increasingly abandoned (Beilin et al. 2014), reforested, or included in rewilding for nature values with the creation of nature reserves or parks (Navarro and Pereira 2012), in particular, also in marginal mountainous areas (Lasanta et al. 2017; MacDonald et al. 2000). In some cases, new residents settle in the depopulated areas, but they are often disconnected from the countryside, have different interests, and different views on landscape management, or even landscaping around their house. This has resulted in another change in the countryside with the appearance of striking urban elements (De Vries et al. 2012; Van der Wulp et al. 2009). As well as a proportion of the rural population, recreational users, visitors and the 'conservation community' have observed a loss of landscape

quality and biodiversity value (Antrop 1997). Consequently, polarisation in the countryside has increased, between high-output production spaces on the one hand, and non-economic agricultural land left for multifunctional land-use or to nature, on the other (Pedroli et al. 2016).

A fundamental need to get to grips with landscape change

An overwhelming body of literature discusses landscape multifunctionality and the many benefits associated with it, such as biodiversity or sustainability (see for example: Brandt and Vejre 2003; Brouwer and van der Heide 2012; Galler et al. 2015; Haaland et al. 2011; Rodríguez-Loinaz et al. 2015).

Central to this thesis, however, are insights into the processes of landscape change, along with tools that help realise a multifunctional landscape: *a sustainable, liveable and biodiverse landscape* that can deliver in the long-term *(sustainability)* and with qualities that are appreciated by land users and stakeholders alike (liveability), including life-support for a wide variety of organisms (biodiversity). Maintaining such a landscape is an important challenge with clear implications for all land uses. It is in line with the United Nations (UN)-sustainable development goal 15: *Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss,* and from this target, more specifically: *'by 2020, integrate ecosystem and biodiversity values into national- and local planning, development processes, poverty reduction strategies and accounts'*. There are major competitive forces at play with respect to the productive versus non-productive uses of space. To meet all future demands requires a combination of landscape functions, or multifunctionality. This is in line e.g. with the European Union's Common Agricultural Policy (CAP) that follows the concept of multifunctional agriculture (Haaland et al. 2011), forests (Rodríguez-Loinaz et al. 2015), floodplains and rivers (Schindler et al. 2016). Multifunctionality is a way to efficiently optimise environmental benefits. Measures to conserve biodiversity and for climate change mitigation have generally high multifunctional effects, and are important for dealing with Ecosystem Services trade-offs (Galler et al. 2015). How can we ensure to maintain a multifunctional landscape, with balanced development of food, timber and other production, recreational functions, conservation of heritage and biodiversity and with sufficient aesthetic value? Therefore, one needs to understand the processes and policies of landscape change.

A case-study based contribution to the understanding of landscape change

This thesis addresses this field of interaction, based on a number of case-studies across Europe. As case studies, specific landscapes in Austria, Denmark, Greece, Italy, The Netherlands, Portugal and Romania, appear in the various chapters of the thesis (Figure 1). These case studies represent areas with different levels of rural development, from peri-urban to marginal rural landscapes. They cover the diverse landscapes in Europe: from the Continental and Atlantic regions to the Mediterranean,

and are, therefore, well-suited for illustrating the variety of processes and patterns of land use intensity in Europe.
The thesis describes the major actors of landscape change: farmers, various levels of government, and residents of the countryside. It also describes how changes take place, where these changes lead, and how the actors and landscape interact. Recommendations are formulated for dealing with the increasing demands of society for productive services, while maintaining other qualities for a liveable and biodiverse landscape. Focus is on the period following establishment of a common European market (EEC) in 1965.

Figure 1: Case studies of this thesis.

In this Chapter, the different dimensions of landscape are introduced, as well as the concepts of cultural landscapes and landscape services (Section 2). This is followed in Section 3 by a discussion of landscape change, illustrated by a short historical review of the modernisation and industrialisation of land use, and introducing the drivers of landscape change and landscape governance. Section 4 presents the problem statement, the objective of the thesis and the research questions addressed in the subsequent chapters.

1.2 Landscape

1.2.1 The landscape concept

Antrop (2000) states that: *'In order to understand the actual changes, an integrated approach is needed. Studying single themes or landscape components does not allow understanding the complex processes of urbanisation that affect the rural countryside at even remote places. Integrated analysis should focus upon the continuous interaction between spatial structure and functioning at different hierarchical scale levels.'* Following Antrop, the landscape in this thesis is approached from an integrative viewpoint, which includes aspects of the biophysical, the anthropogenic and the intangible (e.g. spiritual values, performing arts, social practices, outdoor recreation). This approach was also followed by e.g. Naveh (2000), and discussed by Angelstam et al. (2013), as well as Tress and Tress (2001). Antrop (2000) describes the values of the landscape as the *natural framework* (biophysical), the *cultural inheritance*, and the *aesthetical well-feeling*. This touches upon physical and non-physical properties of the landscape. This is confirmed by the European Landscape Convention (ELC), which positions the relation of humankind with the physical environment centrally. The landscape is defined as: *'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). This holistic landscape concept also captures the integration of ecological processes and agricultural or other production functions at spatial scales that encompass land, soil, water, vegetation and associated biodiversity (Antrop 2000; Naveh 2000), involving landscape planners and ecologists, agronomists and rural sociologists.

The landscape can, therefore, be approached from different disciplines. While landscape might have initially resided in the domain of the natural sciences, over time this has expanded to other domains, such as social sciences, arts and humanities. Moreover, the environmental and social challenges that affect the landscape today are global in scope, and of such complexity that a holistic approach is essential to address the environmental questions that we face (Naveh 2000). This concept was further discussed and developed as a transdisciplinary landscape concept, which is rooted in different disciplines and characterised by five dimensions (Tress and Tress 2001):

- landscape as a spatial entity
- landscape as a mental entity
- landscape as a temporal dimension
- landscape as a nexus of nature and culture
- landscape as a complex system

The landscape concept combines all these five dimensions, as discussed below.

Landscape as a spatial entity

The landscape as a spatial entity represents the more traditional physical or geographical approach to considering the landscape. The landscape, described as a region, formed the basis for traditional landscape ecology. The landscape is defined by its environmental conditions, as well as social fabric of land users and population, economic factors, the political and governance system, etc. Determinant environmental conditions are climate, altitude, soil parent material and land-use (Metzger et al. 2005; Mücher et al. 2010). Land use shapes the landscape, and is visible in landscape features, vegetation, and the crops that are grown. Landscape features include the elements that are typical for a landscape, e.g. small coppices that once provided the farm with firewood and timber, or the presence of terrace walls to allow for farming on sloping lands.

Intensification or extensification of agricultural land use results in change in landscape features: hedgerows and ponds may disappear, terrace walls may collapse, typical parcelling patterns can change, and the accompanying flora and fauna will also alter. However, as Tress and Tress (2001) pointed out, this does not mean landscape loss; it leads to a different landscape.

Landscape as a mental entity

The landscape as a mental entity is focused not only on what we see, but on people's perceptions of the landscape. This also includes how people interpret the observed landscape. From this perspective, people not only shape landscape processes (landscape as a spatial entity), they are part of the system, there is a 'co-evolution'. Landscapes develop through people and people are part of it.

As mentioned in the introduction, for the farmer the landscape is his capital, which is modified according to his needs or interests. The farmer or forester sees a landscape and interprets it with regard to its ability to create profit, produce crops or raise animals, the fertility of the soil, the scale of farming (thus, the existing presence of landscape elements, ditches, or terrace walls and potential for more), but also the way in which the landscape has been modified by previous land managers including preceding farmers. This all affects how the farmer regards the landscape, and affects the responding attitude and behaviour towards it.

Rural residents, observing the very same landscape, see this as the immediate environment in which they live. They are likely to have an emotional bond with it. Tourists and artists may see the aesthetic aspects of the landscape in particular. Conservationists note the natural areas and the presence of flora and fauna, and think about the impact of biogeographical and land use changes that occur. The latter also links to the landscape as a spatial entity, which is not static. This underlines that the different dimensions of landscape are inextricably linked and cannot be separated.

Landscape as a temporal dimension

The temporal dimension of landscape not only defines the landscape as a specific area or region, but also recognises that it is subject to ongoing change. The landscape is, therefore, dynamic and space and time are expressions of each other: *'space change through time, and time through space'* (Tress and Tress 2001). Such temporal change is an element of landscape transitions, which differ from landscape change in temporal and spatial scales.

For example, although the scale and pattern of parcels of peat meadow landscape might increase over time, it basically remains a peat meadow. The landscape is continuously (often gradually) changing. Over time, people notice changes, and can be judgemental about this, young people that have not this long-term notion of change may value the landscape differently. A gradual change over time in landscape scale or pattern may affect the way people appreciate the landscape, but this does not necessarily change the landscape, as such. There is continuous change and adjustment of the system.

Landscape as a nexus of nature and culture

Landscape as nexus of nature and culture has a focus on the interaction between nature and culture, as overlapping entities (Antrop 2000). People have made an imprint on the landscape, they have changed the landscape to suit their needs, but the landscape also changes and affects people. This notion is described in some literature, in which the characters that authors, such as Annie Proulx or David Vann include, are collectively and extensively influenced by the landscape that they live in. For example, the harsh and inhospitable landscapes in 'The Shipping News' or 'Caribou Island', that affects their behaviour, their relation with the environment, and how they relate to people. Here, natural sciences, social sciences and humanities meet, and for a better understanding of this landscape, it is important to combine these scientific disciplines.

Landscape as a complex system

The landscape is considered to be a complex system by many authors (Antrop et al. 2013; Sayer et al. 2013; Walker et al. 2006). The different disciplines or ways of viewing the landscape must not be considered in isolation, but rather must be combined. According to Tress and Tress (2001), we can only describe the landscape as a whole by combining the 'subsystems' of observation. The landscape is the result of a long-term interaction between land users and the biophysical system. From this point of view, the landscape can be considered a Social-Ecological System (SES), sensu Folke et al. (2005). Key to social-ecological systems is that systems are complex and a SES is modified and adjusted by humans, to regulate its services. The SES is defined by local processes at the landscape level, and affected by biophysical and socio-economic processes at higher levels (Opdam 2014). The dynamics of a complex SES is defined by its resilience, adaptability, and the transformability of the system (Walker et al. 2006).

1.2.2 Cultural landscapes

Cultural landscapes are the result of the long-term, complex interactions between humans and nature and, thus, embody cultural heritage (Plieninger and Bieling 2012). The cultural landscape includes farmed landscapes, forested landscapes or other important landscapes. Examples are the hedgerow landscapes in The Netherlands, Brittany (France), Southern England and Wales, the terraced vineyards of Cinque Terre (Agnoletti 2012), and landscapes in Southern Europe like Tuscany (Vos and Stortelder 1992), and the Dehesas or Montados in Spain or Portugal (Martinho da Silva 1996; Pedroli et al. 2016; Plieninger 2006). These types of cultural landscapes denote all landscapes modified by human activity (Jones 2003), which differs from UNESCO that defines cultural landscapes as landscapes with highly valued or unique features that are threatened by change or disappearance. Alternatively, the approach of cultural landscape focuses on the intangible values and meanings that people attach to them (Jones 2003; Plieninger et al. 2013). In this thesis, key cultural landscapes are analysed as case studies, in particular Lesvos (Greece) and Portofino (Italy).

1.2.3 Landscape services

Humans are dependent upon ecosystems, and the ability of ecosystems to provide services contribute to our well-being. The Ecosystem Services (ES) are generated by nature and ecosystems, and derived from natural processes and adaptation of the landscape. The Ecosystem Services concept is based on the Millennium Ecosystem Assessment, and these include provisioning, regulating, cultural, and supporting services (MA 2005). Some argue that the theoretical underpinning of Ecosystem Services concept in landscape research is not very explicit (Fagerholm et al. 2012; Termorshuizen and Opdam 2009). For this reason, I refer to 'Landscape Services' in this thesis, which can be defined as the: *'goods and services provided by a landscape to satisfy human needs, directly and indirectly'* (Termorshuizen and Opdam 2009). Landscape Services are confined to services that depend upon landscape patterns and functions. Many Ecosystem Services are produced at the landscape scale (Huntsinger and Oviedo 2014). Landscape services are concrete, they can be spatially identified, some can be quantified, and they are value-based, i.e. they are defined from the viewpoint of the 'user' or beneficiary (Bürgi et al. 2015; Opdam et al. 2015; Termorshuizen and Opdam 2009). For that reason, they are more suited to capture also the 'cultural values' than Ecosystem Services.

Landscape services includes landscape quality and biodiversity, as indirect benefits of the landscape. They include provisioning services (crop-, feed-, livestock- and industrial production), regulating services (water retention, carbon storage), cultural services (tourism, outdoor sport, cultural heritage, hobby farming) (Hornigold et al. 2016) and supporting services and habitat (wildlife habitat) (Brandt and Vejre 2003). Plieninger et al. (2015) indicate that: *'...the knowledge of how cultural ecosystem services influence land use practice remains incomplete and fragmented'*. Following Opdam et al. (2015), they note that cultural ecosystem services in particular tend to affect the well-being of people. Involvement of a range of stakeholders can be

the best way to improve the provision of landscape services, since at the local level, it is best realised how to reconcile different demands for services. Involvement of different stakeholders will lead to more multifunctional land use, whereby aspects, such as landscape quality, biodiversity or other, non-commercial utilitarian functions, will also be taken into account (Plieninger et al. 2015). There has been a lot of study of environmental governance, but landscape governance is relatively new, and the process through which stakeholders can participate in landscape planning and decision-making is largely unexplored. This is one of the key issues that runs as a common thread through this thesis, and, to which I will return in the last synthesis chapter.

1.3 Landscape change

1.3.1 Introduction

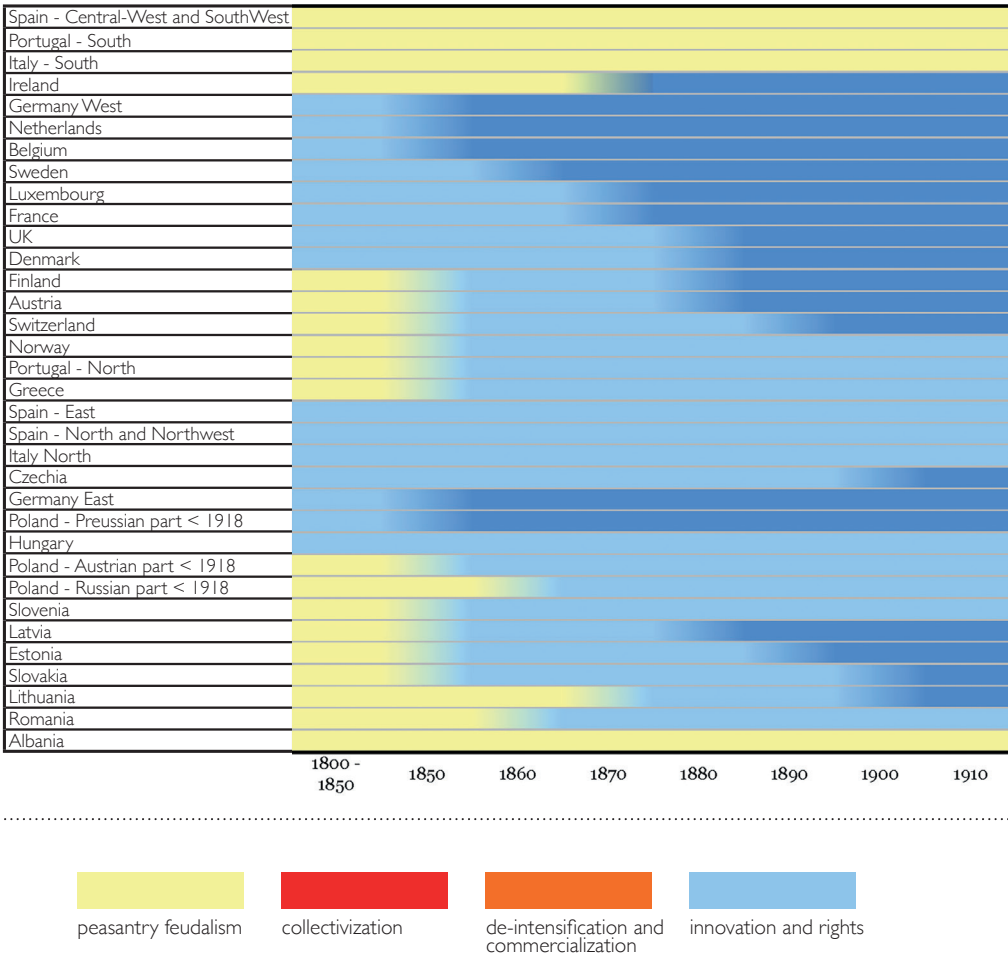
The rural landscape is the result of a long history of human interactions with the natural environment (OECD 2001). Centuries ago rural agrarian economies formed small closed circles with limited inputs and transport over short distances. The entire population took part in the agrarian economy, labour was cheap and locally available (Slicher van Bath 1963; Strijker 2005). The scale of the landscape very much reflected the technical know-how and technology at hand; oxen, horses and donkeys and simple implements resulted in small parcels of extensively tilled fields. The farm often resembled a self-sustained entity, that cared for its own resources. Forested areas formed part of this landscape and were the source of building material, firewood and charcoal, grazing lands (commons and heaths) and other types of feed for livestock.

With limited technological means, farmers from earlier centuries were dependent upon local conditions, soil quality and the distance to markets, nowadays, it seems that all production aspects can be controlled, through high-tech farming and mechanisation, deep tillage, irrigation, import of stock and feeds etc. The farmer modifies the landscape to optimise the production functions. Environmental conditions have become less pivotal in farming, instead the farmer depends upon external inputs, like capital, extension networks, fertilizers and subventions. Modern farming techniques, mechanisation and increased inputs (fertilizers and agrochemicals) have resulted in an environment that delivers high agricultural production, and land management has become industrialised. In more remote or disadvantaged regions of Europe, extensification and marginalisation occurs: forests and farms are no longer maintained, land abandonment is followed by overgrowth, and subsequent damage to infrastructure. This results in a loss of cultural values and a decline in biodiversity (Pedroli et al. 2013; Van der Zanden et al. 2017) with significant consequences for rural populations and community services. This is illustrated in the cases described and analysed in Chapters 2- 6.

1.3.2 Modernisation of the rural landscape

Land management regimes

A study of land use in Europe between 1800 and 2010, described land use regimes in European countries and the tremendous changes that the European countryside went through (Jepsen et al. 2015). From an initial state of feudalism and peasantry in 1800, most countries went through similar phases of land use innovation and industrial and agricultural modernisation (Jepsen et al. 2015). This resulted in an important industrialisation phase, which occurred in most European countries after World War II. The growth of national and European economies resulted in the development of roads and other infrastructure. Farmers increased their impact on the countryside, through intensification and technological innovations, which resulted in larger equipment that offered major advantages in efficiency. Finally, spatial planning developed after the war, which acted as a structural force in the expansion of towns and road networks (Schneeberger et al. 2007).



After the growth in production and change in scale of production processes, a period of increased environmental awareness followed. The increased environmental awareness influenced policies, such as the CAP (MacSharry reforms). It changed consumer behaviour (increased demand for sustainably produced food and products) and the consumer's appreciation of forests and the countryside for recreation.
Eastern European countries typically underwent industrial and agricultural upscaling and intensification (from 1945 onwards). And a phase of de-intensification and commercialisation with some increased environmental awareness followed collapse of the old regime (1989). Figure 2 illustrates the parallels in all these countries, demonstrating that the changes were not isolated national features, but rather part of modernisation processes that occurred at a much larger scale.

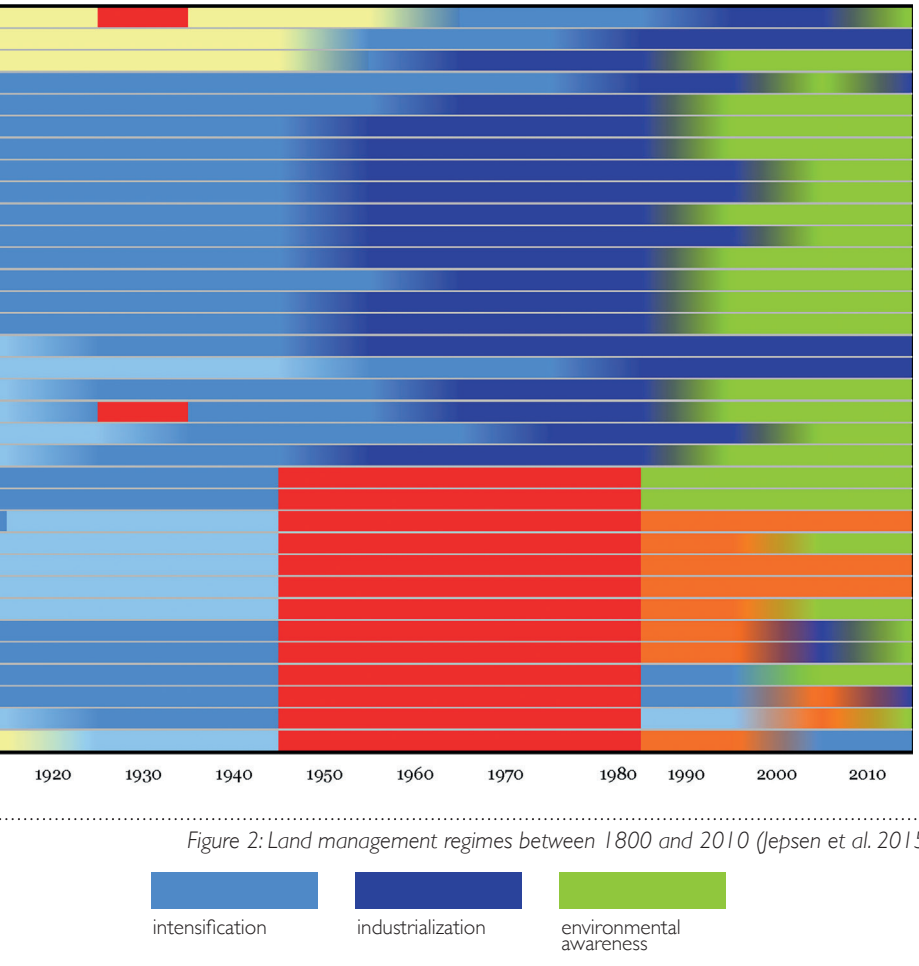


Figure 2: Land management regimes between 1800 and 2010 (Jepsen et al. 2015).

The establishment of the EEC (in 1965) coincided with the industrialisation of land use, in some regions, followed by intensification and increased environmental awareness. The farming sector realised a tremendous increase in production through intensification and technical innovation. Over time, almost all available land in Europe has been converted into productive land at the cost of natural areas (Brussaard et al. 2010). Farming and forestry is the dominant land use in all European countries, and outputs have increased tremendously, as a result of intensified farm management, plantation forestry, large capital inputs, knowledge-intensive farming, and scale enlargement. In contrast, decline in farming in some regions is due to physical limitations, lack of capital or knowledge. In addition, some forest deterioration is due to climate change. In these areas, farming is gradually marginalising or disappearing, while elsewhere intensification takes place (Estel et al. 2016). Intensification and extensification are, thus, key processes in current European landscapes, including within the case study areas.

The intensification or extensification processes (Verburg 2009; Vos and Klijn 2000) affect entire landscapes, landscape identities, landscape characters and biodiversity (Stanners and Bourdeau 1995; Stobbelaar and Pedroli 2011). Agricultural- and forestry expansion often compromise biodiversity, and lead to encroachment of natural areas (Brussaard et al. 2010; Sayer et al. 2013). In general, land use intensification negatively affects environmental quality and biodiversity (Petit and Elbersen 2006).

About production, consumption and protection of landscapes

Wilson (2001) proposes a multidisciplinary approach to assess landscape change beyond the sectoral approaches used so far. The 'post productivist transition' (PPT) provides an understanding: *'...of economic, social and environmental processes that shape the countryside'* (Marsden 1999). PPT defines occupance modes in the field of three major forces: production, consumption and protection (Figure 3) (Wilson 2001). This model may help us to understand the dominant factors that influence decision-making by land users.

However, the PPT focused primarily on the structure of agriculture and associated impacts on landscapes. Realising that in the European context, many other factors contribute to rural landscape dynamics, such as a sometimes densely populated countryside with an active urban-rural exchange, Wilson's framework was extended towards a 'Multifunctional Rural Transition' (MRT). MRT is based on the concept of multifunctionality as an attribute of rural space, and occupancy of land owners. MRT has a focus on societal dynamics, and not on intrinsic landscape values (Holmes 2008; Pinto-Correia et al. 2016b). The framework makes it possible to show how rural areas are positioned towards transition pathways, based on the importance of the driver's consumption, production and conservation.

In many parts of the European countryside, we observe a shift from production (i.e. agriculture, forestry) towards conservation (nature and landscape protection,

forest conservation, wildlife utilisation, rewilding) and/or consumption (residential and recreational purposes) (Figure 3). This marks the current state. It differs widely from the agrarian economy, as described by Slicher van Bath (1963), that we departed from.

The MRT framework is used in this thesis as a reference to explain transitions in the rural landscape, in terms of changing weights attributed to the three main drivers (especially Chapter 4).

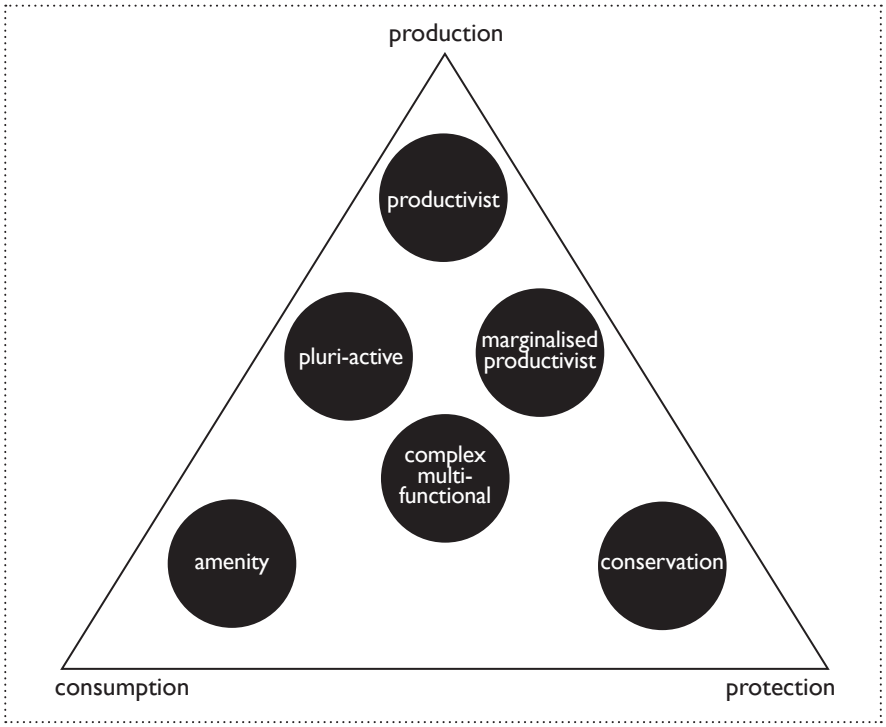


Figure 3: Occupance modes, according to the relative weights given to production, consumption and protection values in the valorisation of rural space (Holmes 2012).

1.3.3 Drivers of landscape change

The landscape is changing in response to environmental, socioeconomic, cultural, technological and political drivers (Bürgi et al. 2004; Primdahl et al. 2013a; Primdahl et al. 2013b; Schneeberger et al. 2007; Veldkamp and Lambin 2001). In addition, governance systems, and how EU policies are implemented in Member States, play a role in regional processes, which lead to differentiation in Europe. Which drivers of change are dominant in landscape change depends upon the location and time, but also on the scale level of observation (from farm to international level). Direct drivers can be natural drivers (floods, storms), or drivers of an anthropogenic origin (such as land degradation, intensification, extensification, unsustainable use, climate change,

species introductions and pollution). Indirect drivers, such as government institutions and their policies, land rights, economic policies, customary rules, international treaties, consumption patterns shape land use. These affect the production assets, which can be infrastructure, but also knowledge, finance, and the (level of) technology.
Basic drivers and policies, which are defined at global- or European levels, indirectly affect the processes at national- and local scales – at which the landscape benefits (services) are also effective. Specific landscape management is often defined by local land managers, farm managers, estate managers or foresters, in response to the drivers of change (Kristensen et al. 2016).
All these drivers have resulted in landscape change, confirming that many policies affect landscape, both intentionally and unintentionally. Chapter 3 illustrates that such developments can also be observed in other cases across Europe.

1.3.4 Landscape governance

The landscape is a complex system that is affected by policies and regulations at various levels. Landscape governance should have a central role in landscape change processes. Governance is defined here as a government's ability to make and enforce rules, and to deliver services (Fukuyama 2013). Governance is about the organisation of processes and steering of all activities (to implement policy). It also refers to new steering mechanisms for social change, the blurring of boundaries between state and civil society resulting in a new division of tasks, and aspects of decentralisation of power (Arnouts and Arts 2009). The EU's land-related policies increasingly dominate national policies: European strategies for rural development steer landscape development through the provision of funds, guaranteed prices for products, setting up markets, development of infrastructure etcetera. These strategies, in combination with local biophysical conditions (soil quality, hydrology, parcel size and access to markets) and the attitude and behaviour of the local land manager, are often decisive in how the land is being developed: the farmer or forester decides on what measures to take, how far production is rationalised and which subsidies he is willing to accept for e.g. agri-environmental schemes. The national- or sometimes sub-national level is where the 'translation' takes place from European policy towards concrete measures and schemes which steer land use development.

Landscape governance struggles to achieve multi-functionality, since policy strategies focus on sectoral aims. '*Reaching any of the visions described above will require policy intervention based on new, integrated policy approaches in support of multiple land use functions*' (Pedroli et al. 2015). This is in line with the 'challenges ahead', identified by the International Association of Landscape Ecology, which advocates for further integrating the concept of landscape and landscape-based approaches among decision-makers in different sectoral policies (Antrop et al. 2013).
Olsson et al. (2004) and Opdam (2014) argue that the wide ranges of spatial and temporal scales in landscape governance can only be addressed with involvement of stakeholders at different scale levels. The management of the landscape towards

public goods provision needs involvement at three scale levels: landscape-oriented management by the land manager (farmer, forester etc); coordination of the land manager's actions at the landscape level; and, conservation of landscape diversity as a public good at EU-level (Lefebvre et al. 2014). In collaborative landscape planning, social-ecological networks can facilitate the planning process in negotiation processes among groups of suppliers and demanders of landscape services (Arts et al. 2017). Aspects of landscape governance are addressed in Chapter 5, which explains how policy implementation affects the landscape, and it is further discussed in the synthesis.

European policies: a largely unrevealed driver of landscape change

European policies have an important direct impact on national- and regional policies. The EU's Common Agricultural Policy (CAP) has arguably been the most influential European policy to affect the landscape (Lefebvre et al. 2014). High production levels resulted from the agricultural prices guaranteed until the 1980s. This has been realised through very intensive farming and land use, abandonment of crop rotations, increasing fertilizer and pesticide use, and strong mechanisation of agricultural practices. Hence, both economic and technological drivers were catalysed by the CAP. This has resulted in a decline of environmental quality (Brussaard et al. 2010; Lefebvre et al. 2014). To counteract the negative impacts of the CAP on the landscape and environment, the MacSharry reforms of the CAP (1992) provided for agri-environmental policies (Buizer et al. 2015), which meant a move away from a policy of price and production support towards direct income aid and rural development, including agri-environment schemes (AES). Sustainability has become an important issue in agricultural management, and regulations, such as the cross-compliance aim for environmental qualities in the countryside, were issued for farm management. Also in the forestry sector, where forest was initially seen as a resource only, sustainability became paramount and ecology and biodiversity gained an important role with the emergence of ecosystem management (Arts 2014; Arts et al. 2013; Christensen et al. 1996).

At the same time, the Habitats Directive (1992) was adopted, which together with the Birds Directive (1982) forms the legal basis for Natura 2000. The establishment of the EU's Natura 2000 network of protected areas has been an important milestone and a turning point in the history of European protected areas (Jones-Walters and Čivić 2013). Natura 2000 is now one of the largest networks of conservation areas worldwide (EEA 2012a). The focus of Natura 2000 is, however, very much directed towards conservation of species and habitats, and also at the protection of 'coherent landscapes', but less so at landscape conservation. Chapter 5 illustrates the compliance issues, and describes how the Habitats Directive is being implemented in different countries of the case studies, how EU-policy relates to the local institutions and what impact this may have on effectiveness of the Directive. This is further discussed in the synthesis.

So, although many policies affect landscape, there is no European landscape policy: landscape is not considered a prerogative of the EU, it is commonly seen as the competence of the Member States. Despite this, the European Commission included in its Rural Development Plan (RDP) 2007-2013 as its second strategic guideline: '*improving the environment and the countryside'.* Landscape is one of the aspects of the territorial dimension of the RDP, and through landscape plans, targeted actions can be taken to improve or maintain landscapes. These landscapes need not necessarily be valuable landscapes, but can also include everyday landscapes and landscapes for restoration. Theoretically, landscape plans should be characterised by a holistic territorial approach, but RDP has a sectorial and less holistic approach in promoting actions for landscape management: '*The overall effect is, however, the result of a large number of individual decisions made by farmers, acting according to an economic rationale, weakly influenced by a territorial one*' (Rega 2014, p. 25).

Under the auspices of the Council of Europe, the European Landscape Convention (ELC) was adopted in Florence in 2000, with currently 40 signatories (ratified by 38). The ELC aims at maintaining landscape quality and to reconcile environmental management with socio-economic development, with a special focus on reconnecting people and communities with place. The ELC aims to mainstream landscape at the European government level, for the benefit of European citizens. Although an official international treaty, the implementation of the ELC depends in practice on voluntary agreements within the Council of Europe.

1.4 Problem statement and knowledge gaps

As stated, the core aim of this thesis is to provide insights into the processes of landscape change and tools towards the realisation of multifunctional landscapes, which can deliver (sustainability) in the long-term, of which the qualities are appreciated by land users and stakeholders alike (liveability) and which support the functioning of a wide variety of organisms (biodiversity).
To summarise the current state of the landscape today, as described in Chapters 2 and 3: agriculture and forestry have shaped the European landscape in deriving food and timber, at the same time, the landscape itself is a widely appreciated good. With the growing population, technological development, and an increased demand for the commodities of food and timber, structural changes have occurred in landscape management, resulting in intensification and specialisation of production in some areas, and marginalisation and abandonment in others. The many externalities of farming in particular have put pressure on the environment, and all processes together have resulted in a tremendous change in the European landscape.

1.4.1 Knowledge gaps

Landscape analysis at the intermediate level

Current literature on landscape change either focuses on large, European-wide assessments of landscape change, or has a focus on detailed landscape studies. European-wide assessment typically uses remote sensing data, global data sets that form a compromise between the presentation of the spatial distribution of the processes at the European level, and the available map scale. For European-wide studies, a grid at a large scale is often used (typically 3x3 km^2 or 10x10 km^2), although the resolution is rapidly improving (Skidmore et al. 2015). Depending upon available imagery, such studies focus on changes during the past decades, usually after 1990.
Commonly used datasets aggregated include: CORINE land cover (CLC) 2000 maps (European Environmental Agency EEA 2013a), LANDSAT, Global Land Cover (GLC) 2000 or MODIS data, such as in the hotspots of landscape change and Land use and Land Cover Survey (LUCAS) statistical data (EUROSTAT 2009). These datasets often lack spatial and temporal resolution (e.g. CORINE has a large minimum mapping unit of 25 hectares) on landscape elements and landscape structure. Another shortcoming is that agricultural abandonment is poorly captured by CORINE (Kuemmerle et al. 2016; Verburg et al. 2009). Regional studies focus on specific landscapes, whereby base maps with a standard level of detail, or sometimes field data are used to analyse the landscape change occurring at micro level (e.g. Gulickx et al. 2013).
The intermediate level, whereby detailed data is used and compared for different regions in Europe, to gain insight into the processes of landscape change forms a gap in current literature. The aim of the thesis is to illustrate, based on the selected cases, the variety of rural conditions in Europe rather than to: *'represent a priori identified typical conditions at either national or European scale.'* (Elands and Wiersum 2003). The approach in which different landscapes are compared with similar baseline data, with additional gathering of supportive evidence of landscape change processes is quite rare (see for examples: Bürgi et al. 2017; Pinto-Correia et al. 2016b).

Effect of policies on landscape

A gap is the lack of detailed knowledge of the effect of policies on the landscape, in particular structural indicators or functional indicators of landscape pattern, landscape structure, and landscape elements in relation to policies (Van der Zanden et al. 2013). Landscape mapping is difficult at continental scales (Mücher et al. 2010), even more so for evaluation of policy. Policies usually have a focus on the direct effects, and non-targeted effects on landscape that are difficult to measure are not well assessed. Major policies, like the CAP or LEADER program have been evaluated based on their effectiveness for farming support (Schuh et al. 2012); typically management indicators are used for impact measurement, such as budget expenditure, hectares paid, number of farmers reached (Masot and Alonso 2017), or impact on ecosystem services (Hauck et al. 2014), but the effects of the CAP on landscape structure or

effects of production subsidies on the maintenance of landscape elements have not been assessed at a European scale. One of the few studies that assessed the impacts of the CAP does acknowledge the different scale level impacts of governance, but does not base itself on empirical landscape data (Lefebvre et al. 2014).
It should be acknowledged that causal relations are hard to define with current methods. It has already been concluded that data-intensive methods based on GIS fail to capture landscape features. Understanding the impact of policies on the landscape is essential to devise strategies for more multifunctional land use.

Bridging the gap of intensification and extensification

Lastly, there is a strong polarisation of land use in Europe: intensification (and scale enlargement) or extensification (and land abandonment) (MA 2005; Plieninger et al. 2016). Both have strong negative effects as described. Is there an alternative for the polarisation? Is there a third way that balances production, consumption and protection? With the place-based approach or 'landscape focus', multifunctional land use should be realised, i.e. a landscape which is sustainable, liveable and biodiverse.
What form should landscape governance take to ensure that stakeholders can partake in this discussion and influence their future landscape? Who is in charge of the landscape? And how can decision-makers be persuaded to invest in a more equitable, sustainable appreciation of nature, landscape and cultural heritage?

1.4.2 Objective of the thesis

This thesis attempts to bridge the identified gaps: gaining a better understanding of changes at landscape level, identifying the role of policies that affect the landscape, and explore the opportunities for multifunctional land use.

The overall objective of this thesis research is, therefore:
To assess the dynamics of landscape change and increase the scientific understanding of the underlying processes and policies that have shaped the rural landscapes of Europe after establishment of the EU.

The insights provided by the thesis should assist in identifying pathways for a rural transition towards more multifunctional landscapes.
The thesis uses an integrated approach to assess the various processes of landscape change: the land use transitions, urbanisation of the countryside, land use intensification and extensification, or land abandonment. The processes are linked to drivers of landscape changes, the role of policies, and how those affect the landscape. These changes affect the landscape spatial structure and, thus, the functioning of the landscape.
The scientific challenge of this research is the combination of local level data with drivers at the European scale, which are translated in different ways due to the various societies and governance systems in Europe.

The case studies introduced in the introductory section are used in the chapters of the thesis. The research combines GIS data, physical data with expert knowledge, which can provide clues of the processes taking place in the countryside, according to the conceptual framework presented in the next section.

1.4.3 Conceptual framework

Humankind is in almost all aspects dependent on the benefits of nature, here defined as the landscape services (see Section 2.3). The availability and access to landscape services define the quality of life, which is highly context-dependent and value-based and contains aspects of food, water, health, education and security (Díaz et al. 2015). This is illustrated by Figure 4, which depicts the conceptual framework for the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). Inspired by this framework, I regard landscape functions as the benefits (goods and services) that landscapes are providing (comparable to link number 8 in Figure 4), while satisfying human demands directly or indirectly (Termorshuizen and Opdam 2009). Through the drivers of change the landscape is affected (comparable to link number 3 in Figure 4). The production assets, with the landscape, will finally define landscapes benefits to people and human well-being. The changing landscape will affect nature's benefits to people, or landscape services, and includes the various benefits, which are important for people's quality of life. Landscape change may alter the services the landscape provides, e.g. production capacity, water retention, biodiversity, aesthetic quality etcetera (Verhagen et al. 2016). Landscape changes can be a result of direct or indirect drivers (see Section 3.3).

Figure 5 illustrates how landscape planning takes place in the social system. This planning happens through actors and institutions, that make interventions in the ecosystem: the governance system. The ecosystem elements are changed through these interventions, and this provides ecosystem services, which may improve human well-being.

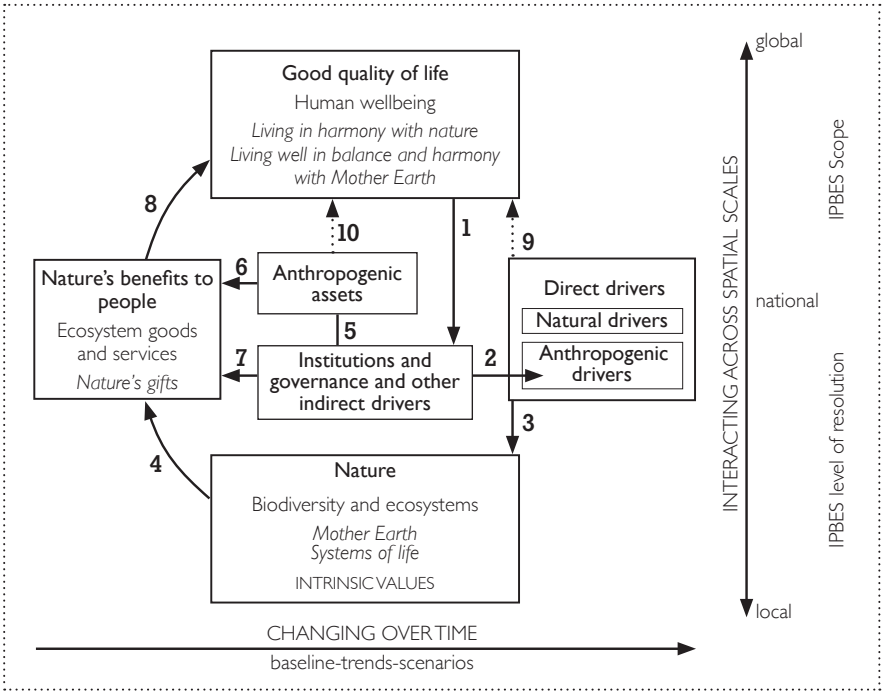


Figure 4: The IPBES conceptual framework (Diáz et al. 2015).

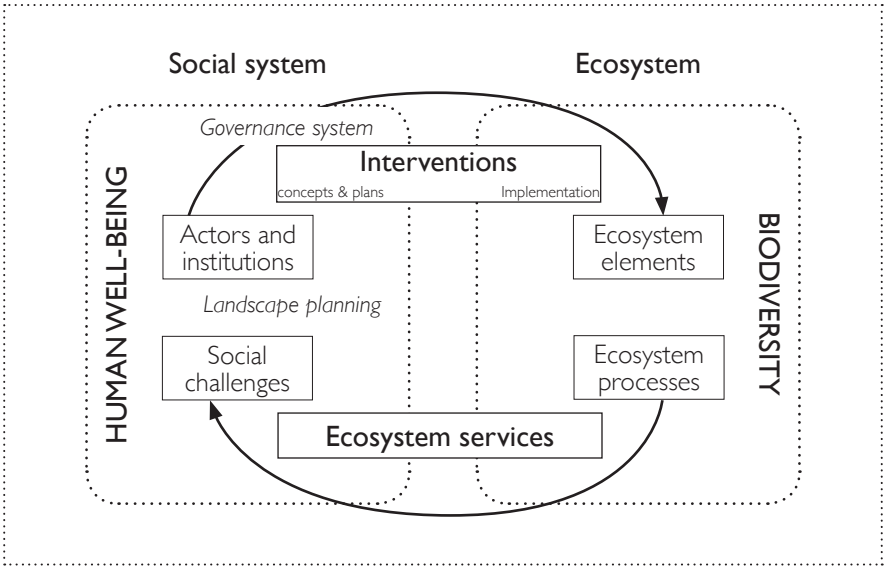


Figure 5: Concept of landscape governance and ecosystem functioning (after C. Albert).

Based on these considerations, and inspired by the models presented in Figure 4 and 5 the conceptual framework for this thesis is presented in Figure 6.
The framework recognises the institutions, the policies (indirect drivers), as well as natural and anthropogenic drivers of change. These drivers affect the landscape, which provides people with landscape services which may ensure the 'good quality of life'. The people will affect in particular the indirect and anthropogenic drivers.

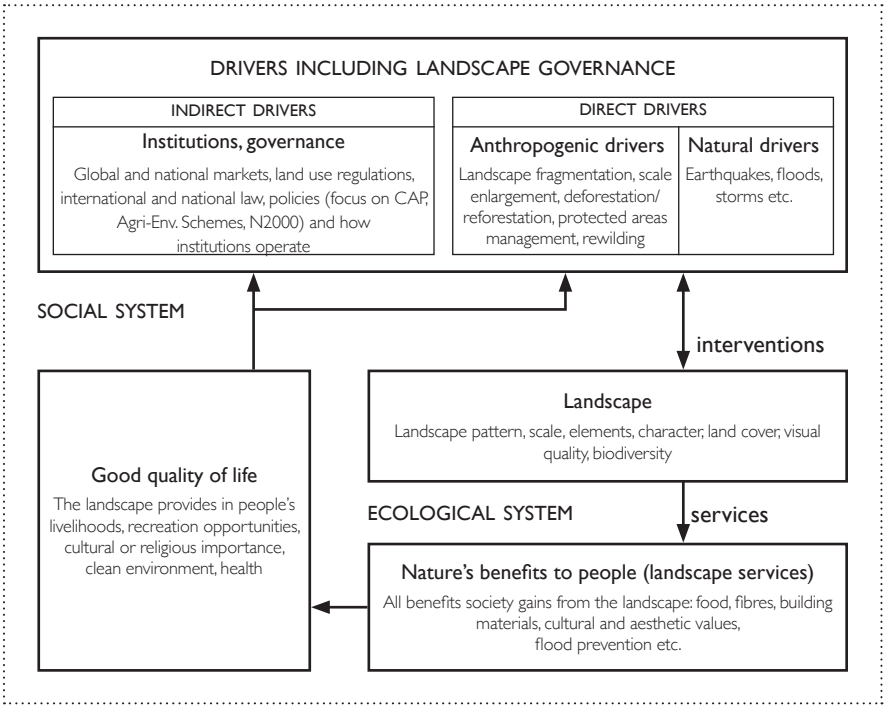


Figure 6: Conceptual framework: The direct and indirect drivers result in changes in the landscape. This will change the landscape services or benefits to people. These services are crucial for people's well-being. Processes at the landscape scale are defined by drivers which operate often at national or global scale. See text for a detailed discussion of the framework.

1.4.4 Research questions

The research objective requires unravelling the correlations between land related policies and landscape change in the EU, the drivers of landscape change and in particular how policies, such as the CAP and Natura 2000 affect the European landscape. To operationalise this objective, the following research questions are addressed:

- Q1. What are the major landscape change processes occurring in different regions of Europe?
- Q2. What are the drivers of landscape change in different regions of Europe, and what is the role of EU-policies in particular?
- Q3. How do landscape changes affect the provision of landscape services?
- Q4. How does the implementation of conservation policies affect processes of landscape change?
- Q5. Which effective strategies and future pathways can be followed to conserve valuable cultural landscapes?

The thesis consists of this introductory chapter, five chapters, each addressing one of the research questions, and a concluding synthesis, putting the findings together and indicating their potential significance for research and policy.
The different chapters relate to the conceptual framework: Chapter 2 relates to the trends in landscapes. Most Chapters (3, 5 and 6) relate to the drivers and processes of change, whereas the impact of the changes on the quality of life is addressed in Chapter 4.

1.4.5 Thesis outline

Research question Q1,
'*What are major landscape changes occurring in different regions of Europe?*'
is addressed by interviewing a large number of farmers in selected study areas in six European countries (Chapter 2). The aim of this survey was to acquire a better understanding of the decision making of farmers, the environmental conditions and the landscape change processes taking place. The focus is on intensification and extensification processes in the case-study areas and regional similarities and differences. A statistical analysis of land use intensity was carried out on the basis of the 462 farmers, who were interviewed.

Research question Q2,
'*What are the drivers of landscape change in different regions of Europe, and what is particularly the role of EU-policies*'
discusses the factors and drivers of change in a meta-study for a total of six countries (Chapter 3). This study is based on how stakeholders interpret the process of change, through Fuzzy Cognitive Mapping (FCM). In five local workshops, groups of landscape

experts have been consulted, to jointly construct a cognitive map of landscape change processes over the past 25 years. The study examines in particular at the storylines of the process of landscape change. Two different cases, the Mediterranean region and the Boreal region, are studied in detail.

Question Q3,
'How do landscape changes affect the provision of landscape services?'
is addressed in Chapter 4, and discusses five European case studies with regard to the change in landscape services. The analysis is based on observed landscape changes by comparing maps for periods of up to 25 years. The observed changes were interpreted for the consequences in terms of landscape services, and related to European processes of landscape change.

Question Q4,
'How does the implementation of conservation policies affect processes of landscape change?'
is discussed in Chapter 5 through focus on landscape governance. The transposition of European policy is assessed for four countries for the case of the Habitats Directive: Denmark, Greece, The Netherlands and Romania. The results demonstrate how legislation is locally translated and how this 'fits' the national governance system.

