Mapping, modelling and discussing rural development options

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Mapping, modelling and discussing rural development options

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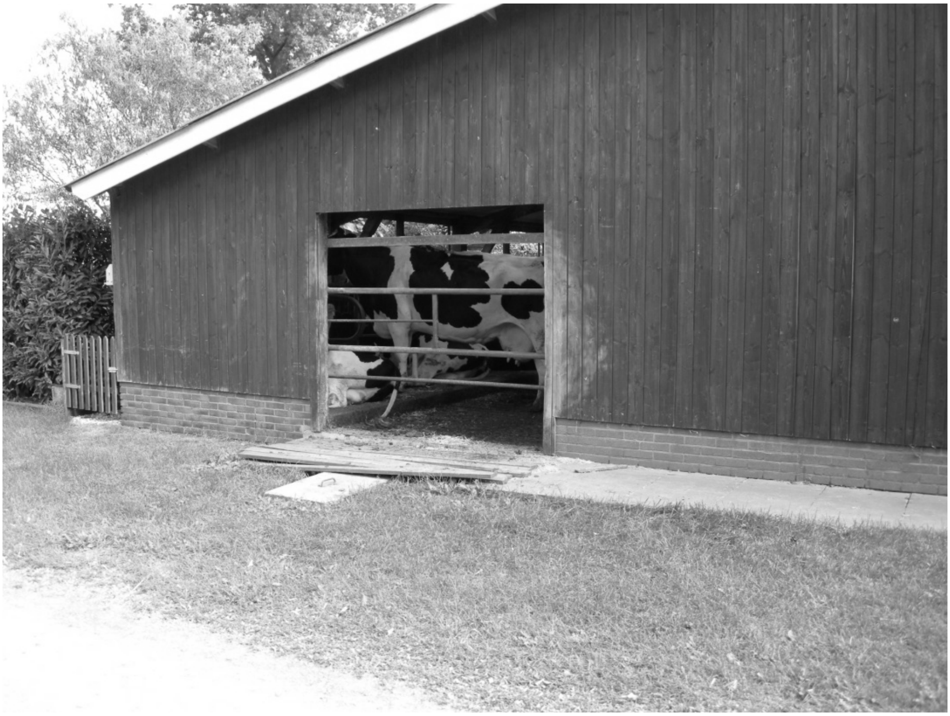
For my Mom and Dad

Contents

Chapter 1



"Rural importance is perhaps best reflected when considering the construction of an impenetrable wall around urban areas separating the two. Urban populations would soon face severe scarcity."

Anonymous stakeholder (RUFUS end meeting Brussels)

Introduction

1. Background

From early human communities to societies of today, people have relied on the surrounding countryside to provide the benefits and services that sustain them (Ramankutty & Foley, 1999; Antrop, 2005). The development of agriculture, forestry and the diversion of waterways has allowed for food and material production, and the ability to supply basic necessities like clean drinking water. Human activity has responded to spatial variability, with developments in locations where resources could be efficiently extracted based on suitable proximity and environmental conditions (Antrop, 2005; Christaller, 1964). The construction of roads and markets, the conversion of land cover and landscape management are just some of the strategies that allowed for efficiency in extracting resources from the land. These developments resulted in changing the function of rural areas over time (Ploeg et al. 2008). With population growth and increasingly complex and changing societal demands, governance was required to organise and allocate resources and to intervene when service delivery was inadequate (Brenner 2004). The variability and dynamics of the functioning of rural areas can be seen as co-evolution of ecological processes with complex human demands and organisational structure at various spatial scales as key drivers (Cash et al., 2006; Van der Ploeg et al., 2012).

Within the last 50 years, growing human populations have increased the pressure on rural areas for providing the benefits and services that sustain human societies (Foley et al., 2011). In addition, processes of globalisation and technological change have accelerated the ability to transform rural space through resource extraction and use (Voinov & Bousquet, 2010; MA, 2003; OECD, 2001). Rural areas have experienced a diversity of changes due to these exogenous processes, with large impacts in some regions and relatively little in others (Van der Ploeg et al., 2012; Terluin, 2003). In some rural regions this has resulted in loss of biodiversity, degradation of waterways due to eutrophication and the homogenisation of the landscape (Wade et al., 2008; Meeus et al., 1990). Changing societal demands for rural services have likewise caused challenges for rural areas and resulted in lower incomes and hardships associated with rural restructuring for some regions and opportunity for others. Depopulation, poverty, low public provision of public amenities and overdependence on subsidies have been some of the unwelcome socioeconomic consequences of these reconfigurations (Wilson, 2010; Ward & Brown, 2009).

Uncertainties about how rural developments will impact environmental and human systems and the need to solve challenges faced by rural areas have stimulated the study of rural development (Chambers, 1994; Scoones, 2009; Marsden, 1999; Van der Ploeg et al., 2000). Rural areas are distinguishable due to their relatively sparse populations and openness in comparison to urban areas (Terluin, 2003). Rural development research is concerned with understanding the drivers of rural change together with evaluating how such changes may improve, or be shaped to improve, the social and economic wellbeing of rural stakeholders and reinvigorate the regions themselves (Van der Ploeg et al., 2012; Wilson, 2010). In this dissertation rural development is addressed using mapping and modelling techniques, and discussion with stakeholders. Each offers specific advantages for understanding the complex issues that often arise in rural areas.

1.2 Rural development

The fundamental question of why one location develops in a certain way while another does not, has long been studied. The famous economist Johann Heinrich Von Thunen (1783-1850) developed one of the earliest spatial models of rural development applying his concentric ring theory to agricultural land use. Adam Smith (1723- 1790) and Karl Marx (1818–1888) were likewise concerned with disparity in social and economic development. The popularity of the study of rural development as a singular academic field began in the 1950 (Ellis & Biggs, 2001). This work focused on development issues and solutions to the poverty and structural problems faced by rural regions in post-colonial and 'less developed' countries (Scoones, 2009; Chambers, 1994). In the last decades studies have also addressed issues facing rural areas of developed countries. Beginning in the nineties, research has focused on the challenges of rural restructuring experienced in the countryside due to the waning importance of the agricultural sector in some regions and issues related to environmental degradation, and social sustainability (Ilbery, 1991; Lowe et al., 1993; Errington, 1994; Lowe & Ward, 1998). This was especially the case in Europe where these issues were acute and high on the public and policy agenda (Lowe et al., 2002).