The last question, Q5,
'Which effective strategies and future pathways can be followed to conserve valuable cultural landscapes?'
is addressed in Chapter 6 on Mediterranean landscape change. Two 'iconic' Greek and Italian cultural landscapes with olive yards were compared. Both landscapes have a centuries-old farming system, representative for local cultural landscapes. We used long-term data sets on landscape change (exceeding 100 years), including map data, interviews, literature etcetera, which were used to discuss the characteristics of cultural landscape management and potential risks for the future of these cultural landscapes.

This is followed by a synthesis (Chapter 7), in which the findings of the different chapters are compared, integrated and synthesised, and the implications for current landscape research and landscape governance are explored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Chapter 2

Changing land use intensity in Europe
Recent processes in selected case studies

Published as:
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Abstract

In recent decades the intensification of agricultural production in many European countries has been one of the key components of land-use change. The impact of agricultural intensification varies according to national and local contexts and a greater understanding of the drivers of intensification will help to mitigate against its negative impacts and harness potential benefits. This chapter analyses changes in land use intensity in six case studies in Europe. A total of 437 landowners were interviewed and their responses were analysed in relation to changes in land use intensity and agricultural production between 2001-2011. In the case studies in Western and Eastern Europe we observed stabilization during the last decade, and no clear tendency of increase or decrease of land use intensity. The use of fertilizers and pesticides seems to have decreased in our cases in Western Europe, which is contrary to trends in Eastern Europe. Agricultural production remained stable in almost all cases, except for an increase in Austria and Romania which may indicate that the farming efficiency has increased. A statistical analysis showed a division between study areas in Romania and Austria (increasing land use intensity) versus those in the Netherlands, Denmark and Greece (decreasing). In the Mediterranean cases we observe a process where agriculture is becoming increasingly marginalised, at the same time as changes in function with regard to urbanisation and recreational land uses have taken place. Logistic regression highlighted the importance of farm size and farmer type in understanding changes in land use intensity. The dominant pattern of stabilization which has occurred over the past 10 years may also partly be a result of effective EU and national environmental and agricultural policies, which are increasingly concerned with improving environmental conditions in rural areas.

2.1 Introduction

Trends in intensification and extensification of land use

Since the Second World War, the two dominant processes in agricultural land-use in Europe have been agricultural intensification and specialization on the one hand and agricultural marginalization and land abandonment on the other hand (Andersen 2009; Brouwer 2006). Both processes have involved a move away from the traditional forms of low-input, labour-intensive crop and livestock production on small to medium-sized farms which, for decades, were prevailing characteristics of rural landscapes all over Europe (Baudry et al. 2000; Klijn 2004; Kristensen 1999). Intensification and specialization are partly a result of technological progress stimulated by economic, political and social events. The associated developments are manifold; an increase in the use of agro-chemical inputs, mechanization, specialization of mixed farmers, efficient land re-allotment, buy-out of small farmers, scale-enlargement and an open European internal market protected by import levies and subsidies. Perhaps the most distinct visual change has been the removal and degradation of (semi-) natural landscape elements (Brussaard et al. 2010). Land use intensification negatively affects environmental quality and biodiversity (Petit and Elbersen 2006) and leads to encroachment onto natural areas (Brussaard et al. 2010). The increasingly mono-functional agricultural landscapes are 'designed' for agricultural production with limited capacity to provide non-commodity services (Baudry et al. 2000; Burel et al. 2013). In addition, land use intensification has led to an on-going homogenization, scale-enlargement and an increase in land productivity (Firbank 2005).

Traditional landscapes were typically a product of 'low-intensity land-use' (Plieninger et al. 2006). Land use intensification resulted in profound changes in the traditional landscape: uncultivated areas were taken into production and transformed into large and production-efficient parcels, easily accessible for machinery. This resulted in a domination of large fields of relatively monotonous cultivated land (Kristensen 2003). However, elsewhere extensification occurred, a process where nutrient and labour inputs decrease, which leads to marginalization of farming and land abandonment. Land abandonment occurs in regions where current land use is not economically viable anymore, and often farming continues as a part-time activity, or with involvement of (cheap) family labour (Duarte et al. 2008). Hobby farming in particular results more often in land abandonment. Marginalization of farming is considered to be 'a process, driven by a combination of social, economic, political and environmental factors, by which certain areas of farmland cease to be viable under an existing land use and socio-economic structure' (Baldock et al. 1996, p. 36). In mountainous regions or in Eastern Europe more 'non-productive' or less productive 'marginal' land was left unchanged (Andersen 2003; Baldock et al. 1996; MacDonald et al. 2000).

Landscape change processes

Intensification or extensification processes affect landscape identity but also landscape character and biodiversity (Stanners and Bourdeau 1995; Stobbelaar and Pedroli 2011). Tscharntke et al. (2005) observe that biodiversity declines in already intensively used agro-ecosystems due to further intensification and technological innovations. To mitigate these negative impacts, it is important to identify and determine the key elements of land use intensification and extensification processes, and adjust policies where necessary (Plieninger et al. 2006). The processes (and speed) of land use change may be strongly influenced by national and EU policies such as the Common Agricultural Policy (CAP) and the Least Favoured Area policy (LFA) (Primdahl et al. 2004). The policies may be the same across Europe, but differences in governance culture (Nielsen et al. 2013), in combination with a situation in Europe where policy develops and is implemented at different speeds and in relation to different environmental conditions, may lead to regions where different landscapes and economies evolve. Based on these observations, one would expect a decrease in land use intensity in some areas (in particular in marginal areas), in other areas an increase. We therefore hypothesise that, in Europe, different patterns will emerge (Plieninger et al. 2006): where good farming conditions prevail, farming will remain an important economic activity; in areas with (severe) natural limitations farming will decline and areas will eventually depopulate, if no new functions develop.

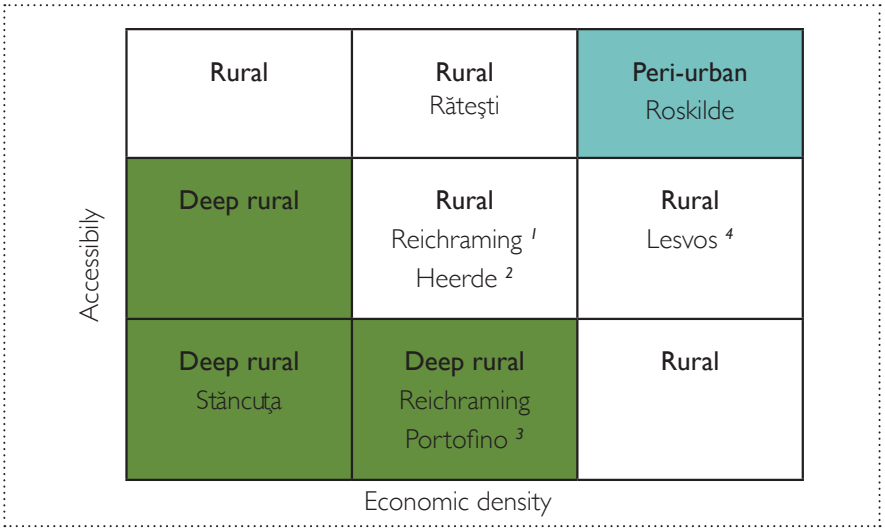

Figure 7: Ordination of case study areas, following the FARO typology (Van Eupen et al. 2012). [1] Half of Reichraming has low, half has average accessibility to services. [2] For Heerde counts that the farming area has high economic density, the forested part has average economic density. [3] The local area surrounding Portofino case area is considered peri-urban, but access to the case area is difficult, and the area shares many characteristics with marginal agricultural areas, therefore we consider the case area as marginal/deep rural, even if the FARO typology designates it as peri-urban. [4] Most of Lesvos area has a high economic density and average accessibility. Here it is classified as rural, although in particular along the coast peri-urban would be justified.

In newly developing economies, industrialization of farming may take place which will dominate land use changes (Baumann et al. 2011; Kuemmerle et al. 2009; Plieninger et al. 2006; Wascher et al. 2008). In North-Western Europe we therefore expect intensification and specialisation of farming, in Southern Europe further marginalisation. Eastern Europe has the potential to grow as an area of agricultural production thanks to favourable farming conditions and the removal of barriers related to trade and policy.

This chapter provides an analysis of changing land use intensity in six case study areas in different area in Europe: Romania, Austria, Greece, Italy, the Netherlands and Denmark. This is carried out in the framework of a broader study of land use transitions in Europe (Kirstensen et al. 2016; Rounsevell et al. 2012). Within the case study areas the changes in land use intensity and the underlying decisions are studied at farm level. Based on the observed trends the impact on the future landscape is discussed. The key question we address in this chapter is whether land use has become more or less intensive in different regions in Europe, and whether there are general patterns emerging for different regions in Europe. Finally we discuss what implications this may have for the future landscape.

2.2 Cases, data and methods

Case study areas

The data for this chapter were collected in the spring of 2012 through a questionnaire survey in 6 case study areas: Roskilde (Denmark), Heerde (The Netherlands), Portofino (Italy), Lesvos (Greece), Reichraming (Austria) and Răteşti and Stăncuţa (Romania). These case studies represent areas with different levels of rural development, from 'deep rural' to 'peri-urban' in the FARO typology (Van Eupen et al. 2012) and represent a cross-section spanning from peri-urban to marginal rural landscapes (Kristensen et al. 2013). They cover the diverse landscapes in Europe and are therefore well-suited for illustrating the variety of processes and patterns of land use intensity in Europe. The environmental conditions vary; they are classified as Atlantic, Continental, Alpine and Mediterranean zones (Metzger et al. 2005) which differ in particular in temperature and degree of oceanic gradient. The areas are described in more detail elsewhere in Kristensen et al. (2013) and in Van der Sluis et al. (2013). The socio-economic conditions also vary and we can ordinate the study areas within the divisions provided by the FARO typology (Van Eupen et al. 2012, Figure 2), as explained in Figure 7.

Based on the FARO typology, the extreme positions (considered from lower left to upper right in Figure 7 are taken by Stăncuţa, which is 'deeply rural' with low economic density, and Roskilde which represents the most peri-urban area in terms of accessibility and economic development levels. Lesvos shares more characteristics with Heerde and Reichraming as rural, with average economic density; the high economic density relates to the west of Lesvos, Mytilini and the infrastructure along

the coast; the inland territories show much less development. Although the local area surrounding the Portofino case area is considered to be peri-urban (proximity to large town and highway), access to the case area is difficult; the Regional Park designation restricts agricultural activities and the area shares many characteristics with marginal agricultural areas including an aging population and a lack of investments (Pedroli et al. 2013). For these reasons we will consider the case area as marginal/deep rural, even if the FARO typology, which uses a coarser geographical resolution, designates it as peri-urban.

In Kristensen et al. (2013) and Van der Sluis et al. (2013) key characteristics are provided for each case study area. The smallest area is Portofino (only 18 km^2), the largest Stăncuţa (255 km^2). The Heerde and Reichraming areas are mainly livestock farming areas, with a limited area of arable crops, Roskilde has mostly arable farming. Portofino and Reichraming have predominantly a forest cover. For basic statistics for the different areas, see Kristensen et al. (2013). The Portofino, Lesvos and Reichraming areas can be classified as traditional land use systems (low intensity tree crops and low-intensity livestock raising in mountain areas) according to Plieninger et al. (2006). The Roskilde, Heerde and Stăncuţa cases would qualify as intensifying regions. Still, this classification seems to neglect the urban pressure, which strongly affects farming in an area like Portofino, and which is reflected in the FARO classification.

Data collection and statistical analysis

Data were collected from 437 landowners. In most cases, questionnaires were completed in face-to-face interviews while in Reichraming questionnaires were completed by the respondents independently. Several studies have shown how differences in farming systems, farmer types and socio-economic settings may lead to different decisions regarding landscape management, and may thus have implications for land use intensity (Kristensen et al. 2001; Primdahl et al. 2013a). Questions therefore also covered social aspects, composition of the household, economic factors, land ownership, changes in land use and motivation for farming decisions.

On the basis of the survey results we analysed changes in land use intensity. Agricultural intensification is defined here as an increase of either inputs or outputs (in quantity or value) of cultivated areas or livestock production per unit area and time (Lambin et al. 2001). A change of land use intensity can be assessed by studying changes of input or output intensity (Erb et al. 2013). Expansion of agricultural land is an alternative for increasing agricultural production. To assess changes in land use intensity, indicators may be defined in order to compare the measure of intensity over time (see e.g. Paracchini et al. 2011). Indicators can include input intensity, output intensity, or system-level impacts of production (Erb et al. 2013). Farmers can intensify or extensify their land use by either:

- changing the area of land in rotation (ha)
- changing livestock numbers (livestock density, per ha)
- changing dosage of farming inputs, and thus capital intensity (nitrogen, pesticides, amount per ha)

The survey of farmers included specific questions regarding changes in those parameters. The questions concerned quantitative changes in land use intensity over the past ten years (in terms of: kg N/ha, Tons of products harvested/ha, Nr of livestock/ha). However, in general the respondents could not provide this level of detail. Rather, they would give a general indication of increase, decrease or stability for each parameter. Each farmer was asked whether (s)he considered himself full-time, part-time, hobby or not active farmer. The group of 'not active farmers' do not use their land for productive purposes: they lease it out, or leave it unexploited. Where necessary the farmer typology was corrected, based on income and time expenditure. Also, if the farmer type was 'unknown', or a 'missing value' was reported the records were checked and updated, where possible and otherwise excluded from the analysis. Subsequently we carried out a quantitative analysis of land use intensity in relation to farmer typologies and regions, in which we investigated the relationship between land use intensity and selected parameters. Indicative for intensification/extensification are changes in scale of farming, livestock numbers, and use of fertilizers and pesticides. A change in crop yield can be an (indirect) indicator of change in land use intensity.

Interpretation of these data resulted in an indication of the type and degree of change and, the number of farmers that reported a decrease or increase in land use intensity. The Chi-square test was used for comparison of the two Romanian case study areas Stăncuța and Rătești, to test if data for the two areas could be analysed as one case study for Romania. Whilst the Chi-square test can also be used to test the significance of the observed changes in land use intensity, with a limited number of observations this test is not reliable. We therefore used the Fisher exact test in GENSTAT 15th Edition (Payne et al. 2008) in order to test the changes in land use intensity and to establish whether countries differed in the proportion for each category. The data for Portofino were excluded in the Fisher test, since there were only four observations. We tested in two ways: the difference in percentage unchanged versus decrease/unchanged/increase; as well as the difference in percentage decrease, versus decrease/increase (thus omitting all cases of no change). The latter is more sensitive in relation to changes that have occurred. Through a multiple logistic regression, we analyzed whether the change in land use intensity can be explained by one or all of the three parameters: country, land owner type or farm size. Farm size was log transformed because of the large range in values. The same analysis was done without the parameter 'country', in order to test if there are overall explanatory variables for all European countries.

Based on the analysis we discuss the observed trends and consider how land use intensity changed over time. Subsequently we assess whether the change in land use intensity is related to changes in landscape structure and the change in land use (as assessed in Kirstensen et al. 2016).

2.3 Results

Changes in land use intensity

For all case study areas we see the general tendency that land use intensity remained unchanged for more than half of the responses (916 out of 1478, Table 1: Case studies of this thesis).
However, for crop yield there was a slight increase reported among a larger group of respondents (80 out of 285). Nitrogen use tended to decrease in quite a few (96 out of 322) cases.

Intensity indicator	Decrease	No change	Increase	Total
Crop yield	41	164	80	285
Cultivated area/Total area	34	218	46	285
Nitrogen use	96	187	39	322
Pesticide use	73	197	38	308
Livestock density	77	150	51	278
Total	**321**	**916**	**254**	**1478**

Table 1: Change in land use intensity indicators.

We analysed further for each of the six countries to establish whether this tendency was confirmed by national figures, but no clear tendencies were observed at country level. For Lesvos (GR) changes were very limited (Table 2), except for a decrease in crop yield (12 out of 21). It was mentioned that production was mainly used for own consumption, which is also the case in Portofino (IT). Olives are the main crop and they are grown in a traditional system and do not require much fertilizer and pest control. However, only a few farmers engage in full time farming (29 out of 90) and most farmers are old. In Portofino there are too few observations to draw meaningful conclusions.
In Heerde (NL) the livestock numbers decreased in 22 out of the 42 relevant cases. The majority of the other indicators did not change, although there is more often a tendency of decrease, e.g. for nitrogen or pesticides. In Roskilde nitrogen and pesticides decreased, along with other indicators which also showed a tendency to decrease. For Reichraming (AT) all indicators remained stable according to at least 50% of the respondents; only the crop yield, cultivated area and livestock density show more often an increase than a decrease.
For the two areas in Romania (Răteşti and Stăncuţa) land use intensity did not change according to at least 60% of the respondents, although there is a tendency of increase in crop yields, fertilizer use and pesticides, and a tendency of decrease in livestock

density (Table 2). 34 out of 98 farmers reported there had been an increase in yield. When we group the survey results according to the farmer typology, we see in general a tendency of 'no change' for all categories (Table 3). However, overall, there is more often a decrease than an increase in land use intensity. For the full time farmers crop yield and cultivated area often increased, the other indicators remaining mostly equal. For all farmer groups nitrogen and pesticide use has more often decreased than increased, which can be a result of the effectiveness of policies and regulations.

Geographical variation in land use intensity changes

We used a Chi-square test to establish whether the two study areas in Romania, Răteşti and Stăncuţa, differed in their pattern over the three categories decrease, increase and unchanged. We found that the pattern only differs significantly for livestock density (P= 0.042). Since this was only found for one indicator, data for the two areas were combined.

The results of the Fisher exact test are presented in Table 4. A different letter for two countries means that they differ significantly using a level of significance of 0.05. For countries with the same letter the null hypothesis of no difference in percentage could not be rejected. Although a stabilization seems to be the overall trend over the past 10 years, we see for Reichraming and Romania a tendency of increasing crop yields and cultivated area (usually less than 20% decrease, Table 4), whereas for Roskilde, Lesvos and the Heerde crop yield more often decreased. Livestock density increased mostly in Reichraming, and decreased or remained stable in all other countries. In Romania we see, next to stability, some increase in pesticides and nitrogen application, which mostly decreased elsewhere. The clustering of countries with similar percentages is shown in Table 4 below.

Crop yield	Decrease	Increase	No change	Count	%Unchanged	%Decrease
Reichraming	3	22	36	61	59.0 . b	12.0 a .
Roskilde	12	8	40	60	66.7 . b	60.0 . b
Lesvos	12	5	4	21	19.0 a .	70.6 . b
Heerde	11	8	23	42	54.8 . b	57.9 . b
Răteşti & Stăncuţa	2	34	61	97	62.9 . b	5.6 a .
Portofino	1	3	0	4		
Count	41	80	164	285		
Cultivated area	**Decrease**	**Increase**	**No change**	**Count**	**%Unchanged**	**%Decrease**
Reichraming	2	19	37	58	63.8 a .	9.5 a . .
Roskilde	14	3	47	64	73.4 a b	82.4 . . c
Lesvos	2	6	23	31	74.2 a b	25.0 a b .
Heerde	12	5	25	42	59.5 a .	70.6 . b c
Răteşti & Stăncuţa	3	11	86	100	86.0 . b	21.4 a . .
Portofino	1	2	0	3		
Count	34	46	218	298		
Nitrogen	**Decrease**	**Increase**	**No change**	**Count**	**%Unchanged**	**%Decrease**
Reichraming	11	4	46	61	75.4 . . c	73.3 . b .
Roskilde	41	1	22	64	34.4 a . .	97.6 . . c
Lesvos	14	4	30	48	62.5 . b c	77.8 . b c
Heerde	19	2	26	47	55.3 . b .	90.5 . b c
Răteşti & Stăncuţa	11	28	63	102	61.8 . b c	28.2 a . .
Portofino	0	0	0	0		
Count	96	39	187	322		
Pesticides	**Decrease**	**Increase**	**No change**	**Count**	**%Unchanged**	**%Decrease**
Reichraming	6	6	50	62	80.6 . . c	50.0 a b .
Roskilde	32	1	28	61	45.9 a . .	97.0 . . c
Lesvos	9	2	32	43	74.4 . b c	81.8 . b c
Heerde	16	2	24	42	57.1 a b .	88.9 . b c
Răteşti & Stăncuţa	9	27	63	99	63.6 . b .	25.0 a . .
Portofino	1	0	0	1		
Count	73	38	197	308		
Livestock density	**Decrease**	**Increase**	**No change**	**Count**	**%Unchanged**	**%Decrease**
Reichraming	8	24	33	65	50.8 a .	25.0 a .
Roskilde	20	11	32	63	50.8 a .	64.5 . b
Lesvos	1	1	3	5	60.0 a b	50.0 a b
Heerde	22	5	15	42	35.7 a .	81.5 . b
Răteşti & Stăncuţa	24	8	67	99	67.7 . b	75.0 . b
Portofino	2	2	0	4		
Count	77	51	150	278		

Table 2: Results Fisher exact test - indicator change per country
Explanation is provided in the text

Farmer typology	Decrease	No change	Increase	Total*
FULL TIME				
All	**81**	**281**	**125**	**487**
Crop yield	7	50	40	97
Cultivated area/Total area	7	72	20	99
Nitrogen use	26	51	21	98
Pesticide use	22	57	19	98
Livestock density	19	51	25	95
PART TIME				
All	**83**	**313**	**70**	**466**
Crop yield	9	60	20	89
Cultivated area/Total area	7	72	11	90
Nitrogen use	24	63	11	98
Pesticide use	17	65	13	95
Livestock density	26	53	15	94
HOBBY				
All	**136**	**231**	**55**	**422**
Crop yield	21	42	20	83
Cultivated area/Total area	16	54	15	85
Nitrogen use	41	50	5	96
Pesticide use	30	50	5	85
Livestock density	28	35	10	73
NOT ACTIVE FARMER				
All	**21**	**91**	**4**	**116**
Crop yield	4	12		16
Cultivated area/Total area	4	20		24
Nitrogen use	5	23	2	30
Pesticide use	4	25	1	30
Livestock density	4	11	1	16
Grand Total	**321**	**916**	**254**	**1491**

*: note, each farmer provided multiple answers, and total does therefore not reflect total sampled population.

Table 3: Change in land use intensity in all areas combined, for different farmer types.

FACTOR		
Crop yield	Reichraming/Romania	Roskilde/Lesvos/Heerde
Cultivated area	Reichraming/Lesvos/Romania	Roskilde/Heerde
Nitrogen use	Romania	Reichraming/Lesvos/Roskilde/Heerde
Pesticide use	Reichraming/Romania	Lesvos/Roskilde/Heerde
Livestock density	Reichraming	Lesvos/Roskilde/Heerde/Romania

Table 4.: Fisher exact test, significant ($p < 0.05$) patterns of similarities/divergence for %change. Countries exhibiting similar patterns of change in land use intensity are grouped together.
(Note: Romania indicates Răteşti and Stăncuţa.)

FACTOR		
Crop yield	full-time/not active farmer	part-time/hobby
Cultivated area	full-time	part-time/hobby/not active farmer
Nitrogen use	full-time/not active farmer	part-time/hobby
Pesticide use	full-time/not active farmer	part-time/hobby
Livestock density	full-time/part-time/hobby/ not active farmer	-

Table 5.: Fisher exact test, significant ($p < 0.05$) patterns of similarities/divergence for %change. Farmers exhibiting similar patterns in change in land use intensity are grouped together.

We used the Fisher exact test to further test the difference in change in indicator per farm type (Annex 1). Here also, stability seems to be the overriding factor for all indicators: all farm types exhibit the same pattern except perhaps for nitrogen and pesticides, where hobby farmers and 'not active farmers' act differently from full and part time farmers, and report a decrease (see Annex 1, %unchanged). If we consider the changes occurring (%changed), crop yield and cultivated area increased most for the full time farmers, for other farmer types it mostly decreased (Table 5). Nitrogen and pesticide use decreased for all farmer categories. Livestock density did not change significantly for different farmer types. Generally speaking, full-time farmers and 'not active farmers' show a similar pattern of change, as opposed to hobby farmers and less so for part-time farmers (Table 5).

Through a multiple logistic regression we analyzed the causes of change in land use intensity. The analysis shows that the geographical location is very significant in all models (see Table 6). In those cases where we compared the percentage unchanged versus all observations, the best explanatory model consisted of country and farm size. The best models to explain the occurrence of change (%decrease), consist of country and farm type. The livestock density is explained mainly by country: this is obviously strongly related to geographical features of the area (several areas are cropping areas with very limited livestock grazing).

INDICATOR	VARIABLE	BEST MODEL
Crop yield	%Unchanged	Country + FarmSize
	%Decrease	Country + FarmType
Cultivated	%Unchanged	Country + FarmSize
	%Decrease	Country + FarmType
Nitrogen	%Unchanged	Country + FarmSize
	%Decrease	Country + FarmSize
Pesticide	%Unchanged	Country + FarmSize
	%Decrease	Country
Livestock density	%Unchanged	Country
	%Decrease	Country

Table 6: Differences in land use intensity indicators, best models based on logistic regression (P<0.5).

In the last step a logistic regression was carried out for all observations combined, where the country was excluded as an explanatory variable, in order to see whether there is an overall effect for all case studies. We assessed the overall effect of farmer type on the change in indicator. No correction was made for farm size, since this is highly connected to farm type. Table 7 shows where farmer types show different responses for each indicator. The full-time farmers in particular differ clearly in their behaviour from part-time and not active farmers.

INDICATOR	VARIABLE	BEST MODEL
Crop yield	%Unchanged	Part-time and full-time farmer, not active farmer and part-time farmer
	%Decrease	-
Cultivated	%Unchanged	Part-time and full-time farmer
	%Decrease	-
Nitrogen	%Unchanged	-
	%Decrease	Not active farmer and full-time farmer
Pesticides	%Unchanged	-
	%Decrease	Not active farmer and full-time farmer
Livestock density	%Unchanged	-
	%Decrease	Not active farmer and full-time farmer, not a farmer and part-time farmer

Table 7: Significant differences (P < 0.5) in farmer types regarding land use intensity. Based on a logistic regression, for all observations, where 'country' is excluded as explanatory variable.

2.4 Discussion

The case study areas form a cross-section of rural landscapes in Europe. From the results of the combined data it is clear that land use intensity over the past decade has not substantially changed in the areas considered. This may indicate that the trend of intensification which is evident from the long term changes since 1960 (FAO 2010), is changing towards stability and for some indicators towards extensification. In the following section the changes for the different indicators analysed in the study will be discussed.

Changing patterns in land use intensity over Europe

FAO provides agricultural statistics for the countries where the case studies are situated (FAO 2010). Crop yield has increased enormously in all countries between 2000 and 2010 (Table 8). In order to make comparisons, the yield for cereals, (coarse) grains and roots and tubers are combined; all countries show a large increase, except for Denmark, but the growth levelled off at the turn of the century. Over a longer period we see close to a doubling of crop yields since 1961. Over the past ten years the cultivated area has decreased or remained stable (in the Netherlands and Denmark). However, the long term statistics show that a reduction of the agricultural area took place in most countries around 1970, when the EU was established. In Greece, the agricultural area initially increased, and finally decreased in the last

decade of the previous century; for Romania a decline was observed only recently. All countries show a strong decrease in nitrogen application over the past ten years (related to the EU Nitrate Directive; EEA, 2006), except for Romania, where it has increased, and Denmark with a slight increase. Pesticides use increased in Denmark, and to a lesser extent in Austria and Italy, and showed a strong decrease in the Netherlands and Romania (FAO 2010). However, there has been a strong decrease in all countries when the previous 20 year period is taken into consideration. The livestock density (cattle) increased in Mediterranean countries and to a lesser extent in Austria but decreased strongly in Denmark and Romania. However, since 1961 there has been a strong decrease, except for the Netherlands and Austria where livestock numbers increased.

INDICATOR	AUSTRIA	DENMARK	GREECE	ITALY	NETHERLANDS	ROMANIA
Crop yield (t/ha/yr)	++ [1]	(-)	++	++	++	++
Cultivated area	--	o	(-)	-	o	-
Nitrogen (kg N/ha/yr)	--	(+)	--	--	--	++
Pesticides	+	++		+	--	--
Livestock density (no. of livestock/ha)	+	--	++	++	o	--

[1] **-** = decrease < 10%, **--** = decrease > 10 %, **o** = stable, **+** = increase < 10%, **++** = increase > 10%, **(+)** = slight increase or **(-)** decrease

Table 8: Summary of national trends for selected indicators of agricultural intensification from 2000-2010 (based on FAO statistics).

Diversification, extensification and on-farm conservation

In Lesvos (GR) and Portofino (IT) changes are very limited since olives form the main crop in both areas; these are grown in a traditional system and do not require much fertilizer and pest control. Only a few of those interviewed are full time farmers (29 out of 90 in Lesvos, none at all in Portofino) and most farmers are old. These factors can be seen to contribute to the decrease in crop yield in Lesvos which can also be attributed to lack of agricultural education and support, as well as a lack of product marketing. It was specifically mentioned that production was mainly for own consumption, which is also the case in Portofino.

The decreasing livestock numbers in Heerde (NL) are a result of farm reorganisation taking place; small farms become further marginalised and, in some cases, big farms take over smaller farms. In addition, Heerde suffered from one of the first large outbreaks of Foot and Mouth Disease in the Netherlands in 2001 and, at that time, several farmers stopped dairy farming. The CAP milk quota system is also likely to

have had an impact; with owners of small farms selling their quota to farmers in need of expansion. Farms that decreased in size, decreased on average by 53%. Those that increased did so by 86%. A number of farms are progressing towards termination with a corresponding increase in marginal farming activities.
In Reichraming (Austria) economic circumstances may be forcing farmers to intensify, resulting in increases in crop yield and cultivated area and in livestock density.
The restructuring of land ownership and farming systems was a major change after the fall of communism in Romania (Răteşti and Stăncuţa). Collective farms were dismantled and land was returned to former owners (based on the 1940s land records; state farms were slowly reorganised into large corporate farms (Vidican 2009). This resulted in fragmentation (Hasund and Helldin 2007; Rusu et al. 1999-2000), land abandonment (Kuemmerle et al. 2009; Müller et al. 2009) and a new land owners' structure, consisting mostly of an older and urban-based population (Amblard and Colin 2009) that have limited experience with farming. As a result, land use intensity mostly remained stable.

Seen across all case study areas, crop yield and cultivated area often increased for the full time farmers while the other indicators remained mostly equal. This shows that farming efficiency has increased leading to a better timing or application of pesticides and nitrogen and resulting in higher productivity. For all farmer's groups nitrogen and pesticide use has more often decreased than increased; we hypothesize that this can be a result of the effectiveness of policies and regulations.
The increase in crop yield in some cases seems to correspond with the increased agricultural production over the past decades, as registered in national figures. The general pattern in all areas is stability, most farmers reported no change in yield, except for Lesvos (decrease). There is however a tendency of increasing yields in Reichraming. If we compare this with national statistics for these countries (FAO 2010) most have seen increased yields over the past ten years (except for Denmark). In general the use of pesticides in Denmark, Italy and Austria has increased over the past ten years, while there was a decrease in the Netherlands and Romania. However, the long term trend from 1990 onwards shows a strong decrease for all countries (FAO 2010). For Greece no statistical data were available. Pesticides use remained mostly stable in the study areas. Denmark experienced a real increase in this period, which is contrary to Roskilde with a tendency to decrease. An explanation for a decrease in Heerde and Reichraming is that most land is used as grassland and forest, where agrochemicals are not used to a big extent.

Urban ecological footprint

In our case study areas we mainly observe stability, with a tendency towards extensification. Some of the processes seem to be closely linked with increasing urban functions for the countryside, such as in the Roskilde and Heerde areas. Here most farmers make choices which can be considered as extensification, despite the fact that the cultivated area remains more or less the same. Researchers have

described the changing role of agriculture in peri-urban locations as characterised by diversification, extensification and on-farm conservation (Antrop 2004; Bryant et al. 1982). These processes may involve a large number of landowners but only cover a small area, in particular in north-western Europe (Lambin et al. 2001).
The trend we see for cultivated areas in each case area is more or less reflected at national level in the FAO statistics, except for Austria, which saw a considerable decrease in agricultural area (FAO 2010). Denmark and the Netherlands remained more or less stable in this same period, so the decrease in area in Roskilde and Heerde deviates from the general picture in those countries. We hypothesise that urbanisation affects the farming practices in these case study areas, which results in a pattern that deviates from the rest of the country. Lambin et al. (2001) show that change as a result of urban structures is important, not so much directly in relation to land cover but the indirect changes, the transformation of urban-rural linkages which results in a large 'urban ecological footprint'.

Regions of farming development: intensifying, marginalising or industrialising

As outlined in the introduction, we would expect three major categories of land where changes in land use intensity occur: areas with good farming conditions, where farming has priority; upland areas, with severe environmental limitations, where farming is in decline; and newly 'industrializing' farming areas, where land use changes are dominant (i.e. Eastern Europe) (Baumann et al. 2011; Kuemmerle et al. 2009; Plieninger et al. 2006; Wascher et al. 2008). Roskilde and Heerde are areas with good environmental conditions for farming and belong to the first category. The full-time farmers here are often intensifying, and in Heerde restructuring of farms takes place which leads to scale enlargement (Hauser 2012; Kristensen et al. 2013). For Portofino (Italy) we see indeed a decline of farming in its final stages; the changes took place decades ago and much farmland reverted to semi-natural habitat (Pedroli et al. 2013). Lesvos is also marginalising, due to limited farming options, narrow profit margins and an aging population; as a result there is a decrease in land use intensity. Hence, these areas fall into the category of areas where farming is in decline. For some aspects Răteşti and Stăncuţa show an increase in land use intensity. Reichraming is very much in the same situation with a tendency towards increased land use intensity. Land use in Roskilde and Heerde remains the same, but the farming population is changing since there are fewer full-time farmers and urban pressures is evident, with farms being bought (and managed) for residential purposes. Land use intensity changes accordingly, with intensification by full-time farmers and extensification by hobby and part-time farmers. In some case study areas we observe changes which are opposite to the national trend, which shows how the impact of the urban area affects farming, and in particular the cultivated area, pesticide use and nitrogen application.

Pathways of extensification and intensification

In some areas of Western Europe hobby or part-time farmers pursue a strategy of extensification. This has been explained in light of 'post productivist transition'. Ilbery and Bowler (1998) describe the situation in European agriculture in the late 1990s as a turning point. After decades of intensification (concentration and specialisation of production), they observed indications of the opposite development occurring (diversification, decentralisation and extensification of production) (Ilbery and Bowler 1998). The ongoing intensification of agricultural production in England prompted some authors to reject the framework or at least to pay attention to the diversity of farm development pathways (Walford 2003; Wilson 2001). Despite its controversy, the framework is useful to identify and discuss major drivers of change for agricultural intensification and extensification.

Lambin et al. (2001) describe three broad pathways leading to agricultural intensification. The first is intensification induced by *land scarcity* which can be caused by population growth but also incursions of other land use or institutional changes which affect land tenure. The second is a *commodification pathway*, triggered by the markets which affect investments in and profitability of agricultural production. It is closely linked to external markets and subsidies. The third pathway is intensification by *intervention*, development programs, (donor) funding etc., with the aim of supporting or developing the agricultural sector. The two case studies in Romania, as well as Portofino, Heerde and Roskilde reflect aspects of the 'land scarcity pathway' (Lambin et al. 2001); in Romania this has to do with the institutional changes that have occurred, insecure land tenure as a result of fragmented properties, administrative procedures and land registration. In the other three areas the urban pressure results in demand from an urban population, that is locally willing to pay higher prices for properties but is also responding to processes of scale in farming. However, the 'commodification pathway' also defines the development seen in Roskilde, Heerde and Reichraming where differentiation takes place as a result of economic factors. Lesvos may have reflected aspects of the 'intervention pathway', in the times that the olives were subsidised in the past (De Graaff et al. 2010; De Graaff et al. 2011) with processes of land abandonment occurring now (Van der Sluis et al. 2014). For Portofino olive growing is too marginal to be impacted much by the market.

Demonstrated differences between cases

The intensification of agricultural production has been one of the key features of the agricultural sector in many European countries in recent decades. This chapter has analysed the changes and drivers behind agricultural intensification in a variety of rural landscapes in Europe, in order to enhance our understanding of the key characteristics of agricultural intensification and help mitigate against the negative impacts of these processes. The overall tendency which we have observed in the study areas between 2001 and 2011 has been stabilization of land use. The statistical analysis shows that the study areas in Reichraming, Răteşti and Stăncuţa on the one hand and those in Lesvos, Heerde and Roskilde on the other exhibit comparable

tendencies in land use intensity and agricultural practice. The Roskilde and Heerde areas as well as Stăncuţa are still dominated by processes of scale enlargement and intensification. At the same time, we see the emergence of urban related functions arising in Western Europe resulting in extensification processes. In the Mediterranean countries, we observe processes of marginalisation of agriculture, at the same time as a change in functions with regard to urbanisation and recreational land uses. In the Italian case study, extensification has in the meantime reached its terminal point; almost all agricultural land has been abandoned. The result of the logistic regression underpins the importance of geographical context, farm size and farmer type in the motivation for intensification or extensification.

2.5 Conclusions

This chapter demonstrates that land use intensity seems to have stabilised or sometimes decreased in the study areas. This stability reflects the type of landscape and socio-economic environment they represent. In the 'deep rural' areas (FARO typology, van Eupen et al. 2012) such as Stăncuţa (RO) and Reichraming (AT) we can still observe an increase for most indicators. In the peri-urban landscapes of Roskilde (DK) and Portofino (IT) we see a population of hobby-farmers or not active farmers who tend towards more extensive farming. Agricultural production has increased in the same period in almost all study areas which may indicate that farming efficiency has increased. At the European scale, the use of fertilizers and pesticides seems to decrease in Western Europe, whereas an opposite trend is observed in Eastern and Southern Europe. This is most likely caused by EU-legislation; stabilization as a result of effective policy implementation.

As indicated in the introduction, the impacts of the marginalization of agriculture in different regions of Europe is a loss of biodiversity and landscape quality. In addition the increasing urban pressure we have observed results in further changes in landscape functions and scale. The observed stabilization of land use intensity does not therefore imply that the landscape does not continue to change; targeted policies are required to maintain a viable and diverse countryside.


30 km
20 mi

Chapter 3

Drivers of European landscape change:

Stakeholders' perspectives through Fuzzy Cognitive Mapping

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Abstract

Understanding complex processes of landscape change is crucial to guide the development of future landscapes and land resources. Through Fuzzy Cognitive Mapping, we studied the processes of landscape change in different environmental zones in Europe. Results show that landscapes are complex systems, with many interactions. Except for one, all regions show a strong decline in landscape quality. Dominant drivers are EU policy and the global economy, sometimes in conjunction with environmental drivers or the governance system. The process of change differs for all cases, through urbanization or land abandonment in some cases, and agricultural intensification in others. The (un)intended effects of policies are difficult to predict. Although some EU Policies directly improve landscape quality, their indirect effects as well as other EU policies outweigh this positive influence and jointly result in a decrease of landscape quality. To counter these negative side effects, targeted landscape policies are urgently needed.

3.1 Introduction

3.1.1 Landscape as social-ecological system

The landscape is dynamic, and continuously changing. Following the European Landscape Convention ELC, the landscape is '*an area perceived by people whose character is the result of the action and interaction of natural and/or human factors*' (Council of Europe 2000). People have been modifying the landscape for millennia, adjusting its properties to suit their own needs and it is therefore a product of interaction between man and its environment. Where landscapes were initially a reflection of the natural conditions mainly, over time they have become more and more influenced by culture and technology (Pedroli et al. 2016; Vos and Meekes 1999). In most of Europe, this transition emerged around 1850 (Jepsen et al. 2015) with the introduction of technological innovations like the steam engine, which allowed large scale landscape modifications, including agricultural intensification, industrialisation and urbanisation (Meeus et al. 1990). Today, many of these landscapes lost their typical pattern and functional relations (Pedroli et al. 2016; Van Eetvelde and Antrop 2004).

In line with the ELC, a landscape can be described as a social-ecological system (SES) (Buizer et al. 2011). Key to SES is that landscapes are to be considered dynamic human-nature complexes and that they should be governed through adaptive management (Buizer, et al. 2011). The dynamics of such complex SES systems are defined by their resilience, adaptability and transformability (Walker et al. 2006). Opdam (2014) and Cáceres et al. (2015) argue that the wide ranges of spatial and temporal scales in landscape governance can only be addressed with involvement of stakeholders at different scale levels.

Landscapes provide so-called 'landscape services', and management interventions in the ecological system generate added value (Figure 8). This process takes place at the landscape scale, yet, the system is also affected by biophysical and socio-economic processes at higher scales (Opdam 2014). Examples are the effects of globalisation, the economy, but also public preferences which stem from the social system. Components of the latter may be individuals like farmers or forest managers, but also organised groups, and institutional rules used to guide interactions with and within the ecosystem. Cultural factors like cognition, beliefs, tradition are also part and parcel of the social context. The ecological system is shaped by all these social components, particularly through land use interventions.

3.1.2 Drivers and processes of landscape change

Drivers of landscape change are determined by the spatial, temporal and institutional scale of the system under study (Bürgi et al. 2004). The driving forces that are propelling change are often categorised as political, economic, cultural, technological

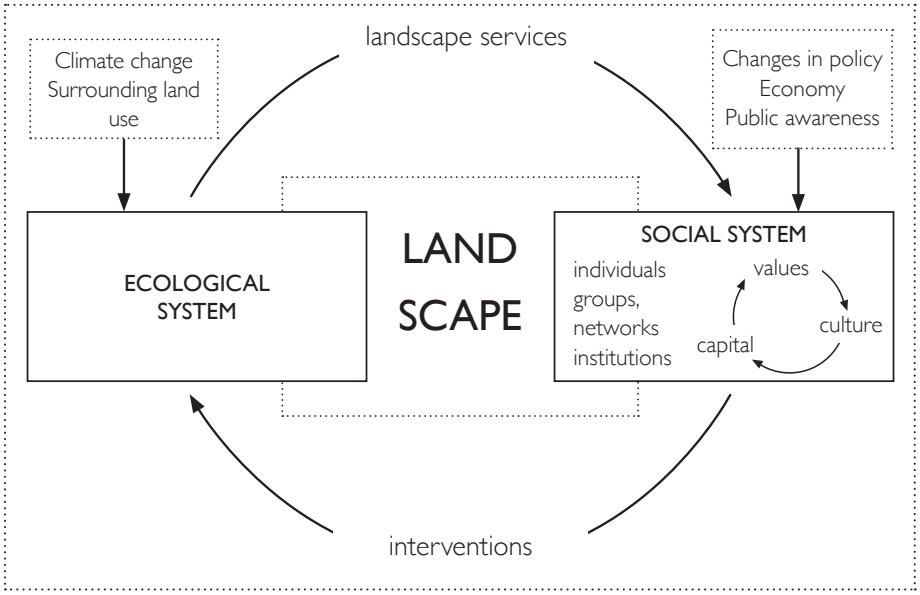

Figure 8: Conceptual framework, the landscape as a social-ecological system provides landscape services for the people (Opdam 2014). The Social system, comprised of individuals, groups, networks and institutions (rules, regulations and procedures) intervene to obtain goods and services from the landscape.

These interventions may include the harvesting of plants, vegetation, animals, management of the agricultural landscape, and construction of infrastructure. The interventions directly and indirectly modify ecosystem structure and function. This takes place at the landscape scale, however, the system is affected at higher scale level by biophysical and socio-economic processes.

and environmental forces (Hersperger and Bürgi 2009; Kristensenet al. 2009). The scale at which they operate also defines the stakeholders that are relevant. Identifying drivers in a system where everything connects to everything is always somewhat artificial. Drivers in this chapter are understood as those factors that are relatively unaffected by other factors in the system, and those that are of prime interest. Drivers can be changed, and the sensitivity of other factors on these forces can easily be assessed. They are not necessarily the factors that are most important for the system.

On the local scale, the landscape is often shaped by local land managers, farm managers, estate managers or foresters. The farmer is a major factor in agricultural land use change (Van Vliet et al. 2015), his decisions are partly driven by economic interests but are also rooted in culture and tradition and the farmer accordingly decides for 'appropriate' management (Arts et al. 2013; Ingram, Gaskell et al. 2013). In response to forest policies and economic conditions the forest manager will decide on tree selection, crop rotation length, as well as mono- or multifunctional use of forests (Forest Europe 2015). In the urbanised countryside of Europe the interaction with urban areas has become important (Kolen and Lemaire 1999; Van Eupen et al.

2012). Urban residents settle in the countryside, and some part-time farmers also gain income from other activities (Primdahl 2014). Large parts of the countryside have thus become dynamic areas which is not predominantly used for farming anymore (Woods 2004). This underlines that the landscape is a complex system.

Policy, landscape governance and economics are essential phenomena to understand the processes of landscape change (Hersperger and Bürgi 2010). In the past, land use economies and policies were defined at national levels, however, after the establishment of the European union, with common market integration processes, national policies and economies became more and more Europeanised and affected by global trends and developments (Brussaard et al. 2010). Today, European land use and environmental policies affect all member states, and transposition of EU-law shapes national and regional land use. Also the European economy drives landscape change ever more.

3.1.3 Tools for landscape analysis

There have been many studies, with different methods, to assess the processes of landscape change. A review from Plieninger et al. (2016) of 144 studies on drivers of landscape change showed that most studies assessed only one case study area at one local spatial scale and they therefore recommend studies that rather do cross-site and cross-country comparisons. They found that some regions are not well covered, e.g. the boreal, steppic and arctic landscapes. Plieninger advocates the use of more robust tools and methods to assess quantitatively the causalities of landscape change, which also identify and assess the role of actors (Plieninger et al. 2016). Other studies analyse the drivers of change, and proximate causes of change, but ignore the role of institutions and actors in the landscape change process. In urban development it was found that the local actors, their coalitions and financial resources typically defined the outcome of the process (Hersperger et al. 2014).

It is possible to deduce what change processes do occur through an integrated approach with different techniques (spatial analysis, in-depth interviews repeated over time), and occasionally such studies are done at a local or regional scale (Pedroli, et al. 2013; Vos and Stortelder 1992). However, this does not provide answers with regard to the origin of changes, and also changes with limited visibility are often not identified (small landscape elements, biodiversity). Recently, some studies focused on the drivers and not so much on the complex system that the landscape is. Van Vliet et al. (2015) in a review of 137 case studies analysed the underlying drivers of agricultural land use change, and highlighted the role of farmers' decisions in land use change. Major landscape change trajectories were related to globalisation of agricultural markets, the transition from rural to urban society, and the shift to post socialism in Eastern Europe (Van Vliet et al. 2015). This meta study however does not identify in greater depth the role of actors, or restricts this mostly to the land user (Van Vliet et al. 2015). Kristensen et al. (2016) approached the process of landscape

change from the farmer level, based on interviews. They found that farm size and ownership of livestock are of particular importance for landscape activities. Jepsen et al. (2015) analysed the temporal dimension of landscape change for different regions, from 1800 AD till now, to identify key periods of landscape management and the underlying drivers of change. They found strong similarities between countries, that were often related to institutional reforms and technological innovations.

What these studies did not address are the processes of change at different scale levels simultaneously, in relation to the role of stakeholders in this process as a crucial part of social-ecological systems. This requires a tool that can analyse the complexity of the landscape system as well as the dynamics of the system, that can be implemented at the landscape level, and has a focus on stakeholders (agents of change and those that perceive the landscape quality). This chapter introduces Fuzzy Cognitive Mapping (FCM) for this purpose and discusses its usefulness.

3.1.4 Objective of the study and approach

The aim of this chapter is to understand better the drivers and process of landscape change. We use Fuzzy Cognitive Mapping (FCM), a system dynamics model that takes a systemic approach. System Dynamic models differ fundamentally from agent-based models that take the agents as entry point. Through FCM we describe the landscape system as perceived by stakeholders and the role of policies and other drivers that affect the European landscape.

Fuzzy Cognitive Mapping is a participatory tool that builds upon perceptions of stakeholders in order to describe a social-ecological system and its agents of change. Since stakeholders represent the social subsystem, and are moreover knowledge holders of the ecosystem, they are assumed to be essential for analysing the landscape system as a whole. In short, FCM can help to describe the dynamics of complex systems. FCM in this case is implemented at the landscape level since landscape changes are defined by environmental conditions, multi-scale level policies and landscape governance, economic factors as well as the social fabric of land users and the population. Through FCM we studied the mechanisms of change in six different case studies in Europe, a meta-analysis of the processes and drivers of landscape change. More than in recent studies of drivers of landscape change we focus on the complex system that the landscape is: Are the driving forces of landscape change linked to technological improvements, to incentives, to policy changes, to cultural/social evolutions? At what level are these evolutions shaped (local, national, European)? What factors are affected by the drivers of change?

3.2 Methods

3.2.1 Environmental zones and Case study selection

The classification of the European environment, resulting into 13 Environmental zones, formed the basis for this research (Metzger et al. 2005; Mücher, et al. 2010). We assumed at the start of our project that environmental conditions are crucial factors or drivers of landscape change. We located six regional case studies in six selected environmental zones (Figure 9), which were based on study areas of a large FP7 project VOLANTE, with two additional cases to cover the wide range of landscapes of Europe. The environmental zones are the boreal/nemoral zone (Estonia), atlantic/continental zone (Denmark), continental/pannonian zone (Romania), alpine south (French Alps), the atlantic/Mediterranean north (Portugal) and Mediterranean south (Greece). Workshops were held in these environmental zones we consider as representative for much of the European landscapes and encompassing the environmental variation in Europe (Van der Sluis et al. 2015). For the readers' convenience reference is made to the countries, not to the environmental zones.