Although throughout the history of rural development research a number of development models and paradigms have been formulated, recent scholarship has distanced itself from a single definition. Empirical evidence about the context specific nature of rural change and the identification of diverse socioeconomic and environmental processes that shape rural areas have demonstrated the futility in describing just one development model (Van der Ploeg et al., 2000; van Eupen et al., 2012). Added to this ambiguity is the subjectivity of 'improving' rural areas. Often there are environmental, social and economic trade-offs associated with rural changes (Piorr et al., 2009; Verburg et al., 2010). These can benefit different rural stakeholders differently based on their interests and values (Burton, 2004; O'Rourke, 2006). Rural developments like the removal of hedgerows or the construction of mega-barns to improve agricultural production for instance have become extremely divisive societal issues (Cairol et al., 2009). A farmer may gain economic benefit and society can benefit from increased food production, but other social and economic trade-offs are also the result. Shaping rural areas to be more attractive, appealing and relevant to societal needs increasingly requires addressing these trade-offs (Van der Ploeg et al., 2012).

A more holistic understanding of the development paradigm has been suggested as better way to solve these social, economic and environmental trade-offs associated with rural development. These approaches acknowledge the multifaceted, often interrelated, forces shaping rural areas while attempting to account for the diverse human demands that are placed on rural space (Potschin et al., 2010; Piorr et al., 2009). Essentially, rural development is conceptualised as the different ways that the countryside might be reconfigured to accommodate new consumption patterns, account for existing livelihood strategies and strengthen rural areas for resilience in the face of environmental pressures (Van der Ploeg et al., 2012; Wilson, 2010; Renting et al., 2009a). In this dissertation we examine development options viewing rural development as the processes by which humans alter rural areas based on goals and objectives and are likewise shaped by them due to environmental and socioeconomic processes and conditions. This accounts for the multiple interests, power relationships and complex forces shaping rural areas that result in different development pathways and their evaluation (Verburg et al., 2010).

1.2.1 Multifunctionality

The concept of Multifucntionality has been suggested as a holistic heuristic to assess the quality of rural development for community resilience. Multifunctionality has been studied from different disciplinary perspectives and there are numerous definitions. In this dissertation it is described as the supply of several goods and services at the same time in a given area (MA, 2003). In the context of rural development it has been both observed as a rural strategy and as a positive end point for which communities can achieve social, economic and environmental resilience in the face of outside pressure from variable market demand for their products (Figure 1.1). Wilson (2011) for instance conceptualises it as a post-productivist strategy for coping with the vicissitude of volatile food prices and a response to new societal demand for rural services. Multifunctionality is viewed as a development that both improves rural livelihoods through economic diversification and maintains critical levels of natural ecosystems (MA, 2003; Kinzig et al., 2011). Changes in the landscape and management of rural areas can alter the balance of social, environmental and economic systems (Figure 1.1). This is suggested to hinder the ability for multifunctionality and decrease the resilience of rural communities (Wilson, 2011). The European Union (EU) now employs a multifunctional strategy as part of their rural development policy (EC, 2005). This includes agri-environmental schemes, which are payments for ecosystem services that remunerate good management of rural areas as public goods.

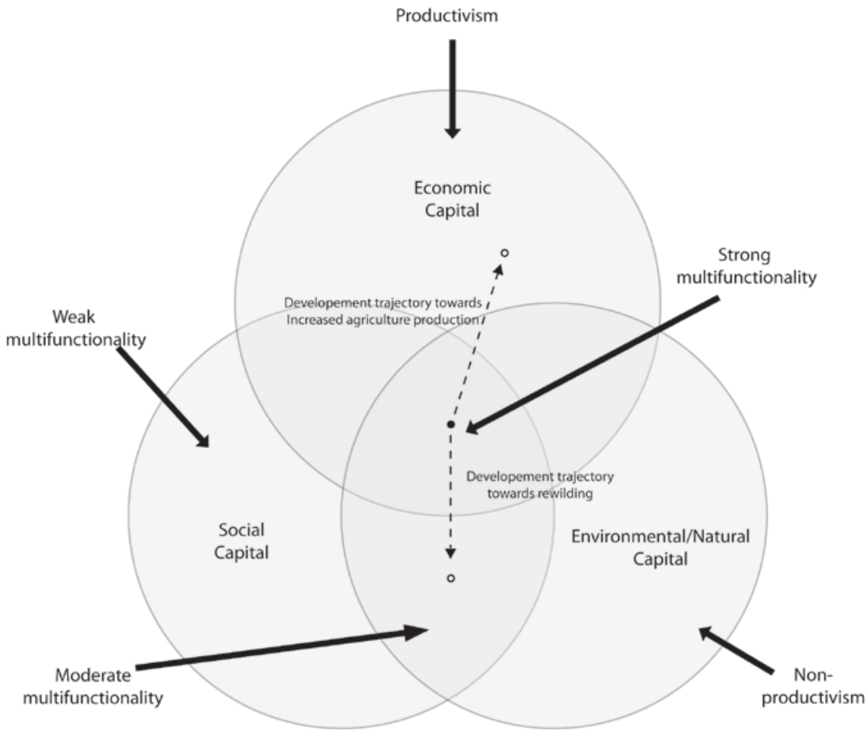


Figure 1.1. Multifunctionality and development – the intersection between regional capital. Source author; after Van Huylenbroek et al (2007) and Wilson (2010)

1.2.2 Driver of rural development

However, the capacity for development and the development of multifunctionality are not equal across rural regions. Differences in the biophysical make-up and structure determine rural functions. 'Function' is used here to denote some capacity or capability of the ecosystem to serve in ways that are potentially useful to people (Potschin & Haines-Young, 2011). A forest area is for instance useful for timber production and as a habitat for different species, but less practical for agriculture. The management and conversion of ecosystems alters functions and the flow of services and benefits obtained from the land (De Groot et al., 2002). The harvesting of that same forest together with know-how regarding agricultural production would increase the agricultural function while generating a flow of food service and local benefit through employment. Such human interventions and capacities determine the quality and quantity of the supply of the services and benefits delivered (Figure 1.2). This human related capacity is also variable across rural regions.

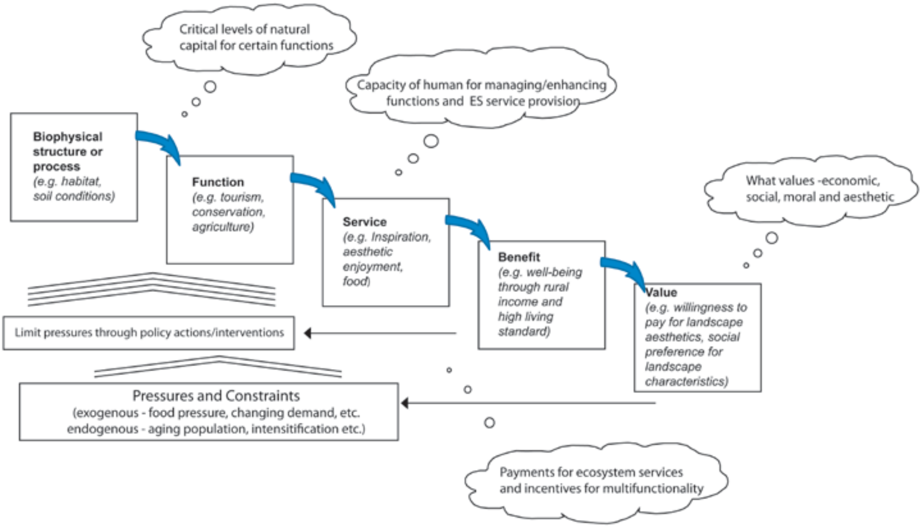


Figure 1.2. Ecosystem cascade as it relates to rural development

The question of why rural regions achieve multifunctionality has been examined from the perspective of both supply and demand (Van Huylenbroeck et al., 2007). From the supply side, multifunctionality has been examined regarding landscape configurations critical for its development (Willemen et al., 2008; Pfeifer et al., 2009), land managers' motivations for engaging in multifunctional activities (Jongeneel et al., 2008) and social and community level processes that are associated with its development (Wiggering et al., 2006; Knickel et al., 2004; Wiggering et al., 2006; Wilson, 2009). From the demand side, societal preference for high quality food production, environmental and landscape values, animal-friendly food production, and rural cultural heritage amenities have also been examined (Cairol et al., 2009). There has been limited integrated study of both these factors.

The concept of territorial capital is used in this dissertation to distinguish between rural regional potentials related to both human and environmental determinants. Territorial capital was first introduced by the OECD (2001) and later taken up by the European Union in their territorial agenda (Faludi, 2006). It has since received increasing attention in rural development and economic development literature (Wilson, 2010; Capello et al., 2008; Van der Ploeg et al., 2012). The term territory is used here in light of the increasing interest in the spatial aspects of sector policies and cohesion (Brenner, 2004). The term capital indicates the capacity of a territory to produce profit and to reproduce itself in expanded forms (Bourdieu, 1986). Put simply, territorial capital describes the total assets available in communities for converting natural capital into goods and services that are demanded by society either through market or public mechanisms. A number of different assets and constraints determine this ability to produce profit, including tangible factors like environmental, natural and financial capital, and less tangible factors like social, human and cultural capital (Bryden & Munro, 2000; Ray, 2002). A comprehensive illustration of the diverse capital is given in Table 1.1. Combinations of different favourable factors give different comparative advantages for the development of certain functions (Marsden, 1999). Such assets are also variable depending on the scale of examination. Every stakeholder, local community and national population, as well as plot, landscape, region or country shows variability in factors that contribute to functions (Biggs et al., 2007; Cash et al., 2006).

Table 1.1. Territorial capital related to rural development (after Capello et al. 2008; Wilson 2010)

Human and Social capital	Environmental and Natural capital	Economic capital
• Education, knowledge and skills, labour, capacity to adapt (open-mindedness); • Networks and connections, relations of trust and mutual understanding and support, shared values and behaviors, common rules and sanctions; • Collective representation, mechanisms for participation in decision-making, leadership; • Close interaction between rural people (tight-knit communities); • Female empowerment/ empowerment of ethnic minorities in rural areas; • Rural stakeholders in control of development trajectories; • Strong governance structures at multiple geographical scales (democratic participation) • Entrepreneurial spirit • Happiness	• Land and produce, water and aquatic resources, forests, aesthetically pleasing landscape, foods and fibers; • Biodiversity/wild life; • Environmental services • Infrastructure (transport, roads, vehicles, secure shelter and buildings, water supply and sanitation, energy, communications); • Tools and technology (equipment for production, seed, fertilizer, pesticides, traditional technology; • High levels of biodiversity; • Good water quality and availability • Sustainable soil management • Predictable agricultural yields.	• Global economic integration level; • Economies of scale; • Diversified income streams (e.g. pluriactivity); • Financial savings, credit and debt (formal, informal), remittances, pensions, wages; • Economic well-being; • Low dependency on external funds; • Multifunctional businesses • Good and transparent land ownership regulations (control over means of production); • Symbolic capital.

These assets are also constantly changing. Different exogenous and endogenous processes alter and modify landscapes' changing capacities for development. Policy interventions change development trajectories through investments in infrastructure, subsidies for certain management practices and environmental regulation. Globalisation, integration of food markets and technology innovation likewise drive rural change with the price production squeeze requiring greater farming efficiency (Verburg et al., 2006; Lambin et al., 2001). Actions at the local scale are not only the consequence of larger-scale processes

(Kathrin et al., 2011; Valbuena et al., 2010). The aging of rural population, changes in farm level management and out-migration of young people all alter rural characteristics over time. One such process can be seen with in-migration of urban residents in rural areas for hobbyfarming, retirement and residencies (Shucksmith & Herrmann, 2002; Kristensen, 2003). Such 'new' residents shape rural areas in highly different ways in comparison to agriculturalists.

1.3 Methodological approaches in rural development research

The study of these rural development processes has been approached from different perspectives each with their own empirical methods and techniques including geography (Christaller, 1964; Wilson, 2009), political science (Brenner, 2004), land use/change science (Verburg et al., 2008), economics (Rizov, 2005; Terluin, 2003) ecology (Van der Ploeg & Vlijm, 1978) and most prolifically from sociology (Van der Ploeg et al., 2000; Lowe et al., 1993; Potter & Burney, 2002). Four main categories of rural development studies can be identified: 1) the definition of normative development strategies for sustainable development (Renting et al., 2009b; Wilson, 2010; Wiggering et al., 2006); 2) the observation of rural development and potential through monitoring of multiscale processes of social, economic and environmental change (Van der Ploeg et al., 2012; van Eupen et al., 2012), often combined with stakeholder assessments (Scoones, 2009; Chambers, 1994); 3) foresight and vision analysis through the modelling of rural dynamics with computer models based on the understanding of the drivers and processes involved in land use change (Verburg & Overmars, 2009; Kathrin et al., 2011; Wissen et al., 2008); and 4) development planning which integrates this information in different media to enable management and decision support (Wissen et al., 2008; Dockerty et al., 2006b; Pettit et al., 2011).

This diversity in rural research underlies the different processes and drivers of change at work in rural areas, as well as the different research questions and stakeholders addressed. Research originating from the social science tradition has mostly examined human behavior and decision making at community or individual scale (Burton, 2004; Halfacree, 2007; Elands & Praestholm, 2008). At a more aggregated level, geographers and ecologists have studied rural development change through empirical observations (Van der Ploeg et al., 2012) or using remote sensing and GIS (Verburg & Overmars, 2009). These disciplinary approaches cover parts of the complex systems that result in rural functions. For this reason, many have called for a more multidisciplinary approach to rural development that integrates these perspectives (Potschin et al., 2010). Such methods strive to account for diverse human interactions with the rural environment as we manage land use, convert land cover and organize our resources. These also account for competing interests and perspectives by integrating both human and environmental assessment (Potschin et al., 2010; Lambin et al., 2001). In this dissertation several qualitative and quantitative techniques for understanding these factors of rural dynamics are used.