3.2.2 Fuzzy Cognitive Mapping

FCM is frequently used to describe complex systems, with many interdependencies and relations between the variables of the system (Penn et al. 2013). FCM consists of a graphical representation of the system in which the factors are described that influence a core problem. Then the links of influence between all factors and their intensity are defined. The importance of FCM lies in the possibility to define how strong political drivers are in comparison with e.g. environmental and economic drivers of change, and it allows for exploring informal knowledge on the complex processes of landscape change. Crucial in the whole method of building participatory models, is the fact that stakeholders determine the strength of all relationships. It is a carefully designed process in which it is first established whether a relationship exists (0 or 1) and which sign it has (+ or -). In a second stage, the relative strength of relationships is determined, which can either be a linguistic class ('weak' or '++') or an interval variable ('0.2'). For various reasons, the system, its components, and the relative strength of relationships cannot and should not be validated. In short, they are stakeholders' opinions of a causal relationship between factors, which exist if they exist for stakeholders. FCM has been used in various types of research, e.g. to analyse the dynamics of deforestation processes (Kok 2009) in relation to securing livelihoods (Diniz et al. 2015), understanding the development of a biobased economy (Penn et al. 2013), and the development of participatory environmental plans and resettlement of people (Özesmi and Özesmi 2004). The theoretical foundations of FCM have been dealt with in detail in other publications (Jetter and Kok 2014; Kok 2009; Penn et al. 2013; Soler et al. 2011).

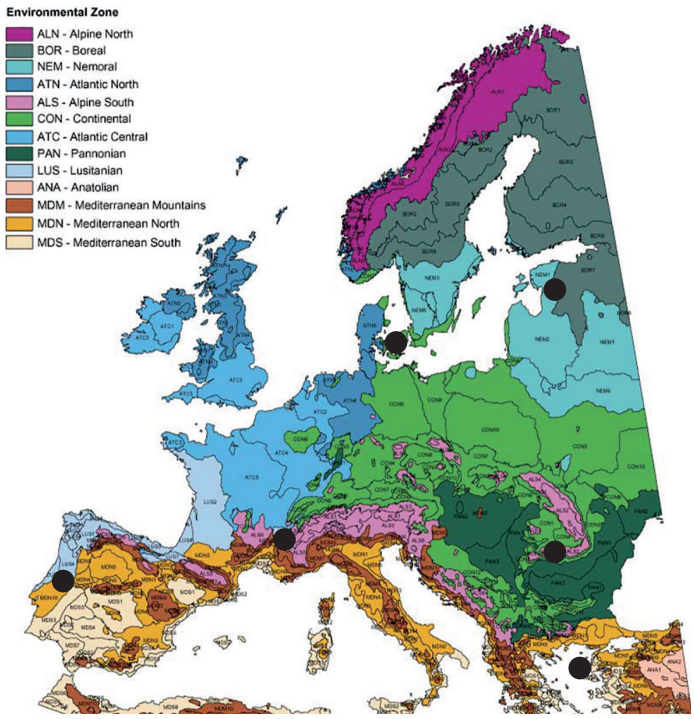

Figure 9: Environmental zones of Europe (Metzger et al. 2005). FCM-workshops were held in the boreal/nemoral, atlantic/continental, continental/pannonian, alpine south, and Mediterranean environmental zones. Black dots indicate the locations where workshops were held, mostly in capital cities.

By using FCM, we study the relationships between driving forces and resulting landscape change. In practical terms, knowledge about the relationships between drivers of change and factors affecting the landscape is translated into simple vector algebra, and used to provide visual output in the form of graphs. We used Excel to describe and analyse the properties of the system and its internal feedbacks when iterating the multiplication of the change vector and a matrix representing all relationships (Kok 2009).

2.3 Regional workshops

In every zone a workshop was held for which experts were invited in the field of land use and landscape change. The experts provided their insights on the drivers of change, the relationships between those drivers as well as their relative importance. By ranking the drivers of change, insight is gained in the relative importance of different drivers and regional variation in landscape change processes (Soler et al. 2011). The credibility of the results of the workshop are very much dependent on the number and 'quality' of the participants. Therefore, we aimed at a minimum of 20 experts with in-depth knowledge of land use and landscape change processes for each workshop. The participants should represent different sectors of society, from different backgrounds: ministries, decentralised government, farmers' organisations, research, hunting, tourism and conservation. Discussion among such experts with different backgrounds will ensure a comprehensive view on change processes, and should provide a reliable picture of processes of change. In Portugal the discussion focussed on land use change, which is better understood in the Portuguese context, this is however strongly related with the landscape and interpreted as such.

For each of the six cases, a meta-analysis was executed of drivers and factors that constitute the process of landscape change. Since it is too much to discuss all these cases in detail, we follow a 'nested approach' here: the Southern Mediterranean zone (Portugal) and the boreal zone (Estonia) are presented in more detail. These cases are contrasting from an environmental point of view, but also differ politically (EU-membership) and culturally. In addition, the Portuguese and Estonian case studies constitute regions which have not been covered well in literature thus far (Plieninger et al. 2016).

The workshops were facilitated by the researchers with the aim to reflect in the results as much as possible the knowledge and opinions of the stakeholders. A brief introduction on the FCM methodology was given to the workshop participants. For each of the six workshops the central question was: how has the landscape in the environmental zone changed over the past 25 years? All workshops followed the same procedure: in the first stage the concepts of landscape change (factors) were identified by the individual experts. The input of the experts was anonymous. Because of existing overlap, factors were organised and grouped together in a joint exercise. The final number of factors varied between 10-12, depending on the region. Subsequently the participants discussed what would be drivers of the system, i.e. factors that are not influenced by other factors. In the next step, participants discussed the causal relationships between the factors which play a role in the identified change processes. The stakeholders also assessed whether the relationship was 'enforcing' and they identified the relative strength of the factor at three levels. The impact on the landscape was assessed as positive or negative, based on the change in quality of the landscape and the multiple services the landscape provides to the stakeholders (Martín-López et al. 2012).

The workshops resulted in Fuzzy Cognitive Maps developed in discussion with the stakeholders. Post-processing was required, either to simplify the FCM, to make the maps more uniform and results comparable and factors being labelled in the same way, or to ensure that the model also works and provides coherent results. The workshop report with the revised map was distributed to all participants, with the request to provide feed-back, in particular whether the discussion of factors was correctly interpreted. Where necessary, corrections were made to ensure proper interpretation and processing of the data.

3.3 Results

3.3.1 Meta-analysis of landscape change

Main components of the FCMs in the six case studies are presented in Table 9. The cultural factors are usually strongly related: demography includes where people settle or whether they migrate to or from the cities, and this is also related to other cultural factors such as values and attachment to the land. Lifestyle is more related to

	Cultural			Technology				Economy/market						
Environmental zone (country)	Demography	Lifestyle	Cultural values	Agriculture & agr. innovations	Agro-industry	Animal husbandry	Permanent crops	Global economy	Regional economy	Natural resource use	Land ownership	Market prices	Funds, subsidies	
Mediterranean south (GR)			x			x	x						x	
Mediterranean north (P)	x	x		x				*			x			
Continental & Pannonian (RO)	x	x		x						x	x	x	x	
Alpine south (F)	x	*						*	x					
Atlantic (DK)	x		x	x	x			*						
Boreal & Nemoral (Est)	x	x		x					x	x				
	11			7				12						

*Table 9: Factors (**x**) and drivers of change (*****) based on 6 FCM-workshops in different environmental zones.*

processes of globalisation and the digital economy, but also to trends such as increased demand for healthy products or ecological food. The governance system refers here to the interactions between different government agencies and stakeholders in decision making. The policies can be largely overlapping, since national policies are usually strongly linked to European policy, and both may include conservation policies. Usually it depended on the weight that participants attributed to certain aspects of a factor how it would be classified in the workshop. Environmental factors include pollution and climate change, but also natural succession.

Asked for the drivers and processes of landscape change over the past 25 years, the experts mentioned a variety of drivers. Policy and legislation were perceived as very important in all cases, since it recurs 15 times as a factor in the Fuzzy Cognitive Maps of which 5 times as driving factor (Table 9), and in the Mediterranean south (Greece) even both drivers resort in the policy and legislative domain. Only in the alpine south and Mediterranean north (Portugal) economy rather than policies are perceived as the main driver. The second important driver is the 'global economy', in France, Portugal and Denmark. Economy relates on one hand to the process of globalisation, on the other hand to markets and prices for food, feed and fibres. Also transport and

	Transport & infrastructure				Policy, legislation				Environment			Sum
	Urbanisation \ sprawl	Roads \ infrastructure	Mass tourism	Small-scale tourism	National Policy \ regulations	EU-policy	Governance system	Sectoral policy	Natural succession	Pollution	Climate	
	x	x		x		*	*	x		x		11
	x	x	x			x	x	x	*			12
		x			*						*	10
		x	x	x		x	x					9
		x		x	x	*		x			x	11
	x			x	x	*						9
	14				15				4			

infrastructure is frequently mentioned as a factor of landscape change (in total 14 times), but never as a driver, mostly infrastructure was driven by policy and legislation. Technology was likewise never considered to be a driver of change. Technological drivers affecting the landscape are mostly related to technological innovations which drive changes in agriculture. Transport and infrastructure relate to all aspects of settlement, settlement patterns and roads, including recreation and tourism development. Environmental policy includes regional, national and European policies, the spatial planning system and its implementation, and farming subsidies or policies for energy supply, of which many are inspired by European policy. Environmental drivers are climate change and natural succession.

3.2 Results of the Portugal and the Estonia cases

General characteristics of the two fuzzy cognitive maps are described in Table 10. The density of relationships is high in both cases, although slightly lower in Portugal, which could be related to less complex landscape change processes. The number of drivers is relatively low (2 resp. 1 for Portugal and Estonia), as is the number of receiving factors (1). The lower density of relationships might indicate that Portugal has a slightly simpler system of landscape change, despite the fact that the FCM has more factors (12) than Estonia (9), and more relationships (36 versus 25).

CHARACTERISTICS	PORTUGAL	ESTONIA
Number of factors (N)	12	9
Number of relationships (R)	36	25
Maximum of relationships (MaxR)	132	73
Density (C/MaxR) (D)	0.27	0.34
Positive relationships	29	20
Negative relationships	7	5
Number of receiving factors	1	1
Number of drivers	2	1

Table 10: Key characteristics of the Fuzzy Cognitive Maps.

Case study Portugal

Context: By the middle of the 20th century the maximum territory of land was used for agricultural production and all rural life in villages and rural settlements was related to agriculture. This however has changed, and also in Portugal rural space is more and more seen as a space for living and consumption (Breman et al. 2010). They also note that traditional agricultural activities have been replaced by new uses, which is extensification and not land abandonment. With EU subsidies much of the land has

been planted with forests, resulting in extensive management and use of land, not necessarily land abandonment (Breman et al. 2010). Since the 1990s the Portuguese rural landscape has been drastically changing as a result of the CAP, but subsidies also resulted in forest plantations, of mostly exotic species such as pine trees (Van Doorn and Bakker 2007), a development also observed in Northern Spain (Corbelle-Rico et al. 2015). In recent years neo-rurals and lifestyle farmers have settled and taken over traditional farming areas, with its own dynamics and impacts on the landscape (Pinto-Correia et al 2016).

The FCM shows how stakeholders see the system. Initially, stakeholders identified 22 factors for the Fuzzy Cognitive Map for Portugal (Figure 10). Slight adjustments were made to the FCM afterwards: some factors were combined, few were eliminated, which reduced the FCM to a total of 12 factors and 36 relationships. The factor 'social cohesion' was more related to demographic processes, and was therefore renamed 'demography', also closely linked to the factor 'urbanisation', which has more a focus on settlement process in and around major cities.

Two drivers were identified: the 'global market economy', and 'natural drivers'. The Global market/economy is a strong driver [+1] of landscape change, and affects most 'EU policies and national policies', but also 'forest policy', which is treated as a distinct factor due to the importance of forests for the Portuguese landscape. The main spatial policies operate mostly through the governance system and result in demographic changes and urbanisation which cause a negative change of the landscape. Also farming technology (changes in spatial arrangement of land, industrial agricultural production) exerts a negative impact on the landscape. These processes have a homogenising effect on farming and other land uses which form the fabric of the landscape.

Natural drivers [+1] entail vegetation recovery after land abandonment, and climate change (here: changing rainfall patterns, increased aridity and soil degradation). Also natural drivers affect the demography and farm technology, both have a negative impact on the landscape and the services it provides. Tourism is partly small-scale, heritage oriented tourism with a positive impact, and some mass tourism stimulating coastal development, where the negative impact is dominant. Tourism is the only feed-back of the system: the quality of the landscape will positively affect tourism. This is however of limited impact on the whole system.
The role of the governance system stands out as important, and all policies operate through this system. The many different institutions involved in landscape policy point towards institutional shortcomings and a lack of policy integration. Effective spatial planning is lacking and planning is not focused on containing urban boundaries, which often results in urban sprawl in rural areas, with a negative impact on the landscape.

The dynamic model shows that the 'Landscape' (i.e. landscape quality), after a short positive response, declines, and after some fluctuations stabilizes at a much lower

level, below all other factors (Figure 11). This can be interpreted as a system whereby different factors interact, and the compounded result is a landscape which is much worse-off than it was at the beginning. In particular farm technology and the governance system are increasingly influential, whereas tourism and to some extent lifestyle are showing a decline as well. In particular small-scale tourism is affected because of the decline of landscape quality, mass-tourism is less likely to be affected. Urbanisation and farming technology have an overriding negative effect.

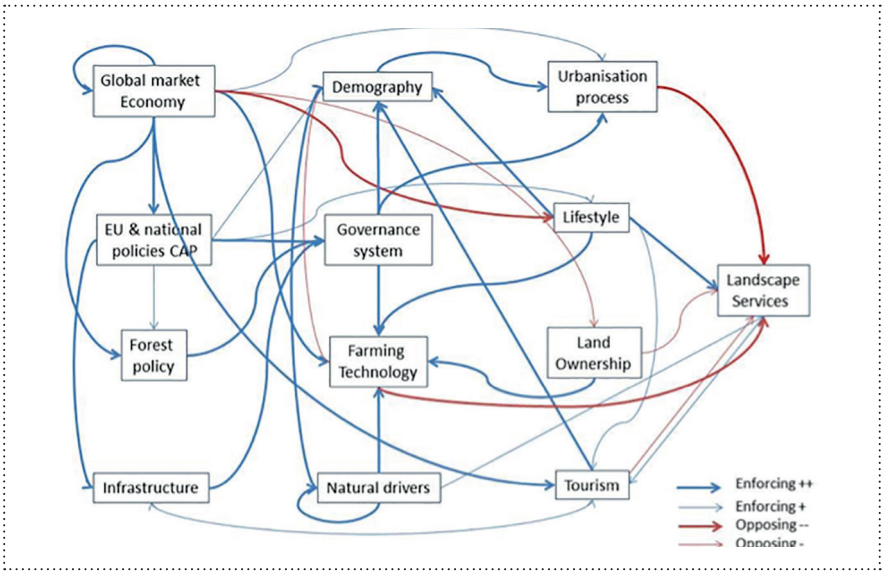

Figure 10: Resulting Fuzzy Cognitive Map for landscape change processes in the western Mediterranean as perceived by experts in Portugal.

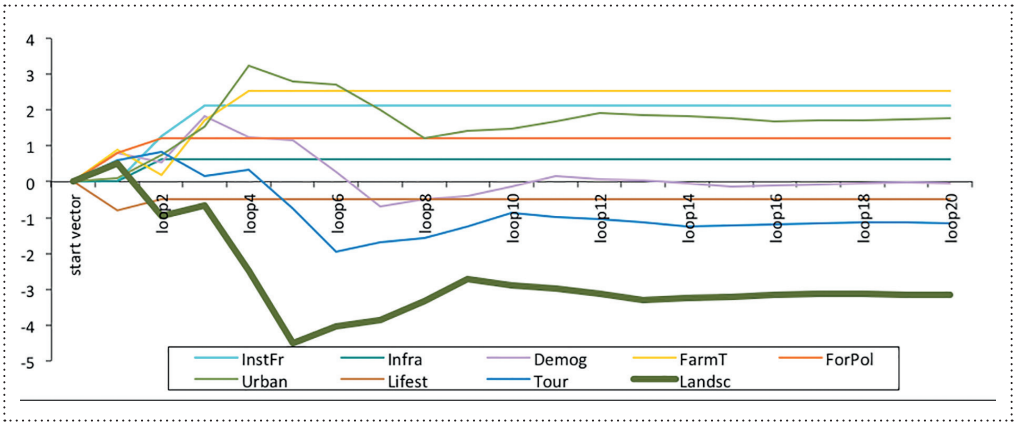

Figure 11: graph for landscape change processes for the Northern Mediterranean (Portugal).

Case study Estonia

Context: In Estonia there seems to be not such a clear notion of a 'traditional landscape'. Usually the landscape which developed before World War II (the end of the Republic of Estonia) is considered as traditional, with small-scale farming, the average size of farms at that time being approximately 22 ha. The USSR brought tremendous changes in Estonia, with scale enlargement, the first collectivisation in the late 1940s, then large-scale amelioration and a more industrial approach to farming. During the Soviet era, arable land decreased by nearly 405,000 hectares, much becoming forest. In 1990 there were 221 collective and 117 state farms with an average of 350 to 400 workers each (Jullinen et al. 2000). After the independence of the Republic of Estonia the 1991 land reform started: land was restituted to the former owners of 1940, the year Estonia was occupied. The reform of Estonia's agricultural system began already in December 1989 with adoption of the Law on Private Farming. Despite the fact that the number of private farmers increased rapidly, land was abandoned in marginal areas (Schneeberger et al. 2007). In the 1990s there were no subsidies for famers anymore and many of them stopped farming. Only from 2001 onwards financial support is provided to land managers, for mowing and grazing of protected areas and potential Natura 2000 sites. Since Estonia joined the EU in 2004, farmlands have been cleared again due to increased land pressure, as a result of an increased demand for agricultural products and availability of subsidies. Between 2003 and 2010 the area of permanent grassland and meadows grew by 18.2 %: from 250,400 ha to 296,060 ha (Agricultural Census in Estonia, 2012).

Initially the stakeholders identified 23 factors for the Fuzzy Cognitive Map for Estonia. Combination of some factors resulted in a total of 9 factors and 25 relationships (Figure 12). The participants defined several closely related factors, like 'political processes', 'disintegration of the USSR', followed by 'EU-membership' and 'introduction of EU subsidies'. All these different factors were combined in one driver, 'EU-policy', in order to reflect the current situation. Another amalgam of factors is: 'transport', 'urbanisation' and 'urban sprawl', in this context aspects of the same phenomena, that we therefore combined as 'transport & urbanisation'. 'Depopulation' and 'Abandonment & marginalisation' finally were considered two sides of the same coin and labelled 'demography'.

The only driver of the system is 'Political change & EU policy' [+1], which is narrowly linked with Estonia joining the EU and implementation of European legislation (Figure 12). EU policy steers the national and regional policies. Some European policies (N2000, Structural Funds and the LIFE program) have a direct positive effect on the landscape: for example, payments for maintaining Natura 2000 habitats in farmland are much higher than farm subsidies. Also recreation and cultural heritage have a positive impact as a result of changes in lifestyle and appreciation of the landscape. Nonetheless, the national/regional policies all have a negative impact on the landscape, through demographical change, transport and urbanisation, agricultural intensification and unsustainable use of natural resources (Figure 13). The economy and agricultural

technology affect demographic patterns which – as a result of lack of planning control – also leads to negative impacts on the landscape. The experts identified no feedback loops from landscape quality level back into the system.

The dynamic model for Estonia shows the direct positive impact of EU policy: in the first iteration the line indicating the Landscape is positive. However, in the following loops the triple negative factors (demography, agricultural intensification and use of natural resources), with some delay, influences the landscape quality that declines and stabilises at a much lower level.

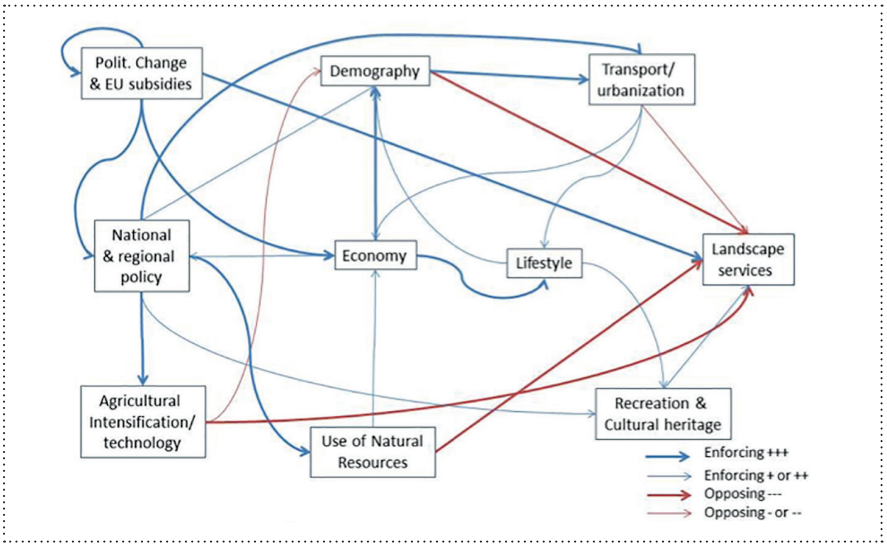

Figure 12: Resulting Fuzzy Cognitive Map for landscape change processes in the boreal and nemoral region, as perceived by experts from the Baltic states.

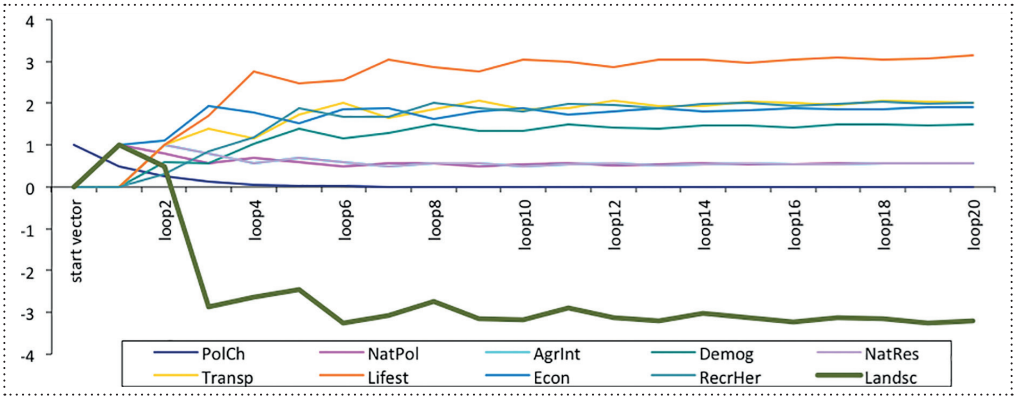

Figure 13: graph for landscape change processes for the boreal zone (Estonia).

The stakeholders' representations of the landscape system show in both cases a

rapid decline in landscape quality: In Portugal this is related to the farming system and institutional framework, in Estonia to lifestyle and economic changes which affect the demography. In Portugal natural drivers and the economy drive the system, in Estonia the EU-policies. Two factors (one of which is a driver) are unique for Portugal: natural drivers and the governance system (Figure 14), all other factors are comparable in the two cases.

3.3 Overall results of the six cases

Also most of the other case studies show a decline in landscape quality, predominantly through demography and urbanisation, but everywhere through a different constellation of drivers and factors. Only for Romania the landscape quality shows slight improvement as a result of policies that have a positive impact on the landscape, at the detriment of the economy. However, another study highlighted that much of the landscape changes had taken place long ago, which had resulted in a rationalised, large scale landscape (Snoeijer 2014).

Still, there are geographical differences, in Northern Europe economic forces are perceived to be more dominant, in the south the role of the government is more pronounced. The governance system is a factor mentioned in particular in the Southern Alps and the Mediterranean. The governance system generally includes formal laws, procedure, and informal conventions, customs, and norms which, in the discussion with stakeholders, often turned out to be an obstacle for good implementation of legislation. For Portugal was explained how in the 1990s the planning system changed, which resulted in scattered urbanisation and subdivision of farm plots. This resulted in many political compromises, not 'technically supported'. Now the spatial plan has become guiding in most cases, but still there is no shared vision of stakeholders on the role and value of landscape. There is a conflict between public and private interests and there are misconceptions of land property rights. This gives way to poor implementation of spatial plans and economic land speculation. The system results in unclear policy interpretation, thus hampering implementation. Clarification of roles and responsibilities in different government layers would be a first step to overcome such institutional inhibitions.

Over the six case studies, we identified two dominant driver categories: 'policy and legislation', and 'economy and market'. Dominant drivers are EU policy, and the global economy, and in all zones at least one of these drivers is dominant. These drivers, although not negative in themselves, affect the system mostly negatively. For example, policies and economic developments result in expansion of infrastructure, demographic changes, urban sprawl, and/or fragmentation, which ultimately have a negative impact on the landscape quality. Despite some policies with clear positive impacts (e.g. in Estonia, Romania and Denmark), other sectoral policies in combination with other factors have an overriding negative impact.

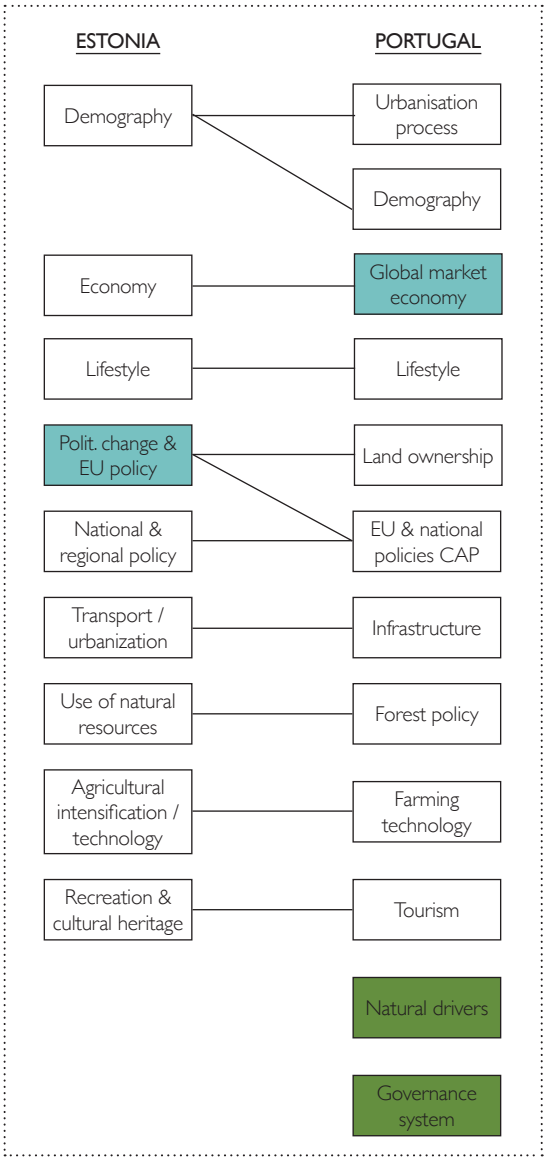

Figure 14: Comparison of factors and drivers (blue and green) for Estonia and Portugal.

The factors that have a positive impact are few: mostly it is related to feed-back loops, related to (eco-) tourism development, such as in France, Denmark and Estonia. Often these factors are not so strong, or overshadowed by the impacts of e.g. mass-tourism that results in concentrated infrastructure development (roads, development of resorts).

The global economy and European policies are the most important drivers in the case studies. The global economy defines prices for agricultural products, which means e.g. that Portuguese farmers have to compete with New Zealand farmers. The global economy has a strong influence on the EU-policy, which is guiding in most territorial policies, funding and subsidy schemes and it defines the framework conditions for farming. Most important, according to the stakeholders, are CAP, LIFE and Rural Development Program RDP. At the same time, various measures cause landscape change, such as urban sprawl, road infrastructure development, or biofuel crops: the (un)intended effects of policies are hard to predict, and are partly a result of how the political system functions. The younger generation often has no ambition to continue farming and leaves to urban areas. An example is the Portuguese institutional system, which is not capable to restrict nor guide the urbanisation process due to uncontrolled demographic changes. The stakeholders described that many different institutions are involved in spatial planning, but there is no shared vision nor effective coordination among them. As a result, construction in the countryside is not contained. With available EU funds (e.g. European Regional Development Fund, Cohesion Fund), this resulted in uncontrolled development, land grabbing for speculation purposes, and a strong decline in landscape quality, all effects that were not foreseen in the formulation of the RDP. The unintended effects of policies were also discussed by Pedroli et al. (2016), describing agricultural and market policies being dominant at European level. Environmental and societal concerns can thus only take place at European level, which results in the local farmer and community loosing autonomy. Such complex relationships are typical for the landscape.

Indeed, all landscape systems are complex, also according to the stakeholders: They are multi-scale, often with multi-layered governance models (EU-policy, regional policies, sometimes a complex governance framework) with complicated relationships between areas (Schneeberger et al. 2007). An example is the case for the Alps, France, where people live in an appreciated landscape, buy their grocery products in cheaper stores in France and work in Switzerland for better income: 'migration d'agrément'. This results in transport infrastructure, changed land use and finally segregation in society and associated cultural changes. In Portugal and other Mediterranean countries the changes may be strongly rooted in traditional cultures and lifestyles (Pinto-Correia et al. 2016). Feed-back mechanisms are not common, these were only reported in Denmark and Portugal, where the landscape quality has positive effect on recreation. According to stakeholders the good landscape quality also attracts newcomers settling in the countryside. An attractive landscape nearby towns and the availability of older farms and houses that are possibly abandoned, or not used, results in a reversed trend and creation of 'lifestyle farmers' in some cases.

3.4 Discussion

The in-depth assessment of the selected cases shows the variation in processes, and how the drivers of change affect landscape planning and landscape quality through various factors. It illustrates how – through different pathways – the global economy affects processes like urbanisation, scale enlargement, as well as marginalisation of farming. As a result different landscapes may evolve in a same direction.

The choice of case studies was based on environmental zones variation, under the assumption that environmental factors would be dominant in landscape change. However, the analysis shows that environmental drivers play only a minor role in landscape change processes, limited to Climate change (Romania, Denmark) and Natural succession (Portugal). Although climate change was mentioned in discussions with stakeholders a few times, it was so far rarely considered a driver of change. This might be explained by the fact that in the workshops we looked at the processes of change over the past 25 years, and the effect of climate change is only surfacing recently. The environmental stratification of case studies turned out to be less relevant.

FCM shows that it is not just globalisation or European policy that results in a perceived decline of landscape quality, but it is often an outcome of parallel processes, that all head in a direction of landscape decline. The additional value of FCM to analyse the processes of landscape change is that it identifies this chain of factors that play a role. Studying aspects of a complex system like landscapes in isolation will not allow such in-depth understanding of the processes of change. FCM makes it possible to explore the knowledge of what local experts perceive as major drivers of change. The experts in the workshops were knowledgeable people well-versed with European policy and its impact on the landscape. Therefore their interpretation of the impact of e.g. regulations on the landscape gives important insights in how policy translates at the regional or local level. At the same time this interpretation is subjective and may differ from what model output suggests. However, the strong points of FCM are the semi-quantitative approach and it produces storylines, which provides insight in the processes of change (Kok 2009). More tools and mixed methods may be required to improve the assessment. Weaker points for FCM are data and literature availability to identify causal relationships, as well as semi-quantification of relationships (Soler et al. 2011): FCM provides no hard scientific answers. In that respect it differs from the traditional scientific approach, which is founded in empirical research and causal relationships. The advantage is that through informal knowledge systems we can describe the processes of change, and quantify them to some extent.

The observed, unintended landscape changes require a different approach for future landscape services. An integrated landscape approach (Sayer et al. 2013) could offer a new perspective for future development, which would suit complex SES such as we found in our study. This landscape approach gives due consideration to: (1) different stakeholders, sectors and scales in a landscape (2) adaptive and participatory

management of change processes; and (3) social learning and capacity building. Hence, contrary to classical policy making, that is highly expert-driven and sectoral in nature (e.g. agriculture separate from forestry), it aspires to be an integrative, participatory and reflexive approach. Part of it is what some scholars coin 'landscape governance' (Buizer et al. 2016; Görg 2007; Van Oosten et al. 2014). This concept calls for considering governance processes – the steering of social change in accordance with public aims (Arts 2014; Kooiman 1993) – against the background of the 'bio-physical conditions of landscapes' on the one hand and 'the politics of scale' on the other. The former reminds us of the physical boundaries and limits of the landscapes we live in, the latter of the political construction of borders, areas, sectors and their qualities. It is within this paradoxical situation of 'natural determinism' and 'social voluntarism' that landscape governance needs to address the various landscape challenges, as identified by landscape scholars and stakeholders, such as in this chapter. Too often, policy makers rely on sectoral engineering of landscapes, while underrating their socio-economic and ecological coherencies and feedbacks. Landscape governance should redress these shortcomings.

Opdam (2014) observes that policy tools developed for landscape management, such as the European Habitat and Water Framework Directives or LIFE-Nature, do not allow for adaptive governance at different scale levels. This is also observed in the case studies, where most policies operate at the national level, few funding tools like LIFE operate at the landscape scale (Estonia, Romania). In Denmark a complaint was the lack of nature conservation funding through e.g. RDP or LIFE program, the complexity of financing systems, and bureaucracy for farmers (Van der Sluis et al. 2015). The designation of N2000 has influenced almost all landscapes, but also the spatial zoning in the various countries is very influential. Policy and legislation can balance to some extent market forces that also exert much influence on spatial development. The aspect of governance and how institutions involved in the implementation of policy function in the end will be very decisive in the effectiveness of a given policy (Frederiksen et al. 2017).

3.5 Conclusions

The stakeholder perspective on the process of landscape change provides important insights in similarities and differences in different regions of Europe. Through FCM and the experts involved, the changes are observed from a human perspective, which is in line with the approach of the landscape as a social-ecological system. The resulting FCMs learn us that there are fundamental differences in the change processes across Europe, that require policies that are not a 'one size fits all', but rather integrated approaches.

Still, except for Romania, we found in all case studies that the landscape quality deteriorates. EU policies such as the CAP, RDP and N2000 are very influential according to the participants in the FCM workshops. This is through indirect

relationships and impact on national policies, and despite the fact that EU policies in principle aim for positive impacts on landscape and biodiversity. In Estonia we observe that EU-policy is strong with regard to implementation of the conservation agenda, with targeted funding through e.g. LIFE-nature for farmland restoration and EU structural funds, that generally exceeds the subsidies from the CAP. At the same time groundwater quality in some regions has declined due to more intensive agriculture based on subsidies. In other regions the EU-policy in particular enhances those factors that affect the landscape quality negatively. Clearly, the processes that occur in different regions of Europe require a more coherent approach. A better screening of the landscape impact of policies is required, such as the required biodiversity proofing since 2011 as part of the EU biodiversity strategy. This study underlines the need for such a 'landscape proofing' as a cross-sectoral measure.

European policies – for instance CAP – could gain in effectiveness when focusing on the identified drivers and trajectories of change. Landscape structure, biodiversity and other ecosystem services could benefit from this approach. FCM provides important complementary information on processes of landscape change, as it allows for the combination of expert-gathered data with 'hard-fact' map data.
From the six case studies we conclude that there are different processes of landscape change. Many factors have negative impact on the landscape and the services provided. Based on the FCM the following short-list of factors are identified, that generally have a positive impact which could help improving landscape quality:

- small scale recreation and tourism
- targeted subsidies in support of landscape quality
- support for farmland restoration and traditional management
- lifestyles which respect traditional landscape values
- organic farming
- forestry policies which support autochthonous forest resources
- policies in support of permanent crops

To ensure an improved allocation of land resources and to safeguard that the landscape also in future will meet the societal demand for landscape services it is important that governments set proper policy strategies: a planning system which is more in control of preferred development pathways. The landscape governance approach as touched upon in the above is promising, as it opens up much more space for stakeholder involvement, policy integration and social learning, compared to current sectoral and expert-driven policies. It promises to better meet the socio-ecological conditions of regions and countries, while being flexible enough for considering different governance scales at the same time.


3



Schst.
Bad
Gosauzwang
Soleleitungsweg
Schst.


Obersee
Schattau
Hst. Halltatt

Chapter 4

The impact of changing land use on the provision of landscape services –

a case study assessment of European landscape transitions

Van der Sluis, T., Frederiksen, P., Kristensen, S. B. P., Pedroli, G. B. M., Buschk, A., Pavlis, V., & Cosor, G. L. (submitted, Landscape Ecology).

Abstract

The European countryside has changed substantially over the past decades.
We studied gross landscape change in six case study areas in five countries, and assessed what the impact is on the provision of landscape services in the past 25 years.
We classified land cover changes as landscape transitions for the case study areas. The changes in landscape service provision are discussed in the context of Holmes' land users occupancy framework, in which the modes of occupancy (use of rural space) of land owners and managers together with the socio-economic context, define the outcome of the landscape transition process.
In the case study areas a large variation in influences of various EU policies can be deduced from the landscape transitions, reflecting drivers of change related to specific societal contexts. In the past 25 years the observed changes in land use are relatively small, with a dominance of urbanisation and afforestation processes. However, the specific landscape services affected by land use change in the cases studied are clearly reflected in a decline in provisioning services, whereas inspirational effects (cultural services) are positive in the cases with low urbanisation pressure and negative in places with higher (peri-)urbanisation pressure.
Although there are many EU policies that lead to land use change, the local societal and environmental context determine to a large extent the specific associated landscape transitions and resulting changes in the suit of landscape services. Policies affecting land use should better take into account landscape services as they are perceived locally.

4.1 Introduction

The character of Europe's countryside is rapidly changing (Primdahl 2014; Rounsevell et al. 2012; Van Vliet et al. 2015), as a result of urbanisation, changing demographic patterns, climate change, changing societal demands and new economic functions (EEA 2015). This is reflected in landscape changes, the most prominent of which are an increase in artificial surfaces and forested areas and a decrease in arable land and pastures. Going beyond the directly observable landscape change in its temporal and spatial dimensions (Tress and Tress 2001), we define landscape transition as a long term structural change in Land Use and Land Cover which affects both the type of services provided, and the physical aspects of the landscape. It explicitly includes changes in land use or in the intensity of use. Transitions can take place e.g. from forest to urban area, or from agriculture to forestry, but also from permanent grassland to improved grassland.

From 2000 to 2006 the net annual change across 36 European countries was 1.3% (EEA 2010). Fuchs et al. (2015) compared different global data sets and calculated the area of land affected by changes during the period 1900 – 2010 and found a gross change of 56% of the total area of all EU27 states (plus Switzerland), on average a change of 0.5% per annum. Moreover, projected claims for land are much higher than what is available, e.g. to satisfy all land use needs in Denmark has been estimated to require up to 140% of the territory by 2050 (Arler et al. 2017).

A dominant driver of landscape change is the urbanisation of the countryside, which, together with land abandonment and agricultural intensification, represent major challenges for sustainable development in Europe (EEA 2015). The diverse impacts of these landscape changes have been described by many authors, such as changes in landscape identity and landscape quality (Antrop et al. 2013 ; Stobbelaar and Pedroli 2011), biodiversity and connectivity (Cormont et al. 2016; EEA 2015; Rüter et al. 2014). Furthermore the impacts of landscape changes manifests themselves in a changed composition of the associated landscape services (e.g. agricultural productivity, or recreation services) either in quantity or quality. The concept of Landscape services used in this paper refers to the goods and services provided by a landscape that satisfy human needs; this concept is further discussed below. The land user will normally manage the land in such a way that the landscape services are optimised for his/her needs and external conditions and factors. Landscape transitions are therefore a result of a change in demand for services. By 'Landscape' is meant '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 trajectories of landscape change differ largely across Europe, even within comparable land use systems: transition processes in abandoned olive yards in Lesvos (Greece) differ from those in Liguria (Italy), or Portugal (Kuemmerle et al. 2016; Van der Sluis et al. 2014). The trajectories of change can be influenced by national and international policies, environmental conditions, economic, social or cultural factors. A better understanding of the landscape transition process and its impact on the provision of landscape services may help to improve policies which can lead to a

more optimal allocation of land resources (Vallés-Planells et al. 2014). However, as Stürck and Verburg (2016) indicate, the indicators and scale which are used to assess landscape services substantially affect the outcome of the assessment, and they recommend that land use policy be adapted to location specific impacts of land use/land cover (LULC) change on landscape services.

The present paper is based on 6 case studies located in five European countries which illustrate a variety of local processes of change across the European countryside, and indicators of the derived impacts for major landscape services, meaningful for future policy formulation for land use. The goal of this study is to assess what implications landscape transitions (as identified by land use and land cover changes) have for the provision of landscape services, and whether these changes can be related to specific drivers of change. This leads to the following research questions:

- What are the landscape transitions which have occurred in the European countryside over the past three decades?
- What are the associated changes in landscape services provision?

Landscape Services

This paper focusses on the provisioning of landscape services. Landscape Services can be defined as the: 'goods and services provided by a landscape to satisfy human needs, directly and indirectly' (Termorshuizen and Opdam 2009). Landscape Services are confined to services that depend upon landscape patterns and functions. Landscape services are founded in the Ecosystem Services (ES) concept, which is based on the Millennium Ecosystem Assessment, and these include provisioning, regulating, cultural, and supporting services (MA 2005). Many Ecosystem Services are produced at the landscape scale (Huntsinger and Oviedo 2014). Landscape services are concrete, they can be spatially identified, some can be quantified, and they are value-based, i.e. they are defined from the viewpoint of the 'user' or beneficiary (Bürgi et al. 2015; Opdam et al. 2015; Termorshuizen and Opdam 2009). Main landscape services include provisioning services (crops, feeds, livestock and industrial production), regulatory services (water retention, pollination, carbon storage), cultural services (tourism, cultural heritage, housing, inspiration, hobby farming) (Hornigold et al. 2016) and supporting services & biodiversity (wildlife habitat) (Brandt and Vejre 2003). Cultural services are commonly defined as the 'nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experience, including knowledge systems, social relations and aesthetic values' (MA 2005). The concept of landscape services was developed further by translating ES to specific services that are most relevant for rural residents (Vallés-Planells et al. 2014). We use the concept of landscape services as the analytical framework to assess landscapes changes and their relevance to society.

Several approaches to characterise the processes of or landscape transitions and the related governance aspects have been proposed in the literature. The following paragraphs describe the approaches applied to the analysis of landscape transitions and suggested drivers of change and policy response.

Landscape Transition

Landscape transitions are considered the result of a changing balance between societal consumption, conservation and production (Holmes 2008; Pinto-Correia et al. 2016) and of changing modes of occupancy (use of rural space) (Holmes 2008 p. 212) of land owners and managers. Also the socio-economic context defines the outcome of the transition process. Within agricultural land use, intensification can take place if labour extensive crops change into labour intensive crops (Vos and Klijn 2000; Vos and Meekes 1999). Wilson (2007) proposes a multidisciplinary approach to assess landscape transitions, above the sectoral approaches commonly used so far, such as for forests (Oduro et al. 2015) or farmland (Van Doorn and Bakker 2007). Realising that many factors contribute to rural landscape dynamics besides agricultural production, Holmes (2008) introduces the concept of Multifunctional Rural Transition (MRT) and uses this framework to explain rural changes under the influence of certain economic conditions, landscape governance and environmental change, for parts of Australia (Holmes 2012). Holmes' framework has also been applied to study change processes occurring in Europe (Carvalho-Ribeiro et al. 2013; Pinto-Correia et al. 2016), where conditions differ considerably from region to region, especially regarding the available land resources and spatial claims on land. Holmes' framework balances production, consumption and protection: from 'mono-functional' land use (top of the triangle) towards multifunctional land use (centre); from production oriented (top) towards provision of a wider array of landscape services, such as housing, recreation (lower left), habitat function (lower right), etc. (Figure 15). Mixed farms (livestock and arable) might depend on additional off-farm activities, for financial reasons, or some might convert to other functions such as residential all together. At the same time there is increased specialisation of farming by full time farmers. Such transitions are largely linked to socio-economic changes, e.g. an ageing farming population and changing societal demands. Holmes' framework is of particular use for a better understanding of regional processes, it transcends the farm level and incorporates other aspects of land use than farming, which makes it useful to analyse landscape transitions. These conceptual considerations will be revisited in the discussion, as these explicitly allow the identification of trajectories in the dynamics of multifunctional land use as observed in large parts of Europe.

Drivers of Change and Policy Response

Landscapes are complex entities, and specific direct and indirect driving forces can lead to landscape change, while other forces result in landscape persistence and stability (Klijn 2004). The drivers in a landscape perspective (see e.g. Van Vliet et al. 2015) are external socio-economic and socio-cultural forces to the local area, that drive human activity. Human activity can increase or alleviate pressures on the landscape, leading to landscape transitions. This may affect the state (landscape composition, capacity) and the impact (on landscape services, such as pollination) and may require responses, such as the diversification requirement in the recent CAP reform. Societal responses may be in the form of policy or legislation to change pressures (the nitrate

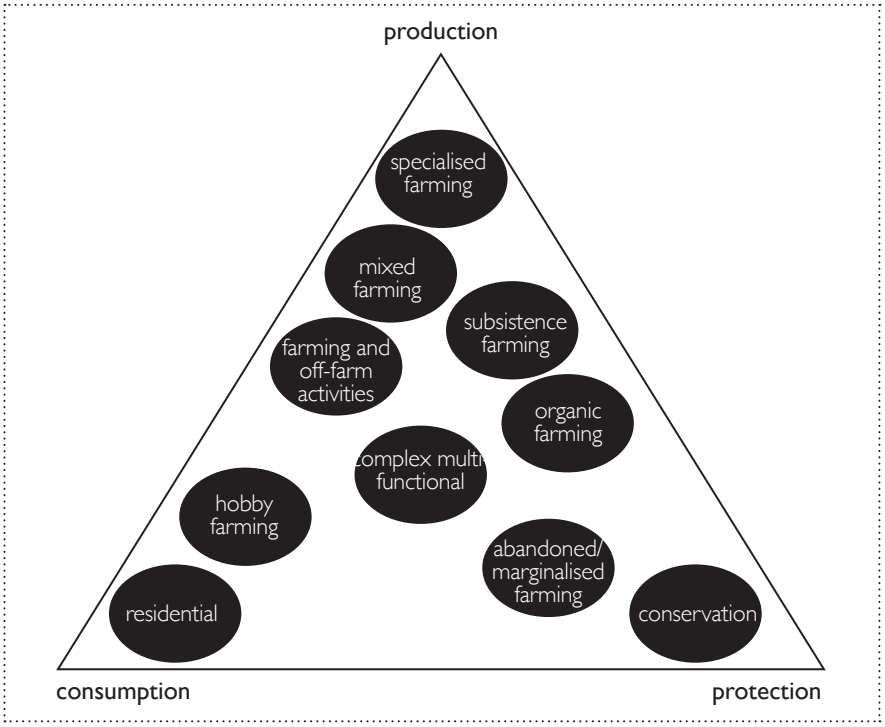

Figure 15: Use of rural space of land managers, after Holmes (2008) and Pinto-Correia et al. (2016).

regulation), but also through management, (e.g. conservation management) which is a form of adaptation of the capacity to provide landscape services, with the aim to minimise negative impacts or increasing the output of landscape service (e.g. timber, or landscape amenity). Hereby 'landscape policy' is defined as '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' (Council of Europe 2000). Policies may be a response to a driver (i.e. a 'correction' of an undesired transition), but at the same time policies can result in land use transitions (a 'proactive' approach to reach a desired state), and thus in transitions in the position of land managers as regards the balance in their use of the rural space between production, consumption and protection (Figure 15).

4.2 Data and Methods

A case-study approach was adopted to assess the landscape transitions and their impact on landscape service provision. Zooming in on the specific processes taking place in selected landscapes in Europe provides a level of detail lacking in large-scale European landscape assessments because of the scale of observation (e.g. many landscape impacts are not visible from large-scale remote sensing or land cover data).

Studying location specific impacts of LULC changes on landscape services might be crucial to detect how land managers may be implicated and what response this may solicit from landscape governance (Stürck and Verburg 2016). Ideally such case studies can be linked to European-wide observations, e.g. through remote sensing. Six case study areas were selected, in different regions and landscapes across Europe: Roskilde (Denmark), Heerde (The Netherlands), Portofino (Italy), Lesvos (Greece), and Răteşti and Stăncuţa (Romania) (Figure 16). The case study areas provide a kaleidoscope of landscape transitions in Europe and exemplify the change processes observed. The smallest area, Portofino, measures 18 km2 whereas the largest area, Stăncuţa (RO), measures more than 257 km2. They form a cross-section of European physical and cultural landscapes and are situated in Atlantic, Mediterranean, Continental and Pannonian zones (Table 11). The two Mediterranean case studies are both predominantly rural areas. The dominant land use on Lesvos (GR) is olive growing which dates back for centuries. Small-scale tourism, dispersed over the island, is gradually increasing. Portofino (IT) was previously intensively used for farm and forest products and then turned into a protected area. Land is mostly state owned, and the dominant land cover is macchia (maquis) and olive yards. Dominant land use in the Northern European case study, Roskilde (DK) is arable farming. There is a strong urban pressure on this area from nearby Copenhagen, which leads to conversion of land and farms for non-agricultural purposes (Kristensen et al. 2013). Land use is also mostly arable in the two case studies located in Eastern Europe, Stăncuţa and Răteşti (RO). In Romania the land has been state owned for almost half a century, but since 1989 at the dissolution of the USSR and fall of the communist government land ownership has mostly been reverted to smallholders again. The impact of these major changes still affects current processes of landscape change. In the central Atlantic case study, Heerde (NL), land use is mostly dairy farming, land ownership lies in most cases with smallholders (Hauser et al. 2016). The area experiences urban pressure from nearby cities.