1.4 Mapping and quantification

While a number of studies have demonstrated that rural development potentials are unequally distributed, there are few spatial characterizations that explicitly address this variability (Van der Ploeg et al., 2012). Traditional mapping approaches examining rural development have focused on trajectories of development through representing economic and social indicators. National scale and regional monitoring of GDP, population growth, migration and education levels have been used for analysis of the socio-economic composition of regions (ESPON, 2006). Still, few studies have examined the potential for development due to disciplinary reluctance (Woods, 2011) and difficulty with linking supply and demand for rural services (Nedkov & Burkhard, 2011; Grêt-Regamey et al., 2010).

Studies mapping and quantifying ecosystem services have made progress in identifying and analysing landscape characteristics that have the potential to be useful to people (Kienast et al., 2009; Willemen et al., 2008). A common approach to mapping these potentials is the definition of generic rules that can be applied to mappable proxies for indicating certain functions. These can be based on expert determinations (Kienast et al., 2009; Norton et al., 2012) or statistical analysis (Willemen et al., 2008). Direct monitoring of actual service delivery has also been employed where actual delivery is observed, for example with soil depth evaluation to localise nutrient content levels (Naidoo & Ricketts, 2006; Egoh et al., 2008). The examination of preferences and values for ecosystem service, either through social or monetary valuation, has indicated aspects of demand and therefore potential for services delivery (Chary-Bernard & Rambonilaza, 2012). Economic valuation uses various methods for estimating the monetary value of services (Cavailhès et al., 2009; Ma & Swinton, 2011), while preference studies link societal demand to location-specific characteristics (Alessa et al., 2008; Brown, 2006; Bryan et al., 2010). Both supply and demand studies have added important understanding about our dependence on ecosystems. However, there has been limited investigation of the human capacities associated with the actual quality and quantity of service delivery. Furthermore, there has been only limited investigation and quantification of cultural services which are often interrelated with rural development in the tourist sector. Assessments have likewise not been conducted at different spatial scales to understand potentials between and within regions.

Mapping rural functions has many policy and management benefits. Identifying location-specific potentials can help in pinpointing interventions that address specific capacities or deficiencies. Spatial planning can also be aided by such specification. Rural areas can be managed to minimize the negative effects of environmental degradation and promotion of multifunctionality through the targeting of management subsidies (i.e. payments for ecosystem service)(Verburg et al., 2010). The identification of locations that are valued by society can similarly help in understanding important priority locations for conservation.

1.5 Assessment of future development

The need to anticipate future trends is likewise vitally useful for the management of rural areas. The dynamic caused by different policy interventions, exogenous processes and local management makes rural development difficult to predict. In combination with computer simulations scenarios can be powerful tools for understanding future change (Alcamo, 2008). Such techniques have been scarcely used for understanding rural development (Woods, 2011). The reason for this absence is primarily due to reluctance in making prediction in the face of uncertainties regarding the non-linear events that usually shape the future (Messina et al., 2008).

Scenarios can be defined as descriptions of possible futures that reflect different perspectives on past, present and future developments (Van Notten et al., 2003). Scenarios essentially give plausible descriptions of how the future might unfold in key areas including socioeconomic, technological and environmental conditions (Moss et al., 2010). The goal of working with scenarios is not to predict the future but to frame uncertainties in ways that can help in decision support and deliberation that are robust in the face of a range of possible futures. The high applicability to strategic thinking has meant that scenarios have been used in a growing number of policy relevant studies (Alcamo, 2008; Tzanopoulos et al., 2011; Groot et al., 2010; Dockerty et al., 2006). Participatory scenario formulation is also used for engaging and thinking creatively about future changes (Xiang & Clarke, 2003; Van Notten et al., 2003; Volkery et al., 2008). Such exercises can be effective for formulating strategies for achieving or avoiding certain development (Carlsson-Kanyama et al., 2008; Kok et al., 2011; Quist et al., 2011) and helping stakeholders step out of traditional ways of thinking (Soliva et al. 2010).

Spatially explicit models can be used to systematize multiple processes, understanding broader emergent processes of the total system (Messina et al. 2008). The interaction of different processes is often a challenge to comprehend. The mimicking and simulation of real world processes can therefore offer simplified insights, which are easier to understand. Different model simulations have been developments that are suited to addressing different scale processes and research questions (Valbuena et al., 2010; Kathrin et al., 2011; Verburg & Overmars, 2009; Mensonides et al., 2008). Cellular models are based on optimisation of economic, biophysical or societal suitability factors determining land change. Each cell is allocated a different use, constrained by the conditions specified in predefined scenarios of future land use (Verburg & Overmars, 2007). This is often criticised as overly deterministic due to the lack of representing the diversity of different actors and decision making strategies. Agent-based models (ABM) simulate both agents and their environment. This allows for interaction between these domains that mimics real world spatial feedbacks (Matthews et al., 2007). ABM also can represent different decision making actors to simulate the actual variability of different interest and values that result in different managements styles. The challenge with agent-based models is uncertainties related to the parameterisation of agents. Decisions that different actors make are inherently unpredictable and therefore social processes exhibit nonlinearity, which is difficult to model.

The visualisation of change made possible by spatial model simulations helps decision makers and stakeholders understand the spatial implication of their policy interventions and socio-economic changes that might be dominant in the future (Valbuena et al., 2010; Kathrin et al., 2011; Verburg & Overmars, 2009); as well as, processes such as climate change projections (Wigley & Raper, 1992). Scenarios likewise help in comparing different alternatives with their rich textual descriptions (Sheppard, 2005). While their applicability for decision support is often cited, models and scenario exercises are rarely used for supporting stakeholder deliberations about rural development.

1.6 Stakeholder participation

Stakeholder participation has increasingly become synonymous with many management-oriented areas of science. Today, few environmental assessments or modelling efforts can be presented without integrating stakeholder involvement in the process. Stakeholder consultation is an important aspect of understanding rural development as local processes are often driven by local decisions. Stakeholders are defined as those actors who are directly or indirectly affected by an issue, and who could affect the outcome of a decision making process regarding that issue, or are affected by it (World Bank, 1996). Integration of stakeholder consultation in workshops, through interviews or in questionnaires, can give valuable insight about context-specific drivers, assets and constraints of development. For this reason stakeholder consultation can also be helpful for model and scenario parameterisation (Voinov & Bousquet, 2010). While stakeholder participation in development planning and exploration of rural concerns is widely used in scientific research (Soliva et al., 2010; Tzanopoulos et al., 2011; Lindborg et al., 2009), the spatial and temporal dynamics of these issues are often thinly explored with stakeholders.