Data acquisition and processing

A spatially explicit temporal analysis was carried out of landscape transitions in the case study areas, based on a comparison of land use/land cover maps over a longer period (at least ten years). Time series for at least two periods were used. The first period for comparison lies between 1972 (establishment of the EEC) and 1992, since EU legislation may be considered one of the key policy drivers of landscape processes in Europe in recent decades (Bürgi et al. 2004; Hersperger and Bürgi 2009; Van Vliet et al. 2015), a key theme in the analysis of this paper. The latter was chosen because from 1992 onwards the MacSharry reform of the European Common Agricultural Policy (CAP) introduced accompanying measures, as the first step towards de-coupling of farmers' agricultural support from production (Primdahl 2014). However, a pragmatic definition of the period was needed to be used based on availability of digital data for each case study area. Land use data originated from a variety of sources, in raster and vector format. For Lesvos (GR) land use maps were

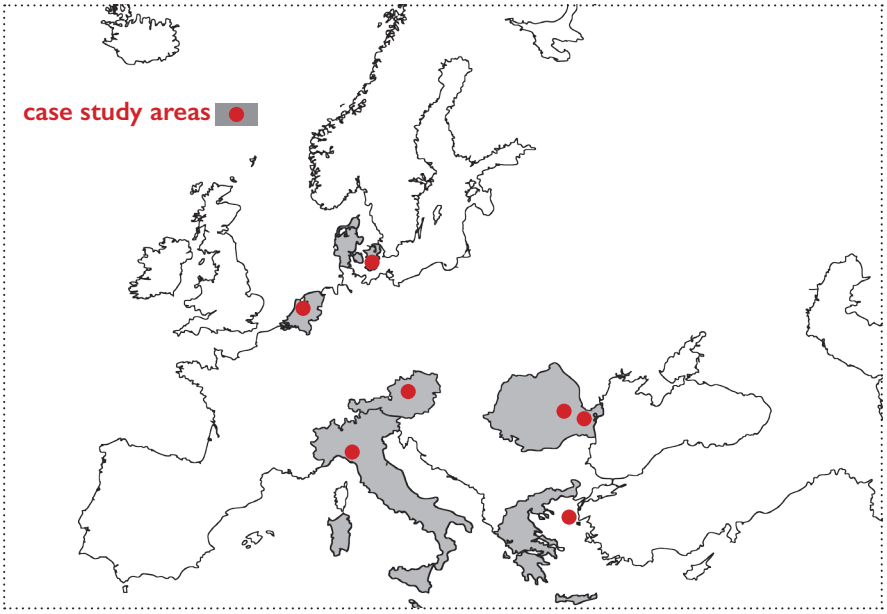

Figure 16: Location of the six case studies in five countries.

prepared based on aerial photographs, for Stăncuţa and Răteşti (Romania) maps were prepared based on satellite imagery. Maps were at different spatial scales but mostly at 1 ha. All maps were converted to raster data, grid size 10x10m. Additional field data was collected on landscape elements, e.g. for Romania (Snoeijer 2014), Portofino (Italy) (Pedroli et al. 2013; Van der Sluis et al. 2014), Heerde (Hauser et al. 2016) and Roskilde (Denmark) (Vesterager, unpublished).

CASE STUDY	Lesvos, GR	Roskilde, DK	Heerde, NL	Portofino, IT	Stăncuţa, RO	Răteşti, RO
Size area (ha)	10800	21200	8000	1800	25670	7900
Environmental zone	Mediterranean South	Continental	Atlantic central	Mediterranean Mountains	Pannonian	Pannonian
Socio-economic zone	Predominantly rural	Intermediate	Predominantly rural	Predominantly rural	Intermediate	Predominantly rural
Dominant land use	Olive yards	Cropland	Grassland	Forest	Cropland	Cropland

Table 11: Characteristics of case study areas. Environmental zone is based on (Metzger et al. 2005) and rural typology, predominantly rural = rural population > 50%, intermediate = rural population 20-50%, predominantly urban = rural population < 20% (EuroGeographics Association 2010). Dominant land use is based on land use statistics.

The land use and farming systems in each area are presented in greater detail in Kristensen et al. (2013).

Method for landscape analysis

The landscape transitions were studied for the case study areas. Any change in land cover or conversion of a land use into a different type (landscape change) is defined as a landscape transition. A spatially explicit temporal analysis was carried out of the landscape change detectable on land cover maps. By distracting the land cover grids for selected time steps for each study area a land-change matrix was calculated. This resulted in matrices with the gross LULC change, which allows to see e.g. what land cover type changed into forest (afforestation), but also what was converted from forest into another land cover type. The possible landscape transitions are shown in Table 12: they range from abandonment and urbanisation to agricultural intensification or extensification. The transitions which took place within the case study areas over the past decades were recorded. Where land use on the maps studied had not changed, it was classified as 'persistent'. Also where this was likely to have remained unchanged, e.g. from lake towards river, or infrastructure towards urban, it was classified as persistent. Changes from farmland into forest were classified as 'Afforestation', but if farmland was converted e.g. into macchia, it was classified as 'Abandonment'. Where natural areas changed into farmland, it was marked as 'Agricultural reclamation', however, if farmland converted from a less intensive crop towards an intensive crop (e.g. grassland into annual crops) it was marked as 'Conversion – intensive'. Where it was unlikely that a conversion had taken place, e.g. from urban area towards cropland, or forest towards sea it was labelled as 'Exceptionality'. In Răteşti (RO) the change of farmland into wetland might be due to the flooding regime of the Danube, which was classified as 'Abandonment'.

CODE	LAND USE TRANSITION	DESCRIPTION
P	Persistence	Areas with no change in land use
A	Abandonment	Abandoned urban or farming areas
U	Urbanization	Change into urban area
S	Succession	Change from ruderal or farmland into natural state
D	Deforestation	Forest converted into other land use
Dg	Degradation	From natural vegetation towards degraded state
Af	Afforestation	Area planted with forest
Ra	Agricultural reclamation	Conversion non-farmland into agricultural use
Ci	Conversion – intensive	Agricultural area with conversion into more intensive use
Ce	Conversion – extensive	Agricultural area with conversion into more extensive use
E	Exceptionality	Unusual conversion

Table 12: Possible landscape transitions in the case study areas.

The purpose of a landscape assessment should ideally guide the approach and possibly the choice of indicators (Wascher 2004). Several authors suggest that the best indicators to describe and quantify landscape transitions are land use and land cover (Benini et al. 2010; Plieninger 2006), and landscape structure (Levin and Jepsen 2010; Van der Sluis et al. 2004). The landscape structure refers to size, shape, arrangement and distribution of individual landscape elements (Walz 2011). Landscape structure is likely to be affected by different parameters, e.g. agricultural policies, land ownership or farming technology. Landscape structure, in particular landscape openness, presence of vertical elements (buildings, treelines, single trees, forest) and the topography will affect cultural services. Landscape elements and landscape structure also affect the life support functions of the landscape, in particular biodiversity. The latter influences landscape connectivity, habitat functions and the potential to sustain wildlife populations (Van der Sluis et al. 2004). The landscape structure can be linked to function, and is therefore considered useful for this purpose (Termorshuizen and Opdam 2009). Therefore the LULC change was calculated relative to the total size of the case study area in ArcGis 10.2 (ESRI 2011), and Google Maps was used to verify observed changes. Also change in landscape elements as well as land use statistics for the different case study areas was calculated.

Land conversion matrices were prepared, and analysed on the type of transition occurring. Also changes in the presence of landscape elements were assessed such as single trees, ponds, hedges, tree rows, stone walls etcetera, based on additional studies, literature or maps available. This comparison allows us to draw conclusions regarding the similarities and differences in change processes and their impacts in different regions in Europe.

Assessment of landscape services

As a result of the landscape transitions also the landscape services change. Selected landscape services for this assessment are: food & feed production, timber, residential function, tourism, natural habitat and scenery. Although this selection might be challenged to be subjective, the selected services are relevant in the wider European context and commonly used in other studies, and selected services may change as a result of landscape transitions (Bürgi et al. 2015; Vallés-Planells et al. 2014). To estimate how the service provision changes over time, a semi-quantitative approach is followed based on the analysis of land cover change (Table 12).

The provisioning service of **food and feed production** was defined based on the potential crop and feed production, which can be derived from an increase or decrease in cropland and grazing land area (farmed land in relation to land abandonment), as well as the productivity, which can be assessed based on intensification or extensification. Changes in **timber** provision are estimated based on forest cover change. The **habitat provision** is assessed based on an interpretation of change in natural areas and abandoned land, which over time transforms into forest again. The **residential** service is derived from the 'built-up' area in the case studies, which to a very limited extent might include some other functions. The **tourism**

service was quantified based on change in aesthetic values, in particular landscape elements and land abandonment as a proxy for naturalness (van Berkel and Verburg 2014). The **cultural** service is dependent on properties of the landscape, in particular aesthetic value (Vallés-Planells et al. 2014; van Berkel and Verburg 2014) which is assessed here as changes in characteristic landscape features, from field observations (Hauser et al. 2016; Pedroli et al. 2013; Snoeijer 2014; Van der Sluis et al. 2014) and general literature (Antrop 2000; van Berkel and Verburg 2014; Van Eetvelde and Antrop 2004) (Table 13). Important landscape features in the Mediterranean region are the terraces and terrace walls which support permanent crops like olive yards and grape vines. Important features in North-west Europe are woody landscape elements, e.g. hedgerows and treelines highlighting field patterns. Old fruit orchards can be important landscape elements, as well as ponds. Geomorphologic features are e.g. the limestone overlying conglomerate in Portofino, and dissected hills and salt flats on Lesvos. In the assessment the landscape transition was linked to the change in service, so if 60 ha agricultural land is converted into urban area, this means a decrease in production services (food & feed) but probably an increase in cultural services (residential).

.

Study area	Change	Source
Lesvos, GR	Migration into the city of Mytilini and suburban locations, increased urbanization countryside. Tourism is slowly increasing, following newly built second houses as well as tourist apartments There is a development of buildings for trade/manufacture purposes. Decline of terraces, conversion of permanent crops towards grazing (goat keeping).	Kristensen et al. 2016 Kizos et al. 2009 Van der Sluis et al. 2014
Roskilde, DK	In 2001 the total length of hedgerows increased to 331 km for more than 2200 elements.	Kristensen et al. 2016; Van der Sluis et al. 2013
Heerde, NL	New landscape elements and natural habitat developed. Expansion of settlements affects the perceived openness of the countryside.	Hauser et al. 2016 Veeneklaas et al. 2004
Portofino, IT	Marginalisation of farming leads to negligence and abandonment of farms and terraces. Strong pressure from tourism in parts of the area.	Van der Sluis et al. 2014 Pedroli et al. 2013
Stăncuța & Rățești, RO	Some clearing of tree rows is related to infrastructure development, otherwise changes in landscape elements are limited	Snoeijer 2014

Table 13: Changes in land use and landscape features which affect cultural services.

4.3 Results

The observed landscape transitions are presented, followed by the impact on The observed landscape transitions are presented in this section, followed by the estimated impact on the provided landscape services, then the multiscale drivers which cause these changes with emphasis on changing policies and regulations regarding land use and environmental quality. The transition matrices for the case study areas are presented in Annex 2.

Landscape transitions in the case study areas

The observed average annual change is 0.55% per annum (p.a.), with lowest change on Lesvos (GR) and in Roskilde (DK), and the highest for Heerde (NL) and Portofino (IT). The change over time averaged for all areas is 10% for the entire studied period (Table 14). The high degree of change in Portofino, where 25% of the landscape changed from 1974 to 2000 (or 0.96% p.a.), occurred mostly in the uncultivated area due to succession and the occurrence of the frequent wild fires in the area. In Roskilde (DK) a relatively small long-term change of 0.21% p.a. was found, since in particular farmland was very stable, and mostly other landscape use categories changed over time (Kristensen et al. 2009). The average annual change was lowest in Lesvos (GR) with 0.11% p.a..

Case study area	Period	Years	Change (% of area)	Annual change (% of area)
Lesvos (GR)	1981-2004	23	2.6	0.11
Roskilde (DK)	1990-2011	21	4.6	0.21
Heerde (NL)	1996-2004	8	7.8	0.98
Portofino (IT)	1974-2000	26	24.9	0.96
Stăncuța (RO)	1980-2003	23	15.7	0.68
Răteşti (RO)	1980-2003	23	8.3	0.36

Table 14: Land use and land cover change in case study areas in recent decades.

Landscape transition	Lesvos (GR)	Roskilde (DK)	Heerde (NL)	Portofino (IT)	Răteşti (RO)	Stăncuţa (RO)
PERSISTENT (HA)	**10,487**	**20,240**	**7,379**	**1,371**	**6,611**	**23,537**
Succession	0%	-	-	4.6%	-	-
Abandoned	-	0.4%	-	0.8%	0.4%	-
Agricultural reclamation	-	-	0.1%	1.3%	0.1%	0.3%
Conversion – intensification	-	0.8%	4.5%	0.1%	7.5%	2.0%
Conversion - extensification	0.2%	-	2.2%	0.1%	1.6%	1.1%
Afforestation	0.3%	1.6%	0.2%	2.0%	2.2%	0.9%
Deforestation	0%	0.1%	-	14.8%	0.1%	0%
Urbanization	2.0%	1.8%	0.8%	1.2%	2.8%	1.0%
Exceptionality	0.1%	-	0.1%	-	1.0%	3.0%
Sum change (ha/%)	**282/2.6**	**987/4.6**	**624/7.8**	**454/24.9**	**1,235/15.7**	**2,139/8.3**
Total (ha)	**10,769**	**21,227**	**8,003**	**1,825**	**7,846**	**25,676**

Table 15: Landscape transitions and associated change in dominant landscape service provision, in ha or percentage of total case study area, for the observed periods (8 to 26 years).

The **urbanization** is the most dominant transition in the form of urban sprawl, houses or sometimes warehouses are constructed in the countryside or expansion is more concentrated near towns and villages. The increase of urban area (which includes generally land take by infrastructure) does not exceed 2.8% (in Răteşti , RO). In Roskilde (DK), the most urbanised area among the study areas, urbanization increased by 1.8% and in Heerde (NL) by 0.8%. On Lesvos migration has occurred from rural villages into the city of Mytilini and suburban locations, as well as into satellite villages with accompanying roads, sports and recreation facilities, expansion of ports, marinas, etc. **Conversion - intensification** occurs mostly in Heerde (NL) due to conversion of grassland and maize into other crops and orchards, while in Răteşti (RO) it reflects a shift of grassland into cropland (7.5%). A reverse shift towards **agricultural extensification** occurs mostly in the same areas, albeit at a lower level (2.2% and 1.6% respectively). **Agricultural reclamation** (conversion from e.g. forest into farmland) is very limited, only 1.3% was affected in Portofino, and lower rates were found for other areas. At the same time land was abandoned in Portofino so the net change is negligible. **Land abandonment** as a category of change was observed mostly in the areas of marginal farming like Portofino and Răteşti (RO), but was also observed in the other study areas. The forested areas increase as **afforestation**

exceeds the **deforestation**, in all areas except for Portofino (IT). The afforestation is 2% on average, and deforestation is negligible in most areas. In Portofino, however, deforestation affects 271 ha (14.8%), mostly caused by a change from macchia into grassland (206 ha). **Succession** (4.6%) is observed in Portofino, as sparse vegetation develops into macchia, and later into forest. Succession results from wildfires as well as farmland abandonment. Exceptionality, finally, explains the unexpected or unlikely changes. The **exceptionality** for Stăncuţa (RO) stands out, however, most (560 ha) is due to cropland which was later classified as 'river'. This can be explained by the flooding of the Danube in 2003 and timing of the aerial photography, which resulted in an 'increase' of 550 ha of river.

Changing Landscape services provision

The landscape changes have an impact on the landscape services in the case study areas, e.g. when in Răteşti the decrease in livestock feed (grassland) results in an increase in food production, or the increase in residential services and tourism services on Lesvos result in a decline of cultural services.

Table 15 and 16 present how landscape services might have changed, based on the observed landscape transitions. The number of terraces and terrace walls on Lesvos (but also in Portofino), typical for Mediterranean land use, often lack maintenance and are decreasing. This with the expansion of built up areas and second homes contributes to the decline of the aesthetic values and thus inspiration services especially (Table 14 and Table 16). Tourism services increased as a result of newly built second houses as well as tourist apartments (Kizos et al. 2009), which was to the detriment of the inspiration service.

Case study / Service provision	Lesvos (GR)	Roskilde (DK	Heerde (NL)	Portofino (IT)	Răteşti (RO)	Stăncuţa (RO)
Food (area potential)	o	o	o	o	o	o
Food (productive capacity)	o	o	++	o	++	o
Feed	o	o	o	o	-	-
Timber potential	o	+	o	--	+	o
Habitat	o	+	o	++	o	o
Residential	+	+	o	+	+	+
Tourism	+	o	o	++	o	o
Inspiration	-	+	+	-	o	o

Table 16: Change in landscape service provision in study areas: **+** *increase (1≤ 4%),* **++** *: strong increase (≥4%),* **-** *decrease (1≤ 4%)* **--** *strong decrease (≥4%), negligible (< 1% change).*

Striking for **Roskilde** (DK) is the increased residential service, driven by processes of urbanisation of the peri-urban countryside. The timber potential increased as a result of public afforestation, as well as hedgerow planting and conversion to wetland, which may be the result of nature restoration or measures to improve water quality and also resulted in an increased habitat provision. The inspiration service may have increased mainly as a result of the afforestation, but also due to hedgerow planting in the region: in 2001 the total length of hedgerows was 331 km for more than 2200 elements (Kristensen et al. 2016; Van der Sluis et al. 2013), which is considered positive for inspiration and habitat provision. There is limited change of service provision in **Heerde** (NL), which may be due to the relatively short period for comparison, 1995-2004. The food production capacity increased, due to intensification of land use, mostly a shift from grass and maize towards more intensive crops. The overall impact of new landscape elements and natural habitat on the inspiration service is considered positive (Hauser et al. 2016) despite the impact of expansion of settlements on the perceived openness of the countryside (Veeneklaas et al. 2004). Dominant changes in service provision in **Portofino** (IT) due to the landscape transitions from 1974-2000 are: a strong decrease in timber potential, a strong increase in tourism, an increase in residential function and in habitat provision, and a decline in inspiration (Table 16). The decrease in potential timber provision is likely to be related to the frequent wild fires occurring, resulting in the forest vegetation being set back to sparse vegetation and macchia shrubland. Portofino is attractive for second house owners, and increased residential function and tourism in the buffer zone of the Nature Park were observed. Tourism services have also increased as a result of the Nature Park and the large number of day-visitors that are attracted by Portofino harbour. The poor profitability of agricultural production leads to negligence and land abandonment of farms and terraces: olive groves have disappeared and chestnut plantations declined, resulting in development of macchia and forest.

Abandonment followed by succession has positive effect on habitat provision (Pedroli et al. 2013). Changes in landscape services have been very limited in **Stăncuţa**, and slightly higher in **Răteşti** (RO). In both Stăncuţa and Răteşti , there was a slight increase in residential services, and a decrease in feed production. Grassland was converted into cropland, forest and some built up-up area. The food production capacity though showed a large increase in Răteşti , as almost 600 ha of grassland was converted into cropland. Also the potential timber production service increased. The scenic quality did not change much, some clearing of tree rows is related to infrastructure development, otherwise changes in landscape elements were limited (Snoeijer 2014). All study areas show an urbanisation trend, with land take ranging from 0.8 to 2.8% (Table 15). The extent of this urban transition depends particularly on spatial planning, which is guided mostly by national or regional policies. In particular in Răteşti (2.8% increase) and Lesvos (2.0%) the urban expansion is concentrated or clustered around existing built-up areas and this seems not so much an intentional effect, but rather the consequence of lack of or ineffective policy (Vesterager et al. 2016). In Roskilde (1.8%) the built-up areas are partly scattered in the countryside.

Succession occurs on bare fields that are re-vegetated, or on burnt areas. This is partly

governed by the Common Agricultural Policy, and related to land abandonment. The designation of Natura2000 areas under the Habitats Directive may also have resulted in stability, since they contain restrictions for building and housing. Despite this, the observed landscape transitions still indicate a dominant trend of intensification.
Related to the transition towards natural habitat, funding seems to play a minor role for the landscape transitions in areas which resort under the Habitats Directive. The afforestation outweighs the deforestation, afforestation schemes have been supported by EU since 1989 and are now part of the Rural Development Programme.
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4.4 Discussion

The large-scale trends taking place in different regions in Europe affect local landscape transitions with a diversity of outcomes and impacts on landscape services. This paper has explored the diversity by case studies in different regions of Europe. The results show that three dominant processes are visible: urbanization occurs in all case studies, with an increase of built up area of more than 1%, except for Heerde (NL), which might be a result of strict national building codes so far. Another dominant process is land conversion, with intensification taking place in Heerde (4.5%), and Romania: Stăncuța (2.0%) and Răteşti (7.5%). To a lesser extent this occurs simultaneously with extensification here, so this might also indicate highly dynamic land use. Afforestation seems dominant over deforestation in all areas, except for Portofino where large wild fires have resulted in a decrease in forest area. Fuchs et al. (2015) estimated gross land cover change based on empirical data for some 10 years, and found 6% of increase of urban area, some 20% change from grasslands to cropland and 19% increase of forests. Compared to these figures, changes in the case studies are relatively small.
A relatively small landscape transition can obscure large landscape changes, e.g. a landscape transition by 2% towards urbanised area in Lesvos (GR) means an increase of built-up area from 424 ha to 648 ha, an increase of 53% in the countryside (see also supplementary data). An important consequence of such change is the fragmentation of the landscape and possibly a decline in aesthetic values and natural habitat (and thus inspiration and tourism), which is also one of the negative aspects of urban land take highlighted in EEA (2015). The impact also depends on the quality, uniqueness, location and spatial arrangement of landscape elements/land use classes which have been changed. Invisible change occurs due to negligence of landscape elements and land abandonment as a result of poor profitability for agricultural production. Land abandonment was observed to a limited extent in Roskilde (DK) and Răteşti (RO), and with the concurrent succession it is an important transition in Portofino (IT). Terres et al. (2015) identified Italy and Greece as countries at risk for land abandonment. Abandonment is a consequence of the high labour demand for maintenance of the traditional slope terraces in the Mediterranean (Van der Sluis et al. 2014). For part of the terraces in Portofino and Lesvos the decline is still invisible, but it will eventually lead to erosion, collapse and further decline of the scenic quality. Lastly, the

timeframe investigated will also influence the findings. In the present paper the use of a timeframe of almost 25 years may conceal that large changes and in fact opposite changes have occurred in the preceding period. Fuchs et al. (2015) reconstructed the change during the 20th century based on global data sets, and found that overall change was as much as 56%, and the Mediterranean region was considered a hotspot for change (Fuchs et al. 2013). For the Netherlands it has been well documented how the forests, heathlands and moors were converted to productive land already at the beginning of the 20th century, tremendous changes occurred in the 1960s as a result of land rationalization: removal of landscape elements, hedgerows, single trees, ponds, natural brooks etcetera (Hauser et al. 2016). Similarly, in Răteşti and Stăncuţa (RO) forests and lakes were replaced by grasslands and pastures and in the mid-19th century by large scale farming (Blacksell 2010; Snoeijer 2014). Over time an increase in natural habitat is seen in most case studies (Table 16).
A study of hotspots of land use change in Europe at NUTS-2 level revealed that most widespread land use change between 1990 and 2006 was cropland decline, followed by forest area expansion and pasture increase (Kuemmerle et al. 2016). This trend is confirmed even at smaller spatial scale in this study, where we found that in most cases also the food production potential decreased and timber production increased. An increase of pasture land was not observed, but only Heerde (NL) contains significant grassland area and here on the contrary important grassland areas were converted to cropland and urban area. Kuemmerle et al. (2016) found that overall changes were moderate, from <1% (grazing land) to 5% (urban area) between 1990-2006, which was similar to our findings (Table 14). Stürck and Verburg (2016) concluded that the selection of scale and used indicators very much influence the findings of such studies.

If we relate the observed landscape transitions with Holmes' approach for use of rural space to better compare the main trends found in each case area. A general trend is observed from production towards consumption for Lesvos (GR) and Roskilde (DK), a shift towards production, intensification and increased production for Heerde (NL) and the two Romanian cases (Figure 17). This concurs with the existence of large-scale but not very intensive farming in Romania before the political changes of 1989. The ample available land at relatively low costs causes farmers to intensify and reduce the yield gap compared to other EU member states. In Heerde, farmland of ceased farms is taken over by neighbouring (large) farms. The strong market pressure in Heerde results in changing crops or changing landscape elements, which was also found by Hauser et al. (2016). Protection has increased in Portofino, but since farm houses are taken over by non-farmers, also the consumption aspect has an impact on the land transition. Some marginalised farming continues but production is very limited (Van der Sluis et al. 2014). The increase in residential functions in Roskilde (DK) is driven by processes of urbanisation. The impact has not led to very significant changes north of Roskilde, as it has mostly occurred as 'hidden' urbanisation, where former farms have been converted to residential or other economic uses than agriculture (Busck et al. 2006; Præstholm et al. 2006). The strict zoning policy has prevented large-scale urban

sprawl (Busck et al. 2008), but east of Roskilde still considerable urban development took place. In Lesvos farming has not been very profitable since olive subsidies were reduced or abandoned, at the same time living standards increased and funds became available to develop (second) houses in the countryside, and urbanization is here the most important transition in the studied period.
Multifunctional land use can be a means to meet the many demands that are placed on our landscapes, but also calls for prioritization and a more rational use of land resources. In most areas a trend away from production, towards consumption or protection seems dominant, however, in the Netherlands and Heerde intensification seems more prevalent (away from multifunctionality, at least in part of the area), and in cultural landscapes like Portofino or Lesvos land abandonment leads to monofunctionality.

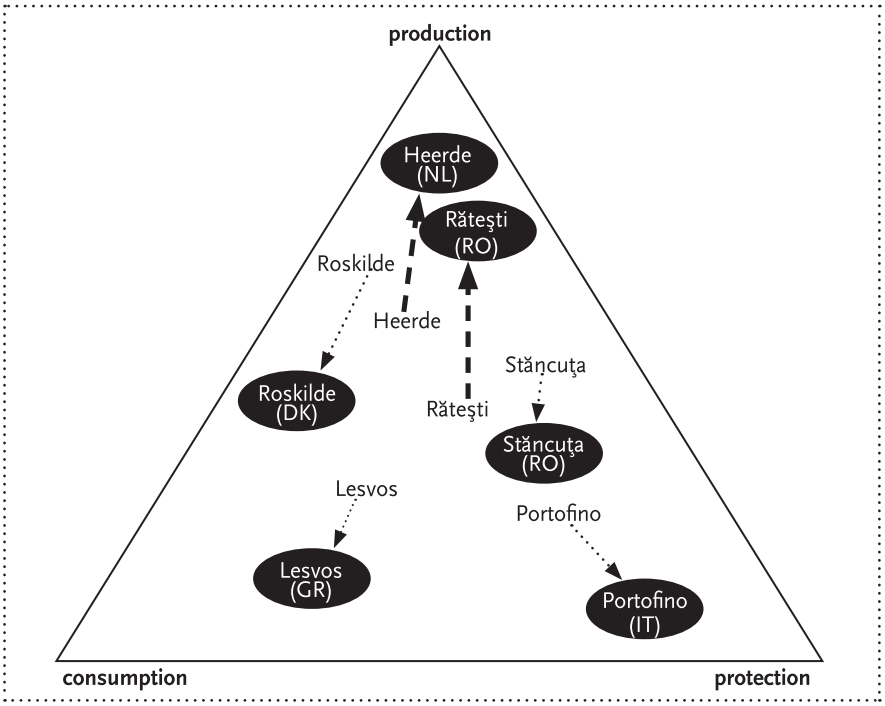

Figure 17: Observed changes in use of rural space, following Holmes' (2008) approach.

The large-scale trends taking place in different regions in Europe affect local landscape transitions. The cases, although not representative for all European landscapes, show how zoning and policy may guide spatial developments, while at the same time transitions driven by market forces and urban sprawl can still lead to development processes which are contradictory to the spatial zoning plans.
Policymakers respond to the landscape transitions and may attempt to guide landscape changes in a certain direction through directives and policies. The major transitions observed in the case areas relate to intensification and extensification

of agriculture, to land abandonment, and in some areas succession. All of these processes were strongly influenced by EU policies. During the studied period, the EU protected its agricultural sector through the CAP, EU-Least Favoured Area policy and structural funds (Donald et al. 2002). Other important EU policies affecting rural land use are the Birds and Habitats Directives, the Water Framework Directive, EU-Nitrate Directive and regulations on pesticides. These policies are supplemented by national and local sectoral plans. On top of that, global driving forces act directly on the landscape or they are 'filtered' and adjusted through regional and national policies (Ramos 2011). From Roskilde (DK) and Heerde (NL) case studies it is known that zoning has a big influence on the location of residential areas, and spatial planning decreases the land use change options (Primdahl et al. 2009; Van Den Brink et al. 2006). Most of the changes observed in Roskilde (DK) were conversion of cropland into forest or settlements. The combined drivers affect in particular the choice of crops, intensity and scale of farming and agricultural production system, but also to some extent demography, e.g. migration within the European Union (Primdahl et al. 2013; Swaffield and Primdahl 2010). This subsequently affects labour availability, particularly in Romania or Lesvos (GR), where outmigration resulted in shortages in farm labour (Van Vliet et al. 2015), in particular for skilled, laborious work like terrace maintenance (Kristensen et al. 2016; Van der Sluis et al. 2014). The 25% change in Portofino from 1974 till 2000 resulted from deforestation and in some areas re-vegetation after fires and land abandonment, as well as (successful) environmental policies and legislation which led to landscape protection and guided tourism development (Pedroli et al. 2013). Although this resulted in a decrease in aesthetic value and thus of inspiration, tourism increased, while agricultural production declined. Similar change processes (though at a much smaller scale) take place in Lesvos (GR), but without considerable change in landscape, since the terraced landscape can be seemingly quite 'inert': initially the decay is not very conspicuous (Van der Sluis et al. 2014; Vos and Stortelder 1992).

In the case study areas the EU policies and subsidies mentioned above have mostly contributed to extensify production, and for nature and environment (Pavlis et al. 2016). This does not stop the intensification, which may partly be attributed to the CAP and the pricing structure in the EU. That land use policy is a major driver for landscape transitions was also shown by e.g. Klijn (2004) and Plieninger (2006). The CAP leads to intensification and land abandonment– and both result in a decline in biodiversity and aesthetic values (van Berkel and Verburg 2014). Despite all landscape measures, the question is whether landscape services can be restored to what existed several decades ago, since habitat functions and possible inspiration has in the long run declined. This was also concluded by Crofts (2014), who points to the negative landscape and biodiversity effects of CAP subsidies and the impact of fragmentation on biodiversity. Some policies have been effective to maintain land use and halt land abandonment despite processes of marginalization, as was described for the Mediterranean landscapes (De Graaff et al. 2010; Pôças et al. 2011; Terres et al. 2015). However, at the same time it has been concluded that also very detailed and focussed policies are not easily implemented, for reasons such as national factors

affecting the local policy development and inertia of the institutions (Vesterager et al. 2016). The differences in both policy legacy and policy cultures can imply that effective policies implemented in one member state will be more or less neglected in others (Frederiksen et al. 2017). Bateman et al. (2013) show that in the long term planning for multiple landscape services can be most beneficial; however, it is crucial that spatial targeting of policies is done instead of a 'one-size-fits-all' approach, this can generate major gains at regional level. Even an approach whereby negative impacts of policies on species diversity are ruled out, performs much better if all services are taken into account (Bateman et al. 2013).

4.5 Conclusions

In this study important landscape transitions are described in six case studies The goal of this study is to assess what implications landscape transitions have for the provision of landscape services, and whether these changes can be related to specific drivers of change. In this study important landscape transitions are described in six case studies which represent a range of European rural landscapes. The case studies, though not representative for all of Europe, provide insight in the processes and changes which have recently occurred in rural Europe. Different types of service, i.e. provisioning, cultural or supporting services, are affected in different ways. Holmes' approach (Holmes 2008) is useful to describe the drivers behind landscape transitions and resulting shifts in landscape services. Some specific conclusions are:

- The urban sprawl and 'land take' in some countries seem to take place in a random way, since spatial planning is not always effective in guiding and containing sprawl. In particular urban centres generate demand for nearby recreational areas. Conversion of farms for residential purposes results in an increasing share of the population that has no real attachment to the farming sector (Verhoeve et al. 2012; Verhoeve et al. 2015), which is observed in the case studies in Heerde (NL) and Roskilde (DK).

- The change in land use (on average some 10% over 25 years) is surprisingly small considering the time period if compared to other studies (e.g. Fuchs et al.;(2013, 2016), still, in some areas it is almost 1% per annum. This 'limited' change conceals that some transitions may have a relatively large impact on landscape services in the countryside.

- Cultural services (tourism, inspiration) are not well protected through policy and legislation and only receive attention if they are part of an economic development strategy, governed by national spatial planning regulations. Inspiration as a service seems insufficiently safeguarded, e.g. through the European Landscape Convention. Urbanization in particular affects the inspiration and habitat services negatively.

- Most land abandonment is observed in case studies in marginal farming areas in Europe which are depopulating, in mountainous regions and southern Europe. Portofino (IT) and Lesvos (GR) exemplify traditional land use systems (low intensity perennial crops and livestock raising), which experience an increase in natural habitat and tourism services, and a decline in agricultural production. Tourism may provide options to maintain farming, increase aesthetic values and thus inspiration services.

- Environmental and agricultural policies should support and promote services of cultural landscapes that are currently facing rural depopulation, declining agriculture and succession after abandonment.

- Although this study cannot provide conclusive evidence, it seems that policies that result in land use transitions are mostly related to the provisioning services of the landscape. The cultural services (residential function) are mostly governed by the regional and national spatial planning framework, and thus at risk in an era of strong decentralisation tendencies all over Europe. Habitat services are mostly vested in the EU-Birds and Habitats Directive and national forest policies. The Habitats Directive and environmental zoning (spatial planning) limit the possibilities for landscape transitions, however, the impact of these Directives has not been very large for the studied period.

- European policy measures and subsidies (especially the CAP) are dominant drivers in landscape transitions. The outcome is often multi-directional: European policies may have counteracting or mutually amplifying effects on land use development. Some may result in change (e.g. as a result of investment subsidies), while others at the same time can inhibit change and 'conserve' a status quo (e.g. through agri-environmental measures, the nitrate directive or CAP payments for olive growing). National policies are important for e.g. forestry and tourism, as are spatial planning.

Supplementary data

Supplementary data are presented in Annex 2 and provides the Land conversion matrices per case study area.


Ακ. Μαχαίρα
Παραλία
Παναγούδα
Αλυκάνα
Λουτρά
Ακρωτήρι Φτέλια
Ακ. Καραμπάσης
Ακ. Κέφαλος
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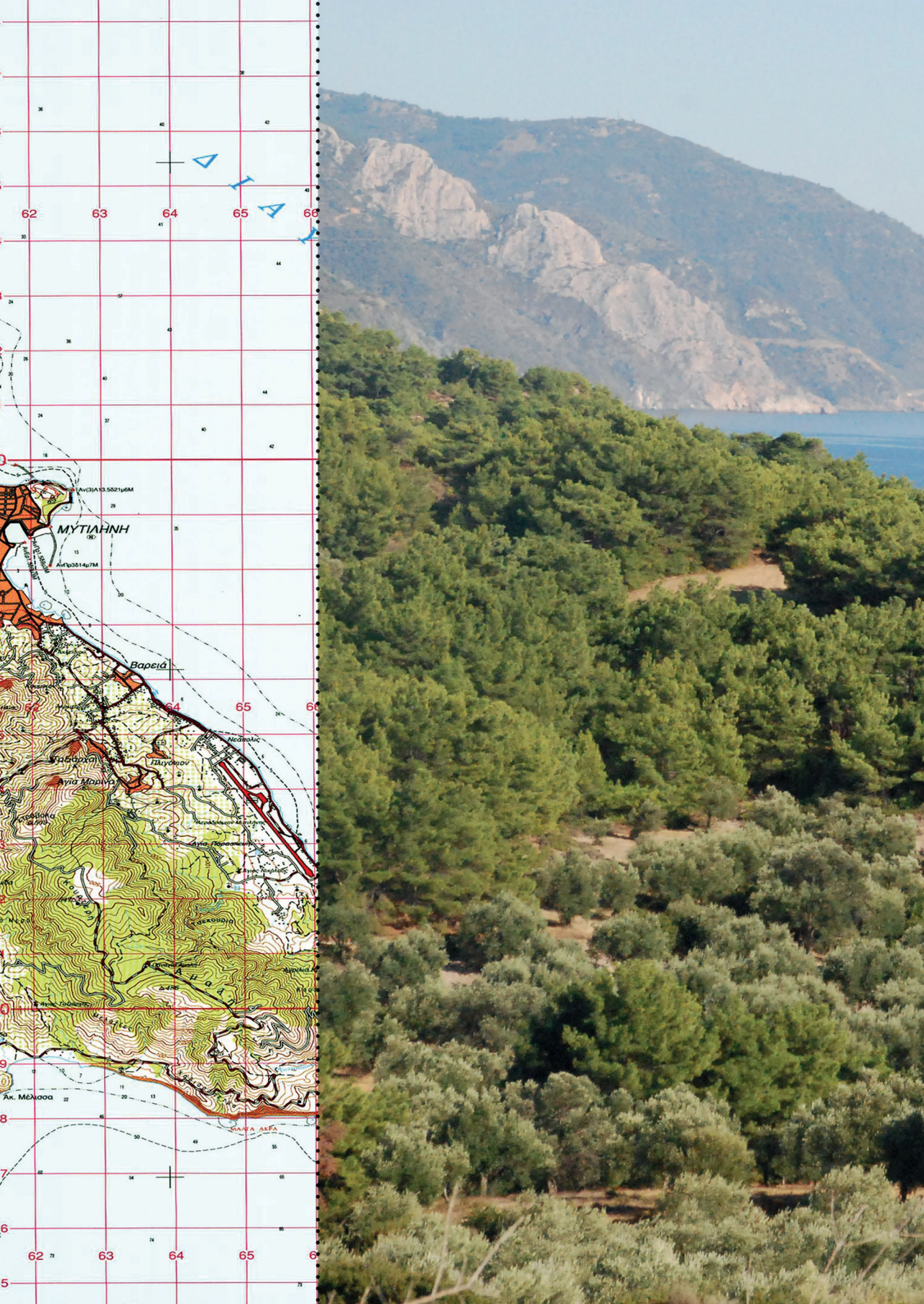
ΜΥΤΙΛΗΝΗ
Βαρειά
Νεάπολις
Ακ. Μέλισσα
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Chapter 5

Misfits and compliance patterns in the transposition and implementation of the Habitats Directive – four cases

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Abstract

This chapter investigates the transposition and implementation of the Habitats Directive in four European member states, namely Denmark, the Netherlands, Greece, and Romania, and the role that institutional misfits have played in more or less successful implementation processes. Departing in the 'Worlds of Compliance' literature, it also explores if this typology can be useful for understanding the ways member states address institutional adaptation pressures in the implementation steps following the transposition phase. The requirements in the Habitats Directive expanded most member states' nature conservation frameworks, especially in the obligation to introduce pro-active conservation, and it also laid down a number of steps to be taken for creating the European Natura 2000 network. It was found that the trans-position did mostly follow general compliance types, but that these types also helped the extent and adequacy of adaptations and changes to the institutional framework in the implementation processes following the directive's adoption. Implementation challenges were different for different countries. They showed a need to align institutional frameworks for

a) Natura 2000 in areas with several existing types of landscape protections and ensuing spatial and institutional overlaps;
b) clarifying the roles and responsibilities of various authorities involved in implementation;
c) ensuring coordination with the other sectorial policy areas that interact with the Habitats Directive (such as the Nitrate Directive and the Water Framework Directive). It turned out that there could be a need for more flexible and less-top-down European legislation, providing a larger room-for-manoeuvre for integration with domestic approaches.

5.1 Introduction

The development of European landscapes is driven by the complex interaction of many different factors. Urban development and transport infrastructure affect the structure and composition of the landscape by seizing and fragmenting an increasing share of largely agricultural land in Europe (EEA 2013b; Hersperger 2009), while agriculture and forestry drives structural development through processes of expansion, homogenisation, and abandonment (Verburg et al. 2010). European environmental policies aim to steer these processes to counteract unwanted development pathways, but policies are not always implemented in ways that lead to the desired outcomes in the member states.

Greening – understood as integrating environmental concerns in sector policies – was introduced to the European policy agenda in later decades, and became institutionalised with the adoption of the Single European Act (1987), which forms the legal basis for environmental policies (Matthews 2013). Since then, a number of environmental policies have been approved for the management of the land area, such as the Nitrate Directive, the Habitats Directive and the Water Framework Directive, as well as various agri-environmental schemes under the Common Agricultural Policy. The importance of these policies for the European landscape development depends on their appropriate implementation in the member states.

However, EU policies are not always adequately transposed and implemented, and particularly in the environmental policy field, poor implementation performance has been documented by the large number of infringement procedures within this policy field (Etherington 2006). Inadequate implementation has been ascribed to various causes, including in the literature on institutional aspects. Some of the more persistent explanations provided here are a lack of fit between European and domestic institutional frameworks (Knill and Lenschow 1998), domestic opposition (Mastenbroek 2005; Treib 2003), and different domestic approaches to compliance and Europeanisation (Falkner et al. 2007; Liefferink et al. 2011).

The Habitats Directive aims to protect European habitats and species. It is one of the older environmental directives, with more than 20 years of implementation history, and it has contributed importantly to protection and conservation of European biodiversity, both for habitats and target species of the Directives (McKenna et al. 2014; Trochet and Schmeller 2013) and non-target species (Van der Sluis et al. 2016), though highly variable across Europe (McKenna et al. 2014). The implementation and however has been afflicted by numerous delays in domestic responses (e.g. Lasén Diaz 2001), as also demonstrated by the frequent involvement of the European Court of Justice (ECJ). Though the directive was initially perceived as a model of effective nature protection law, its implementation and enforcement have not been entirely successful (Apostolopoulou and Pantis 2009; Ferranti et al. 2010) - even deemed a 'performance of failure' (Beunen et al. 2013). It has also been argued that

legally bound procedural issues in day-to-day implementation of the directive seem to become more important than the substantial requirements – improvements to habitats and species (Wandesforde-Smith and Watts 2014). Hence, it presents an appropriate case for studying institutional impediments to policy transposition and implementation.

5.1.1 Implementation insights

Lack of compliance and implementation failures and successes related to EU policies have been studied extensively; reviews of the field were carried out by Mastenbroek (2005) and, with a specific focus on environmental policy, Etherington (2006). In the late 1990s, studies were increasingly inspired by theories of Europeanisation and neo-institutionalist theory, focusing on the nature of the domestic administrative structures and the complexity of the legislation, as well as the extent to which the EU policy approach 'fits' the domestic institutional set-up – factors which were seen as critical to a smooth implementation process (Mastenbroek 2005).

The goodness of fit theory guided a number of studies, with the key hypothesis that a lack of fit between European policy requirements and existing domestic institutional frameworks, leads to a large adaptation pressure, i.e. adaptation to core elements of the institutional framework, and less effective policy implementation (Bailey 2002; Knill and Lenschow 1998). This theory was later criticised for the lack of acknowledgement of domestic interest constellations and how they play out in different phases of implementation (Treib 2006). Knill and Lehmkuhl (2002)) suggested that the type of mechanisms used in an EU policy intervention would influence the role that national interest constellations and opportunity structures could take. They distinguished between three Europeanisation mechanisms with decreasing prescriptive power; one that prescribed a specific institutional model for implementation; another which aimed at changing domestic opportunity structures, and the third and weakest mechanism which aimed at re-shaping domestic beliefs and expectations. Further, they suggested that the prescriptive model provided less space for domestic interest constellations than the latter two, and that in cases of requirements for fundamental changes in domestic institutions this might provoke lack of compliance. In cases of smaller adaptation needs, or the use of less prescriptive mechanisms, the outcome would be more open to the influence of domestic interest constellations. (Etherington 2006) observed that EU environmental policy primarily works through the prescriptive type of institutional compliance mechanisms, and this might suggest that the arena for domestic politics was smaller than for other policy areas.

The goodness of fit argument has also been criticised for disappointing empirical verification (Falkner et al. 2007; Mastenbroek 2005). Based on studies of the transposition of six European Union labour laws, Falkner et al (2007, 2008) were not able to verify the misfit hypothesis, and found that comparatively small necessary legal adaptations could still be heavily delayed in some member states, while larger misfits were in some cases relatively smoothly transposed. Based on a more aggregated

level analysis, they identified clusters of member states representing what they call ideal types of transposition styles. They introduced the idea of specific national cultures – Worlds of Compliance (WoC) - of appraising and processing adaptation requirements, which would emerge as combinations of neglect or obedience by administrative systems and policy actors respectively, and found examples of this in their studies. These so-called compliance types were characterised as follows: 1. Worlds of law observance: the compliance goal typically overrides domestic concerns (Denmark, Finland, Sweden); 2. Worlds of domestic policies: EU law observance is one priority amongst many (Austria, Belgium, Germany, the Netherlands, Spain, UK); 3. Worlds of transposition neglect: compliance is not a goal in itself, and without powerful supranational action transposition obligations are not recognised (France, Greece, Luxemburg, Portugal); 4. Worlds of dead letter: systematic contestation at transposition stage but timely transposition, and non-compliance in enforcement and application (Czech Republic, Slovakia, Hungary, Slovenia). The latter category differs from the first three, in the sense that they are all accession countries since the turn of the century, and that the high compliance in transposition in spite of political contestation could to some extent be understood as a response to conditionality vis-à-vis accession, while the later lack of enforcement was mainly found to be based on weak economies and insufficient enforcement systems, rather than reluctance or resistance in political and administrative systems. Hence, the WoC approach does not see institutional legacy as the main impediment to transposition, and does not find certain adversarial aspects of domestic institutional frameworks. Rather, it observes at an aggregate level that transposition follows different patterns in member states.

A third comment to the misfit approach derives from studies arguing for a supposed shift in policy style represented by 'a new generation' environmental directives (Beunen et al. 2009; Liefferink et al. 2011), characterised by long-term and substantial goals and more process-oriented obligations, with choice of approaches and instruments left to national discretion. In their study of the implementation of the Water Framework Directive (WFD), Liefferink et al. (2011)found that the misfit approach was less adequate for this policy style due to the considerable room for nationally defined pathways to the goals. The Habitats Directive represents an earlier period of EU policy, and in some ways it represents an in-between type of policy, prescribing a set of obligations related to general instruments and corresponding deadlines, while reaching its ultimate objective of reaching and maintaining a 'favourable conservation status' for habitats and species of European interest, leaves considerable domestic discretion in instruments and measures applied within the general framework.

The implementation of the Habitats Directive has been discussed in a large number of articles with different aims and approaches. Domestic implementation is one issue covered, of which the Netherlands stands out as a thoroughly investigated case (e.g. Arnouts and Arts 2009; Bennett and Ligthart 2001; Beunen 2006; Beunen and de Vries 2011; Beunen et al. 2013; Ferranti et al. 2010). These studies uncover heavily conflict-laden processes and the necessity of finding new ways to deal with these. They also confirm that misfits in the governance style related to nature conservation

have been quite influential for the transposition of this directive, at least in the Netherlands, but also that transposition and implementation overlaps in time, and different factors may be at stake in the various steps in the process.

5.1.2 Aims

In the present chapter, we aim to further explore how the processes of transposition and implementation of the Habitats Directive have taken place in member states, given the regulatory style of the directive, and the procedural steps required to implement it. We hypothesize that during the transposition and subsequent implementation of a complex directive like the Habitat Directive smaller and larger institutional misfits will appear in various phases in most countries, but that the approach to necessary adaptations reflects different general compliance patterns – or cultures -in different countries. We specifically ask:

- If compliance in the transposition and subsequent implementation differ among case countries
- What role institutional misfits play for major delays in the transposition and implementation of the Habitat Directive in the selected member states
- If the response to institutional adaptation pressures correspond to expectations vis-à-vis compliance patterns identified as 'Worlds of Compliance' – in transposition as well as in implementation.

First, we describe the Habitats Directive and the instruments and mechanisms introduced by this directive, as a basis for case-country analyses. Next, we introduce the approach and methods to analyse compliance in transposition and implementation in the case-countries, to identify potential misfits between the Habitats Directive requirements and domestic institutional frameworks for nature conservation, and the adaptation taking place in these frameworks. Following, the results section presents an overview of the compliance to deadlines in case-countries, as a background for the analyses of the misfits that can be identified in the respective case-countries' institutional frameworks for nature conservation and the Habitats Directive regulation, and the adaptation or non-adaptation taking place in transposition and implementation processes. Each case-country section concludes with a small discussion of the compliance patterns observed, and we finalise with a discussion of the contribution that compliance cultures can offer for understanding transposition and implementation pathways.