The need to integrate stakeholders in development planning is recognised in both scientific and policy domains (World Bank, 1996; Petheram et al., 2012; Zoppi & Lai, 2011; Kok et al., 2011). However, meaningful integration of stakeholders is often challenging due to stakeholder apathy, which can cause low participation rates. Considering the values and interests of the stakeholders involved (legitimacy), investigating issues relevant to them and society (saliency) and offering plausible information (credibility) is often seen as a way to combat apathy and create stakeholder buy-in (Cash et al., 2006; Xiang & Clarke, 2003; Sheppard, 2005). A key factor for this legitimacy, saliency and credibility is effective communication with different stakeholders. Model simulations, maps and visualisation have recently been investigated for aiding in such broad targeting of different stakeholders (Dockerty et al., 2006a; Tress et al., 2005; Soliva et al., 2008). The novelty of such tools can increase participation due to stakeholder curiosity. There is also increasing evidence that these tools create cognitive engagement due to the realism and tangibility of representation (Vervoort et al., 2010; Dockerty et al., 2006a). In addition, such tools can convey complex ideas about spatial and temporal dynamics and exogenous and endogenous processes that may be unknown to stakeholders for meaningful discussions (Shaw et al., 2009; Meitner et al., 2005).

1.7 Content of thesis

1.7.1 Objectives

Effective management of rural areas is essential to ensure continued societal and community level benefits from the development occurring in rural areas. Existing knowledge about the processes that lead to rural change over time has not been equally complemented by information about the distribution and dynamics of rural functioning to support this management (Van der Ploeg et al., 2012). Providing information about the drivers and determinants that shape these developments can aid in understanding where developments can occur and can help in anticipating how landscape functions might change in the future. Gaining foresight about problematic trajectories by unravelling how dynamics will affect rural development capacity in the future is important for informing current development decisions (Potschin et al., 2010; Wilson, 2010). Determining the location of local assets and constraints can help in targeting intervention and strategies towards specific locations that can be valorised or benefit from subsidies or regulations. This dissertation investigates methodological tools that address these practical development needs. The objectives of this dissertation are twofold. First, the goal is to analyse and quantify spatial aspects of rural development potentials; and second, to add insight into methods that represent the spatial variability and dynamics of rural change for stakeholder decision-support regarding rural development. To address these aims, four questions are formulated:

1. How can rural assets related to different development options be identified and mapped?
2. What landscape characteristics determine the value of the landscape in providing cultural services?
3. How can spatial and temporal representations frame stakeholder dialogues to include understanding of the variability and dynamics of rural development potentials?
4. What tools can help in eliciting context-specific understanding of development options in terms of temporal dynamics and spatial variability?

1.7.2 Outline

The following 4 chapters answer these research questions. Figure 1.3 presents the structure and sequencing of this thesis. In *Chapter 2* a methodological framework is presented to identify development potential at the continental scale. Territorial capital related to intensive agriculture, tourism, off-farm employment and conservation is determined through expert consultation. These responses are converted into mappable proxies of both human and environmental characteristics and each layer is summed to give an indication of potentials in these sectors. Individual rural functions are then combined to give a picture of the locations where multiple functions are possible.

Subsequent chapters explore the local determinants of development that are not visible at the continental scale of examination. *Chapter 3* uses a number of qualitative techniques including interviews and stakeholder workshops to ascertain the assets and constraints for different rural developments in the Portuguese parish of Castro Laboreiro. Storyline descriptions of possible rural developments are constructed based on interview responses and presented to stakeholders in a workshop discussing spatial and temporal dynamics of rural developments. Photo-realistic montages depicting the expected landscape changes are used to complement storylines.

In chapter 4 and 5 separate studies are conducted using the same case study location of Winterswijk. C*hapter 4* presents the findings of a study using an agent-based model (ABM) to help stakeholders consider, discuss and incorporate spatial and temporal factors driving development in their region. A backcasting exercise is used to formulate local interventions that address these processes and achieve regional development goals. Region-specific scenarios are constructed based on interviews with local experts. The scenarios are simulated in an ABM incorporating rural residents and farmer characteristics, the environment and different policy interventions for realistic projections of landscape evolution. Results of the model simulations are presented to stakeholders representing different rural sectors at a workshop. Stakeholder suggestions for development interventions based on the backcasting exercise are incorporated into the model to evaluate their effectiveness.

Chapter 5 demonstrates a method to map and quantify the cultural services of a rural region. Many studies quantifying ecosystem service limit their investigation of cultural services to mapping tourist potential. In rural areas intrinsic factors such as cultural heritage, inspiration and spirituality are important services that these landscapes provide. In the study we survey visitors to a Dutch rural area that is well known for its cultural landscape. Both a social and economic estimation is made of the value of the cultural service provided by the agricultural landscape. These are mapped to indicate important locations where the strucuture and composition of the landscape is valued.