5.2 Intervention mechanisms in the Habitats Directive

The Habitats Directive (Council Directive 92/43/EEC) was adopted in 1992. The main aim of the Directive is to promote the maintenance of biodiversity by requiring member states to identify areas which are key for habitat and species conservation

(the designation of sites) and take measures to maintain or restore natural habitats and species of European conservation interest to a favourable conservation status in their natural range, introducing robust protection for those habitats and species of European importance. The Habitats Directive can be viewed in conjunction with the Birds Directive, and together they constitute the Natura 2000 network of protected areas in Europe. The two pillars of the Habitats Directive are site protection and species protection. The species and habitats which are protected are listed in the annexes of the Directive, and Annex I habitats compose the legal framework for habitat protection in the EU. The main reasons for selection of protected habitats are: measure of threat to habitats, presence of unique species, habitats being representative of biogeographic regions, and characteristics of habitats (Bunce et al. 2013). For each biogeographical region, lists of species requiring conservation measures are prepared. A coherent European ecological network of protected sites (the Natura 2000 network) is designated for protection based on Annex I (habitats) and Annex II (species). Species which are not particularly connected to a certain habitat type or site location are protected under Annex IV.

The directive builds on international conventions, notably the Bern Convention on Conservation of European Wildlife and Natural Habitats from 1979. The Habitats Directive establishes an ecological network of areas of special conservation interest – an approach that was subsequently mimicked by the Emerald Network set up in the framework of the Bern Convention (Jones 2012). This approach mainly rests on a biogeographic and landscape ecological foundation using spatial conservation planning as approach to nature protection (Evans 2007). The directive text was conceived in the period 1988 to 1992 and adopted under Dutch presidency and was by some Dutch officials perceived as a 'Dutch directive'. It has been argued that it took much inspiration from the Dutch nature policy, especially the creation of a network of protected sites, such as in the Dutch National Ecological Network (Van Keulen 2007; Wurzel 2008), which was conceived in the Dutch Nature Policy Plan adopted in 1990 (Keulartz 2009).

Transposition of the directive required administrative provisions for the obligations laid down in the various articles of the directive, to be implemented within defined deadlines. The scope of the present study has been delimited to focus mainly on the article concerning the terrestrial habitat conservation and the management of the Natura 2000 sites (article 6). Obligations and deadlines in relation to this are as follows:
Transposition of the directive (laws, regulations, and administrative provisions) was to be concluded by 1994, including provisions for:

- Creation of the Natura 2000 network – designation, delimitation and domestic adoption of the Habitat Directive sites (articles 3 and 4, addressing Annex I habitats and Annex II species);
- Protection of the Natura 2000 habitats from deterioration, from the date of the EC adoption of Sites of Community Interests (SCIs, article 6.2);

- Appropriate assessments of implications of projects and plans which might affect the protected habitats or species (article 6.3);
- Implementation of necessary conservation measures (possibly management plans) for maintenance or restoration at a favourable conservation status, corresponding to the ecological requirements of the protected habitat types and species, from the date of domestic approval of the Natura 2000 sites onwards (under the Habitats Directive called Special Areas of Conservation (SACs, article 6.1).

Article 6.3 is stronger than environmental impact assessments, as negative assessment outcomes can only be ignored in cases of 'imperative reasons of overriding public interest' (article 6.4).

Furthermore, procedures and deadlines for the establishment of the SACs are outlined in the directive. Firstly, member states were obliged to propose lists of habitats/species and their location to the Commission in 1995, as a basis for negotiating 'proposed Sites of Community Interest' (pSCIs). Within three years (scheduled 1998), the Commission should adopt the national lists of SCIs. Subsequently, the domestic approval of the sites (as SACs) should take place within six years of the EU adoption of lists, i.e. by 2004 at the latest.

The process of domestic approval of the Natura 2000 sites as SACs by the member states is a crucial step according to the Commission (EC, 2012) as it triggers the implementation of necessary conservation measures. It is completed with binding domestic adoption of the SACs, involving a statutory, administrative and/or contractual act.

Even if not completely explicit in the directive, it has been argued that it is crucial to formulate conservation objectives for Natura 2000 sites, as they are mentioned in the directive text, and necessary for interpretation of a range of other requirements in the directive, not least the habitat conservation requirements. It is however, not clarified how they should be defined (Stahl 2015).

Hence, the regulatory style of the directive is a traditional command and control like style, with specific obligations for site designation based exclusively on scientific criteria, leaving little room for discretion and flexibility in the designation approach. The directive also lay down a firm procedure to ensure that the Natura 2000 network is restored and maintained in a favourable status, with deadlines for the activation of protection and conservation instruments. The measures used for management and maintenance of the Natura 2000 sites are however at the national discretion, and there is no ultimate deadline given for reaching the 'favourable conservation status'. Moreover, the directive aims to contribute to sustainable development, and the member states have to take into account economic, social, cultural and regional conditions in the management of the network.

5.3 Analytical framework, data and methods

Four countries were selected for the national level investigations, representing expected variations in compliance patterns, based on former studies. These included Denmark, the Netherlands, Greece and Romania – the latter representing a later accession country. The selection was to some extent pragmatic and comprised the best possible selection given the project partnership.

Bearing in mind the observations of Liefferink et al. (2011) that compliance may change during the various phases of policy transposition and implementation, we first analysed and mapped the compliance in the transposition phase, followed by the various steps in the implementation of article 6 obligations.

Transposition compliance was investigated by analysing the transposition in the case countries, identifying to what extent this complies in terms of completeness and timeliness with the requirements and the deadlines provided by the Habitats Directive. The article 6 provisions could be transposed to domestic law as new legal acts and/or adaptations to existing acts.
Transposition completeness was based on the transposition of the provisions for designation, protection and conservation, and timeliness was assessed as years of delay from the deadlines given in the directive. In order to allow for various levels of delays we divided the transposition and implementation delays into three categories (Table 17). The period of minor transposition delay (1994-1998) is before the Commission takes steps to open cases against several countries for not complying with transposition obligations. The period of medium delay (1998-2004) ends when the implementation process should have been finalised based on the original timeline.

	DELAYS
Minor	up to 4 years
Medium	4-10 years
Major	more than 10 years

Table 17: Categories of delay.

Although Romania was only accessed to the EU in 2007, no transition period was asked for, for this policy area, and no transition period was granted in the final negotiations (EC 2005b). Hence, we have based the analysis on the view that all legal measures should be adopted in Romania by the end of 2006. This would also be in accordance with the position paper published by Romania in 2001[1], which assumed an even shorter transposition period.

[1] *Position paper of Romania, Chapter 22 Environmental protection. Conference on accession to the European Union - Romania. Brussels, 30 October 2001. CONF-RO 37/01.*

Implementation compliance was investigated in the same analytical model as for transposition. We focussed on the timeliness of activities and steps to be taken to implement article 6, i.e. the designation, binding adoption and establishment of a management regime for the Natura 2000 sites under the Habitats Directive. The same categories of delay as for transposition were used, and delays for pSCI lists, EU approval of lists and domestic adoption as SACs were assessed according to the original schedule, while the activation of article 6.1 conservation measures was assessed relative to the SAC adoption (at the latest 6 years after SAC adoption according to the directive). For Romania, delays are measured since the transposition deadline in 2006.

The Natura 2000 procedure involves the domestic adoption of SCIs as SACs, in a legally binding form. This step was treated as part of the implementation procedure, as it invokes the next step in implementation, the application of necessary conservation measures.

Institutional causes of delays were investigated by identification of potential misfits between the Habitats Directive article 6 requirements and former domestic nature conservation arrangements. This concerned the designation instrument, and the protection and conservation that followed the designations. Did designations for nature protection exist before, did the designation criteria differ, and which protection and management did it entail? Responses to adaptation pressures in transposition and implementation processes were explored to uncover if and to what degree misfits were addressed. This analysis was built on document analyses, scientific literature and interviews. This allowed us to discuss if the Worlds of Compliance patterns (WoC, see Table 18 for a summary of WoC categories) may explain the ways that misfits were addressed in the case countries.

Worlds of Compliance patterns	**Transposition**
law observance	timeliness and completeness in transposition and legal adaptation
domestic policies	a) fast or slow transposition and legal adaptation, b) importance of contradictory interests among policy actors
transposition neglect	slow and/or incoherent transposition and legal adaptation, neglect in administrative and political systems
dead letter	fast transposition and legal adaptation, lack of enforcement

Table 18: Compliance patterns adopted from Falkner et al. (2007, 2008).

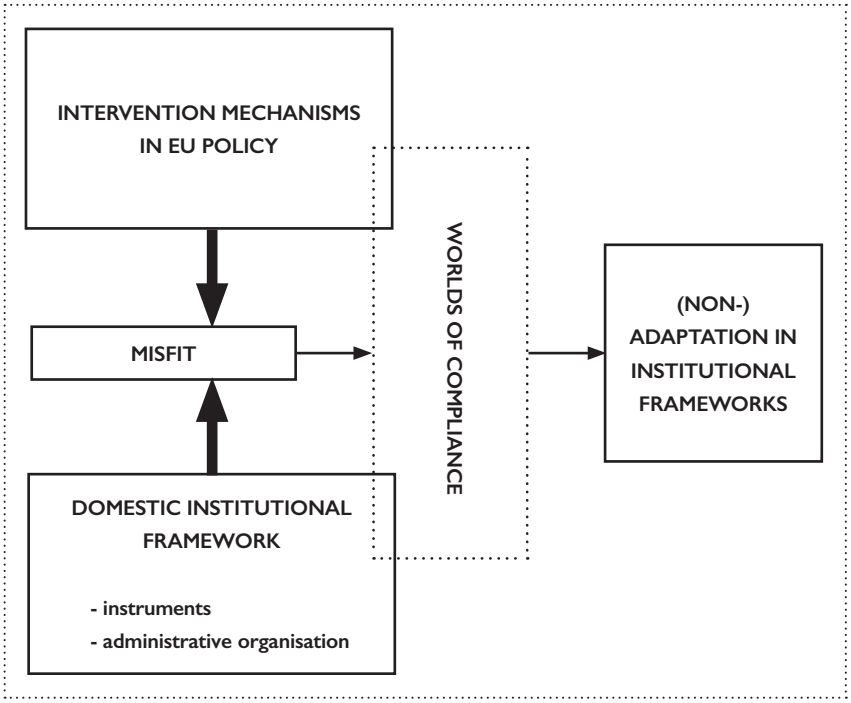


Figure 18: Analytical framework.

In this perspective, transposition would take place in a timely and complete manner in countries characterised by a culture of Law Observance, as both the administrative system as well as policy makers share a compliance culture which would result in necessary institutional adaptations to possible, even severe misfits. On the contrary, in Worlds of Neglect countries, administrative systems would not care to bring the necessary awareness to policy makers on the content of EU laws, and policy makers in their turn would tend to believe in the supremacy of domestic arrangements, no matter the degree of fit or misfit of the institutional requirements. In countries categorised in Worlds of Domestic Policies, political actors rather than reluctant administrative systems would be critical for outcomes, as new supranational requirements might be contested, if working against political priorities in governments or major interest groups. If this is not the case, the administrative systems may efficiently deal with transposition requirements. Hence, institutional mismatch is not the main issue preventing transposition in these countries, but rather potential conflicts of interest among strong political actors.

	Years of transposition	Laws transposing the Habitats Directive
DK	1998, 2003	1998: Habitats executive order 2003: Law on environmental objectives
NL	2002, 2005	2002: Flora and Fauna Act 2005: Revised Nature Conservation Act
GR	1998, 2008, 2011	1998: Joint Ministerial Decision (JMD 33318/3028). Determination of Measures and Procedures for the Preservation of Natural Habitats and Wild Flora and Fauna, with amendments 2008 2011: Law 3937, §5 of Article 9, and §2 of Article 22.
RO	2000, 2007, 2011	2000: Law no 462/2000 for the approval of Emergency Government Ordinance No 236/2000 2007: Government Emergency Ordinance (GEO) no 57, on the regime of protected natural areas, conservation of natural habitats, wild flora and fauna 2011: Law no. 49/2011 approving above Government Emergency Ordinance

Table 19: Transposition time lines in case countries.

This would potentially also affect implementation. In the countries characterised by Dead Letter, misfits in the transposition stage would be expected to eventually be overcome both in the political and administrative systems, while other issues, such as economic capability could severely affect the ensuing implementation.

A conceptual model of the analytical framework is presented in Figure 18.
The data collection was performed by national scientific partners. Document analysis of national reports, legislative texts and ministerial chapters was carried out, and semi-structured interviews were conducted with policy makers, civil servants at national and regional levels, NGOs and experts, using common guidelines. The total number of interviews in the four countries was 27 (DK 6, NL 8, GR 5, RO 8).[2]
Possible causes of delay, incompleteness or non-compliance with obligations and deadlines were explored in the interviews, investigating whether and how potential institutional misfits were addressed, and which types of adaptations took place.

[2] *Where no other reference is given, results are derived from the reports from the country studies, which can be found at www.volante-project.eu, deliverable 2.2 with annexes (Frederiksen et al. 2013).*

Procedural steps	Formal deadline	DK	NL	GR	RO
Designation process					
First proposed list of designations delivered to EU (pSCIs)	1995	1998	1996	1996	2007
Commission first approved list of terrestrial SCIs	1998	2003	2003	2006	2011
Numbers and areas of SCIs *)		234 (3211 km^2)	139 (3178 km^2)	241 (21616 km^2)	382 (39925 km^2)
Domestic adoption (SACs, 6 years after EC SCI adoption)	2004	2011 – all approved together	2015: almost all are adopted under national law – one by one	239 of 241 – all together in 2011	2015: no SACs yet
Management provisions regarding article 6					
Protection against deterioration or disturbance and assessment of implications of projects or plans	1998	1998	2002	(1999, 2010) mainly 2011	2007
Domestic adoption as SACs instating proactive conservation (SACs, with management plans, 6 years after EC SCI adoption)	6 years after EC adopted SCI list	2011 all management plans adopted	11 management plans adopted in 2015	Two management plans adopted by 2015	14 management plans adopted by December 2013, less than 20 in 2015

*) Adapted from Natura 2000 Newsletter 2014

Table 20: Implementation process of protection of habitats (article 6).

DELAYS	DK	NL	GR	RO*
Transposition	medium	major	major	medium
Designation of pSCIs	minor	minor	minor	no
SCI list approved by the Commission	minor	minor	medium	minor
Domestic adoption as SACs	no	not finalised	medium	not finalised
Management plans for SACs	minor	not finalised	not finalised	not finalised

* Romania assumed to have a deadline for finalization of transposition and approved SCI list by the end of 2006

Table 21: Delays in the implementation of Article 6 obligations.

5.4 Results

5.4.1 Overview of transposition and implementation delays

Transposition of the Habitats Directive in the member states has involved both the adoption of new regulations, based on the EU directive, and adaptations of existing laws to comply with the new requirements. Table 19: Transposition time lines in case countries illustrates the timeliness of the transposition in the case countries.
The table shows that none of the countries managed to carry out even the first transposition attempt within the deadlines given - apart from Romania, where the alignment to the environmental acquis took place in the pre-accession process. From 1997, the EC initiated infringement procedures towards several countries for not complying with the transposition requirements, and in some cases rulings were needed before domestic actions took place. Finalisation of the transposition differed – Denmark adopted a planning framework for Natura 2000 in 2003, while the Netherlands adopted necessary amendments for habitats protection in 2005, and Greece only delivered on transposition shortly before the second reporting period for the Habitats Directive, by adopting a new law for all types of protected areas in 2011 – the same year where Romania finalised transposition.
The timeliness of implementing the various steps in the Habitats Directive's management regime did also differ among the case countries, as shown in Table 20.

None of the countries managed to comply with the deadline for proposing (terrestrial) SCIs. However, the timing and process until designations were approved by the Commission and subsequently for the national governments to adopt the SCIs as SACs differed substantially. Moreover, the transposition and implementation steps overlapped due to delayed or incomplete transposition, and all case-countries initiated identification and designation of pSCIs before transposition was finalised. Two of the countries – Denmark and Greece – chose to adopt the SACs all at once; Denmark concurrent with the adoption of a management plan for all sites, while in Greece the adoption of SACs took place in spite of missing targeted – and legislated – measures for most of them (Tryfon 2015). In the Netherlands and Romania the SACs adoption was following the production and adoption of a management plan site by site - a process that is still ongoing.
Table 21 shows a summary of delays in the transposition and implementation process.

5.4.2 Country study accounts

Denmark

Misfits. Some misfits were apparent between the management paradigm that existed in Denmark and the Habitats Directive's approach. The Danish Nature Conservation rested on traditions of balancing different interests when limiting the

threats to habitats. Nature conservation designations were known, both as part of comprehensive protection for the sake of nature, cultural heritage, landscape or other, which would trigger compensation to owners, but also in weaker forms. A general protection to (semi-) natural habitats, such as heathland, salt meadows, ponds, bogs, meadows, dry grassland and streams was introduced with the Nature Protection Act of 1992. This implied protection against changes in their state, while existing – e.g. agricultural – activity could be continued. Some of these areas later became the backbone of the Natura 2000 designation, and thereby protected under the Habitats Directive and the new management regime. Institutional misfits were most apparent in the following areas: a) classification systems of habitat types used in Denmark (and other North Western European protection schemes), which differed from the EUNIS classification in the Habitats Directive, (Bunce et al. 2013), imposing a need for translations and adaptations in the Danish system before designations could take place; b) the strength of the impact assessment of projects and plans and c) the mandatory restoration and conservation management for the sites.

Adaptation in transposition and implementation processes. The transposition in Denmark took place through the Habitats Executive Order in 1998, and was completed in 2003 with the Executive order on Delimitation and Administration of International Nature Protection areas and with the Law on Environmental Objectives. This was several years delayed compared to the directive's deadlines. The initial conception in the Ministry of the Environment was that the Danish laws already implemented the Habitats Directive through the 1992 Law on Nature Protection, and through other existing laws on forests, resources and watercourses (Rudfeld 2015). The initial transposition was mainly considered ad administrative issue. It was enacted through minor adjustments to existing legislation and through the adoption of a Habitats Executive Order (1998). This order included provisions for prevention of deterioration, and it also specified other laws and executive orders for which assessment of implications should apply. Moreover, it provided for the national designation of SCIs. During this phase scientists and NGO's were heavily involved in the process of exploring what a full transposition involved, using juridical and expert competence to support claims that the transposition was not complete, due to a lack of provisions for forward looking management measures. In 2002, the Forest and Nature Agency asked the legal advisor to the Danish Government to investigate the Danish implementation of the Habitats Directive. It was concluded that Denmark needed to establish a more precise, legal framework for the implementation mechanisms. Meanwhile, the EC was also increasingly observant on the transposition of the article 6 protection obligations, and a letter of notification was submitted to Denmark in 2003. At that time, amendments to the Law on Nature Protection and the Law on Forests were however already prepared, and a new Act, the Law on Environmental Objectives (2003) was adopted for the finalisation of the transposition. The latter concerned provisions for the Water Framework Directive and the Habitats Directive, and introduced a planning framework for the pro-active management planning of water bodies and Natura 2000 sites. Legislative adaptation has subsequently taken place, and Denmark has not yet had any court cases in ECJ.

A preliminary list of proposed SCIs was submitted to the Commission in 1995. An infringement procedure was however initiated by the Commission in 1997 against Denmark (and a number of other countries), as the proposed areas were considered insufficient. The Danish authorities extended the list, but the Commission maintained that the extent of the nature types was not appropriately covered. A final list of pSCIs was then agreed and approved by the EC in 2003. National stakeholders were – contrary to the directive's emphasis of scientific criteria as the sole basis for identification – positively involved in the identification and delimitation of sites, which according to the interviews was part of the reason for delays.
The organisation of the planning and enforcement responsibilities in the administrative system was initially delegated to the counties, formerly responsible for nature management. A structural reform abolished the counties in 2007, but legal and administrative adaptations ensured a distributed responsibility for Natura 2000 management. Natura 2000 planning was centralised to the national level Nature Agency, while enforcement through local plans of action was delegated mainly to the municipalities – except for areas with state ownership. Meanwhile, the finalisation and approval of the Natura 2000 plans were delayed in 2008–2009 due to politics related to the aquatic environment, which have played a dominant role in Danish environmental politics for decades, due to the high stakes for the agricultural sector. The planning processes for water and nature plans had been aligned time-wise and to a large extent also in terms of procedural steps, aiming for concurrent adoption of all management plans. When the WFD planning was set on hold in 2008 due to the development of a Green Growth Strategy for the agricultural sector, this also delayed the Natura 2000 planning process. According to interviews this delay was used by the Nature Agency and the Local Government organisation jointly to develop a consistent paradigm for the action planning, which is a Danish invention for the local implementation of the Natura 2000 plans. The Natura 2000 plans were adopted altogether in 2011, and thereby also the SCIs as SACs.
Compliance patterns. Some delays in the transposition phase were followed by minor delays in the various phases on implementation.

Mismatches could be identified between EU level and Danish nature conservation approach, and certain pressure on the authorities was continuously exerted by Nature Conservation NGOs and experts for adapting legislation to meet the Habitats Directive's requirements. New acts and legal adaptations were adopted when the authorities recognised what the directive required, either in domestic processes or in the dialogue with the Commission, resulting in comparatively early and complete transposition. Delays in the designation phase were partly due the collection of scientific knowledge and adaptation of criteria for identification of sites and the involvement of stakeholders in this process. Delays in the phase of conservation planning were caused by centralised political processes in policy-making for aquatic environment in a phase of economic and agricultural crisis and a government desire to publish the Natura 2000 plans and the water plans at the same time.

The administrative roles and responsibilities followed the organisational structure that existed for nature conservation, with planning and management responsibilities for a large part delegated to the counties. When these were abolished in the structural reform, adequate legal and administrative adaptations took place for ensuring the organisation of Habitat Directive requirements. Hence, adaptations in the organizational structure were a result of the reform and not of the conservation requirements. The planning approach and the related hearing phases implied that the relatively rigid directive mechanisms were balanced with the Danish tradition of consultation, thus avoiding the larger legal battles experienced in some other countries. Even if notifications of non-compliance have also been received in Denmark, no cases at ECJ have been opened, since adaptations have taken place. Hence, a Law Observant compliance culture has largely characterised the transposition and implementation of the Habitats Directive. Delays in the planning phase related to political controversies in the implementation of the sister directive, the WFD, due to strong, domestic conflicts of interest in major stakeholders' policy agendas, related to agricultural and water policy. These conflicts have roots in EU policies with greater political stakes than nature policies in Denmark, and while the overall implementation process of the Habitats Directive shows a strong tendency towards a law observant compliance culture, he process also shows that domestic policies may be more influential in policy areas with larger contradictory interests.

The Netherlands

Misfits. Preceding the Natura 2000 protection was a historic emphasis in the Netherlands on nature conservation through State nature reserves. In 1990 a Nature Policy Plan was adopted by the Dutch parliament, which introduced the National Ecological Network (NEN), as a network of habitats connected by corridors that was to be realised before 2018. Since 1991 this was implemented at high costs, and designations were integrated in the spatial planning system which rested on balancing and deliberation among stakeholders. Against this, the Habitats Directive approach using purely scientific criteria for designations presented a significant mismatch with the existing practices, and even though the Directive is concerned with habitat networks, the focus and legislation concerned the identification and designation of habitat sites. On the other hand, the NEN involved a change from traditional conservation practise, aiming at status preservation, to an active form of nature protection and development, in which acquisition of land for nature reserves and management agreements with farmers were prominent tools (Jongman 2008) – an approach that fitted well with the Habitats Directive.

Adaptation in transposition and implementation. The Dutch government devoted little attention to the transposition of the Directive in the 1990s. The initial perception of authorities was that the existing nature conservation systems would suffice, as the Habitat Directive was modelled over the Dutch conservation planning approach. The existing regulation however, did not entirely match the Habitat Directive requirements. The prevalence of ecological criteria over societal ones was a new

principle for The Netherlands, where an integrated approach to nature conservation was employed, in which agricultural, recreational and economic values could be taken into account. In 1998, the government was made to consider the directives in a more serious way due to increasing media attention following lawsuits regarding nature conservation and infringement procedures opened by EU on insufficient designations of pSCIs. The resulting Nature Conservation Act (1998) and the Flora and Fauna Act (2002), were hurriedly adopted and were considered sufficient to transpose the Habitats Directive. However, in 2000 the EC notified the Netherlands of incomplete transposition and in 2002 an infringement procedure was opened by the EC for failure to legally implement the directive correctly. A new Nature Conservation Bill (coming into force in 2005) had to be adopted before the EC finally approved transposition.

The implementation process also moved slowly forward. In 1996 only 27 pSCI sites were designated, but after the opening of the infringement procedure in 1998, more areas were added and a court ruling was avoided. In 2003, the Dutch government was the first to submit a full pSCI list of 141 sites to be approved by the EC. The official designation as SACs under Dutch law then became seriously delayed as regional authorities requested the national government to first undertake the management planning prior to official designation. The management planning process for Natura 2000 sites is quite extensive, and the designation of sites takes place one by one, only after the management plan is agreed upon. A formal dialogue is organised involving working groups and public consultation procedures, in which institutional and other stakeholders participate. As a result, the majority of the sites were not nationally designated until 2011-2013, and some are still pending (Snijders 2015).

The approval of management plans had in 2009 come to an almost stand-still due to the close relationship between Natura 2000 management plans, the water level management and the nitrogen regulation, both highly contested due to alleged economic (agricultural) implications. Too high a load of nitrogen in Natura 2000 sites is an issue in 117 out of 166 sites. As a result, in 2012 only three management plans had been approved and less than half of the sites were officially designated, due to concerns about permitted economic activities.
Administrative mismatches also needed to be overcome, as the environmental and nature policy areas fell under different ministries, and in general, the tradition of multi-level and multi-actor governance and its related call for coordination, implied problems and delays both for the inclusion of the Habitats Directive requirements in sectoral legislation, and for the implementation in administrative land use planning procedures. From 1993 onwards, substantial decentralisation and relocation of responsibility for rural areas to provinces took place (Jongman et al. 2008), and a shared decision-making for the Natura 2000 network was developed between central and provincial authorities, coordinated by an 'Intergovernmental Bureau'. Once the designation of sites was finalised, this Bureau was dissolved and a Bureau of the Provinces took over the responsibilities with regard to the implementation of management plans. The

responsibility for the preparation of management plans under the Habitats Directive depends on the ownership of the areas. For 101 out of 162 management plans the responsibility is at the provincial level.
However, traditional management plans were internally oriented, describing measures for conservation. The new management plans asked for a prescription of activities that are allowed and those that would require permission, i.e. a legal aspect was added which resulted in a change of discourse. Hence, the management model to some extent resembled that of the National Ecological Network in terms of management plans, but required adaptations (Bouwma et al. 2016).

Compliance patterns. Major delays in the transposition phase were followed by minor delays in SCI designation and Commission approval. The approval of SACs has shown to be seriously difficult, with major delays as a consequence.

Different causes seem to exist for the delays in or lack of compliance to requirements and deadline, but especially the designation approach that rested solely on scientific criteria collided with an approach that aimed to conserve biodiversity in a multifunctional combination with other policy objective. Moreover, a change in regulatory style from the tradition of negotiation and deliberation to an emphasis on legal requirements took place and has already been well-documented in the literature for the Netherlands (e.g. Arnouts and Arts 2009; Beunen 2006; Beunen et al. 2013; Van Keulen 2007) describing how the uncertainty related to the implications of the designations created resistance to the designation process, and also, how deliberation processes, formerly taking place through governance traditions related to spatial planning processes, were overtaken by legal procedures, where interests were increasingly pursued in court cases (Beunen et al. 2013). These findings of delays, opposition and distrust, were confirmed by respondents in this study, explaining that even if interaction has improved, lack of communication still gives rise to myths on the implications of the site designation for economic activities.
Secondly, the administrative implementation proved complicated, and the partial decentralization that was later carried out may have been a move to ease the communication. It has however, also been regarded as a way for the Ministry to shift the responsibility for resolving potential conflicts to the provinces, according to respondents. It seems that the ball was returned by the request to undertake the management planning before the final adoption of sites could take place. This is heavily influenced by the interaction with other domestic policy processes related to the implementation of the Nitrate Directive and the WFD, both with high stakes for farmers and water boards.

The process illustrates that in the Netherlands, which could from a superficial point of view present a case with smaller misfits than many other countries, adaptations to misfits has anyway caused domestic resistance to the Natura 2000 network among institutional as well as private stakeholders, and compliance to implementation deadlines has in later phases been subordinated to domestic processes related

to conflicts of interest and coordination with other policy processes. Thus, the compliance pattern fits to considerable extent the World of domestic policies.

Greece

Misfits. In Greece, various types of natural areas, such as forests and wetlands, have been recognised as areas under special protection status, since 1937, and until 1986 the provisions of the Forest Law made reference to the declaration of various types of areas protected under own regulations. In 1986 a law was adopted whereby natural areas of absolute protection, areas of nature protection, national parks, protected landforms, protected landscapes and landscape features, as well as areas of eco-development were established, classified and regulated, including designation criteria and principles for protection and management. The criteria that related to nature conservation were (national) species oriented (Tryfon 2015), while the Habitats Directive introduced criteria related to habitat types. Hence, delimitations of SCIs would not necessarily coincide with existing designations. Importantly, an operational system that could manage spatial issues in a coherent, horizontal manner did not exist (ibid), as spatial planning traditions were limited. Moreover, an appropriate management structure needed to be designed.

Adaptation in transposition and implementation. The first attempt at transposition in Greece took place in 1998 with a Joint Ministerial Decision on The Establishment of Measures and Procedures for the Conservation of National Biotopes and of Wild Flora and Fauna, with later amendments in 2008. This followed from a notification and subsequent ruling by the ECJ in 1997 for failure to transpose the laws, regulations and administrative provisions required by the Habitats Directive. Disputes arose between the former Ministry of Environment, Physical Planning and Public Works and the Ministry of Agriculture – the two main ministries responsible for the designation and management of Greek natural areas since 1986 – since power would be shifted to the former. This delayed the transposition process, and was only solved by the ministerial decision in 1998, which almost literally transposed the directive (Andreou 2004).
The existing law from 1986 on the Administration and Management of Protected Areas was amended but coherence between the regulations was not ensured. The traditional nature conservation approach in Greece was that of avoiding human activity in protected areas, but a large number of protection types were introduced by national and international institutions during the preceding decades, based on both scientific and cultural-aesthetic criteria and each with their own management regime, and the Natura 2000 protection became one of many. A general lack of policy coherence in protected areas was not sufficiently dealt with until 2011, when a new act, the Law on the Protection of Biodiversity and other Ecological Values, was adopted, which finalised the transposition of the Habitats Directive. It established a National System of Protected Areas, covering all categories of formerly protected areas, but also designations in relation to the Birds Directive and Natura 2000 sites. The law laid down provisions for characterisation and management of the protected areas, and included a specific article regulating the protection and management of the

SACs, in compliance with the Habitats Directive, and in this way it sought to provide more clarity to the area protections.
A long and iterative process for site designations started with the submission of the first SCI lists in 1996 and 1997, after which domestic unwillingness to further designations developed (Tryfon 2015). The first EC approval of the SCI lists took place in 2006. In total, 11 submissions took place from 1999 to 2012, supported by several LIFE projects for identification. The protected areas in Greece doubled in size and about half of the formerly protected areas overlapped with Natura 2000 sites (EEA 2012b). The official designation as SACs took place through the 2011 law, but even in 2012 it was noted that 'there are institutional problems concerning the legal form of the designation texts and the competencies of the Management Authorities' (Tryfon 2015). Also for some sites the legal acts had to be changed as they were deemed improper by the Council of State. National designations or re-designations by presidential decree are still pending for most sites. Management plans are mandatory, but only two management plans had been approved by March 2013, and objectives had not yet been developed for the majority of the areas concerned.

Today the Ministry of Environment, Energy and Climate Change is responsible for the designation and planning of the nature reserve areas, and they have the overall control of the Natura 2000 network. A Law on Spatial Planning and Sustainable Development, adopted in 1999, sought to take the step from protection to management. It laid down provisions for the establishment of Management Authorities in protected areas, as well as for their competences and mode of operation. In 2002, 25 Management Authorities were established by law for protected areas, increasing to 29 in 2012. Some of the Management Authorities were merged into other forms or were abolished in 2013, leaving 14 independent Management Authorities, and transfer of responsibilities for other sites to public bodies. In spite of the reforms in 2011, a lack of alignment of legislation still results in an overlapping and incoherent legal framework. A report from the Ministry of the Environment, Energy and Climate Change claims that large parts of the Natura 2000 sites are both protected under the new law and under forest law, giving rise to continued confusion of the management basis and inter-ministerial conflicts. Several respondents also claim that the legal basis was and is insufficient for implementation.

The management authorities are private legal entities governed by a board consisting of representatives of relevant ministries, NGOs and private stakeholders, and their role is to formulate management plans and regulations, to monitor and assess the implementation of the latter, and to control human intervention in the areas under their jurisdiction. They should also ensure the participation of local communities and stakeholders in decision making. If no Management Authority is appointed for a protected area, this may be assigned to an existing public service or a service appointed to this purpose.

The establishment of Management Authorities lags behind. The chairwoman for the national Natura 2000 committee stated in 2013 that management bodies exist only for 25–30% of the protected areas, and that lack of targets, priorities and further steps prevailed, including how progress will be monitored. According to the evaluations, even the existing Management Authorities are not viable due to a lack of human and financial resources, and they do not function due to neglected procedures, lack of interaction with local stakeholders and communities. Interviews support that civil servants at all levels complain about lack of clarity of jurisdiction and organisational effectiveness.

Compliance patterns. Transposition took place with large delays and the resulting legal framework was, and still is, incoherent and incomplete. Implementation steps were considerably delayed and management planning has only just started.

Misfits in the institutional frameworks have not been sufficiently addressed, and where site designations have taken place, they have not been nationally approved. In addition, legislative rules for designation have not always been followed, all of which owes to a generally confused, bureaucratic and unorganised process. A functioning management system for Natura 2000 sites is still largely missing, and ownerships of the designated sites are not clear. While 'transposition neglect' does not reflect the present situation – given that transposition has taken place through several pieces of legislation – it is evident that sufficient effort has not been allocated to make the directive functional in practice, and a high degree of both administrative and political neglect seems to characterise the way that the directive is implemented in Greece. While this lack of effort – and priority – seems to have characterised the whole process, obviously also other explanations for delays have been at stake, such as lack of knowledge, human resources, and financial constraints.

Romania

Misfits. The first 'Nature Protection Law' was issued in Romania in 1930, aimed at preserving pristine natural areas of up to thousands of hectares with rich flora and fauna, representing valuable 'centres' of untouched nature as well as small reserves (usually < 0.5 hectares) of very valuable components of nature, as 'natural monuments'. Transition from the classical concept and practice of nature protection towards a broader, holistic concept, which considers the dynamic complexity among the components of nature and (human) environment, took place from 1973 onwards as forerunner of the Natura 2000 concept. This was inspired by the approaches in the UNESCO-MAB Secretariat, IUCN and the Secretariat of the World Heritage Convention. Hence, main misfits in relation to the Habitat Directive did not relate to the nature conservation approach but rather to the complex task of harmonization of the composition and structure of the domestic regulatory system with that developed and applied in the EU-space, and improvement of the organizational and institutional capacity to effectively use the EU rules, mechanisms and standards in the implementation.

Adaptation in transposition and implementation. The Habitats and Birds Directives were initially adopted within the domestic regulatory system during the pre-accession process by Law 462/2001 with subsequent changes in the former domestic legislation. No transitional period was negotiated, and implementation of procedural steps was supposed to be finalised by the time of accession.
The transposition process was embedded in the accession procedure. Legal restructuring in Romania was heavily influenced by the socio-economic changes in 1990 and the following process related to the desire to access the EU. Full transposition took place in two stages: firstly, by a Government Emergency Ordinance in 2007 on the regime of protected nature areas, conservation of natural habitats, wild flora and fauna. Secondly, this was approved with amendments and concluded by a Law in 2011, which established the institutions and penalties for violation of provisions contained in the Birds and Habitats Directives. This law is the main piece of legislation transposing the Habitats Directive. It provides for management plans for Natura 2000 sites, and prioritises the targets, site maps and measures for the approved site specific management and action plans in regional, county and municipal planning.

During the pre-accession phase new authorities such as the Ministry of the Environment, Water and Forests (1990) were established. The intention of the newly established policy and decision making authorities was to adapt the existing protected areas and/or to designate new ones, based on a research program for identification and delineation of vulnerable species, ecosystems and landscapes, as well as eco-regions (1991/1993) (Vadineanu et al. 1992). The first National Strategy for Sustainable Development for 2000–2006, approved in 2000, however, hardly considered nature conservation, which reflected limitations in the Action Plan of the first National Strategy for Biodiversity and Action Plan from 1998. While the policy and strategic objectives of these domestic documents were more or less similar to those of the EU strategies, there were no clear and binding links with the Habitats Directives.

A process of identification, consultation and designation concluded with the approval of the SCI list of 273 sites by the EC in 2007, albeit still with insufficient coverage, and it was further supplemented until 2011 (to a total of 382 sites). The EC approved of this list in 2011, and the national official designation is planned to be finalised in 2016. The protected area in the country tripled, while almost all existing protected areas also became Natura 2000 sites (EEA 2012b). Management plans, mandatory in Romania, should include present state description, the targets for a favourable protection status, detailed site maps, a proper package of specific measures and specific action plans. By 2015 less than 20 management plans had been approved, and no SACs have been adopted (Smaranda 2015). This was considered a delay according to the government's plans for spending funds under the Romanian National Rural Development Plan, but is not yet considered a delay in terms of the 6 years deadline from SCI approval.

In Romania, the Natura 2000 designations were contested by nature conservation experts and NGOs devoted to traditional nature protection concepts, resisting direct and indirect human interventions in the protected areas. The large Natura 2000 designations are however composed of mixed land uses. The interviews among regional authority respondents revealed that the site boundaries were drawn arbitrarily regardless of local particularities (urban, forest parcel boundaries, natural boundaries, and overlapping protected areas) and of opinions of land owners, and inadequate public awareness and consultation campaigns in designation of the Natura 2000 sites process were sources of persistent controversy.
The administrative structure in Romania underwent large changes due to the socio-economic transition. A National Environmental Protection Agency with regional and local bodies, responsible for the implementation of the Habitats Directive, was established in 2004. The organisational structure for Natura 2000 however resembles former models for protected areas. As existing protected areas were included in the Natura 2000 sites, this implied that regulations also overlap with other types of protected areas (natural and national parks, biosphere reserves, strictly protected areas, etc.). Respondents from the local and regional authorities claimed that the emphasis on the compliance with immediate legal requirements resulted in a law which suffered from a lack of clarity on the distinction of administrative responsibility and goals between the Natura 2000 sites and the national types of protection (see also Iojă et al. 2010).

Site-specific management plans are delegated to appointed administrators, in consultation with advisory and scientific bodies operating within the special management structures for these sites. For smaller Natura 2000 sites that do not require administrative structures, management plans are produced by contracted custodians. This structure was inherited from the pre-Natura 2000 institutional framework. By 2012, contracts were signed with 42 administrators (forest administrations, NGOs, universities, commercial societies) and 304 custodians (same institutions plus local authorities and environmental agencies). Some respondents claimed that management bodies are often dysfunctional, due to a general lack of trained personnel, and due to the custodians – often NGOs – concerned with gaining access to funds, without primary concern for conservation issues. This has implications for the delays in management planning.

A particular problem has been the delay in compensation to owners of land in Natura 2000 sites. Under the National Plan for Rural Development (2007–2013), a considerable sum was allocated for implementation of site specific measures under the schemes for Natura 2000 sites. Management plans were supposed to be finalised and approved by 2010 and 2011. Meanwhile, however, these subsidies could not be spent before approval of the plans, and as restrictions to activities were already imposed with the approval of the designations, public understanding and trust with respect to the Natura 2000 network declined. One expert respondent suggested that implementation of the Habitats Directive takes place more as an obligation to

Brussels than as a domestic priority; the focus is thereby more on compliance with procedural steps than making things work in practice.

Compliance patterns. Some similarities with the Dead Letter compliance type can be identified. Directives have been almost literally translated into national legislation, and pre-occupation with compliance to EU rules and procedures in the accession phase partly explains this pattern. Hence, legal and public institutional structures are in place. Implementation, however, have met various obstacles. During the first phase of the socio-economic transition, the most influential stakeholders considered that any investments in biodiversity conservation and reduction of the environmental liability of the existing built infrastructure would slow down macro-economic reform and economic growth, and nature conservation thus received poor consideration in national strategies and operational plans. On the other hand conventional concepts and practice of nature conservation were frequently promoted by the most active actors (in particular experts in nature conservation, scientific staff and NGOS active in nature conservation), which may explain the controversies occurring during identification and describing SCI sites and their related targets and conservation measures in the management plans. Even today, the management structures for Natura 2000 sites are not fully in place, and where they are established, they are often not well-performing. This situation could also indicate some degree of neglect.

5.5 Discussion

As the summaries above indicate, timeliness has been a critical issue in the transposition as well as in the implementation phase of the Habitats Directive. According to Krämer (2015) the full account of the transposition completeness across the EU is not available, as no official documentation exists on the extent to which member states have correctly and completely transposed the directive. None of the case countries however complied with the directive's timetable for transposition, and several had to be coerced through the transposition step by notifications and sometimes rulings by the ECJ. This is however a common picture of the situation across Europe, where in 1997 eight countries including Greece, were prosecuted for non- or incorrect transposition (Lasén Diaz 2001), and as late as 2001 reasoned opinion was sent to five countries including the Netherlands, for inadequate national legislation (EC press release of 6 August 2001). These initial delays seem to some extent to be due to the complexity of the directive, and ignorance of the full extent of the requirements. Even so, differences in the transposition delays are identified between the case countries, Greece standing out with particularly long delays. The adaptation pressure exerted by the ECJ implied that hurried transposition often resulted in almost literal translation of the Directive text, which could result in a need for later amendments and lack of or insufficient adaptation to other domestic legislation, as was the case in Greece.

Delayed transposition implied that steps of transposition and implementation overlapped, as the directive's requirements to produce draft lists of sites was initiated before completion of transposition in all case-countries. Thereby, the implementation of the various steps required by the directive's article 6 and the extent to which this resulted in timely implementation and an effective institutional framework also followed quite different patterns in the countries, as summarised in Table 21.

The study shows that the intervention mechanisms used in the Habitats Directive did not fit most existing domestic institutional frameworks though in different ways. For all countries adaptation pressures were related to the regulation concerning appropriate assessment, which required stricter assessments than traditional environmental impact assessments following the EIA directive (85/337/EEC). In addition, the explicit scientific criteria for designation did not fit well with traditions of deliberation and participation in multi-level and multi-actor settings, which characterised especially the Netherlands and to some extent Denmark with scarcity of land and strong land use planning traditions. This is clearly expressed in a recent evaluation, where the Dutch representative of the IPO[3] states that ECJ rulings tend to obstruct sustainable growth, based on the legislative text and on its interpretation through ECJ, which is in contradiction to other EU initiatives for ecosystem services, due to the one-sided focus of the habitats assessment (Snijders 2015). Moreover, adaptation pressures deriving in particular from the requirement of pro-active conservation in Natura 2000 sites obviously presented a series of challenges. Efficient implementation would require alignment with existing domestic nature conservation management frameworks, including designation criteria for other types of protected areas and their associated conservation targets and measures, with management bodies and their provisions, and it would require consideration of spatial overlaps between different types of protections. These misfits were present especially in Romania and Greece where Natura 2000 sites to considerable degree overlap with existing natural parks and other types of protections, and where spatial planning traditions which might cope with these challenges were poor.

Responses to misfits differed among the countries, as indicated by the extent of transposition delays. Both the Netherlands and Denmark delays prevailed in the first phase due to the authorities' perception of compliance based on the existing nature conservation frameworks. However, when the Danish legislation was questioned, investigations were initiated and the legislative framework was subsequently prepared and adopted, a process that was also assisted by the parallel planning requirements in the WFD. In the Netherlands persistent political resistance to legal change implied that the eventual transposition became hurried and needed subsequent adaptations to regulations. In Greece, transposition was delayed until a ruling by the ECJ forced it to happen, to some extent due to political controversies over jurisdiction between the two main involved ministries (agricultural and environment), which were inherited from former biodiversity policy frameworks (Andreou 2004). The eventual transposition was incomplete and several amendments followed over the years, without creating a fully coherent and comprehensible administrative basis. The transposition process

[3] *Ministry of Economic Affairs, Ministry of Infrastructure & Environment and the Association of the Provinces of the Netherlands (IPO)*

in Romania was assisted by the accession process and took place as a largely non-controversial issue, however without a full alignment with existing legislation. Hence, at a general level, approaches to transposition and adaptations to regulation reflected the expectations vis-à-vis compliance cultures as found by Falkner et al. (2007) and Falkner and Treib (2008).
All case-countries chose to use obligatory management plans as the instrument for implementing the pro-active measures in all Natura 2000 sites, but the management systems were organised in very different ways and implementation pathways differed substantially. In Denmark, structural reform changed the management system of nature conservation, but did not change the 'one vertical string - one horizontal paradigm' approach to management organisation and planning, where state and municipalities had each their responsibilities, and where the plans followed a common outline. All plans were adopted at once, also approving them as SACs. In the Netherlands, the responsibility for management planning was decentralised to the Provinces, and stakeholder groups were involved for the specific sites. Lack of initial stakeholder dialogue however provoked continued contestation of management planning in relation to Natura 2000, and Beunen et al. (2013) argue that the efforts to decentralise and increase involvement has not been successful due to the long period of negative framing, and that the room for negotiation is in reality small.

Domestic policies have interfered with the management planning in both countries. In Denmark, the national planning process was interrupted for a couple of years due to interference from other, more conflicting policy processes related to water planning. This delayed all management plans, and the process illustrates that even in a generally 'compliance observant' country, politics may interfere periodically, if sufficiently important to the government or influential stakeholders. In the Netherlands the site specific process differs a lot from the Danish, as national designation, management planning and SAC adoption is moving from site to site. Each process has a high conflict potential in many sites, due to the strong economic interests involved and the interacting policies that also affect land use, notably the water and nitrogen policy. In this case, compliance to deadlines is overridden by domestic processes, which cannot be ascribed to institutional misfits, but related partly to spill-over from other policy processes and partly to a management planning that aims to take into account those trade-offs that different land use affecting policies entail. The difference between the approaches taken by the two countries is obvious and it can be argued that the Dutch approach – and delays – to a higher degree reflects the compliance pattern of the 'world of domestic policies'.

New autonomous management authorities were to be established for the larger Natura 2000 sites in Greece and Romania – in administrative models resembling the set-up for other types of protected areas, which is based on outsourcing of management of smaller sites to private actors and NGOs. In Greece, 25 management bodies were established in 2003. Apostolopoulou and Pantis (2009) note that 2003 was also the EU deadline for the return of allocated funds from the second Community

Support Framework for Greek protected areas – a fact that may have influenced the timing and sudden speed. Providing the bodies with sufficient competence was however not effectuated, and the spatial misfits that derived from several regulatory frameworks covering the same areas were not resolved. The Greek government has not yet managed to create an administrative system that covers all protected areas - 30% of the Natura 2000 area I covered - and the lack of transparency and alleged influence from ministers and powerful economic actors on the selection and zoning of protected areas has led to mistrust and opposition to the Natura 2000 network (Apostolopoulou and Pantis 2009). In Romania, effective administrative systems are not in place for all Natura 2000 sites. This includes institutions for interaction with stakeholders, and it implies that the issue of compensation of landowners for their economic loss due to required conservation measures is far from solved (Stancioiu et al. 2010). Management plans are lacking for most sites, but the existence of these plans is conditional for the allocation of funds for the implementation of site specific measures. The Habitats Directive is not properly reflected in national strategies, and perceptions are sometimes that implementation steps are responses to procedural requirements from the EU rather than prioritization of the provision of an effective nature conservation framework.

The way implementation takes place in the two countries show some similarities. The processes are not really well defined neither by patterns of 'dead letter' or 'neglect', while the latter seems to be the most suitable notion. Rather than favouring domestic approaches in front of the EU regulation, it seems as if it is a general neglect of the importance of the policy area from politicians and policy makers that are at stake – in combination with conflicts over jurisdiction, and thereby possibly also conservation and economic interests in the areas. Resulting implementation seems to take place in very slowly progressing steps, uncoordinated and with lack of enforcement, leaving space for illegal actions and violations of the intentions for nature conservation (Knorn et al. 2012; Tryfon 2015). On the other hand it is argued that even in these countries which are mainly characterised by neglect or non-priority of the issue of nature conservation, the adoption of the Habitats Directive has brought about an increasing domestic focus on biodiversity and nature conservation, both in governments and in the population (Smaranda 2015; Tryfon 2015). Also, the lack of progress in the implementation cannot be ascribed only to a question of lack of compliance, but the lack of human and financial capacity that characterises these countries are also influential. This was a point of concern raised by several respondents in both Romania and Greece. Former studies has also documented that implementing the full environmental acquis in new member states was regarded as a major challenge and often constrained by lack of financial and administrative capacity (Laffan 2004).
At least for the Europeanisation mechanisms represented by a regulatory framework such as the Habitats Directive, the goodness of fit concept seems to have some merit for understanding the type and degree of adaptive pressures on the institutional approaches that meet the member states in a specific European environmental regulation. Several implementation requirements presented serious mismatches to

existing approaches in all case-countries, and even for the Netherlands that at first glance seemed to represent the best fit, as basic ideas in the directive derived from the spatial planning tradition in this country, misfits e.g. in the lack of sustainability balancing in designation resulted in domestic opposition and a bumpy implementation process. However, institutional misfits that surfaced in the implementation processes did not necessarily lead to non-compliance, and were met differently with respect to adaptive responses. In fact, the implementation processes reveal that approaches to compliance suggested by Falkner et al. seem to have considerable explanatory force for the ways and the efforts that the case countries allocate to overcoming misfits between the Habitats Directive and domestic institutional frameworks, but also other impediments to implementation.

The study confirms that misfits have constituted obstacles to timely implementation of the Habitats Directive in the case-countries – but to different degrees, in different phases and with different effects on implementation. The Habitats Directive includes a series of implementation steps and the observation by Liefferink et al. (2011) that compliance patterns may change in different phases of implementation for directives that involve several procedural steps and longer timeframes, is also reflected in the present study. Still, it seems that the speed and completeness of adaptation in the institutional frameworks in the case-countries to some degree reflects the generalised WoC patterns. The most important institutional change has probably been the requirement for action – or at least for planning action – expressed in the pro-active conservation requirement, and as realised in the establishment of management plans for the areas. It is yet to be seen if the differences in management planning will turn into differences in the realisation of results and outcomes. Time will show if a 'Law Observant' country like Denmark, where the Natura 2000 plans have been produced – and finalised – in a relatively centralised and unified way, will reach the targets faster than a 'World of Domestic Policies' country like the Netherlands, where site related negotiations on management plans try to reconcile various interests before adoption and thereby slow down the planning process – or if this process rather ease the later implementation steps.

5.6 Conclusions

In conclusion, we find that the transposition and implementation of the Habitats Directive follows quite different pathways in the case countries. The goodness of fit approach compose a valuable framework for understanding the severity of adaptation pressure on domestic institutional frameworks for implementing a complex environmental directive like the Habitats Directive with several procedural steps in transposition and implementation. When it comes to responses to adaptation pressures, however, country-specific approaches to compliance, domestic policy priorities and unclear jurisdiction, bureaucracy and the possibility of neglect seems to present considerable explanatory power for the processes taking place.

While important misfits in designation criteria and process, impact assessment and in particular pro-active conservation existed in all case-countries, these only sometimes led to large delays. The responses reflect to a considerable degree the compliance patterns found by Falkner et al. (2007), Falkner and Treib (2008), and this emerges as a useful aggregated perspective, not only for understanding transposition compliance, but also where and when adaptation pressures in implementation are addressed, and how implementation progress is prioritised in political and administrative systems. The study confirms that the one-dimensional scientific focus in the designation has prevented some checks and balances that could have eased the interaction and trust by those stakeholders affected by the site-designations, and that more flexible and less-top-down European legislation may be needed to create a larger room-for-manoeuvre for integration with domestic approaches. The study also points to an increased attention to the biodiversity agenda, even in countries with low compliance, but also that supranational pressure and support for progress is needed.


5

Chapter 6

Mediterranean farmlands:

impacts of land abandonment on cultivation terraces in Portofino (Italy) and Lesvos (Greece)

Van der Sluis, T., Kizos, T., & Pedroli, B. (2014). Landscape change in Mediterranean farmlands: impacts of land abandonment on cultivation terraces in Portofino (Italy) and Lesvos (Greece). Journal of Landscape Ecology, 7(1), 23-44. https://doi.org/10.2478/jlecol-2014-0008

Abstract

The Mediterranean landscape has been rapidly changing over the past decades. Many regions saw a population decline, which resulted in changing land use, abandonment of marginal lands and colonisation by shrubs and tree species. Typical features like farming terraces, olive yards, and upland grasslands have been decreasing over the past 50 years. This results in a declining biodiversity and loss of traditional Mediterranean landscapes. In this chapter we assess the landscape changes that took place in two areas, in Portofino, on the Italian Riviera, and Lesvos, a Greek island near the Turkish coast. We compared land use maps and aerial photographs over the past decades to quantify the land use changes in these two areas. Additional information was acquired from farmers' interviews and literature. We found that changes are related to societal changes in the appraisal of agricultural land uses, and to the urban expansion, tourism and recreation. These diffuse processes are a result of policy measures and autonomous societal transformations. This is confirmed by the results of two interview surveys: between 1999 and 2012 agricultural land use in Portofino regional Park and buffer zone further marginalised, and the associated landscape changes are perceived as a substantial loss of character and identity. This problem is emblematic for large parts of the Mediterranean. Comparing different landscapes reveal similar processes of landscape change, which can be related to similar driving forces. Based on such comparisons, we learn about possible trajectories of change, and ask for a comprehensive approach to land use management.

6.1 Introduction

The Mediterranean region is well known for its high biodiversity (Aronson et al. 1998; Scarascia-Mugnozza et al. 2000). With 25,000 plant species and 770 vertebrate species the Mediterranean Basin is one of the 25 hotspots worldwide for biodiversity (Myers et al. 2000). The high biodiversity is a result of the long history of human influence (Hubert 1991), to such an extent that entire vegetation communities are kept in a state that it suits man (Farina 2006). A number of land management systems have contributed to this, some related to cereals – fallow – grazing, others with permanent crops (mostly olives and vines), with grazing systems and agroforestry. The recent collapse of the agro-silvo-pastoral system, however, has resulted in major changes in plant communities (Médail and Quézel 1999). This has led to a homogenisation of floral and faunal communities and thus a loss of biodiversity. The increasing dominance of forest species in silvo-pastoral systems may lead to a rapid decline of species diversity (Gondard et al. 2001; Pedroli et al. 2013).
Although Mediterranean landscapes were never static, the rate of change has rapidly increased over the past decades. Many regions saw a population decline, which resulted in changing land use, abandonment of marginal lands followed by colonisation of shrubs and tree species. As a result of agricultural policies and opportunities elsewhere, people are abandoning rural areas (Caraveli 2000), and farming is marginalised. Marginalisation of farming ('a process driven by a combination of social, economic, political and environmental factors, by which certain areas of farmland cease to be viable under an existing land use and socio-economic structure', Beaufoy et al. 1994) may lead to different strategies, or responses from farmers, such as change of land use, e.g. from crops to grassland or forests or buildings; reduced inputs, stocking densities, maintenance of infrastructure ('extensification'); restructuring of farming, farms being taken over by other farmers (enlargement); contraction of the farming system, intensification in places, abandonment elsewhere; or complete land abandonment.

Farina (2006) describes the Mediterranean landscape as a 'historically fragmented landscape'. The recent degradation of landscape and nature values (Aronson et al. 1998; Zavala and Burkey 1997), leads to changes in the human-perceived scenic value of the land mosaic. This problem is rampant in many parts of Europe today (Conacher and Sala 1998). Due to land abandonment former mosaic landscapes change into homogeneous forested areas (Baudry 1991), often resulting in irreversible ecological changes. The farming systems often 'represent very old biological adjustments and equilibria that include complex food webs, migration patterns and symbionts etc. representing delicate balances' (Bernáldez 1991). Land abandonment is the third-most important factor for decline of threatened plant species in Europe (OECD 1997). Intensification with industrial arable plants or permanent crops is another development typical of many level areas suitable for irrigation. As a result the productivity and stability of Mediterranean ecosystems is threatened and therefore measures are required (Etienne, in Aronson et al. 1998).

In this chapter we compare two different Mediterranean landscapes, the ones of Portofino in Italy and of Lesvos Island in Greece (Figure 19). In these cases the dominant driving forces of landscape change in the region today are represented: abandonment and urban sprawl (including tourism uses). Although these landscapes seem apart, agro-climate, landscape genesis and farming practices are quite similar, and olive cultivation links them, as olive trees and vine cultivation on a larger scale were re-introduced on Lesvos under the Genovese Gatellouzi rule (1354-1462). Portofino is less than 30 km from Genoa, where the olive tree (with the Taggiasca and Lavagnina varieties) was probably introduced and diffused in medieval times by the Benedictine monks of the San Fruttuoso monastery not far from Portofino.
The trajectories of farming and landscape management in the countries of the case study areas of this chapter, Italy and Greece, were similar. In Italy, inaccessible and rural agricultural lands were abandoned over the past 50 years (Van der Sluis et al. 2013). Forests, which had an important role for provision of firewood and charcoal for cities, were also less intensively managed, along with Chestnut plantations (Castanea sativa) which provided in staple food for the poorer peasant population (Vos and Stortelder 1992). Also labour intensive practices such as maintenance of terraces and dry stone walls, or livestock herding and transhumance decreased or were abandoned. This caused changes in landscapes, typical features like farming terraces, olive yards, and upland grasslands have been decreasing over the past 50 years. This results in a declining biodiversity and loss of traditional landscapes, typical for the Mediterranean region. Similarly, in Greece several spatial and thematic processes are recognised as important for changing rural landscapes (Kizos and Vlachos 2012): the first is the intensification of farming in favoured areas, especially the plains; the second is tourist-urban-industrial sprawl mostly in peri-urban areas, coasts and along roads that takes up good farmland, but also results in the break-up of the landscape; and the third is land abandonment, evident in mountain areas and islands. Remaining farms are typically small, extensive and multi-functional.
An important characteristic of many Mediterranean landscapes are the terraces. Cultivation terraces are artificial, level surfaces used for cultivation on sloping terrain, in the Mediterranean usually supported by a stone wall (Petanidou et al. 2008) and sustaining a variety of different land uses, including perennial crops and arable crops. Terraces support a number of different ecosystem services, including soil erosion prevention, less surface water runoff, increase of soil depth and moisture, and they also often characterise the landscape. They have been used in the Mediterranean since the Neolithic by many different societies and cultures (Simon and Nixon 2005), but their dating is not always easy or feasible. The various types of building material, frequency of maintenance, building craftsmanship and subsequent use determine to a large degree the state of these terraces (Pedroli et al. 2013, 447-469).
To this background the chapter aims to answer the following questions:

- How is the landscape history of the two case areas reflected in land use change of the last decades?
  What is the impact of changing land management on landscape character

and diversity, focussing on a particular feature of the landscape that these areas have in common: cultivation terraces.
- How can production functions be maintained, and which effective strategies and future pathways can be followed to conserve valuable cultural landscapes such as these in the Mediterranean.

To this end, we have utilised already existing material to compare developments and impacts of land management practices (including their abandonment). Most of the material is already published, and is complemented by unpublished material and our own personal experience on the localities, land management and cultivation terraces.

6.2 Methods and Material

Study areas

The two study areas that we compare are located on the Mediterranean coast (Figure 19 and Table 22): Portofino is situated in Liguria; Lesvos is one of the largest Aegean islands near the Turkish coast. Both areas are in or directly adjoining a biodiversity hotspot (Figure 19, after Médail and Quézel 1999).

Portofino

The picturesque former fishermen's village Portofino is a famous tourist attraction on a small peninsula near Genoa, Italy. Most of the peninsula is since 1935 part of the Parco del Monte di Portofino, which since 1977 has the status of a Regional Nature Park. The people live mostly outside the park area, except for Portofino village which is fully located within the park. The total protected area is 1056 ha. A main feature of the peninsula is the steep south-faced ridge that rises from sea level up to Monte di Portofino (620 m). The geology, microclimatic variations together with the various expositions and slopes of the place, has decisively determined its vegetation differentiation (Gentile et al. 2004). There are two major geological formations in the area: the Portofino conglomerate is overlying the Monte Antola limestone. Most common are natural vegetation types: apart from the macchia-covered south slopes, most part is forested, and some 20 % of the area has an agricultural function. The climate is mild Mediterranean, the mean temperature ranges from 13.5-15.5 degrees, with an average rainfall of 1227 mm.

The long history of human habitation (from prehistoric times onwards) has shaped the landscape. Apart from a strategic transit harbour, the village of Portofino was since at least Roman times a fishermen's place. From the 16th century onwards multifunctional land use was common. Over the past decades it changed, and tourism, habitation and nature conservation have become important. Less suitable farming areas have been abandoned. Portofino became internationally famous among tourists already more than 100 years ago.

Over the recent decades there has been a strong pressure on the coastal area of Italy, a spread of villages and towns due to economic activities as well as tourism occurred with detrimental effects on the coastal zone. Today, it is a well-known resort and an attractive site for the 'rich and famous', for second houses, and for investors to develop facilities for tourism (Cosor et al. 2012; Kristensen et al. 2012; Kristensen et al. 2013; Van der Sluis et al. 2013).

Previous research (Pedroli et al. 2013; Van der Sluis 2002; Van der Sluis et al. 2013) shows that currently farming in the Portofino area has mainly a subsistence character, or represents a part-time activity – both indications of low intensity farming.

Agriculture has been widespread in the east of the Park (see Figure 20), in total some 360 ha and in addition some 40 ha of abandoned agricultural areas. In the past the

	PORTOFINO	LESVOS
Area size (km^2)	42 km^2	1,456 km^2
Population (2011)	18,000	90,000
Topography	Mountainous, with 90% sloping land, highest elevation 610m	Hilly, with 70% in sloping land, highest elevation 980m
Climate	Ranging from sub-humid in the South (920 mm precipitation) to damp in the North (1150 mm precipitation)	Ranging from semi dry in the East (400 mm precipitation) to semi wet in the West (600 mm precipitation)
Geology - soils	Dominant is the very hard calcareous Conglomerate (northern slopes) that is overlying the soft clayey limestone (southern slopes)	Ranging from Holocene volcanic material in the west to Mesozoic schist and limestone material in the east
Land use %	Agriculture (total): 365.4 ha (20%) Olive yards 250.0 ha (14%) Other agriculture 115.5 ha (6%) Abandoned 72.4 ha (4%) Infrastructure 67.1 ha (4%) Natural vegetation 1340.9 ha (67%)	Utilised Agricultural Area (UAA): 88155.1 ha Arable land: 2714.6 ha (3,1% of UAA) Tree crops: 41284.8 ha (46.8% of UAA) Grazing lands: 43569.4 ha (49.4% of UAA)
Terraces	Two types: stone walls and embankments. Stone walls are mostly parallel – braided terraces but in some cases half-moon shaped supporting one tree	Three types: (a) parallel – braided terraces with scattered trees in each terrace at irregular spaces; (b) braided terraces with individual terraces around some of the trees on the terrace; (c) individual terraces around trees

Table 22: The case study areas.

gathering of firewood was definitely one of the main factors determining vegetation patterns in the Mediterranean areas. Wood was the only source of energy for many economic activities until the 19th century. In Italy the trade of charcoal was important for energy supply to all main cities, and was among the major sources of income for the rural population , which was the case on the Portofino promontory as well. Chestnut grows mostly on terraces, in oak forests, at more favourable, deep moisture retaining soils on north facing slopes. The Chestnut was intensively managed until the end of the 19th century, but due to the rural exodus as well as decreasing demand for chestnut poles, fruits, charcoal and firewood, plantations were abandoned.

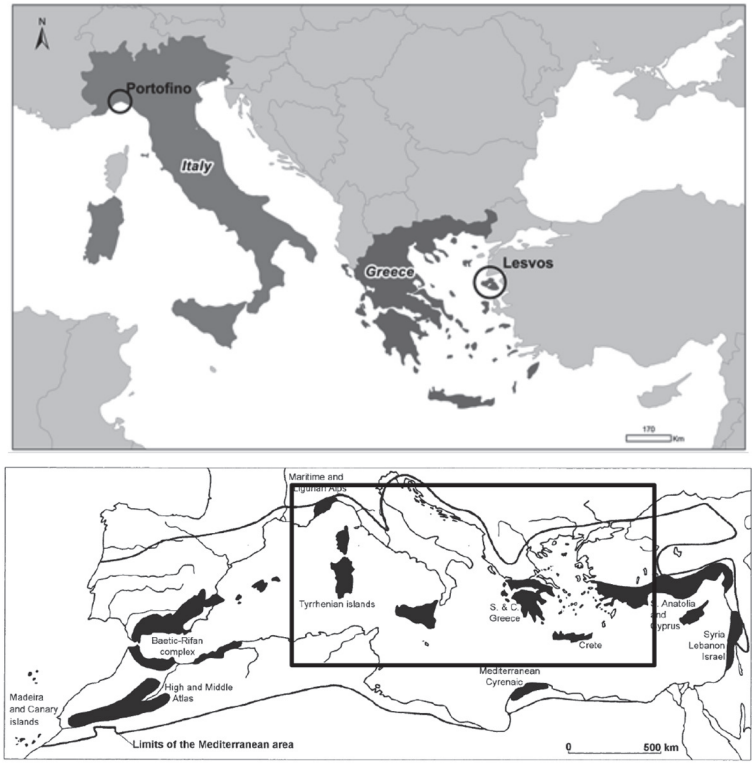


Figure 19: Location of the study areas and location of the 10 biodiversity hotspots in the Mediterranean, based on plant endemism and richness (from Médail & Quézel, 1999).

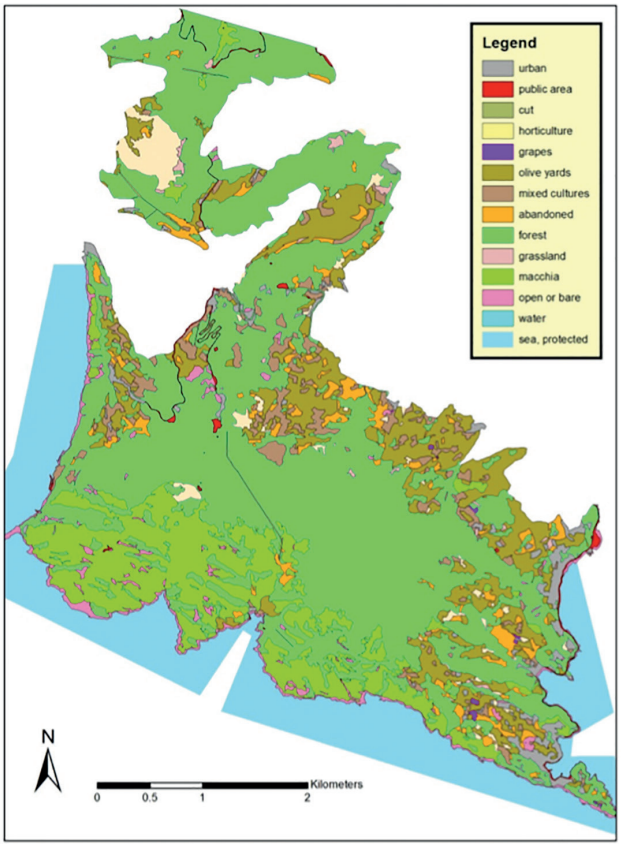


Figure 20: Vegetation and land use map Portofino for 2010.

Lesvos

Lesvos is the 2nd biggest island of the Aegean (1,456 km^2) with a population of 90,000 people. Its climate is Mediterranean from semi dry in the East (recent volcanic material, 400 mm precipitation) to semi wet in the West (schist and limestone material with 600 mm precipitation). This diversity results in a number of distinct landscape types. Although the number of farms has recently declined, agriculture is still quite important in terms of the jobs and income it provides. The most important agricultural landscapes consist of olive plantations in the eastern part of the island and grazing lands (for sheep) in the west (Kizos et al. 2013). The olive plantations constitute mostly a homogenous landscape, very characteristic for Lesvos and part of its local identity, with most of the trees on small, hilly or mountainous and sloping fields. The number of farms with olive plantations makes up 95% of the total number of farms (more than 15,000), 45% of the total Utilised Agricultural Area (UAA) and roughly 30% of the total area of the island. The olive plantations on slopes steeper than 10–15% are all terraced, either in pocket type (a single terrace in semi-circle

around one tree), in parallel-braided type, or often in mixed types (Kizos and Vlachos 2012). The abundance of pocket terraces is a unique characteristic for olive cultivation globally.

Previous research shows that the significance of olive cultivation rose rapidly after the 18th century (Kizos and Koulouri 2006). But, a number of economic and social changes including a significant rural exodus (-35% from 1951 to 1981 and stabilisation and ageing afterwards) and a recent drop of olive oil prices have caused negligence or abandonment of olive plantations. These plantations are of the 'Low-input traditional plantations and scattered trees' category and are managed with few or no chemical inputs, but with a high labour input (Stroosnijder et al. 2008). The tree density is low (typically 20 to 50 trees per ha). The management of the understorey rarely involves grazing, more often mowing and/or tillage. Pesticide use is minimal or occasional, irrigation is not usual, although it is becoming common on some fields in level areas. Harvesting is usually performed by hand, or may be left in years of little harvest. Typical yields are in the range of 200 – 1500 kg/ha. Consistency of annual yield is low, due to modest fertilisation and irrigation practices. Labour requirement is very high in harvesting, pruning, maintenance of terraces and walls, scrub control, etc. Neglected plantations are in between cultivation and abandonment, in which little other management is practised besides collecting olives.

Research approach - material

For Portofino, land use was recorded from aerial photographs for 1936, 1954, 1974, 1991, and 2000 from Ercoli et al. (2001). The 2011 situation was derived from aerial photography as well. A landscape ecological survey was done, which included field work during 1999, 2000 and 2001, and description of 140 sites. Old farmers (30) were interviewed in 1999 about their (former) land use and land use constraints, and the survey was repeated in 2012. The description of terraces is derived from Pedroli et al. (2013), and is based on mapping from aerial photographs and field inventories of the terraces in the area. Based on this a typology of terraces and infrastructure was prepared, and the state of maintenance was mapped.

For Lesvos, the materials used for the analysis include official statistics from the Greek Statistics Office (EL.STAT.) from past censuses of agriculture and animal husbandry and population censuses; land cover data from the CORINE data base, and published research (Kizos and Koulouri 2006); (Kizos et al. 2010; Kizos et al. 2011) that includes interviews with farmers on land management and landscape practices. They also include the personal observations of the authors on the island, including terraces' styles and land management.

An analysis of landscape change was performed in ArcGis10 (ESRI 2011) to quantify conversion of land from appr. 1975 onwards, marking the start of the EEC. The material for the two areas differs and is not always directly comparable, reflecting different statistical data availability and previous research on each locality. Nevertheless, despite this diversity, we have attempted to focus on the similarities and compare and

discuss the situation, rather than provide separate accounts of landscape history only. The ultimate goal is to shed some light on the impact of changing land management on landscape character and diversity, focussing on a particular landscape feature: cultivation terraces.

6.3 Results

Land cover and landscape change and their driving forces

Land use and landscape changes in Portofino

Farming in the Portofino area is mainly for subsistence or as a part-time activity – a characteristic of low-intensity farming. The area is considered as a small-scale farming region (Beaufoy et al. 1994) with low intensity farming (the term 'low-intensity farming' is used for those farming systems with a reduced use of external resources, especially fertilisers and agrochemicals). In Portofino, agriculture has been widespread to the east of the Park, amounting to about 150 ha inside the park. In the East about 50 % of the land was cultivated, shown by the terraces and orchards (partly abandoned). In the past there were also terraces to the western side, but these have been abandoned and are now totally eroded. Grazing appears to be historically limited in this area (Mosconi 2000) and today it is no longer permitted inside the Park. In 2010 there are only small vineyards left, garden-like, all situated on the east-side of the promontory, in total not more than a few hectares.
The land uses and landscapes of 1936 appear to be well-managed, all suitable agricultural land was intensively used and properly maintained. There were no signs of abandonment yet, and olive plantations and 'coltura mista' (mixed culture of permanent and annual crops) were widespread (Ercoli et al. 2001). The decline of farming coincided with land abandonment which started in the 1950s.

Abandonment seems to fluctuate around 80-100 ha and abandoned land tends to gradually develop into natural vegetation, which category consequently increases over time (Figure 21). Over time farming marginalises and has almost vanished from the area: it decreased by 40%, from more than 600 ha in 1936 to a mere 324 ha in 2010 (Figure 21 and 22). In the period 1974-2000 in total 34% land cover changed. The classification differed over the years, which makes some changes hard to detect, most conversion occurs between agricultural crops. The conversion table (Table 23) shows vegetation cover in 1974 (lines) and 2000 (columns) and changes between these two periods. Some 302 ha of olive yards remained stable, whereas some 16 ha was 'abandoned', 17 ha turned into forest and 29.5 ha changed into farmland. Some 56 ha. of macchia developed into forest, however, 206 ha. was classified as grassland, which may be due to fires which destroyed the macchia and gave an appearance of open grassland. A recent development is that some old abandoned farmland is used

again and terraces are restored, houses renovated, often by people not originally from this area. A relatively new way of small scale farming are vegetable gardens, typically located close to the house or the settlement. It is a type of mixed crops or mixed farming with orchards, fruit, some vegetables and often wheat or alfalfa. This category is too small to be represented in the graphs.

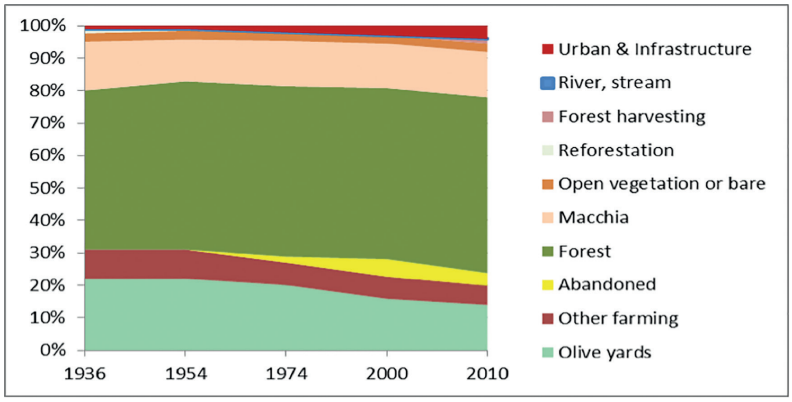


Figure 21: Changing land use in Portofino, for the period 1936-2010.

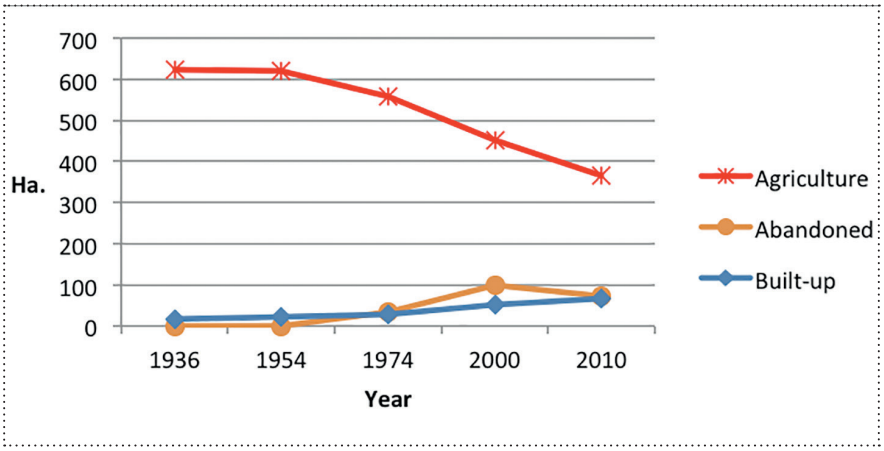


Figure 22: Decline of farming in Portofino, for the period 1936-2010.

	BUILT-UP AREA	PUBLIC AREA	POWER LINES	AGRI CULTURAL AREA	HORTI CULTURE	VINE YARDS	
Built-up area	15.10	-	5.70	-	-	0.32	
public area	0.08	3.05	-	-	-	0.03	
Power lines	-	-	0.13	-	-	-	
Agricultural area	3.05	0.07	3.46	-	11.22	45.55	
Horticulture	-	-	-	-	-	-	
Vineyards	-	-	-	-	-	-	
Olive yard	2.86	0.06	3.58	-	7.46	32.65	
Abandoned	-	-	0.08	-	1.53	1.54	
Forest	2.64	0.61	5.12	-	2.90	2.43	
Grassland	-	-	-	-	1.03	-	
Macchia	-	-	-	-	-	0.09	
Sparse vegetation	0.06	0.10	0.17	-	0.04	-	
SUM	**23.78**	**3.94**	**18.25**	**0.00**	**24.18**	**82.61**	

	AIRPORT	BARE GROUND	BRUSH	BUILD UP	CONIFEROUS FOREST	
Airport	23	-	-	-	-	
Bare ground	-	148	-	-	-	
Brush	-	2	811	1	-	
Build up	-	-	0	418	-	
Coniferous forest	-	-	-	8	2,690	
Crops	-	-	-	27	-	
Grassland	-	0	-	3	-	
Marsh	-	-	-	-	-	
Not classified	-	-	-	3	-	
Olive yard	-	-	0	181	31	
Sparse conif. forest	-	-	-	-	-	
SUM	**23**	**150**	**812**	**648**	**2,721**	

	OLIVE YARD	ABANDONED	FOREST	GRASS LAND	MACCHIA	SPARSE VEGETATION	SUM
	0.06	-	0.12	-	0.14	-	**21.44**
	-	-	0.20	-	-	-	**3.36**
	-	-	0.11	0.05	-	-	**0.29**
	29.45	4.63	9.00	0.67	0.73	-	**107.81**
	-	-	-	-	-	-	**-**
	-	-	-	-	-	-	**-**
	302.76	6.90	14.61	2.29	0.23	-	**373.40**
	15.98	5.76	4.17	1.70	-	-	**30.75**
	17.24	0.94	900.88	43.17	3.08	0.08	**979.10**
	0.34	-	8.05	10.18	-	-	**19.61**
	0.06	0.07	55.96	206.38	0.56	-	**263.12**
	0.04	-	1.09	1.74	27.77	-	**31.03**
	365.94	**18.29**	**994.18**	**266.18**	**32.51**	**0.08**	

Table 23: Portofino land use change, comparison 1980 (rows) with 2000 (columns) (ha). It shows how land cover changed over time. For example, olive groves were 373 ha. in 1980, and in 2000 some 2.8 ha. changed into 'build-up area', i.e. olive groves were converted in housing area.

	CROPS	GRASSLAND	MARSH	NOT CLASSIFIED	OLIVE YARD	SPARSE CONIFEROUS FOREST	SUM
	-	-	-	-	-	-	**23**
	-	-	-	-	-	-	**148**
	-	1	-	-	0	-	**815**
	-	0	-	-	6	-	**424**
	-	0	-	2	0	-	**2,701**
	437	-	-	0	0	1	**466**
	-	564	-	15	0	-	**582**
	-	-	39	-	-	-	**39**
	1	1	-	59	2	0	**66**
	18	3	-	1	5,156	-	**5,390**
	-	-	-	-	-	201	**201**
	456	**570**	**39**	**77**	**5,167**	**201**	**10,865**

Table 24: Lesvos land conversion, comparison 1981 (rows) with 2004 (columns) (ha). Statistics are for Eastern Lesvos only.

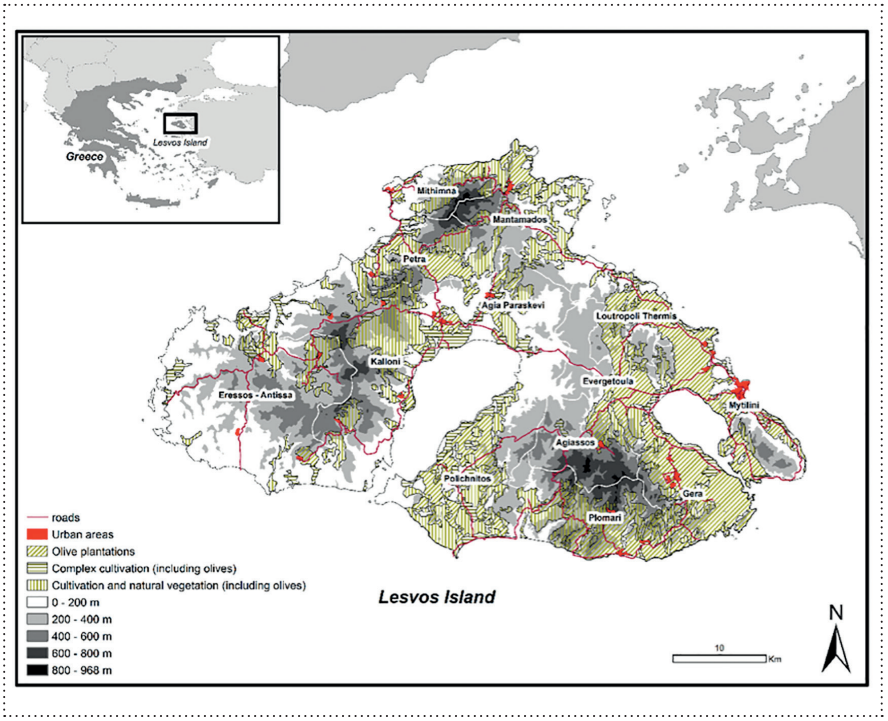


Figure 23: Land cover and terraces expansion on Lesvos.

Land use and landscape changes on Lesvos

For Lesvos, a number of changes in farmland use is evident in the second half of the 20th century. As Table 24 and Figure 23 demonstrate, most olive plantations are found in the eastern part of the island, in six former Municipalities (currently the whole island is one Municipality) where the share of tree crops (practically all olives) in the Utilised Agricultural Area (UAA) is higher than 80%. Overall, the decrease of UAA in this period is driven mostly by the decrease of arable land that has increased the share of olives from 39.4% of the UAA in 1961 to 46.8% in 2000. Olive plantations are nominally decreasing by 1.7% in this period, although many more plantations are neglected, but still considered as farmland by their owners. A detailed assessment of land use change for Eastern Lesvos from 1981 to 2004 shows very little change, only 3%. However, the conversion taking place is mostly from olive groves into build-up area (181 ha, see Table 24), or into cropland (18 ha) and coniferous forest (31 ha). Also some 27 ha. of cropland converted into build-up areas.

Abandonment and loss of olive plantations is higher in the municipalities where olives dominate, elsewhere some arable land was replaced with olives, especially in the 1970s and 1980s (the remaining arable lands were converted to grazing lands, Kizos et al. 2013). The decrease of olives (and UAA in general) is in general much lower than would be expected considering the decrease of the numbers of farms in the same period. The overall decrease of farms was 42.7% and the decrease of the

numbers of tree farms 41.3%, slightly lower in the olive dominated parts of the island but still very important. This decrease meant that the average size of the olive farms nearly doubled from 1.6 to 2.7 ha, but with significant internal differences: few very big farms and many small.

What is not recorded in the official data is abandonment and negligence ratios of olive plantations. This is a slow process and it is estimated that it may take 30 -50 years (depending on moisture mostly) for the field to become 're-wilded'. But even in such cases, a clearing of the understorey and pruning of the olive trees is enough to make the field productive again (see Kizos and Koulouri 2010 for examples). Fields in sloping or remote areas are more prone to abandonment, but in general it is the age or the willingness of the farmer and his/her family that determines which fields will be abandoned and which not. The symbolic value that farmers attach to 'their' olive plantations is another important factor, according to (Kizos and Vlachos 2012) they are considered as a family asset. An almost invisible development is urban expansion. Although official data indicate an increase of 2.1 % in the last 2 decades, this increase is very unequally distributed over the area and concentrated around the town of Mytilini and in tourism developed coastal areas.

Therefore, the actual landscape changes on Lesvos, and especially in part dominated by olive plantations, are rather limited in the last decades. Despite the decrease of the numbers of farmers by more than 40%, land cover did not change much. This is related to the particular land use and the slow rate of change, at least for a time period of decades, as discussed in this chapter.

Cultivation terraces

Cultivation terraces are among the most characteristic features of Mediterranean landscapes. The terraces as well as the landscape in the two case study areas have suffered from negligence during the past decades. This is discussed in the following paragraphs.

Portofino area

Although the first terraces may date back to prehistoric and Roman times, documentation of large scale terracing dates from the Middle Ages on the south side of Portofino. San Fruttuoso Abbey and other churches were at the time a driving force behind terrace construction (Pedroli et al. 2013). The maximum extent was reached during the 19th century, and during the 20th century terraces were constructed on the higher south-eastern slopes for reforestation purposes (Figure 24), visible on aerial photographs from 1936. Within Liguria Region more than 20% of the territory is terraced (Brancucci and Paliaga 2006). The structure of the terraces would depend on the slope inclination, the geological and morphological characteristics which define lithology, rock outcropping formation, detritus layer and soil depth (Pedroli et al. 2013, Figure 25). The slope's inclination would define the height and width of the terrace.

Two types of terraces are found (see Figure 26 for examples): stone-walls and

embankments. The dry-stone walls are either with a 'loose matrix' (muri secci), i.e. walls which are not cemented, and more recently cement walls have appeared near houses and roads. The second type, embankment systems are earthen walls which are mostly more gently sloping than stone walls, and either placed on a rock foundation or on the soil (Figure 25E). Their distribution can be more or less regular, depending on the slope morphology. The embankments require much less laborious manual work than the dry-stone walls. Also an 'intermediate type is observed, mostly in the Chestnut cultivation system, the lower part consisting of stone walls, with an earth embankment on top (muri di sottoscarpa).

Almost all terrace walls are linear, only on the southern side at San Fruttuoso we observe half-moon walls (muri a lunetta) which support only one tree. There are variations in form and shape of the walls.

Important factors are the lithological material, which depends on the geology and geometrical characteristics of the available rock type. The walls from Portofino Conglomerate are more irregularly formed than the walls build from rather square blocks of Monte Antola Limestone.

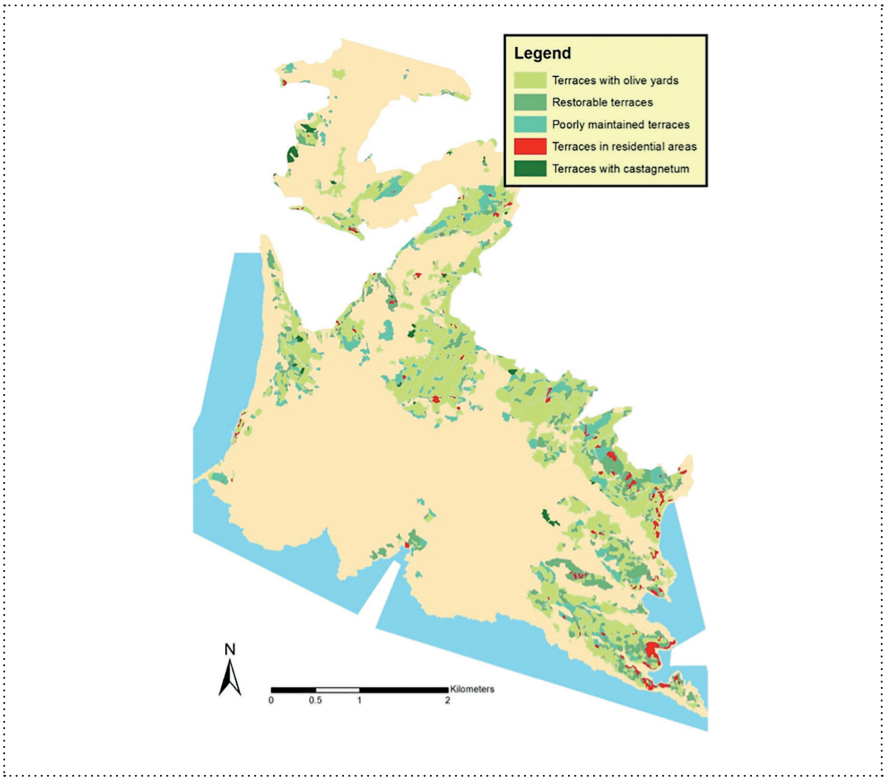


Figure 24: The state of terraces in Portofino in the year 2000.

The current abandonment of terraces might have started around the early 1950s, judging from the vegetation that has established itself on the former terraces. In total 65% of the terrace area is still recognisable, and in fair shape (Figure 24). Some 30% is not in good shape (restorable or poorly maintained). A small proportion is located in residential areas. The different terrace types as well as the processes which may lead to their collapse are presented in Figure 25 (after Brancucci and Paliaga 2006).

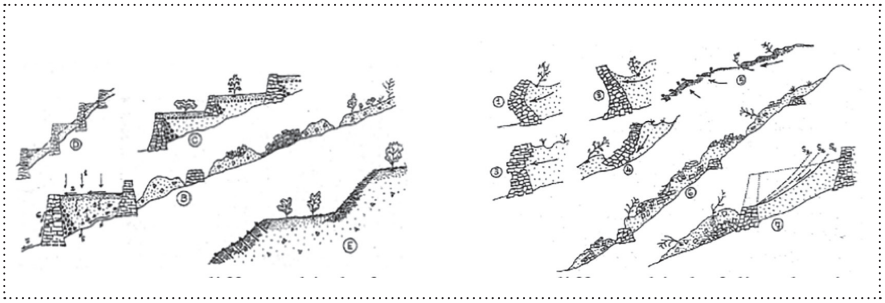


Figure 25: Terrace types (B to E) and processes of collapse (1 to 7) (Brancucci and Paliaga 2006).

Lesvos area

Terraces in olive plantations on Lesvos can be classified according to their type, the building material and the style of masonry. There are three types, as described by (Kizos et al. 2010): (a) parallel – braided terraces with scattered trees in each terrace at irregular spaces; (b) braided terraces with individual terraces around some of the trees on the terrace; (c) individual terraces around all trees. Out of these three, the last one has been constructed for olives and the date of the terraces coincides with that of the oldest trees in the plantation.

The building material comes from the different substrates upon which olive plantations are grown (Kizos et al. 2010): limestone (Figure 26, Lesvos, A, B and C), which provides heavier building stones that can be carved to fit exactly and make the best walls; schist (Figure 26, Lesvos A), which provides lighter stones, that come typically in slabs, are easily eroded and make walls that are easier to break; and volcanic rocks (andesite and trachite in olive growing areas, Figure 26, Lesvos D) which are relatively light and many are rounded, they are harder to carve and the walls built with such rocks are of inferior quality compared to those made with limestone, but generally better than those made with schist. Finally, there are three or four types of masonry which are related with the materials used: individual terraces are typically lower than the other types and are made with schist and less often with limestone, especially in the Plomari and Gera areas (Figure 23). Limestone is used for all types of terraces, and can be relatively high. Around the town of Mytilini they are made in a very distinctive and robust style of a trapeze with a very large base compared to the stem of the terrace. Terraces with volcanic rocks have two or three distinct styles, one around the Mandamados area, where larger boulders are embedded in the walls

and the craftsmanship is of high quality, and another one in the Polihnitos area where terraces are made in the same style as stonewall enclosures, with smaller and carved stones. Around the plain of Kalloni a third style can be seen, lower in height and of lower quality terraces, many of which are in bad shape, due to the uncontrolled grazing as well. The total extent of the terraces on Lesvos is unknown, but a rough estimation based on slope gradient and land cover provides a figure of 52% of the total olive plantations.
The state of terraces today can only be roughly estimated. Previous research indicates that the maintenance of terraces is not considered a priority for most farmers. In fact, Kizos et al. (2010) claim that part-time farmers more frequently maintain their terraces, at least partly.

6.4 Discussion

Landscapes change continuously. The two landscapes studied here represent two different Mediterranean trajectories of rural landscape change: (a) tourism (and urban) development that places stress on land values and causes widespread changes on landscape structure and functions; (b) abandonment of farming - part time farming of permanent crops and a slow change of the landscape towards more natural vegetation. The case of olives in both studied landscapes is typical of the second trajectory. These olives are low intensity systems and since they are very well adapted to the local climate, their abandonment changes the landscape in a rate that is not easily witnessed by annual observations, or even over decades. Other types of change, such as tourism or urban sprawl, are much more rapid. In the end, dramatic changes of society and economy over a period of 50 – 60 years have left only a small footprint on the landscape (e.g. on Lesvos the population has decreased by 35% and the town of Mytilini has nearly tripled in size). This 'landscape legacy' (Plieninger et al. 2011) of olive plantations does not mean that this change is 'positive' in economic, ecological and/or symbolic terms (see Kizos and Koulouri 2010 for a discussion on these services), but it emphasises that proper consideration of diverging change rates is vital for understanding and managing landscape change and its environmental impacts.

Land abandonment has different impacts: the landscape changes, slope stability is altered, and also the diversity will be affected. The landscape changes from a cultural landscape with dispersed houses and farms with olive yards and gardens into a landscape where natural processes dominate. In a decade the fields will overgrow, followed by decay of infrastructure such as houses and terraces. If the terraces are well constructed they can be rather persistent, but the stability differs. Also, impact of livestock and wildlife can speed up the decay. Grazing livestock can damage the stone walls, as well as the grubbing behaviour of wild boars. In particular on steep slopes the risks of collapse of terraces are profound.
The decay of terraces and the absence of management also leads to a dense,

Figure 26: Pictures of terraces from Lesvos and Portofino: Lesvos A: Mixed masonry of schist with later limestone addition near Mytilini; Lesvos B: Olive nets on very well preserved individual limestone terraces near Agiassos; Lesvos C: Braided limestone terraces near Mytilini; Lesvos D: braided terraces with volcanic material near Kalloni; Portofino A: Embankments with olive yards; Portofino B: Supporting dry stone wall in undefined bond using blocks and elements from weathered conglomerate; Portofino C: Olive harvest at a small farmstead near Nozarego; Portofino D: Gentle terraced slope with low embankments, material originating from marl-limestone rock types.

homogeneous vegetation cover, which results in less biodiversity. The increased biomass is prone to fires, which are difficult to control and can have severe impacts by burning of trees and destruction of the soil structure. Also this process may lead to increased soil erosion, siltation of streams, and landslides (Figure 27). This results in landslides, as well as inundations and floods, affecting houses and the landscape (Galve et al. 2014).

Some features of the landscape are less prone to change than others, due to their nature or due to the type of changes that affect a landscape for a particular period. Cultivation terraces are labour intensive to construct and may prove extremely persistent especially when the land they are located in is abandoned. This is demonstrated by the case studies presented in this chapter. Although different driving forces were involved, the immediate change was similar for one type of change: abandonment. Abandonment has affected land cover and the landscape in Portofino more than in Lesvos due to the particular land cover: olive plantations generally change very little for the time periods examined here, even when abandoned.

This is true for their terraces as well. Literature suggests that their preservation is related with their functional role in the productive and land management systems in an area (Petanidou et al. 2008). When this function is lost due to economic or land use changes, they are considered either as an obstacle (e.g. in grazing lands on Lesvos, see Kizos et al. 2013) or at best as something of no 'value'. Kizos et al. (2010)) have found that 'hobby' or part time farmers more often recognise the symbolic (and environmental) value of the terraces.

If we compare the current - and possibly future – use of the terraced, cultural landscapes, we see that in Portofino the decline of farming has come to what seems to be an 'end' stage: very little is used for commercial farming, most in fact is still maintained for horticultural purposes or as garden. Lesvos clearly hasn't reached such a stage yet, but there seem to be tendencies in the urban sprawl occurring, and more esthetical functions developing here. Comparison of the land use change trajectories can provide these insights, and can serve as a model to actively intervene in landscape development, to maintain productive, cultural and aesthetic qualities of the landscape.

Driving forces of Mediterranean rural landscape change

Although landscapes are dynamic and change continuously under the influence of different driving forces, the rate of change can differ significantly. Bürgi et al. (2004) identify five major types of driving forces: socioeconomic, political, technological, natural, and cultural, with strong linkages, dependencies and feedback loops over 'several temporal and spatial levels' and with different rates of change. They also separate 'primary, secondary, and tertiary driving forces, and 'intrinsic and extrinsic driving forces'. Intrinsic driving forces act locally, and are influenced by local actions and people and may include both social and economic factors. Extrinsic driving forces include broad processes such as globalisation, climate change, urbanisation, EU policies (especially the CAP).

Mediterranean landscapes are strongly influenced by natural and cultural drivers.

According to Horden and Purcell (2000) varying precipitation even in short distances, seasonal differences in precipitation patterns with intra- and inter- annual variability, stress periods (dry summers) and especially stress years, together with periodical droughts and the intense geomorhoplogy and relief result in a number of different 'microecologies'. Despite different power and political structures throughout history, the navigable sea resulted in an extensive trading network. This resulted in three basic principles that shape land management systems in the Mediterranean region: diversification (for land uses to reduce risk), redistribution (to proximate and more distant markets) and storage (to smooth out annual or seasonal differences).

Permanent crops such as olives and vines characterise market economies in the Mediterranean as their products cannot be used for subsistence, but are sold in (proximate or distant) markets to buy cereals and other staples (Horden and Purcell 2000). The two case studies in this chapter are rather typical examples: for Lesvos, the rise of the demand of olive oil in the 18th century, the prices of olive oil in the international market and the growth of commerce, have been major driving forces for landscape change towards olive plantations, and cultivation terraces are a 'side-effect' of this change. Grapes are less important today given that prices are currently low and the crop is labour intensive (Mosconi 2000; Stobbelaar et al. 2000).

The rate of change increases for the Mediterranean and the case study landscapes in the second part of the 20th century. Social driving forces are the decreasing attractiveness of farming as a livelihood compared to services, the increased importance of second - holiday homes, and the quality of life offered in cities. Economic driving forces include the low profitability and productivity of farming, new transport infrastructure and especially roads, the rise of tourism as an economic activity, but also the increasing importance of EU level agricultural policies which have altered rapidly many landscapes (Benoit and Comeau 2005; Caraveli 2000; OECD 1997). The results are different spatially and thematically and three important processes stand out today as changing Mediterranean rural landscapes: intensification, tourist-urban-industrial sprawl and abandonment. The economic crises seems to affect Portofino less than Lesvos, which may relate to the dependency of the people on the land and its resources. In Greece people returned to the countryside, exploit the olive yards for fire wood which is seen from cutting and pruning trees. In Portofino the landscape is more a cultural landscape, which attracts visitors to the park.

Intensification and professionalisation of farming in favoured areas, especially the plains, is characterised by the growing size of owned and leased land of farms, typically with industrial arable crops, garden crops, olives, and to a lesser degree tree plantations. This intensification is based on mechanisation but also on the availability of cheap immigrant labour in the past 20 years. The resulting landscapes are homogenous monocultures, but with smaller fields than equivalent European areas (Kizos and Vlachos 2012). The tourist-urban-industrial sprawl is evident mostly in peri-urban areas, along coasts and roads. Farmland in these areas is very expensive and this sprawl takes up high quality farmland, but also results in the break-up of the landscape. Abandonment is evident in mountain areas, less productive areas and islands and results in a gradual return to a more natural vegetation, especially in mountain areas.