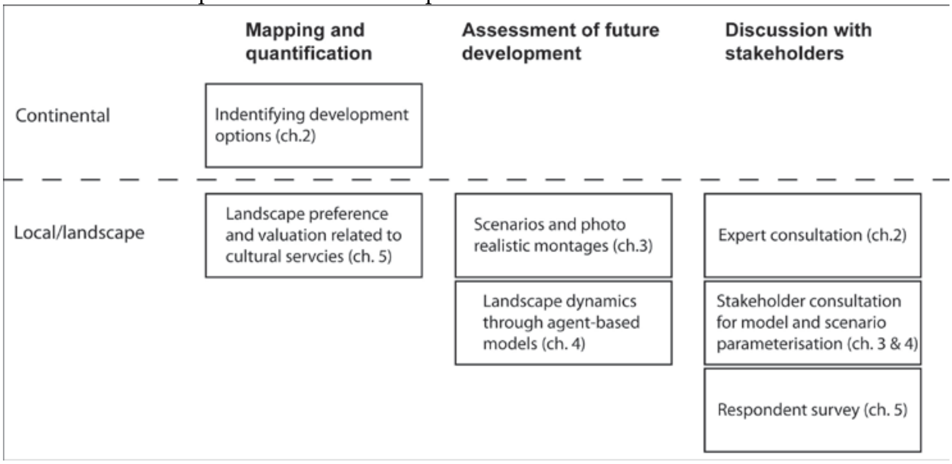


Figure 1.3 Outline of this dissertation

1.7.3 Study area

The multi-scale approach is applied to the European Union (EU) and in two case studies that typify issues of restructuring occurring in the EU (Figure 1.4). Rural regions in the EU have experienced a diversity of changes driven by multiple interrelated socio-economic, policy and environmental processes (Van der Ploeg et al., 2012). Decreasing subsidies for farmers and world food price have each contributed to restructuring in the agricultural sector in many regions. Both mountainous and areas of Southern Europe have experienced agricultural abandonment and rewilding of traditional landscapes as a result of these processes. As agricultural incomes decrease through the price production squeeze traditional production systems are no longer efficient for agricultural production (MacDonald et al., 2000; FAO, 2006; Bielsa et al., 2005). In other strategically placed locations, agricultural production has intensified with green houses, monocropping and mega-barns (Neumann et al., 2009; Wade, et al. 2008). Some of these changes have caused significant alteration to traditional rural landscapes. In France and the Netherlands, traditional *Bocage* landscape characterised by interlinking tree lines and hedgerows have been removed to facilitate the movement of agricultural machinery and increase production (Meeus, 1993). In Portugal, Spain, Italy and Greece a number of traditional landscapes are also being altered including Dehesa and Huerta due to discontinuation of traditional management practices (Zimmermann, 2006). In areas with suitable growing conditions, mono-cultivation of olives and grapes has likewise transformed the landscape. These changes have been linked to less biodiversity and loss of cultural diversity (Zimmermann, 2006; Wade et al., 2008). Growing urbanisation through expansion of manufacturing and residential infill (Antrop, 2004), as well as increased urban linkages through commuting and cottage industries have similarly altered rural areas, blurring the line between urban and rural (Brenner, 2004; Terluin, 2003). Tourism, recreation, hobby farming, horsiculture and hunting have become fixtures of rural areas driven by extralocal, often urban, demand (Cairol et al., 2009; Van der Ploeg et al., 2012).

Figure 1.4. Land use/cover map of the European Union and the location of case study areas. Source: National Geographic

Such developments have had major consequences for the rural areas in the EU and the functions that they provide. At local scale there have been economic winners and losers with some regions able to harnesses their local resources for financial gain and others less successful (Terluin, 2003). 'Loser' regions have faced depopulation, decrease in public service provision and declining infrastructure. The social cost has been poverty, income disparity and overdependence on subsidies (Ward & Brown, 2009; Wilson, 2010). 'Winner' regions have experienced development challenges related to overuse and management of resources including desertification, salinization, poor water availability and uncertainty of agricultural yield (Wade et al., 2008; Meeus et al., 1990; Wilson, 2010). At the societal level, issues facing rural areas are also high on the agenda. Concerns regarding the preservation of cultural heritage of rural areas, issues related to animal welfare, health and safety considerations (pesticides) and the retention of a rural identity have been raised (FAO, 2006). There is also frustration regarding the societal burden of subsidizing rural areas (i.e. land managers, farmers) for services that are not valued or viewed as undelivered. The role that policy plays in this has also be critiqued while opportunities are seen for incentivising better land stewardship (Marsden & Sonnino, 2008).

The two case studies each represent common processes occurring in rural areas of the EU (Van der Ploeg et al., 2012). Castro Laboreiro is a marginal mountainous rural area experiencing depopulation and agricultural abandonment due to an ageing farm population and poor production potential. The main activities in the region include small subsistence farming, a limited tourist industry and a number of rural residencies. Greater tourism potentials do exist due the region's status as a national park, cultural heritage that includes unique agricultural management that defines the landscape and a number of tourist attractions (e.g., white water kayaking, traditional Portuguese architecture and Celtic burial grounds). Winterswijk is a rural community located in the Achterhoek region of Netherlands and can be described as marginal in Dutch terms due to the relatively hilly relief and remoteness in comparison to other regions. Milk and fodder production is the main agricultural activity, while the main town serves as a regional centre. There is also substantial tourism with 300,000 camping and bed and breakfast visitors estimated annually. The unique *Bocage* landscape and numerous bike paths are an attraction for tourism. However, these same landscape features limit agricultural production due to tree shadows and are a hindrance to the movement of modern farm machinery. Farmers wishing to increase production sometimes choose to remove hedgerows and tree lines to improve production. Both cases are examples of multifunctional potential that faces pressures that threaten multiple service provision (Figure 1.1).

Chapter 2

"Development is also about ' intangibles' like image. Look at how many people go to Nottingham forest because of the legend of Robin Hood"

Anonymous stakeholder (RUFUS meeting Amsterdam)

Sensitising rural policy: Assessing spatial variation in rural development options for Europe

Regional distinctiveness is supported by the European Union in rural development policy. However, there is little information about the spatial distribution of the potential for rural development across Europe. The concept of territorial capital is used to consider spatial characteristics in assessing the capacity for rural development. Expert-based descriptions of territorial capital are translated into mappable proxies to locate regions with development capacities in intensive agriculture, off-farm employment, rural tourism and conservation. Combining these potentials, the capacity for multiple functions within regions is assessed. A partial validation of the expert-based weighing of territorial capital is done by comparison with an empirical approach based on logistic regression. The results indicate strong variation between regions in rural development potentials. In Western Europe, regions with high rural tourism probability also share a high potential for conservation while opportunities for intensive agriculture and off-farm employment are generally low. In other parts of Europe these correlations are less pronounced. Several regions offer limited potential in all four considered functions while few regions have potential in all four functions. The assessment provides policymakers with assistance in identifying competitive rural development projects. Targeting rural development policies to high potential areas may increase policy efficiency.

Based on Van Berkel, D.B. & Verburg, P.H., 2011. Land Use Policy Volume 28, Issue 3, July 2011, Pages 447–459

2.1 Introduction

Increasing global competition in food markets, technological innovation, growing urban influence and reorientation of the Common Agriculture Policy (CAP) are drivers of changing European rural landscapes (Antrop, 2005; Lowe et al., 2002, MacDonald et al., 2000; Terluin, 2003). Significant policy challenges related to these changes are land abandonment and depopulation (FAO, 2006; MacDonald et al., 2000; Pinto-Correia & Breman, 2008), intensification of agricultural production in environmentally favourable areas (Vos & Meekes, 1999) and urban expansion at the expense of rural land (Brenner, 2004; Bryden & Bollman, 2000). These changes have been linked to environmental degradation, a loss of aesthetically pleasing landscapes and altered rural character (Meeus et al., 1990; Zimmermann, 2006). The diversity of local endogenous conditions across the European territory, including natural resources, rural amenities and human and social capital, has also resulted in a diversity of economic fortunes (Bryden & Bollman, 2000; Marsden, 1999).

The challenges of land abandonment and rural depopulation are proposed to be managed through a more competitive rural development policy as formulated in the European Agricultural Fund for Rural Development (EAFRD). These CAP reforms progressively decouple subsidies away from agricultural production levels towards land stewardship incentives (Lowe et al., 2002). The environmental and land management incentives are believed to promote new rural functionality through diversification of rural areas (EAFRD, 2005). Yet, with the exception of a few rural development programmes that are targeted to specific local needs (LEADER, LFA), rural subsidies (single farm payment) and land management incentives (Agri-environmental schemes) are applied uniformly throughout the EU territory (Von Haaren & Bills, 2010). This uniform application does not consider the diversity of rural development trajectories and endogenous conditions of rural Europe which require different policy interventions (Verburg et al., 2010). The lack of spatial specificity is one factor related to the ineffectiveness of rural development projects (Marsden, 1999; Ray, 2002).