Remaining farms are typically small, extensive and multi-functional. At the same time, landscape features are neglected or destroyed, often leading to the degradation of landscape and nature values ((Aronson et al. 1998) (Zavala and Burkey 1997), and land abandonment is mentioned as the third most important factor for the decline of threatened plant species in Europe (OECD 1997).
In the case study landscapes, intensification was not feasible due to the geomorphology (few level areas, sloping lands) and the lack of natural resources, including soils and available water. Abandonment and tourism driven urban sprawl are the two processes that the two areas share, albeit with different intensities and extent: tourism is much more important in Portofino than Lesvos, while abandonment has affected bigger areas on Lesvos.

6.5 Conclusions

This chapter shows that landscape history is to a limited extent reflected in land use change of the last decades. Especially in olive plantations there is a considerable time lag between the abandonment and the complete disappearance of the olive trees. Olive yards are apparently very persistent to lacking maintenance.
However, the impact of changing land management on landscape character and diversity is well reflected in part of the cultivation terraces: depending on the type of terrace, they are very vulnerable to degradation due to erosion, to destabilisation due to disturbance by wild boars or grazing animals, and to landslides due to unbalanced drainage of precipitation water.
The last research question of this chapter how production functions can be maintained, and which effective strategies and future pathways can be followed to conserve valuable cultural landscapes such as these in the Mediterranean, is more difficult to answer. We observed that processes in both landscapes are similar, often as a result of similar drivers. The disappearance of farming in Portofino has resulted to some extent in a loss of values and functions. The marginalisation of farming results in both areas in a rural exodus, but also physical deterioration of terraces and the general landscape, with a loss of all its support functions. In Lesvos this advanced stage hasn't been reached yet, we should therefore ensure that here and similar landscapes measures are taken to retain the inherent qualities of Mediterranean landscapes. Landscape governance can include measures under the Common Agricultural Policy or Natura 2000 to maintain and promote farming (which will also be in line with the European Landscape Convention) and retain valuable landscape features such as farming terraces.
In conclusion, landscape change in the Mediterranean is more complex than simple frameworks of 'urbanisation and coastalisation – abandonment of hilly areas' (see Benoit and Comeau 2005) suggest. There is a number of reasons for that. One is related with the geographical diversity of the region, which has resulted in many different land management systems in the past, many of which respond differently in similar driving forces. Another is the characteristics of the nature of the Mediterranean,

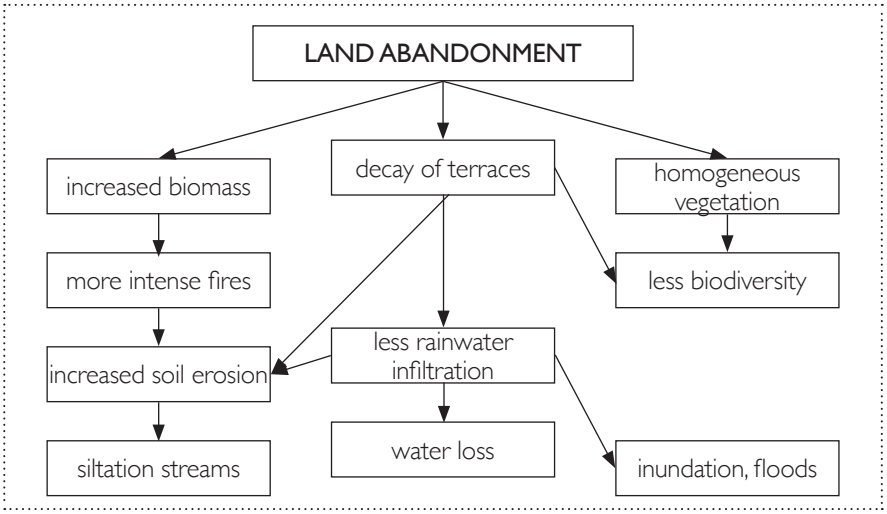
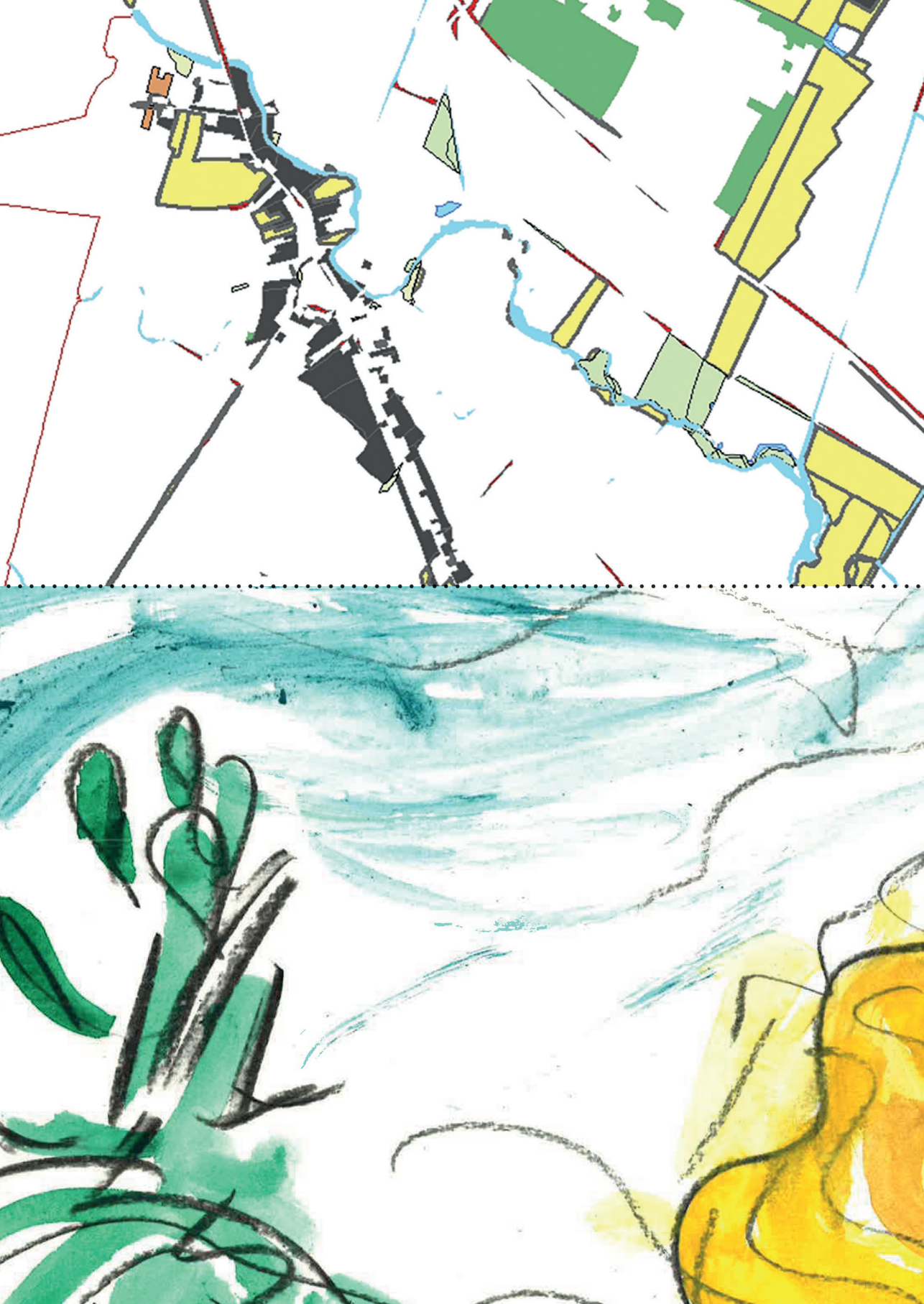
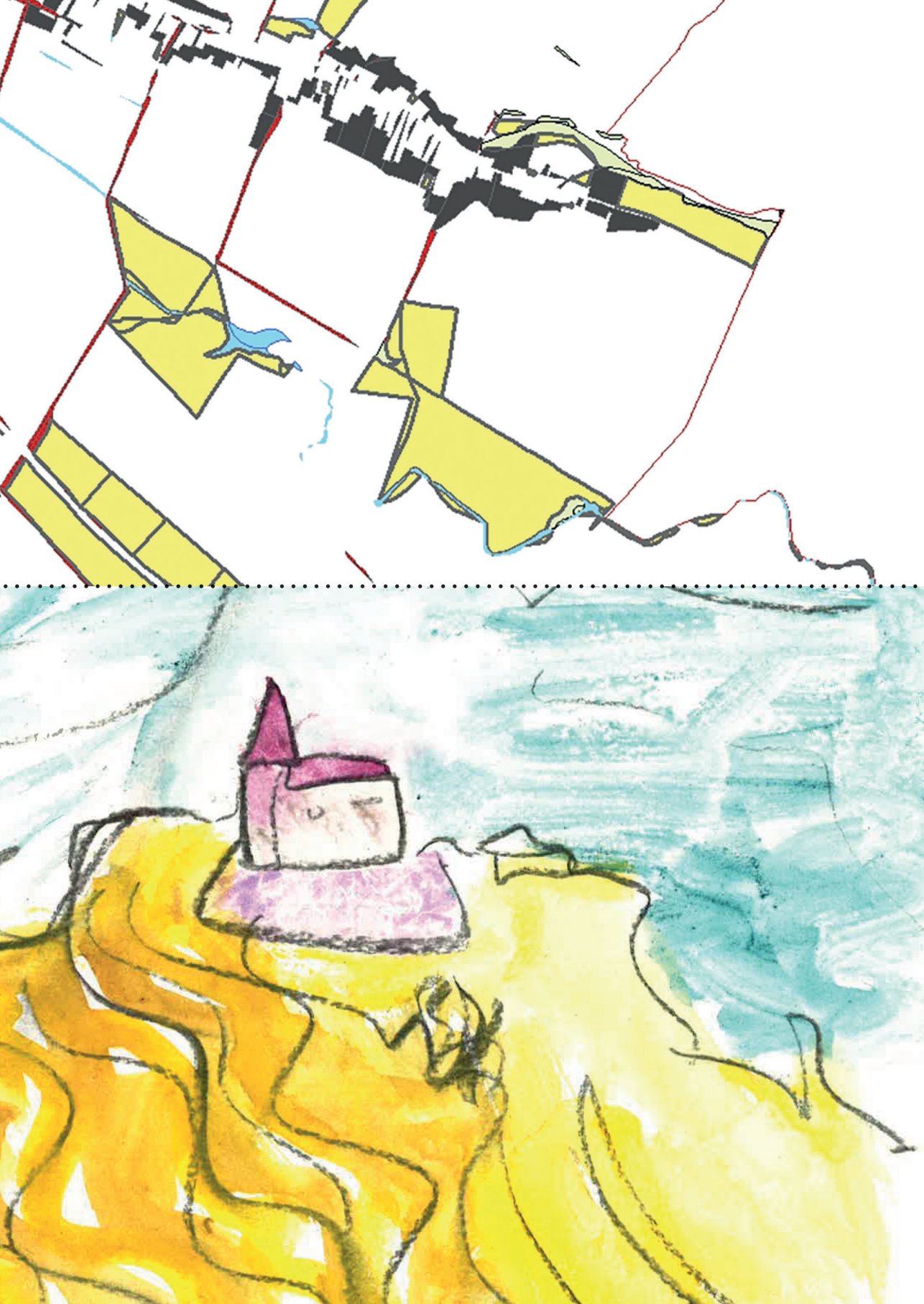


Figure 27: Chain of events leading to marginalization of agriculture, loss of biodiversity, land degradation.

Blondel and Aronson (1995) and Grove and Rackham (2003) among many others stress the resilience of Mediterranean flora in relation to disturbances (natural or human induced). Another reason, suggested by the findings of this chapter, is the type of land use, which often seems to imprint a legacy on the landscape that changes very slowly. This is important in terms of managing Mediterranean landscapes and some of its most characteristic features, such as cultivation terraces. This chapter is a step towards the deeper understanding of such processes if we are to be able to conserve and revitalise such landscapes.





Chapter 7 Conclusion and reflection

7.1. Introduction

The objective of this thesis is:
to assess the dynamics of landscape change and increase the scientific understanding of the underlying processes and policies that have shaped the rural landscapes of Europe after establishment of the EU.

To achieve this objective, five research questions were formulated that formed the basis of the different chapters. Each chapter takes a different angle and a different approach to explore how landscape changes occur and what impacts these ultimately have on the landscape.

This final chapter reflects on the results and conclusions of the previous chapters and on the scientific and societal significance of the thesis as a whole. Section 7.2 discusses the findings that result from the empirical studies presented in chapters 2 – 6. Section 7.3 reflects on a number of key issues in this thesis. Section 7.4 presents reflections on the methodology and approach. Finally, recommendations are formulated based on this thesis in Section 7.5.

7.2. Research Findings

The different chapters in this thesis address the research questions from different angles and with different approaches (as introduced in Chapter 1). Below, the research questions are answered with a reflection on the findings.

7.2.1 The trend in intensification of land use seems to be slowing down

What major landscape change processes are occurring in the different regions of Europe?

The first research question deals with the landscape change processes occurring within different regions of Europe and is addressed in Chapter 2. This chapter zooms in on the intensification and extensification of land use. Intensification may occur through changing the area of land in rotation, changing livestock numbers and changing the dosage of farming inputs, such as nitrogen and pesticides. Extensification may occur through reduction of the farmed area, lowering cattle densities and reducing fertilizer and pesticide use. The study assessed changes in six case study areas over the period from 2001 to 2011.

The combined data show that land use intensity over the past decade has not substantially changed in the areas considered, and seems to be stabilising in Western and Eastern Europe. This may indicate that the trend of intensification is levelling off and approaching stability.

The use of fertilizer and pesticides seems to have decreased in Western Europe. An opposing trend is observed in Eastern and Southern Europe. In the Mediterranean cases, agriculture is becoming increasingly marginalised, at the same time as changes in land use function have taken place, with regard to urbanisation and recreational land use in particular. It is hypothesised that the dominant pattern of stabilisation over the past 10 years may be partly a result of effective EU and national environmental and agricultural policies, which are increasingly concerned with improving environmental conditions in rural areas. Agricultural production has increased in the same period in almost all study areas, which may indicate that farming efficiency has increased. Comparing the results for livestock numbers with FAO statistics for this same period, we observe that livestock density (cattle) has increased in Mediterranean countries, and to a lesser extent in Austria, but strongly decreased in Denmark and Romania.

Farm size and farmer type are important in understanding changes in land use intensity. In the peri-urban landscapes of Denmark and Italy, a larger proportion of the population are hobby farmers, non-active in farming, or practising extensive farming.

Holmes' Multifunctional Rural Transition (MRT, Holmes 2008) is used to explain the dynamics of the changing countryside. MRT balances occupancy modes between production, consumption and protection (Chapter 4). The forces that drive the transition can be expressed as a resultant that goes towards production (generally intensification) and consumption and protection (extensification), indicated with the arrow (Figure 28). Full-time farmers are mostly involved with intensifying production, whereas the other farmers demonstrate a trend of extensification of production.

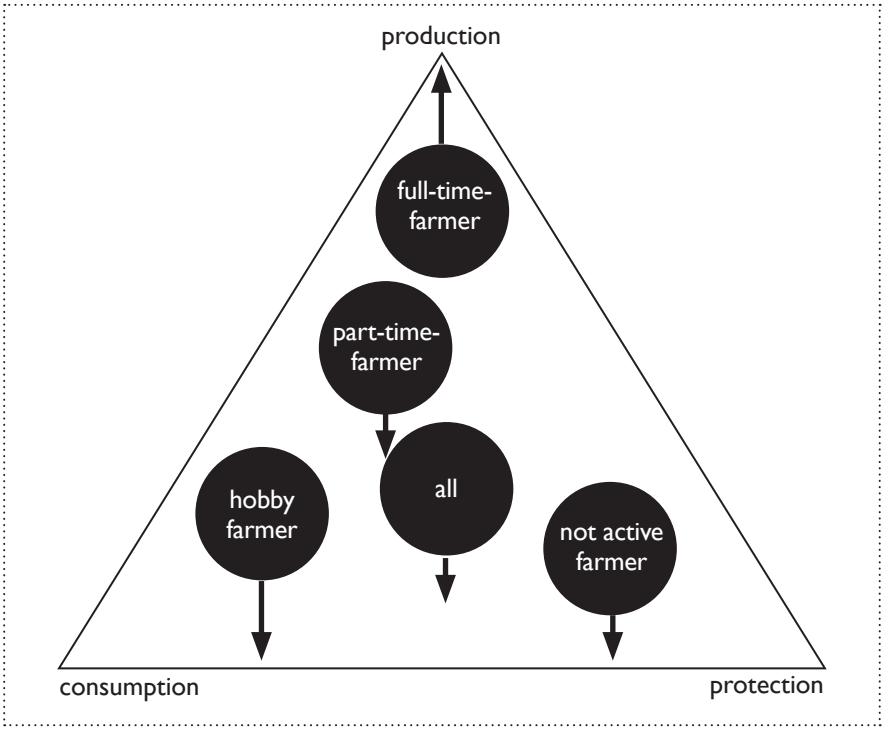


Figure 28: Observed intensification and extensification processes with reference to Holmes' MRT framework.

The observed stabilisation of land use intensity differs from that which some authors note with regard to intensification of land use. At a global scale, the increase in landscape pressure continues with a consequent decline of biodiversity (Butchart et al. 2010). Many European studies show that bird and butterfly species from agricultural habitats continue to decline due to agricultural intensification, as they are not well covered by the Natura 2000 protected areas network, and are under pressure in farmland (Kleijn et al. 2001; Kleijn et al. 2009; McKenna et al. 2014; Pe'er et al. 2014; Tscharntke et al. 2005; Van der Sluis et al. 2016). An explanation of this difference can be the time lag effects or critical thresholds that may have been passed. The 'general public' and communities are increasingly concerned about the steady decline of the countryside, the creation of sterile green pastures and the absence of meadow birds (e.g. in the Netherlands Berendse 2016; De Boer 2016).

The observed 'stabilisation' of the trend seems to be opposed to the conclusion that landscape quality is declining almost everywhere, which is discussed in the next section.

7.2.2 Global economy, EU- and national policies lead to a decline in landscape quality

What are the drivers of landscape change in different regions of Europe, and what is the influence of EU policies? This question focuses on the different drivers and the combined impact of drivers on the landscape for different environmental zones of Europe (Metzger et al. 2005). This question is addressed in Chapter 3 based on six expert workshops (Figure 9).

In all countries where expert workshops were held, except for Romania, a decline in landscape quality was observed, although processes of change differ by area. The dominant drivers for landscape change are the global economy, EU policy and national policy. Together with other drivers, they cause landscape change through indirect dependencies and impact on national policies.

Globalisation partly defines European and national agendas. Policy and economic drivers set most processes of landscape change into motion, but how changes occur differs very much by country: local cultures and traditions also affect local landscape development. Agriculture and agricultural technology are central in these processes of change. In Northwestern Europe, farms often are agribusinesses; experts described the agro-industrial complex as driving landscape change. Although it was observed in the previous section that land use intensification is slowing down, it is possible that there is a time lag in the impact of previous intensification processes on landscape quality, as has been demonstrated for biodiversity (Bürgi et al. 2016; Nagelkerke et al. 2002).

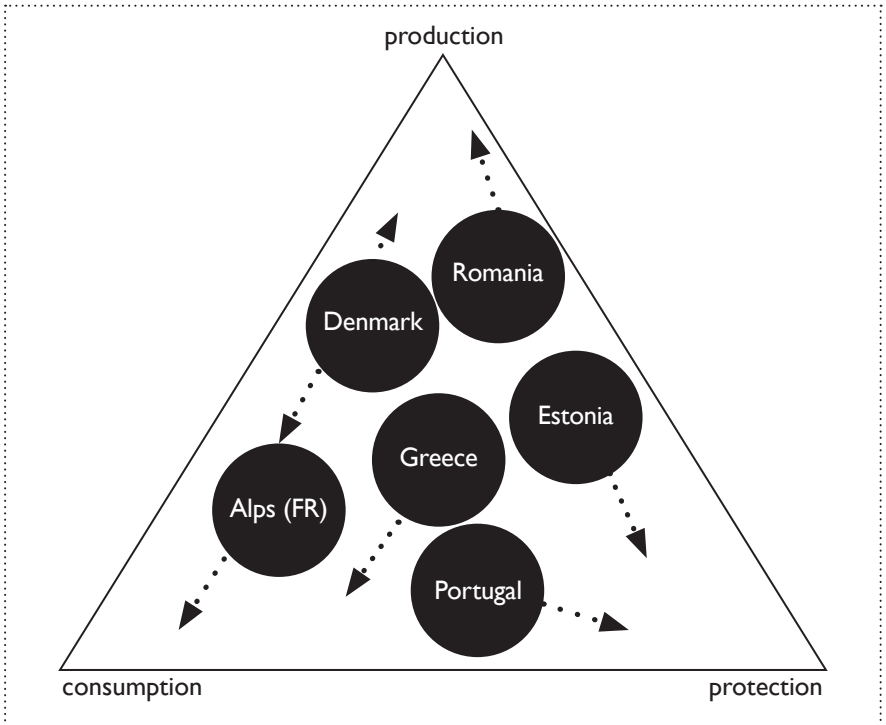


Figure 29: Rural development in countries, based on expert input in FCM.

Moreover, compounding factors in landscape change processes include urbanisation of the countryside and tourism development. European and national funds are used for the upgrading of infrastructure. Forest policies also play a role in all regions; subsidies and conservation policies resulted in an increase in forested areas in the two highlighted regions in Estonia and Portugal. Compared to the previous section, intensification is just one of the aspects of landscape change taken into account, which may explain why there is an apparently different result. Also, this analysis focused on the country instead of a case study area.

The processes of change are a result of autonomous societal transformations and policy measures: EU policies, such as the CAP, RDP and Natura 2000 are very influential through indirect relationships and impact on national policies. EU policy is considered a positive driver in countries such as Estonia, where the impact of funding for farmland restoration exceeds the (negative) impact of the CAP: the implementation of the conservation agenda is a strong driver here. In other regions, the indirect effects, as well as other EU policies, outweigh this positive influence and together they result in a decrease of landscape quality. The dominant trend in rural change observed over the past 25 years is indicated with an arrow (Figure 29). Denmark demonstrates both tendencies: production and consumptive use of the countryside. In the Alps and Greece, consumption is important. In Estonia and Portugal, where there are more marginal farming areas, protection seems dominant.

The decisions that result in landscape transformations are progressively taken further away from local stakeholders. This is illustrated in Figure 30. Global driving forces, i.e. the global economy, as well as European and national policies, affect countries and regions. Effects finally trickle down to the local level: changing farming methods and migration or urbanisation processes.
To reverse this top-down process, decision-making should take place closer to residents and stakeholders by strengthening their role in landscape planning. One option could be to give stakeholders influence in e.g. Agri-Environmental Schemes (AES) and Rural Development Programme (RDP) budget spending.

7.2.3 A shift from food production to tourism and residential services is taking place in some regions

How do landscape changes affect the provision of landscape services?
Chapter 4 analyses the changes that have taken place in the case studies over 25 years.
The land use and land cover (LULC) changes as well as change in landscape features were classified as possible long-term landscape transitions, which were explained as changes in service provision. Holmes' Multifunctional Rural Transition approach balances occupancy modes between production, consumption and protection: from 'mono-functional' land use towards multifunctional land use; from production-oriented

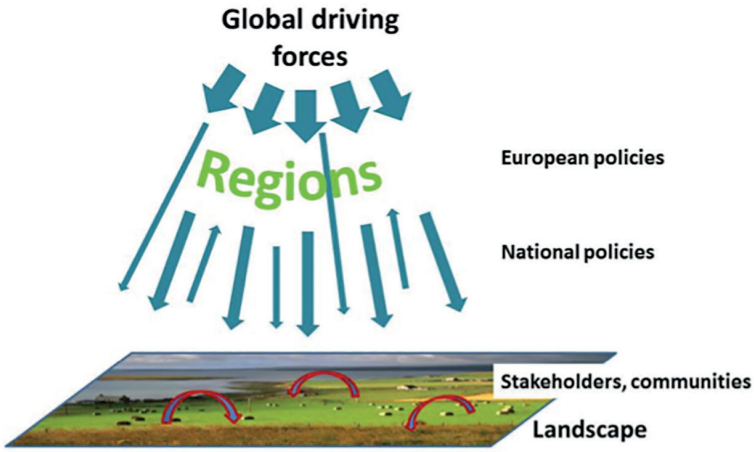


Figure 30: The processes of landscape change, influenced by external drivers which work through regional policies (after Ramos 2011).

use towards the provision of a wider array of landscape services, such as housing, recreation or habitat function.

Figure 31 shows different occupancy or farmer types positioned vis-a-vis the forces that drive landscape transitions. Figure 32 shows the transitions taking place based on the LULC change, which affects landscape services, mostly a shift from food production towards tourism and residential services, which means greater multifunctionality. However, in Rătești and Heerde, a shift towards production is observed. The observed decline in services is mostly in cultural services (inspirational services), affecting landscape quality and tourism potential in Lesvos and Portofino, as well as a decrease in grazing (feed) and timber (provisioning services) in Portofino. The negative impact of intensive land use in Northwest Europe on cultural services is partially mitigated by landscape restoration measures taken through EU programmes such as LIFE, RDP, AES, forestry or national habitat restoration programmes (hedgerow planting, creation of small habitats). This was observed in the case studies in Heerde and Roskilde (Hauser et al. 2016).

Although there are many EU policies that lead to LULC change, the associated landscape transitions and resulting changes in the suite of landscape services are more dependent on local societal and environmental contexts. Policies are mostly related to the provisioning services of the landscape, e.g. food production (CAP, the EU's Nitrate Directive) and timber production (national forestry legislation). Cultural services (inspiration, residential, tourism) are mostly affected by the regional and national spatial planning frameworks, and they are thus at risk in an era of strong decentralisation tendencies throughout Europe. Supporting services like natural habitats are mostly vested in the EU Birds and Habitats Directive and national forest

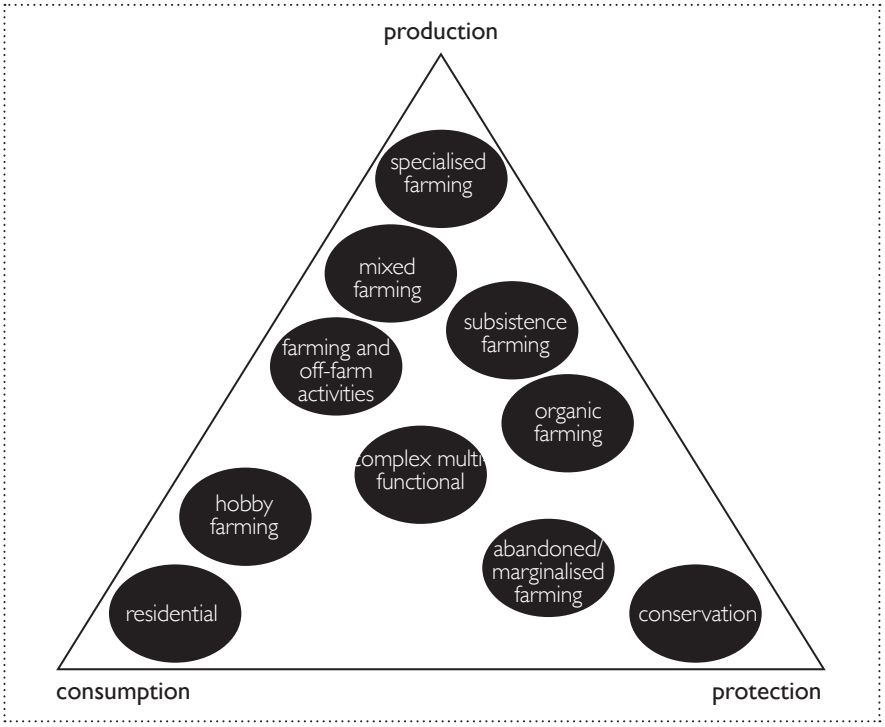


Figure 31: Occupancy of European land managers, after Holmes (2008) and Pinto-Correia et al. (2016).

policies, and are under strong pressure from global economic forces. Policies affecting LULC should therefore take into account landscape services to ensure continued provision of cultural and supporting services.

7.2.4 Habitats Directive yields very different results in different countries

How does the implementation of conservation policies affect processes of landscape change?

Chapter 5 focuses on the Habitats Directive (HD), specifically how the Habitats Directive is being implemented in different countries. The Habitats Directive is a typical example of a policy that has been implemented in a rather prescriptive, top-down manner (Beunen et al. 2013). It seems fairly straightforward in the way it has been conceived and should be implemented, yet it still yields very different results in different countries. This has to do with policy culture, but also with governance, the national setup of the government institutions and their effectiveness (Knill and Lehmkuhl 2002).

Assuming that a policy has been implemented in line with the Directives and has been accorded by European agencies, the impact of the Directive still depends on

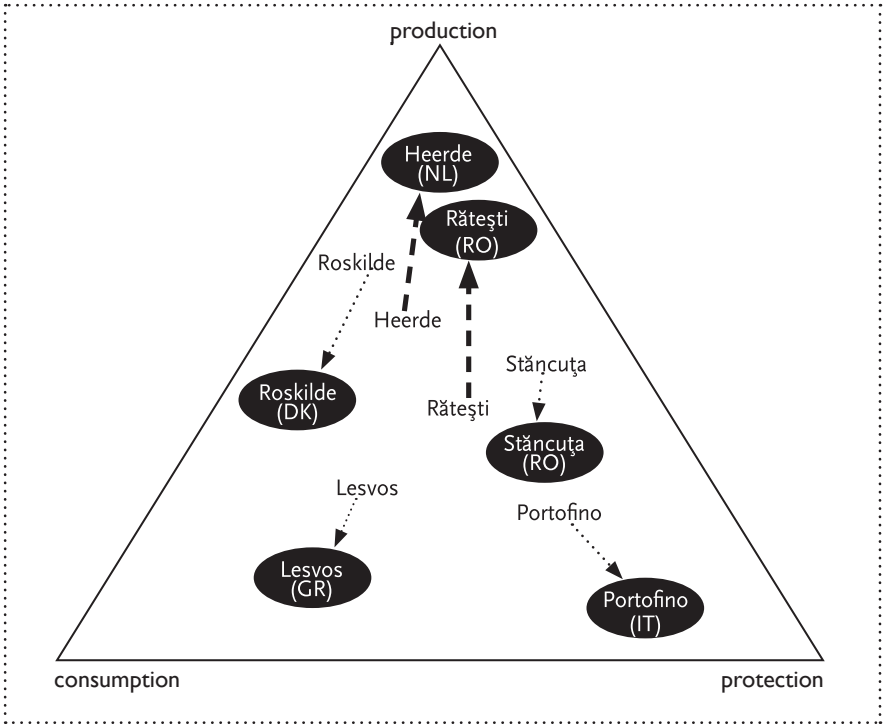


Figure 32: Observed changes in the case studies, following Holmes' (2008) approach.

government approaches, state bureaucracies and policy style or culture. Also chapter 3 shows that in the case of Southern European countries, the role of the 'bureaucracy', the competencies of institutions and policy culture in implementing a policy may be very influential. Governance is decisive in the success of a policy.

One would expect that implementation of the Habitats Directive would have its centre of gravity in the protection of the rural landscape (Figure 33), but all countries studied came to some kind of political compromise. Compared to other countries much weight is given to agricultural production in the Netherlands, considering the complexity of formulation of management plans for Natura 2000 sites. In Greece and Romania, conservation is compromised with regard to economic goals.

The many different institutions involved in landscape policy point towards institutional shortcomings and a lack of policy integration. Planning is not effective and focused on containing urban boundaries, which often results in urban expansion in rural areas with a negative impact on the landscape. This risk is particularly significant in the case of a mismatch between the required structures and agencies to implement a policy and the existing structures in the country. If these do not match (and this is for example the case in Romania, which only recently joined the EU), it is more difficult to prevent conflicting competencies, power struggles and ineffective implementation by agencies that are not competent or are not willing to cooperate.

It may be more effective if countries can devise for themselves structures to implement

policies. This would require a shift from input orientation towards performance and result orientation, whereby European institutions would focus on measuring the quality and effectiveness of implementation of regulations. An example for such a policy can be found in the Water Framework Directive: innovations included water management at hydrological scales, the role and interplay of institutional actors, the involvement of non-state actors in planning, as well as a common strategy to support EU member States in implementation (Behagel and Turnhout 2011; Boeuf and Fritsch 2016; Nielsen et al. 2013).

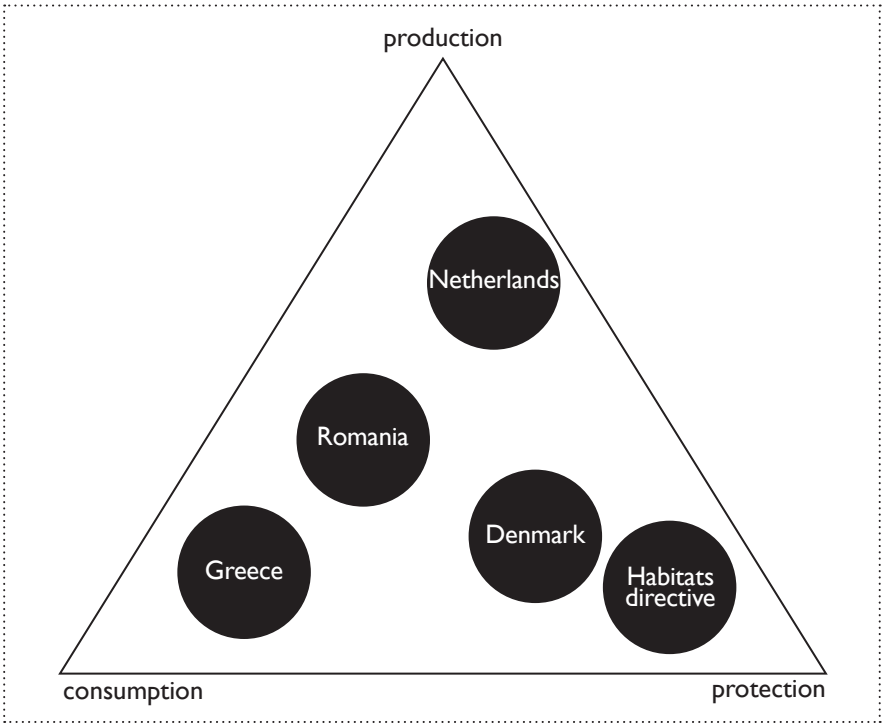


Figure 33: Implementation of the Habitats Directive in European countries. Dominant rural forces affect the implementation, based on fit towards institutions, and policy culture.

7.2.5 Consistent measures are needed to retain inherent landscape qualities

What are promising future pathways to maintain valuable cultural landscapes?

This question adds a long-term perspective to the process of change in cultural landscapes and focuses on the socio-ecological aspect. Chapter 6 shows that changes in cultural landscapes are related to values placed by society on agricultural land uses, to tradition and culture, e.g. olive yards, vineyards and agroforestry or complex horticultural systems, which are often small-scale and result in a diverse landscape pattern. Both Lesvos and Portofino were formed over centuries, and are vested in old farming and silvicultural systems that depend on traditional knowledge, techniques

and skills for landscape maintenance. Since income has been declining, and farming is labour-intensive with no opportunities for mechanisation, the area of farmland has decreased. Everywhere in Portofino land abandonment and extensification is visible, and in some cases 'rewilding' takes place, which has led to an ultimate form of land abandonment in 2010 (Figure 34). As a consequence, residents and (former) farmers in Portofino report that the park and surrounding areas have changed, and that the area has lost part of its character and identity.

Cultural landscapes are also negatively affected by globalisation and the economy, e.g. farming subsidies (olives, grapes), prices of olive oil or premiums for sheep and goats. The smallholders in these areas do not benefit from these; the local administration in Portofino has not succeeded in making funds available for the few smallholders still farming, which underlines the (in)capacity of administrations to make effective use of policies and regulations to maintain such landscapes. In Lesvos there is very little participation in Agri-Environmental Schemes (Pavlis et al. 2016).
The farms become dependent on income gained outside agriculture. There is a mobile population with rural residents migrating to towns or abroad, as well as counter-urbanisation, where residents from urban areas settle in the countryside. Urban expansion resulted in the construction of new houses or the renovation of old farmhouses; these houses and gardens often have few ties to former land use, which results in alienation.
Additionally, tourism and recreation have an impact on the landscape: the economy is partly based on hotels and tourism, and the increase in the number of houses also invites the development or upgrading of infrastructure like roads, airports and shops.

As a result of similar drivers, the processes of change in cultural landscapes are often similar. The disappearance of farming has resulted in a loss of landscape values and functions: land degradation, erosion and decline of cultural heritage.
The marginalisation of farming results in a rural exodus, but also in the deterioration of characteristic landscape features such as terrace walls, olive yards, 'coltura mista' and chestnut plantations, with a loss of all of their support functions. This leads to significant physical and material damage and consequently high costs for repairs and the restoration of infrastructure. Over time, the traditional knowledge and skills for landscape management and maintenance have been lost.

An alternative pathway should focus on measures to retain the inherent qualities of landscapes. Farmers are crucial in this process; they should be supported to continue their activities, in particular landscape maintenance such as conserving terraces, cultivation of extensive agro-forestry crops and restoration of landscape elements which form part of the cultural landscape. The CAP, RDP, or Natura 2000 may offer funding opportunities to maintain and promote farming in cultural landscapes. Through such schemes some of the valuable landscape features and landscape diversity can be maintained. Training and support of young farmers is of particular importance to ensure future continuation of the activities. This could link up with certain innovations,

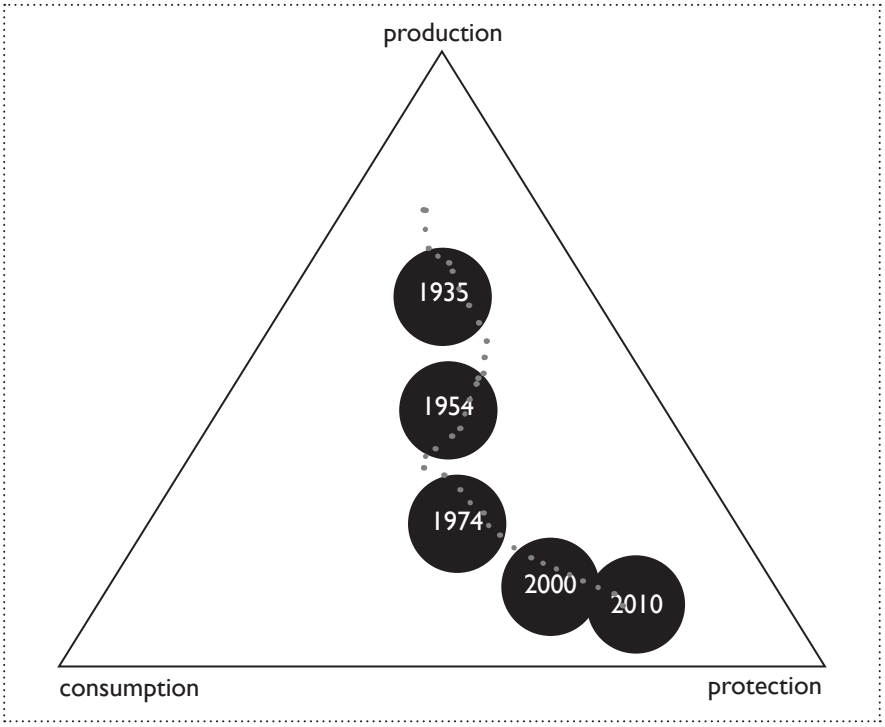


Figure 34: Portofino: from a multifunctional landscape towards conservation and marginalised farming.

such as small-scale horticulture combined with running a restaurant, or agro-tourism ventures established in old buildings in the area.

7.3 The paradox of landscape change

7.3.1 Introduction

The landscape in Europe is permanently changing as a result of complex interacting drivers. Policy is one of the important drivers, but the landscape changes that take place are not the outcome of one specific identifiable policy which steers landscape development. This development is the outcome of various economic drivers and policies, specifically the Common Agricultural Policy (CAP). The paradox is that the **intentions of different European and regional spatial policies are ambitious with regard to rural development, environmental quality, conservation of natural habitats and cultural heritage. In the end, however, the complex interactions among direct and indirect drivers do not result in the sustainable, liveable and biodiverse landscape that is valued as a major asset of the European territory; instead, policies frequently lead to unintentional changes negatively affecting these values.** In other

words, dominant drivers of landscape change (global economy, European policies such as the CAP, LIFE and RDP) result in an outcome whereby the landscape 'loses out': we end up with a landscape that suits large parts of the agricultural and forest sector, but that otherwise nobody aimed for, and which was also not envisaged by policy.
The following sections reflect further on the findings in this thesis, and synthesise the implications for future landscape planning. Focus is on three crucial issues with respect to a sustainable, biodiverse and liveable landscape:

- multifunctionality and pathways to multifunctionality.
- landscape policy.
- landscape governance.

7.3.2 Multifunctional landscape management

The competing claims for services as a result of economic prosperity, a growing population, resource conflicts, climate change and other environmental pressures result in an increasing challenge for spatial planners and land managers. Without proper allocation of land resources and failure to regulate sustainable use, landscape services will decline. One approach to meet the demands for services is to realise the provision of multiple benefits through multifunctional land use (Bateman et al. 2013). As indicated in Chapter 1, the assumption thereby is that a multifunctional landscape has all aspects of a sustainable, liveable and biodiverse landscape. Multifunctional landscape management can generate multiple benefits, e.g. in floodplain landscapes (Schindler et al. 2014). However, as demonstrated in Chapter 5, it is important that policies are location specific (Stürck and Verburg 2016) in order to be effectively implemented.
Figure 35 illustrates how a situation of multifunctional land use regressed to monofunctional use (polarisation). A more balanced situation would require a greater combination of functions. Characteristics of multifunctionality in farms are: strong regional connections, cooperation between stakeholder groups, high environmental

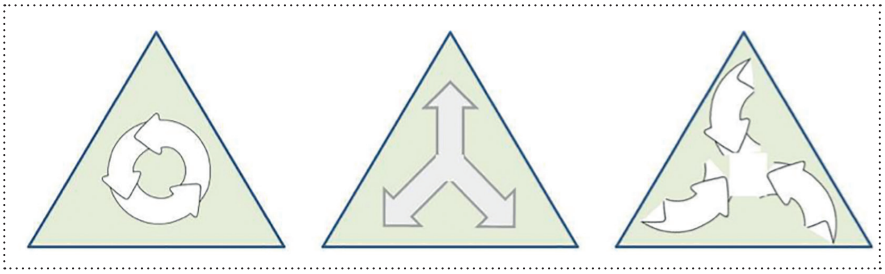


Figure 35: In earlier decades, the landscape was multifunctional (a), in the past there has been a process of specialisation and divergence resulting in monofunctional land use (b). In future, it would require harmonisation, bringing back a multifunctional landscape, in which production, consumption and protection all have a role in the same landscape at a regional scale (c).

sustainability (often combined with a focus on local food chains), high food quality and scepticism towards use of Green Revolution or GMOs. Strong multifunctional farms are more likely to be less integrated in the global capitalist market (Wilson 2008). As Wilson wrote, the attractiveness of the concept is that strong multifunctionality is intuitively 'good', since '*most of its dimensions resonate positively with what producers, rural stakeholders and wider society would see as the 'optimum' type of agricultural regime*' (Wilson 2008; italics in this quote were added by the author). Multifunctionality also relates to the protective and creative measures in the European Landscape Convention (Selman 2009).

Part of the forest sector is also moving towards integrated multifunctional management, as required to balance the provision of a multiplicity of ecosystem services. In many countries a shift has already occurred towards combining forest production with other functions (Forest europe 2015): biodiversity conservation, recreation, carbon sequestration and water protection are functions and services that can be achieved alongside wood production (Nabuurs et al. 2014). The steady increase in forest area in Europe, therefore, is beneficial for multifunctionality.

Wilson explored the different multifunctional transitional processes at farm level over time, and introduced the notion of multifunctional path dependency and decision-making corridors (Wilson 2008). The pathway choices differ for different types of farms, from agribusinesses to upland or hobby farms. Lowland farms and agribusinesses are by their nature weakly multifunctional, whereas upland farms, model farms and hobby farms are at the other end of the spectrum and are usually less embedded in national or global agro-commodity chains. The case studies in this thesis may be characterised by rather different farm types that by nature differ in multifunctionality: the marginal areas in southern Europe are less embedded in the global economy and demonstrate high multifunctionality. In addition, forestry in Southern Europe is less important for wood production due to climatic and geomorphological conditions and has all characteristics of multifunctionality, e.g. for recreation, carbon sequestration, water and soil conservation, etc.

Denmark and The Netherlands show typical 'lowland farm types'—agribusinesses (section 7.2.2) that are weakly multifunctional. The Eastern European cases of Romania and Estonia are more multifunctional. The pathway opportunities here are smaller than in Western Europe, or in other words, the room for manoeuvre is smaller, with strong multifunctionality compared to West European farms.

The opportunities are mostly dictated by environmental conditions (marginality of land) and the economy. Farming in these regions may have been profitable in the past, but now abandonment is looming if no measures are taken to counteract driving economic forces.

Cultural landscapes are particularly highly multifunctional. Historical comparisons of the landscapes (Portofino and Lesvos, Chapter 6) and additional research (Pedroli et al. 2013) show a complex system where multiple crop production is combined with agroforestry; some production is for subsistence use, and olive oil and meat is

sold to markets, sometimes with subsidies (olive oil, ewe and goat premium). Farms depend partly on off-farm work in tourism and the hospitality industry and explore new opportunities through agro-tourism and the sale of farm produce, biological or regional products, etc.
This system is in decline: data acquired from interviews show that landscapes will deteriorate if they are not well maintained. Farming terraces can be rather resilient, but the hidden effect of overdue maintenance is that terraces decline due to the impact of weather, water run-off, land abandonment, human activities and roaming domestic animals. Traditional management is no longer practiced due to the ageing population, lack of labour, skills, high costs etc. The old Portofino farmers interviewed in 1999 (Mosconi 2000) were no longer to be found in 2012, and in their absence this body of knowledge is disappearing. According to residents, the modified landscape loses part of its value and character. This problem is emblematic for cultural landscapes, whether in Ireland, Romania or Portugal. The examples in Chapter 6 illustrate how societal changes, regional development and a changing farming sector affect cultural landscapes.

If these iconic cultural landscapes are to be preserved for the future, deterioration must be contained through control of animals, farmland management and regular repair of terraces, stone walls, hedges or fences. Traditional knowledge, skills and techniques are key for maintaining valuable cultural landscapes, such as those found in Southern Europe.
Solutions must be found to preserve the knowledge and traditions of landscape management. Funding and labour are also required to maintain these landscapes. Payment schemes could be based on the notion of the important cultural, provisioning and supporting services that are provided by these landscapes, and if this is acknowledged, payments could be administered through Agri-Environmental Schemes, Hill farmer schemes or High Nature Value farming.

For the peri-urban countryside, opportunities lie in providing guidance, information and advice to the new urban residents. This can reduce the impact of counter-urbanisation and alienation of the countryside. This is particularly important for non-farming rural residents that have no access to funds, and may lack skills and knowledge for traditional management.

7.3.3 Are our landscape-related policies sufficiently effective to manage or protect the landscape?

This thesis illustrates that the landscape is permanently changing as a result of complex interacting drivers. Policy is one of the important drivers, but the landscape changes that take place are not the outcome of a single policy that steers landscape development, but is rather the outcome of globalisation, economic drivers and policies; mostly the CAP, RDP and national forest policies that affect the landscape to a significant degree. There is no European policy for landscapes: landscape is not a prerogative of the EU.
Appropriate policies regulating land use and resource planning may decrease conflict and mitigate or compensate for environmental pressures. To develop appropriate policies, it is essential to understand how landscape change processes take place in Europe.

A tailor-made approach for European policies for each country is essential, taking into account the structure and functioning of existing institutions in member states without losing sight of the overall aims of a policy. This requires input from the recipient countries in designing schemes or regulations, adapting it to existing institutions and modifying current practices.
This can be realised if a country is allowed to define its approach, methods and instruments (regional approach), while the final goals and targets for landscape policies are defined by European authorities.

If we relate the policies to Holmes' MRT approach, the CAP seems a dominant policy related to production (Figure 36). The cross-compliance of the CAP requires protection of environmental quality, but in practice it does not maintain landscape quality, nor, in many cases, biodiversity (Kleijn et al. 2009; Pe'er et al. 2014). Regional planning is particularly important where 'consumption' is a strong driver. Natura 2000 aligns with protection and, to a limited extent, production. The Water Framework Directive lies somewhere in between these fields, also due to its focus on water management and water bodies.

Although schematic, the graph shows that there is a 'greyish' area with few effective policies. This 'range' may allow more multifunctional policies that thereby counterbalance the dominant position of production and consumption. Most countries do not seem to have policies that can fill the 'gap' for Multifunctional Landscape Management: areas that do not fall into the category of Natura 2000 or High Nature Value farming areas, areas outside urban zones, not affected by the WFD or national forest policies are insufficiently covered at present by effective planning for multifunctional land use. Besides, the areas under the CAP are still dominated by the production paradigm, even in those areas where demand for multiple functions can be satisfied.

The existing (sectoral) schemes need to be re-examined with respect to multifunctionality. Possible multifunctional effects should be considered in decisions

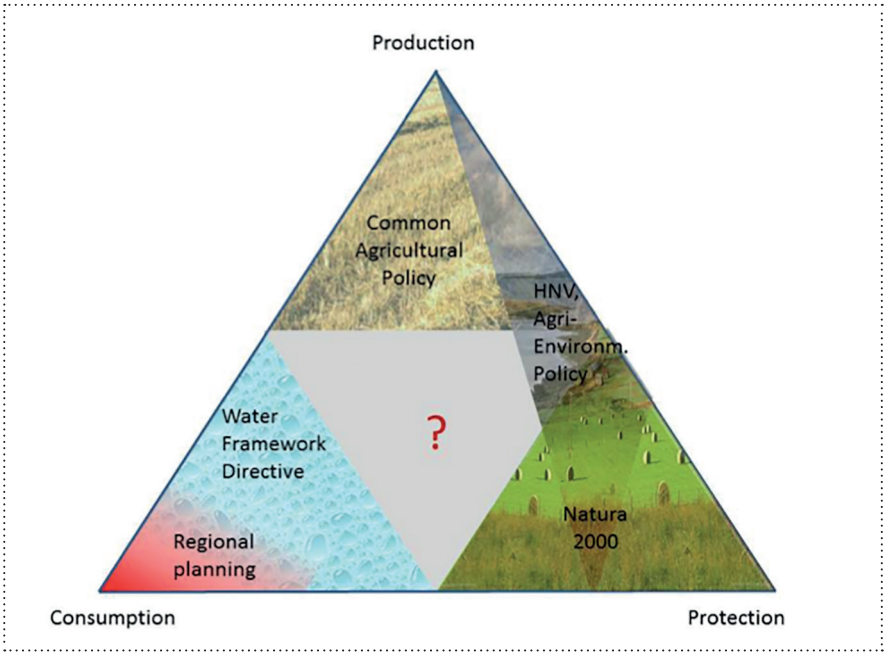


Figure 36: The importance of policies with regard to landscape and land use; the '?' indicating where multifunctional policies can play a role.

about measures included in e.g. payment schemes in the CAP or in Natura 2000, and in appropriate target areas for measures. Making more funds from e.g. CAP and RDP available for multifunctional land use could lead to more land sharing.

If landscapes produce supporting or cultural services it incurs costs for the land manager. Payment for these services can be a tool to realise land-sharing models; the landscape would benefit from modalities to cover the costs incurred from lower production. The payment for regulating and cultural services could be integrated into existing funding programs, e.g. through better targeting of AES at smaller farmers in valuable landscapes. Often the farm size affects beneficiaries; the AES for example does not reach the small farmers of Portofino (Chapter 6, Pavlis et al. 2016). Funding schemes should ensure that small, multifunctional-oriented farmers who particularly need support can benefit.

To make better use of the added value potential of multifunctional effects, it is necessary to spatially target (agri-) environmental measures or conservation measures in Natura 2000 (Bateman et al. 2013; Galler et al. 2015). In the end, landscape quality would improve, and thus also the attractiveness of the countryside for residence, recreation and tourism. This leads us to the implementation of policy, the importance of governance and tools for policy implementation.

7.3.4 Landscape governance

Implementation of policy

Chapter 5 (implementation of the Habitats Directive) and Chapter 3 (drivers of landscape change) show how domestic policy approaches can affect policy implementation. In a parallel study to the Habitats Directive, the implementation of the Agri-Environmental Schemes of the CAP was evaluated with similar findings: countries implement policies differently, but key for its success are local conditions, the availability of existing institutions that implement policy, empowering these institutions and the establishment of the appropriate administration. Also, the building of new institutions is time consuming and requires staff development (Vesterager et al. 2016). Most countries implement the Habitats Directive with adjustment of existing policy instruments or initiate the development of new policy instruments. New instruments usually fit the existing implementation style (Bouwma et al. 2015). Also, it is generally more effective to adapt institutions to implement new policies than create new institutions, due to conflicts arising in the field of competence and powers.

Tools

To make optimal use of landscape services, tailored approaches in landscape management coupled with financial support programs are required to realise solutions that are space- and time-specific. There is a choice of different tools; a mix of these can be used to realise effective landscape governance.

Market Based Instruments (MBIs) may regulate or influence people's behaviour regarding landscape management or consumption. Besides the MBIs, there are sticks (law) and sermons (education, awareness raising). The MBIs include financial incentives like subsidies and payment schemes in various forms, and may include direct payments for measures (e.g. for planting or managing particular landscape features such as late mowing for meadow birds); voluntary price instruments (eco-products) etc. However, as shown in this thesis, these instruments on their own may be insufficient to harmonise the different aims of multifunctionality. Despite the AES, as discussed in the previous section and 7.2.1, biodiversity and landscape quality is declining. Not all functions are easy to align, and some functions are more dominant than others. This requires interventions and choices for trade-offs to be made (Arts et al. 2017). In the case of the dominant power of globalisation and European markets, payment for landscape services alone is not effective, so additional incentives may be required for the valorisation of these services and to stimulate multifunctionality.

Regional integrative approaches could be supported, for example: the Island of Samsø (Denmark) or Goeree Overflakkee (the Netherlands) could be earmarked and supported for sustainable development, stimulating farmer collectives to engage in sustainable food production, tourism development and landscape diversification combined with energy neutral development. A prerequisite is that stakeholders

share a common sense of urgency and that there is a landscape confined by the community. Such developments could be supported through alternative funding schemes, provided that there are no obstructions for such experiments, as reported e.g. in the Farming for Nature initiative (Buizer et al. 2016).

Involvement of stakeholders

Stakeholder involvement in landscape governance promises to better meet the socio-ecological conditions of regions and countries, provided that it is flexible enough to consider the different scale levels (Buijs 2009; Ramos 2011; Walker et al. 2006). This requires a dynamic process to mobilise the stakeholders, as well as flexibility towards negotiations and conflict management at the landscape level. In particular, these last issues can be decisive for successful landscape governance. Sayer et al. (2013) formulated ten principles for a landscape approach to reconcile agriculture with conservation to be taken into account in a landscape approach. However, as Arts et al. (2017) show, in seven landscape initiatives these principles were selectively used which resulted in all cases in institutional problems and power disparities.

Van Oosten et al. (2014) advocates a flexible governance approach to establish novel public-private institutional arrangements at the landscape level. One such example of new constellations of civil society and government is a complex landscape change process in the Province of Overijssel, the Netherlands, where a Water Board takes the lead, in coordination with the Province and civil society (Folkert and Boonstra 2017). Such arrangements are currently tested in many regions of Europe; another example is community-based landscape planning in Northern Jutland, Denmark. Here, a thousand-year-old farming landscape has lost much of its function due to industrialisation and population decline. A community-based landscape strategy was developed, and the municipalities are now supported in the restoration of coastal farmlands and sustainable development of the area (Pedroli et al. 2016). In addition, a group of concerned citizens in Amsterdam, 'De Ruige Hof', have been managing and safeguarding an area of urban green space against urban encroachment for over 30 years. By adopting pieces of derelict land and managing it for conservation, several rare and threatened species have returned (Buijs et al. 2016). The role of NGOs and community groups are particularly important in changing the attitude of residents or mobilising people (sermons), but industry can also play a role in new landscape constellations, such as in floodplain management (Buijs 2009; Schindler et al. 2016).

And back to policy...

Notwithstanding some successful new approaches of stakeholder involvement in landscape management and new avenues for landscape development, there are also drawbacks: in all such processes, there is a risk that collaboration results in power inequalities that affect the outcome, or may give certain groups more benefits than others, which may make it unsustainable. As a result, democratic principles may not

be guaranteed.
Finally, a shift from government to governance may result in a public erosion of services (Arts et al. 2017). Therefore it remains important that landscape also finds its place in existing legislation and regulations and is further integrated into land-related policies.

7.4 Methodological and theoretical reflections

Undoubtedly, the objective for this thesis has been challenging—to expand knowledge beyond general ecological knowledge, governance or policies and regulations, which are all very relevant for a better understanding of landscape change processes. My reflection will focus on three aspects: the sample of study areas, the data used and the theoretical framework that was used.

Sample of study areas

The research was developed within VOLANTE, a European 7th Framework Program, which allowed me to collect empirical data. The research is based on seven case studies situated in six countries (Figure 1). This was an obvious consequence of the VOLANTE project; partner organisations brought in their study areas and collected part of the data. The advantage was that for some cases, data and maps were available. Chapter 6 was partly built on earlier research (Kizos and Koulouri 2006; Kizos et al. 2010; Pedroli et al. 2013; Van der Sluis 2002). Only the Heerde case study (the Netherlands) was new, and was selected based on the diversity of the landscape and land use, as well as the size of the area and number of farmers.
The case studies were well distributed over different environmental zones (Figure 9, Chapter 3). For Chapter 3 additional workshops were held in the Boreal/Nemoral region (Estonia) and the Western Mediterranean (Portugal). Although the workshops focused on environmental zones, in practice the experts were not sufficiently familiar with these environmental zones and would rather discuss the change processes in the country and (except for Estonia) not discuss landscape processes beyond their own borders. The relative importance of the natural environment might not have required segregation on the basis of the environmental zones.
The case studies are unique; perhaps findings cannot be generalised across Europe, but the cases do cover the variety of European landscapes, with typical examples from Western, Eastern and Southern Europe. Europe's kaleidoscope of different landscapes and rural development challenges is well represented in this selection.

Data on landscape

The aim of this thesis was to assess the impact of policy on the landscape, under the assumption that it would be possible to link observed changes in the landscape with the particular moment in time that a policy had been adopted. It was, however,

underestimated what data could be collected or would be available for such an analysis. Also, time lags due to policy transposition in the different countries, and in particular the role of the governance system is important. Governance and transposition are decisive factors in the success of policy implementation, and study of these two factors is rather complex.
Two important lessons were learned from this:
1) Very few if any studies analyse the physical impact of policies on landscape in a structured way. If the impact on the landscape is studied, it is either based on a limited area (rarely comparisons over more countries and regions of Europe are made), or it is based on (for this purpose) imprecise data, such as LUCAS Land cover/use statistical data.
2) The landscape change processes and the dynamics of policy implementation are probably too complex to allow for such an analysis.
At the European landscape level, very few structural or functional indicators are known to assess the impact of e.g. the CAP on hedgerows, stone walls, ponds or other landscape elements; the same may count for indicators of forest policies (Lomba et al. 2014; Paracchini and Capitani 2011; Piorr 2003; Verburg et al. 2013; Wascher 2004).

In the VOLANTE project, the deliverables and partners were defined beforehand; the partners brought in their own case studies and they had resources allocated for different tasks. The deliverables were to be submitted according to the project schedule. This required a flexible research plan, since the results were partly dictated by agreed procedures with partners, as well as deliverables that were required by the funding organisation (7th Framework Program). Some project deliverables formed the basis for the papers that were written.

This approach may be typical for applied research and will differ from academia, in which the methodology and data collection is optimised to address research questions. Time in many cases may be less of a constraint than in applied research. There is possibly more control of the research set-up and the cases studied, and the links between the different research questions is more or less controlled.
Initially, the biodiversity impact of policies should also have been covered. However, no biodiversity data was available for the case study areas, and due to lack of time (budget) and lack of expertise with partners, such data could not be collected. Even detailed maps were not available for one case, Reichraming (Austria). These limitations affected the findings of this thesis to some extent.
Although some additional workshops were held, e.g. for Chapter 3, Drivers of change in the French Alps, Portugal and Estonia, to compensate for this, it is clear that without these limitations the findings of this thesis would certainly have been stronger.

The SES landscape model and MRT approach

The conceptual framework for the research reported in this thesis (Figure 37) has been adequate in structuring the analysis. The abstraction of landscape change processes was guiding in the formulation of the research questions. All elements in the model were addressed with a specific question, except for Q5, the 'pathways to conserve cultural landscapes'. This is linked with the social system, interventions and landscape services.

Evidently, this framework does not capture the full complexity of the scale dimension, the European 'landscape' scale. Every landscape has very specific environmental conditions, landscape history and the specific roles of communities, traditional knowledge and how this affects the drivers of the system. The intricacy of 'the' European landscape cannot possibly be captured in such a framework.

The Multifunctional Rural Transition (MRT) approach was employed to understand the major forces that shape the European landscape. Intuitively, it provides an understanding of change, which is part of its attractiveness. The change processes are brought back from complex systems (such as in Chapter 3, Fuzzy Cognitive Mapping) towards a simple model with three variables.

The model, developed initially for rural Australia, conceptualises the rural transition taking place with a mixture of consumption (lifestyle) and protection (including 'land care') that '*contested the former dominance of production*' ('livelihood values') (Holmes 2008; italics were added by the author).

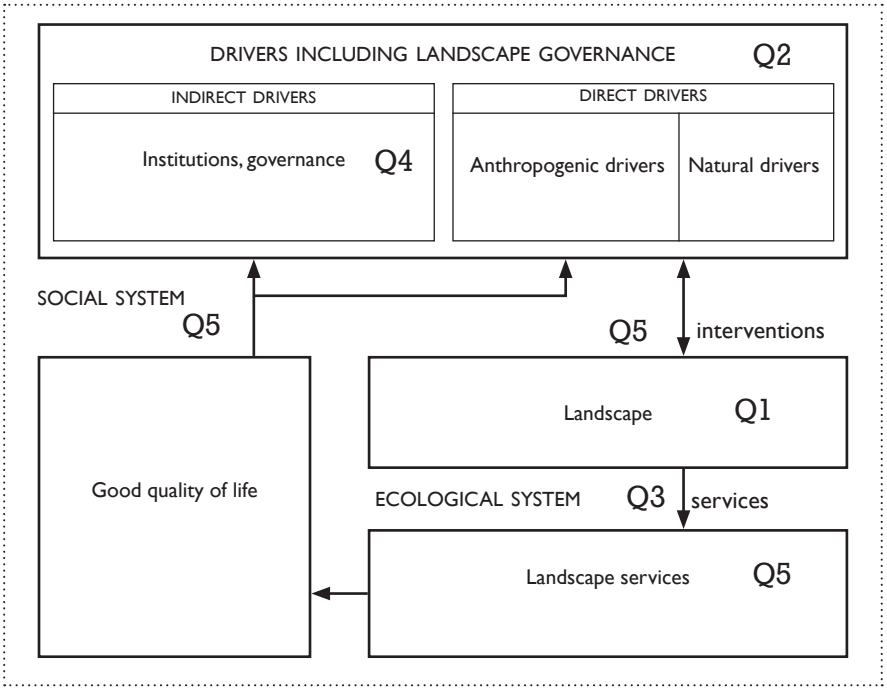


Figure 37: Conceptual framework and research questions Q1-Q5.

Application of the approach in very different regions of Europe shows that the main occupancy modes are well covered with this concept, although the seven modes identified for Australia (Figure 15) may differ widely from Europe, e.g. Figure 31 already shows some ten modes.
The MRT approach was found to be a useful analytical tool for landscape change processes, to relate these processes to the main drivers and allow for comparison between landscapes. It focuses on what is driving the landscapes transitions and the functionality of the landscape. For example, in Chapter 4 an interpretation of landscape change is translated into a shift in 'occupancy' based on the change in area and landscape features. The intensification is based on a shift in area towards more intensive crops. This model was also used for other transitions and even management strategies, e.g. by individual landowners. For example, Figure 17 positions different occupancy modes between intensification and extensification.

Returning to the objective of this thesis, referring to the discussion of the evidence presented, and despite the limitations of the conceptual model and the MRT approach, the findings have definitely contributed to the understanding of the process of landscape change.

7.5 Recommendations

Policy recommendations:

- The commonly applied sectoral approach to land management no longer suffices to meet societal challenges, such as sustainable development, urbanisation and halting the loss of biodiversity. It is essential to harmonise competing claims on the landscape as much as possible; policy integration is essential to realise a multifunctional and thus sustainable, liveable and biodiverse landscape.
- It is recommended that EU policies related to landscapes are developed (and adjusted) by European countries in a flexible way such that they easily fit into national institutions and planning approaches. The Water Framework Directive makes some first steps towards such policy innovation and thus sets an example for other landscape-related policies.
- In 2011, the EU committed itself to halt the loss of biodiversity by ensuring (among other measures) that the budget spent under the EU budget has no negative impact on biodiversity. It is recommended that this policy be extended to landscapes, in order to better screen the landscape impact of policies. An assessment and monitoring of the 'landscape impact', as required by the European Landscape Convention, should therefore be obligatory for all policies. A 'landscape-proofing' would also contribute to the EU biodiversity strategy.

Governance recommendations:

- New institutions may not be a solution for new societal challenges. It is instead recommended to work within existing institutions, employing existing knowledge and capacities. This is likely to expedite the implementation of policies and avoid competency conflicts.
- It is recommended to experiment more with decentralised governance; the model of the Dutch Water Boards could be followed to come to 'inclusive' decision-making in rural development and landscape planning. The benefit being that the disconnect between European policies and stakeholders is bridged: stakeholders can thus seize more control in shaping their landscape and living environment.
- It is recommended that top-down and bottom-up approaches in landscape planning are further harmonised. Such integrated approaches provide a framework for better balancing spatial claims and integrating policies for multiple land uses within a given area.

Research recommendations:

- No 'strict' causality could be demonstrated among policies and landscape change. However, the emergence of new technologies, availability of remotely gathered data and the analysis of big data will very probably allow for more accurate assessments of such causalities, although policies always operate in complex fields of multiple and related drivers (Skidmore et al. 2015). Therefore, research should focus on the reconstruction of historic landscape maps of previous decades with the newest remote-sensing technologies to determine such causality. In due time, we might then be able to answer the research question how policy has affected multifunctional land use in greater detail.
- Research is required into how policy can contribute to the protection and sustainable use of cultural landscapes, since they either are not protected (see Greece, Romania) or national policy has been abolished (Netherlands). Provided that landscape policy is well implemented, these landscapes can be important future showcases for multifunctionality.
- Further research and experiments are required to explore new innovative ways of 'traditional' landscape management, to come to a better understanding of the link between cultural landscapes, traditional management and new financing models for such management.


7

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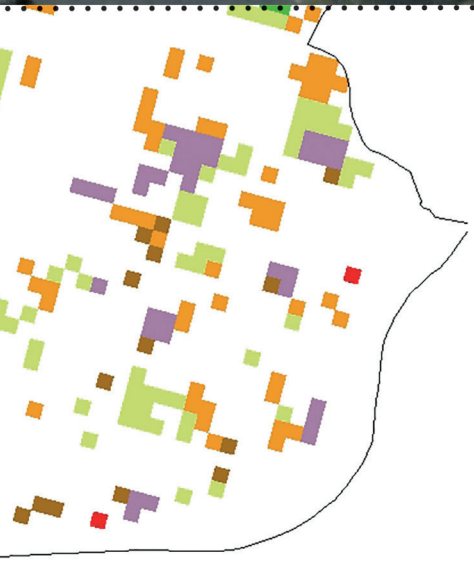

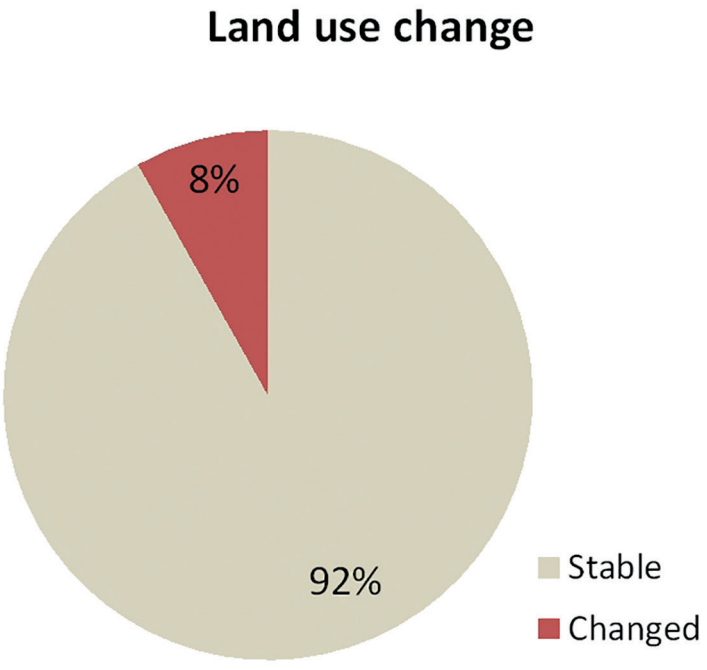
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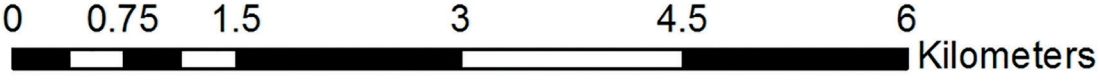
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Summary

Europe: the Paradox of Landscape change

A case-study based contribution to the understanding of land use transitions

Summary

This thesis explores the processes of change in European rural landscapes. Landscapes have evolved over millennia as a result of human influence on the physical environment. Europe has a wide variety of landscapes that can alter within a relatively short distance, and which often form part of the national cultural identity of a European country. Central to this thesis, however, are insights into the processes of landscape change.

In this context, the overall objective of this thesis is:
To assess the dynamics of landscape change and increase the scientific understanding of the underlying processes and policies that have shaped the rural landscapes of Europe after establishment of the EU.

The focus is on the period following the establishment of the European Economic Community in 1965, which is hypothesised as the main driver of landscape change. European policies have an important direct impact on national and regional policies. The way that European policy transposition took place, existing governance structures and policy cultures also defined how 'European policy' influenced countries and regions. The object of this study is in particular the changing rural landscape, including the role of European agricultural policies, such as the Common Agricultural Policy (CAP) and conservation policies (for example Natura2000) in these changes.

The thesis uses an integrated approach to assess the various processes of landscape change: land use transitions, urbanisation of the countryside, land use intensification, extensification or abandonment. These processes are linked to drivers of landscape changes, the role of policies, and how these affect the landscape processes.

Research questions

The research objective requires unravelling the correlations between land-related policies and landscape change in the EU, the drivers of landscape change and in particular how policies affect the European landscape. To operationalise this objective, the following research questions are addressed:

Q1. What are the major landscape change processes occurring in different regions of Europe?

Q2. What are the drivers of landscape change in different regions of Europe, and what is the role of EU-policies in particular?

Q3. How do landscape changes affect the provision of landscape services?

Q4. How does the implementation of conservation policies affect processes of landscape change?

Q5. Which effective strategies and future pathways can be followed to conserve valuable cultural landscapes?

The thesis consists of an introductory chapter, five chapters each addressing one of the research questions, and a concluding synthesis: putting the findings together and indicating their potential significance for research and policy. The first chapter introduces the theoretical framework, which focusses on the benefits (goods and services) that landscapes provide, satisfying human demands directly or indirectly. The framework recognises the institutions, the policies (indirect drivers), as well as natural and anthropogenic drivers of landscape change. The five central chapters have each been submitted to international peer reviewed scientific journals, three of which have been accepted, and two have been revised and resubmitted.

Research question Q1,
'*What are major landscape changes occurring in different regions of Europe?*'
is addressed by interviewing 437 farmers in six selected study areas in Denmark, the Netherlands, Austria, Greece and Romania (Chapter 2). The aim of this survey was to acquire a better understanding of farmer's decision making, the environmental conditions and the landscape change processes taking place. The focus is on intensification and extensification processes in the case-study areas and regional similarities and differences. A statistical analysis of land use intensity was carried out on the basis of the interviews.

Research question Q2
'*What are the drivers of landscape change in different regions of Europe, and what is particularly the role of EU-policies*'
discusses the factors and drivers of change in a meta-study of six countries (Chapter 3). This study is based on stakeholder's interpretations of change processes, using Fuzzy Cognitive Mapping. Groups of landscape experts participated in five workshops to jointly construct a cognitive map of landscape change processes over the past 25 years. The study examines in particular the storylines of the processes of landscape change. Two cases of Mediterranean and Boreal landscapes, are detailed.

Question Q3,
'How do landscape changes affect the provision of landscape services?' is addressed in Chapter 4, and discusses five European case studies with regard to changes in

landscape services. The analysis is based on observed landscape changes by comparing maps for periods of up to 25 years. The changes were interpreted in terms of the consequences for landscape services, and related to European policies of landscape change.

Question Q4:
'How does the implementation of conservation policies affect processes of landscape change?' is discussed in Chapter 5 through focus on landscape governance. The transposition of European policy is assessed using the case of the Habitats Directive in four countries: Denmark, Greece, The Netherlands and Romania. It is assessed how legislation is locally translated and how this 'fits' the national governance system.

The last question, Q5:
'Which effective strategies and future pathways can be followed to conserve valuable cultural landscapes?'
is addressed in Chapter 6 on Mediterranean landscape change. Two 'iconic' Greek and Italian cultural olive yard landscapes were compared. Both landscapes have a centuries-old farming system. Long-term data sets on landscape change (exceeding 100 years) were combined with map data, interviews and literature, to discuss the characteristics of cultural landscape management, opportunities and potential risks for the future of these cultural landscapes.

The final chapter, Chapter 7, reflects on the results and presents the conclusions of the previous chapters, and on the scientific and societal significance of the thesis as a whole. It is concluded that the landscape in Europe is permanently changing as a result of complex interacting drivers. Policy has been one of the important drivers, but the landscape changes that have taken place are the outcome of various economic drivers and policies. **The paradox is that the intentions of different European and regional spatial policies have been ambitious with regard to rural development, environmental quality, conservation of natural habitats and cultural heritage. In the end however, the complex interactions among direct and indirect drivers led to unintentional changes** negatively affecting landscape value, resulting in land degradation, loss of cultural values and biodiversity. In other words, dominant drivers of landscape change (global economy, European policies) resulted in an outcome of landscapes that are preferred by the majority of the agricultural and forest sector, but otherwise no specific stakeholders were targeted, an outcome which was not envisaged by the policies.
Without efficient allocation of land resources and failing to regulate sustainable use, the landscape services are declining. One approach to meet the diverse demands for landscape services is to focus on the provision of multiple benefits, using a multifunctional land use approach. The assumption thereby is that a multifunctional landscape has all aspects of a sustainable, liveable and biodiverse landscape.
The case studies landscapes in this thesis are characterised by different approaches that differ in multifunctionality: the marginal areas in southern Europe are less

embedded in the global economy, and demonstrate high multifunctionality. Denmark and The Netherlands show typical 'lowland agriculture', that are weakly multifunctional. The Eastern European landscape cases in Romania and Estonia have higher multifunctionality, but the opportunities for change towards multifunctionality are less than in Western Europe. The opportunities are mostly dictated by environmental conditions, in particular the marginality of land, and the economy. Farming in these regions may have been profitable in the past, but abandonment is looming if no measures are taken to counteract economic driving forces.
The cultural landscapes such as in Lesvos and Portofino are particularly highly multifunctional. These old social systems are in decline: landscapes have deteriorated and changed since they have not been well maintained. The discontinuance of traditional management has occurred due to ageing populations, a lack of labour, skills and high costs. If iconic cultural landscapes are to be preserved for the future, deterioration must be halted. Traditional knowledge, skills and techniques are key for maintaining valuable cultural landscapes, such as in Italy and Greece, but also cultural landscapes in Western Europe like England or France, or traditional landscapes in Hungary or Poland. Solutions must be found to preserve the knowledge and traditions of landscape management, but also funds and labour are required to maintain these landscapes.

European landscapes have been permanently changing as a result of complex interacting drivers. Policy is one of the important drivers, but the landscape changes that take place are not the outcome of 'a' policy which steers the landscape development, but as the outcome of globalisation, economic drivers and policies; mostly the CAP, Rural Development Plan (RDP) and national forest policies which affect to a large measure the landscapes. There is no European policy for landscapes: landscape is not a prerogative of the EU.
Therefore, a tailor-made approach is essential for European policies implemented in each member state, taking into account the structure and functioning of existing national institutions, without losing sight of the overall aims of the policy. This requires input from the recipient countries in designing regulations, adapting them to existent institutions and modifying historical and current practices.

Holmes' framework for changing modes of occupancy (use of rural space) has been used, whereby landscape transitions are considered the result of a changing balance between societal consumption, conservation and production. Landscapes where (agricultural or forestry) production is less dominant, may allow for more multifunctional policies that counterbalance the dominant position of production. Most countries do not have policies that fill the 'gap' of multifunctional landscape management. Gaps exist for landscapes not subject to Natura 2000, high nature value farming areas, outside urban zones, locations not affected by the Water Framework Directive or national forest policies, or those insufficiently covered at present by effective planning for multifunctional land use.
Existing (sectoral) schemes need to be re-examined with respect to multifunctionality.

Potential multifunctional impacts should be considered in policymaking, e.g. payment schemes in the CAP or in Natura 2000, and about appropriate target areas for measures. Making more funds from CAP and RDP available for multifunctional land use could lead to more land sharing.

Landscapes, particularly iconic cultural landscapes, can benefit from mechanisms that allow the costs incurred by lower agricultural production to be covered. Payments for regulating and cultural services could be integrated in funding programs, e.g. through better targeting of Agri-Environment Schemes (AES) at smaller farmers in these valuable landscapes. Funding schemes should ensure that small, multifunctional farmers particularly in need support benefit. Better use must also be made of the added value potential of multifunctional effects. Increased multifunctionality would benefit the attractiveness of the countryside for residence, recreation and tourism.

Countries implement policies differently, but key success factors for multifunctional landscapes are the existence of locally- appropriate institutions that implement multifunctional policies. Building of new institutions can be time consuming and requires staff development.

Policy instruments on their own may be insufficient to harmonise the different aims of multifunctionality. Despite the AES, biodiversity and landscape quality is declining. The domination of some functions requires interventions and choices about trade-offs to be made (Arts et al. 2017). Given the dominant power of globalisation and European markets, payment for landscape services alone is ineffective, requiring additional incentives for the valorisation of these services, and to stimulate multifunctionality. Regional integrative approaches could be supported, with positive examples provided in the cases of alternative funding schemes, and how obstructions for such experiments can be tackled.

Finally, stakeholder involvement in landscape governance appears promising as a way to better meet the socio-ecological context within a landscape, provided that stakeholders address different scale levels. This requires a dynamic process to mobilise stakeholders, and flexibility of the government towards negotiations and conflict management at the landscape level. In particular, these last issues can be decisive for successful landscape governance. Different landscape governance arrangements are currently being tested in Europe which demonstrate new avenues. Notwithstanding some successful stakeholder involvement in landscape management, there are also challenges: in all such processes, there is a risk that collaboration results in power inequalities that affect the outcome, or may give certain groups more benefits than others, which may make the process unsustainable. It remains, therefore, important that the concept of multifunctional landscapes is integrated in existing legislation and regulations, and further integrated into land-related policies.


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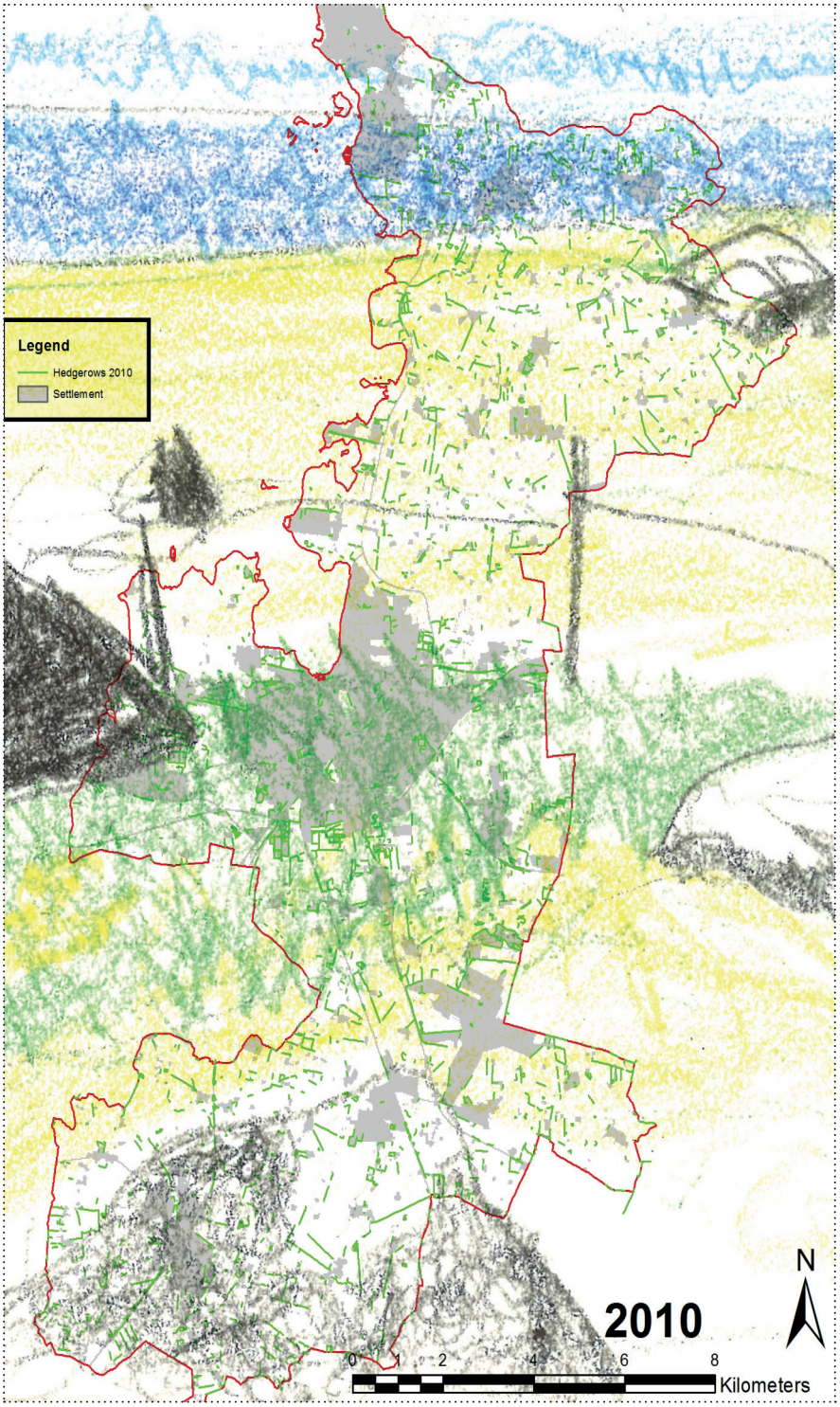
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Annex 1: Results Fishers exact test –

indicator change per farmer type (Chapter 2)

CROPYIELD	DECREASE	INCREASE	NO CHANGE	COUNT	%UNCHANGED	%DECREASE
FullTime	7	40	50	97	51.5 a	14.9 a . .
PartTime	21	20	42	83	50.6 a	51.2 . b c
Hobby	4	0	12	16	75.0 a	100.0 . . c
NotActive	9	20	60	89	67.4 a	31.0 a b .
Count	**41**	**80**	**164**	**285**		
CULTIVATED AREA	DECREASE	INCREASE	NO CHANGE	COUNT	%UNCHANGED	%DECREASE
FullTime	7	20	72	99	72.7 a	25.9 a .
PartTime	16	15	54	85	63.5 a	51.6 a b
Hobby	4	0	20	24	83.3 a	100.0 . b
NotActive	7	11	72	90	80.0 a	38.9 a b
Count	**34**	**46**	**218**	**298**		
NITROGEN	DECREASE	INCREASE	NO CHANGE	COUNT	%UNCHANGED	%DECREASE
FullTime	26	21	51	98	52.0 a .	55.3 a .
PartTime	41	5	50	96	52.1 a .	89.1 . b
Hobby	5	2	23	30	76.7 . b	71.4 a b
NotActive	24	11	63	98	64.3 a b	68.6 a .
Count	**96**	**39**	**187**	**322**		
PESTICIDES	DECREASE	INCREASE	NO CHANGE	COUNT	%UNCHANGED	%DECREASE
FullTime	22	19	57	98	58.2 a .	53.7 a .
PartTime	30	5	50	85	58.8 a .	85.7 . b
Hobby	4	1	25	30	83.3 . b	80.0 a b
NotActive	17	13	65	95	68.4 a b	56.7 a .
Count	**73**	**38**	**197**	**308**		
LIVESTOCK DENSITY	DECREASE	INCREASE	NO CHANGE	COUNT	%UNCHANGED	%DECREASE
FullTime	19	25	51	95	53.7 a	43.2 a
PartTime	28	10	35	73	47.9 a	73.7 a
Hobby	4	1	11	16	68.8 a	80.0 a
NotActive	26	15	53	94	56.4 a	63.4 a
Count	**77**	**51**	**150**	**278**		

Annex 2: Supplementary data,

land transition matrices (Chapter 4)

	AIRPORT	BARE GROUND	BRUSH	BUILD UP	CONIFEROUS FOREST	
AIRPORT	23	-	-	-	-	
BARE GROUND	-	148	-	-	-	
BRUSH	-	2	811	1	-	
BUILD UP	-	-	0	418	-	
CONIFEROUS FOREST	-	-	-	8	2,690	
CROPS	-	-	-	27	-	
GRASSLAND	-	0	-	3	-	
MARSH	-	-	-	-	-	
OLIVE GROVES	-	-	0	181	31	
SPARSELY CONIFEROUS FOREST	-	-	-	-	-	
SUM	23	150	812	648	2,721	

Persistent	Natural succession	Abandoned	Ia- Agrarian Intensification	Ci- Conversion intensification	

	SETTLEMENT	LAKE	FOR
SETTLEMENT	4823	-	-
LAKE	0	282	-
FOREST	0	1	70
GRASSLAND	-	-	-
WETLAND	0	-	-
CROPLAND	385	14	33
SEA	-	-	-
SUM	5207.6	298.1	103

	CROPS	GRASS LAND	MARSH	OLIVE GROVES	SPARSELY CONIFEROUS FOREST	SUM
	-	-	-	-	-	23
	-	-	-	-	-	148
	-	1	-	0	-	815
	-	0	-	6	-	424
	-	0	-	0	-	2,701
	437	-	-	0	1	466
	-	564	-	0	-	582
	-	-	39	-	-	39
	18	3	-	5,156	-	5,390
	-	-	-	-	201	201
	456	570	39	5,167	201	10,865

Table 25: Lesvos land conversion, comparison 1981 (rows) with 2004 (columns) (ha).

	Ce- Conversion extensification	Afforestation	Deforestation	Urbanization	Exception

EST	GRASSLAND	WETLAND		CROPLAND	SEA	SUM
	-	-		-	-	4822.5
	-	-		-	-	282.4
7	4	6		4	-	722.5
	1238			172	-	1409.3
	-	400			-	399.6
3	-	68		12783	-	13583.1
	-	-		-	7	6.6
9.8	1241.1	473.4		12959.3	6.6	

Table 26: Roskilde land conversion, comparison of 1990 (rows) with 2011 (columns) (ha).

	GRASS	MAIZE	HORTI CULTURE	ORCHARDS	CROPS	DECIDUOUS FOREST
Grass	3087	201	2	21	79	13
Maize	138	236	-	5	42	-
Horticulture	-	-	9	-	-	-
Orchards	2	3	-	28	-	-
Crops	35	-	-	8	40	-
Deciduous forest	-	-	-	-	-	514
Pine forest	-	-	-	-	-	1
Water	-	-	-	-	-	-
Built-up area	8	-	-	1	-	-
Forest with residences	-	-	-	-	-	-
Bare terrain	-	-	-	-	-	-
Infrastructure	-	-	-	-	-	-
Natural area	5	-	-	-	-	-
SUM LGN-3	3275	440	11	63	161	528

Persistent	Natural succession	Abandoned	Ia- Agrarian Intensification	Ci- Conversion intensification

	BUILT-UP AREA	PUBLIC AREA	POWER LINES	AGRICULTURAL AREA	HORTICULTURE
Built-up area	15	-	6	-	-
public area	0	3	-	-	-
Power lines	-	-	0	-	-
Agricultural area	3	0	3	-	11
Horticulture	-	-	-	-	-
Vineyards	-	-	-	-	-
Olive yard	3	0	4	-	7
Abandoned	-	-	0	-	2
Forest	3	1	5	-	3
Grassland	-	-	-	-	1
Macchia	-	-	-	-	-
Sparse vegetation	0	0	0	-	0
SUM	23.8	3.9	18.3	-	24.2

	PINE FOREST	WATER	BUILT-UP AREA	FOREST W. RESIDENCES	BARE TERRAIN	INFRA-STRUCTURE	NATURAL AREA	SUM LGN-5
	-	1	50	-	-	-	31	3485
	-	-	2	-	-	-	-	423
	-	-	-	-	-	-	-	9
	-	-	-	-	-	-	-	33
	-	-	1	-	-	-	-	84
	-	-	4	-	-	-	-	518
	1972	-	1	-	-	-	-	1974
	-	137	-	-	-	-	-	137
	-	-	561	-	-	-	-	570
	-	-	3	54	-	-	-	57
	-	-	-	-	8	-	-	8
	-	-	-	-	-	152	-	152
	-	-	-	-	-	-	580	585
	1972	138	622	54	8	152	611	

Table 27: Heerde land conversion, comparison LGN-3, 1995 (rows) with LGN-5, 2004 (columns) (ha).

Ce- Conversion extensification	Afforestation	Deforestation	Urbanization	Exception

	VINE YARDS	OLIVE YARD	ABANDONED	FOREST	GRASS LAND	MACCHIA	SPARSE VEGETATION	SUM
	0	0	-	0	-	0	-	21.4
	0	-	-	0	-	-	-	3.4
	-	-	-	0	0	-	-	0.3
	46	29	5	9	1	1	-	107.8
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	33	303	7	15	2	0	-	373.4
	2	16	6	4	2	-	-	30.8
	2	17	1	901	43	3	0	979.1
	-	0	-	8	10	-	-	19.6
	0	0	0	56	206	1	-	263.1
	-	0	-	1	2	27	-	31.0
	82.6	365.9	18.3	994.2	266.2	32.5	0.1	

Table 28: Portofino land use change, comparison 1974 (rows) with 2000 (columns) (ha).

	BUILT AREA	INFRA-STRUCTURE	LAKES	GRASSLAND	RIVERS
Built area	189	4	0	0	1
Infrastructure	7	90	0	0	1
Lakes	0	0	15	1	1
Grassland	8	1	4	5	15
Rivers	-	-	0	-	2
Forest, shrubs	3	0	-	0	0
Permanent Grassland	10	4	12	8	20
Cropland	121	44	16	11	47
Permanent crops	24	1	-	-	0
Vineyards	-	0	0	-	-
SUM	362	145	46	26	87

Persistent	Natural succession	Abandoned	Ia- Agrarian Intensification	Ci- Conversion intensification

	BUILT AREA	STRUCTURE	LAKES	GRASSLAND	RIVERS
Built area	265	2	-	-	2
Infrastructure	1	168	-	14	40
Lakes	-	-	-	-	3
Grassland	1	2	-	18	22
Rivers	1	92	-	18	2,583
Forest, shrubs	-	1	-	2	46
Permanent Grassland	19	16	-	1	47
Cropland	15	97	-	29	568
Permanent crops	1	1	-	-	-
Vineyards	-	1	-	-	0
SUM	302	380	-	83	3,310

	FOREST, SHRUBS	PERMANENT GRASSLAND	CROPLAND	PERMANENT CROPS	VINEYARDS	SUM
	-	-	16	0	-	211
	-	-	21	0	-	119
	0	-	2	-	-	18
	102	5	13	-	-	153
	17	1	1	-	-	21
	473	-	10	-	-	487
	2	81	576	-	-	713
	54	56	5,751	2	-	6,102
	-	-	50	-	-	75
	-	-	5	-	-	5
	648	143	6,445	2	-	7,904

Table 29: Răteşti land use change, comparison 1980 (rows) with 2003 (columns) (ha).

	Ce- Conversion extensification	Afforestation	Deforestation	Urbanization	Exception

	FOREST, SHRUBS	PERMANENT GRASSLAND	CROPLAND	PERMANENT CROPS	VINEYARDS	SUM
	-	24	10	-	-	304
	-	0	7	-	-	229
	19	-	7	-	-	28
	160	12	9	-	-	224
	26	10	44	-	-	2,774
	7,663	-	-	-	-	7,712
	18	314	512	-	-	926
	-	147	12,520	-	-	13,376
	-	8	3	-	-	12
	-	-	88	-	-	90
	7,887	514	13,200	-	-	25,677

Table 30: Stăncuţa land use change, comparison 1980 (rows) with 2003 (columns) (ha).

Curriculum vitae

Theo (Teunis) van der Sluis was born on the 13th of March 1963 in Heinenoord, Zuid-Holland. At a young age, from his parents, he acquired a love and appreciation of the landscape of the island of Hoeksewaard; the traditional 'grienden', the 'gorzen en slikken', the polders and Oudeland van Strijen (respectively: 'osiers', and 'mud flats and reed swamps').

He attended the MAVO at the Christelijke Scholengemeenschap in Oud-Beijerland, followed by HAVO at the RSG-Oud-Beijerland. He worked for half a year as quantity surveyor in West-Germany in the Eifel, then half a year of volunteer work at the Voorne's Duin nature reserve of the Dutch Society for the Preservation of Nature - Natuurmonumenten, which was very important for his further choice of study.
In 1982 he was admitted to the Hogere Bosbouw en Cultuurtechnische School in Velp, where he studied Nature Conservation and Landscape Management. His internship on ecological networks for amphibians was with the State Forestry Department in Tiel, followed by an internship on tourism management with Pembrokeshire Coast National Park in Wales. He interrupted his studies for one year to do research on the impact of grazing on vegetation in Northern Israel, for the Israel Nature and Parks Authorities NPA. In 1987 he got a double BSc degree, in Nature Conservation and Landscaping, as well as Tropical Forestry and Land Use, and his BSc thesis addressed the management of the population of Mountain Gazelles of the Golan Heights, Israel. Central throughout his work has been the landscape approach, which gives due consideration to different stakeholders, sectors and scales in a landscape, to adaptive and participatory management of change processes; and social learning and capacity building. After finalising his studies, he worked briefly for Dienst Beheer Landbouwgronden, but was then selected by SNV-Netherlands Development Organisation for a posting as Land Use Officer, and he moved with his family in April 1988 to Botswana. He worked for five years within the Ministry of Agriculture in Ngamiland District, on natural resources management studies, participatory land use planning and Community Based Natural Resources Management, around the Okavango Delta. The Xaixai ecotourism project with Bushmen, which was initiated as part of the land use plan he prepared for Western Remote Zone, remains operational to the present day.

After returning from Botswana in 1993 he was employed by the Institute for Forestry and Nature Research (IBN) as a research assistant. Initially working on ecohydrological conditions of brooks and marshlands, he later worked on amphibians and landscape connectivity. From 1999 onwards, IBN continued as Alterra and Theo became as researcher involved in European research, in particular spatial modelling and the development of ecological networks. His MSc in Environmental Sciences in 2002 concluded with the completion of a thesis on Ecosystem Services for the Portofino

regional park in Italy. In the years that followed he did many projects in different regions in Italy. Of the work he carried out in many countries, most notable was the field work in Portofino and the expeditions in the Pechora Basin and Ural mountains in Russia for which he coordinated the Dutch input. Next to his work, he organised as tour guide hiking tours for the Dutch Mountaineering Club NKBV, in Italy, Bulgaria, Botswana, Zimbabwe, Malawi and Zambia.

From 2005 to 2008 Theo was employed by SNV-Netherlands Development Organisation as Senior Advisor natural resources management in Ho, the Volta Region, Ghana. He did capacity building and training of staff of the National Parks department and NGOs. His main achievements were a tourism development plan for Kyabobo National Park, which has since been implemented, and the development of a stakeholders platform for conflict resolution and management support for Kalakpa Game Reserve.

In 2008 he returned to Alterra, and since then he has been mostly involved in projects in Eastern Europe, Ukraine and Russia. He was Long Term Expert in the EU Steppe project in Ukraine, Moldova and Russia, worked also on biomass from reedlands in Ukraine, carried out studies on the effectiveness of Natura 2000, was evaluator of the EU-LIFE program and was involved in various short missions and capacity building. He led a team in the development of an integrated land use plan for Chobe District, Botswana, and ecological network studies in Israel. In parallel to his work, in 2011 he began his PhD study on processes of landscape change in the framework of the VOLANTE project, which has resulted in this thesis.

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Acknowledgements

I began this research endeavour with the aim of gaining more insight into the processes of landscape change. What puzzled or perhaps dismayed me was the way that landscapes seemed to decline without people noticing it: every Dutch village now has its own industrial area, every kilometre of highway has its own roadside retail outlet or car showroom which effectively obliterates the previous landscape. My fascination with these issues may have started with my first internship, at the State Forestry Department, where the landscape architect of the A15 from Nijmegen to Rotterdam showed the detail of planning in the early seventies and the visual quality of the resulting landscape image. The past years have also seen this landscape change, with apparently no masterplan to provide a strategic approach.
Working in many projects and on scientific studies for IBN, later Alterra, also left some feelings of dissatisfaction. Regret about the lack of time to analyse or publish interesting data from biodiversity studies in the PRISM project in Russia, or the work on reserves in Ghana; however, over successive years the number of interesting projects increased. The opportunity to work in the VOLANTE project opened the door to a PhD study which would allow some welcome in-depth study of a field; it also required me to read articles and write publications. The years working on my thesis has been an inspiring period. It contributed greatly to my understanding of processes of landscape change.
It has allowed me to gain a better understanding of the linkages and complexity of the landscape as a 'complex system'. The composition of the thesis has taught me that landscape planning is complex, and to ensure that our landscape is valuable and enjoyable (yes, biodiverse, sustainable, liveable), the involvement of a balance of stakeholders that have an opinion on landscape, and can influence choices in landscape development is clearly urgently needed. Furthermore, everyone has an opinion on landscape, in some way.

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Colophon

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