Debates about how best to achieve rural development have concluded that diversification or multifunctionality is a sustainable option (Marsden & Sonnino, 2008). Multifunctionality can be described as the provision of a number of goods and services in one location (MEA, 2003). Multifunctionality, in relation to rural development, has most significantly been examined for the agricultural sector and related to the well-being of agriculturists (Knickel & Renting, 2000; Van der Ploeg et al., 2000). This literature, however, does not consider the specific spatial heterogeneity of local assets that determine the possibility for multifunctional development. Characteristics like economic structure and activity, peripherality, demographic and social composition all contribute to such differentiated capacities and are highly spatially variable (Jongeneel et al., 2008; Marsden, 1999; Ray, 2002; Wilson, 2009). The objective of this paper is to make an assessment of the capacity for the development of a number of rural options throughout Europe given the spatial variation of environmental and socio-economic characteristics. The assessment should assist policymakers to promote management options for different rural activities tailored to territorially distinct competitiveness. The identification of spatially diverse potentials for rural development will enable the targeting of policy interventions and incentives to actual rural capacities or needs.

A number of earlier studies have added to the understanding of spatially differentiated capacities through mapping the provision of ecosystem services (Egoh et al., 2008 & Nelson et al., 2009) and landscape functions (Kienast et al., 2009 & Willemen et al., 2010). However, none have taken the rural development perspective. Kienast et al., (2009) mapped the capacity of the landscape to provide a number of different goods and services at the EU scale using land cover data. The study employed an expert-based approach for classifying different spatial features as either positive or neutral for ecosystem service delivery. Differently to the Kienast study, we focus on rural development potentials instead of the actual delivery of specific ecosystem services. We also use a higher spatial resolution (1 km^2 grid rather than the NUTS-X administrative level) for the assessment to capture relevant spatial nuance important for rural development. Other studies (Egoh et al., 2008, Nelson et al., 2009; Willemen et al., 2010) have focussed on relatively small regions for which detailed data were available assisting in the mapping process.

In the assessment presented in this paper we account for regional assets of different developments options. This is similarly addressed as 'capital' in rural development literature (Coleman, 1990, Fukuyama et al., 2001; Putnam, 1995). We specifically use the concept of territorial capital, which was first introduced by the OECD (2001) and later taken up by the European Union in their territorial agenda (Faludi, 2006). The term territory is used here in light of the increasing interest in the spatial aspects of sector policies and territorial cohesion (Brenner, 2004). The term capital indicates the capacity of a territory to produce profit and to reproduce itself in expanded forms (Bourdieu, 1986). A number of different assets and constraints determine this ability to produce profit, including tangible factors like environmental, natural and financial capital, and less tangible factors like social, human and cultural capital (Bryden & Bollman, 2000).

The following sections present the overall method used to identify the determinants of rural development options in the EU. In the results section the identified factors are translated into maps to visualise the spatial variation in development options across the EU. In the discussion the approach and its policy relevance are evaluated.

2.2 Methodology

2.2.1 Selection of development options

In this paper the capacity for the development of intensive agriculture, off-farm employment, rural tourism, nature conservation and multiple functions is assessed. These development options are selected based on their fit with EU policy objectives and have been identified in scenarios related to future societal needs and demands (MEA, 2003, Vos & Meekes, 1999; Westhoek et al., 2006). Agricultural intensification is included as global integration of food markets has increased competition for producers making the prices of local inputs increasingly important, while global demand for agriculture products continues to increase (Vos & Meekes, 1999). Off-farm employment is considered in the assessment given the decline of agricultural livelihoods in many regions (Terluin, 2003). The growth of rural manufacturing and industry has created job opportunities in rural areas, which indicates an option for rural vitality (Bryden & Bollman, 2000). Rural tourism is selected given the demand for leisure and recreation activities from urban populations (Bryden & Bollman, 2000; Vos & Meekes, 1999). Rural regions with aesthetic beauty, cultural amenities and 'competitive conditions' can possibly develop tourism for increased rural employment.

Nature conservation is chosen given environmental concerns and current under-competitiveness of some areas. By allowing some regions to re-wild, the provision of habitat and regulation of broader societal benefits (e.g., water purification, gas exchange) may be enhanced (Vos & Meekes, 1999). Multifunctionality is assessed given the fact that diversification enjoys wide academic and policy support as a development option that can sustain rural areas (Marsden & Sonnino, 2008; Van der Ploeg et al., 2000; Wiggering et al., 2006).

2.2.2 Workshop

The literature on rural development does not provide a general list of development assets and constraints with the exception of a few studies (Ilbery, 1991; Jongeneel et al., 2008; Lobley & Potter, 2004; Wilson et al., 2001). Therefore it was decided to collect data at an expert workshop regarding the assets and constraints of the different development options examined. Expert workshops are widely used in modelling exercises when different contextual knowledge must be synthesised for greater system understanding (Kok et al., 2006; Rotmans et al., 2000; Shearer, 2005; Soliva et al., 2008; Xiang & Clarke, 2003).

Twelve experts representing a number of European countries were invited to a 1 day workshop. This included scientists, policy advisors and policymakers all working in rural development and rural typology domains. The workshop addressed the different determinants of the development options individually through an interactive discussion. This resulted in a list of assets and constraints for each option. There was relatively wide agreement between participants that the list of development assets and constraint gathered had captured the relevant development capital. After the workshop, initial maps were developed with each territorial capital weighted as per author criteria (as described in more detail in Section *Workshop results*). These maps were presented to different regional experts in project workshops and by mail. In this phase of evaluation, some disagreement was encountered pertaining to spatial configuration of produced development capacities, weighting and factors used for the assessment. Workable feedback was applied to new weights and in some cases new factors where added. This consultation was conducted on three occasions with a number of regional experts.

2.2.3 Data collection

The assets and constraints mentioned during the workshop were categorised according to territorial capital and translated into spatial characteristics that could be mapped. Most factors could be approximated by spatial characteristics. Some factors had to be discarded due to an absence of representative spatial proxies. Collected data included administrative boundaries, land use/cover and biophysical maps and socio-economic proxies (Table 2.1). All data were converted into the same projection and format. A 1 km^2 pixel was chosen as a resolution capable of representing the variation of territorial capital throughout Europe. Continuous, nominal and categorical data were used. Location data like UNESCO sites, campsites and beaches were mapped as nominal dummy variables. Data like potential productivity, travel time calculations and evapotranspiration were mapped as continuous variables.

Table 2.1. Description of independent variables used as proxies for territorial capital.

Variable	Description	Spatial resolution/year	Source
Protective designation of origin (PDO)	Protection for specific regional speciality goods (e.g. Feta cheese limited to production in Greece)	1 km2; Estimations of boundaries of PDO based on the DOOR documentation; often unable to pinpoint exact location (buffer used). Data derived 2008	EC (2009a)
Endangered mammal and plant ranges	Plants and Animals at risk or concern (yellow or red) in categories of future prospects and overall assessment. The database includes range, population and habitat assessments for each species	1 km2. Missing data for the countries of Romania and Bulgaria. Suspected low categorisation of species at risk/concern for the countries of the UK and Spain. Data derived from multiple year studies	EEA (2009)
Irrigation infrastructure	The areas equipped for irrigation of 22 crop varieties	5 arc-minutes resolution downscaled to 1 km2; around the year 2000	Portmann et al., (2009)
Forest density	The percentage of forest per 1 km2 area as derived from NOAA-AVHRR data.	1 km2; around 2000	Schuck et al., (2002)
Protected regions	The protected areas of Europe including UNESCO sites and national protection areas (IUNC)	1 km2 shapefile conversion; 2009	WDPA (2009)
Corine landuse/cover	Land use/cover for the European Union as derived by the Corine project	25 m2 resampled to 1 km2; around 2000	EEA (2005)
High nature value farmland	Areas where farming practices are associated with high biodiversity. Continuous variable indicating the fraction of HNV farmland strength of the nature value	1 km2; around 2000	Paracchini et al., (2008)
Natura2000 sites	The 2000Natura network-designated areas for the protection of birds and habitat combining Special Protection Areas (SPAs) and Special Areas of Conservation (SACs)	Shapefile conversion to 1 km2; published 2009	EC (2009b)
Arable agricultural production potentials	Potential for production of the crops wheat, spring barley, grain maize, rape seed, sunflowers, potatoes, sugar beets and field beans based upon soil parameters, weather information and crop factors (as modelled in the MARS project)	1 km2; data obtained for 2007	Goot et al., (2004)
Grassland production potentials	Grassland production calculated by IMAGE and modified by soil suitability information from MARS	1 km2; combination of different resolution data	Goot et al., (2004)

	database		
Travel time to urban locations	Average of all time/cost for urban centres >100,000, >500,000, >650,000, major airports of Europe and Ports (harbours) >150 ton/year	1 km2; the data is calculated from population and road infrastructure data for 2000	Verburg et al., (2010)
Nitrate vulnerable zones	Country derived Nitrate vulnerable zones	1 km2; around 2006	EEA (2003)
Leader sites (LAG local action groups)	The location of LEADER I, II and +sites for Europe	Shapefile conversion to 1 km2; all years	EC (2006b) and Eurostat (1999)
Camping sites	An approximation of the location of camping sites for a majority of Europe	Point conversions to 1 km2; partial coverage suspected; 2008	ASCI (2009)
Ski resorts	A sample of ski resorts for all European countries reporting	Point conversion to 1 km2; as of 2008	J2ski (2009)
DEM	Digital elevation model for Europe	70 m2 upscaling to 1 km2; Sweden and Finland have coarser resolution	NASA (2003)
Species corridors	The major ecological corridors as determined by the PEEN project	Conversion of shapefile to 1 km2; missing data for Romania and Bulgaria. 2006	PEEN project
Precipitation	Long-term yearly precipitation averages	1 km2; high correlation with elevation; long-term	Hijmans et al., (2005)
Temperature	Long-term global temperature averages	Resampling from 5 arc-minutes to 1 km2; long-term	Hijmans et al., (2005)
Evapotranspiration rates	Calculated as the difference between precipitation and potential evapotranspiration	1 km2; combination of different resolution data	Hijmans et al., (2005)

A number of new spatial datasets were developed for this study. The protection designations of origin (PDO) boundaries were approximated for all of Europe. PDOs are defined by the EU as "agricultural products and foodstuffs which are produced, processed and prepared in a given geographical area using recognised know-how" (EC, 2006a). A database with registration of such products was used to obtain approximate production boundaries for all PDOs. In some cases, administrative boundaries coincided with PDO boundaries, while, others refer to a number of towns and cities. In these latter cases, a buffer of 10 km around the locations approximates the PDO boundary. The ranges of 'species at risk' for both plants and mammals were obtained from the EIONET (article 17) database which lists amphibians, reptiles, fish and invertebrates. This newly established database rates species according to range, distribution, number and outlook giving an indication of future population trends. Some 700 shape files of species ranges were downloaded, converted to raster files and summed to determine regions with a large number of species at risk.

Assessment of multifunctionality

The multifunctionality option was treated differently than the singular rural development options. For the development of multifunctionality high capacities for multiple individual options are needed (Metzger et al., 2006; Wiggering et al., 2006). Therefore, the capacity for multiple functions was assessed by calculating the number of rural development options with high development capacity (highest 35% of assessed development capacities) following:

$$M = A + O + T + C \quad (1)$$

where M is the number of rural activities with high development capacity; A is high capacity for the development of intensive agriculture; O is high capacity for the development of off-farm work; T is high capacity for the development of rural tourism; and C is high capacity for the development of nature conservation.

Validation

Full validation of the approach was not possible due to lack of data, which has also been encountered in other studies (Kienast et al., 2009). However, a partial validation is possible evaluating the rural tourism development option. Observations of the current tourism activities provide an independent dataset. Locations of ski resorts (5 km buffer) and inland camping sites (5 km buffer) are compared to the expert-based maps of high potentials for winter and nature tourism respectively.

In addition, associations between the observed locations of tourism activities and spatial data (Table 2.1) were used to empirically identify the most important determinants of tourism locations. A stepwise backward logistic regression was conducted, eliminating non-significant variables (entry $p < 0.01$; exit $p > 0.01$). The variance inflation index (VIF) was calculated to ensure variable independence, discarding highly correlated values. The VIF is an indicator of the effect that all other independent variables have on the final standard error of the regression coefficients (Hair et al., 1998). The fit of the model was quantified by calculating the area under the ROC curve, which plots the probability of true positives against the false positives (Overmars & Verburg, 2005). Standardised betas are calculated according to Menard (2004).

Finally, a qualitative validation was conducted drawing on the spatial knowledge of regional experts. Independent infield assessments of development capacities were conducted in a number of rural regions and compared with the calculated capacities.

2.3 Results

2.3.1 Workshop results

The main results of the workshop are summarised in Table 2.2. The table provides an overview of the territorial capital discussed at the workshop. Many of the workshop results could be confirmed by evidence in scientific literature (e.g., Bryden & Bollman, 2000; Courtney & Moseley, 2008; Terluin, 2003). The representation of territorial capital by spatial data is categorised as direct (a) or indirect (b). A direct representation means that territorial capital mentioned in the workshop is mapped as a spatial variable, for example in the case of potential productivity. An indirect representation is made when data are used that approximate the spatial distribution of a territorial capital. An example is the use of PDOs, LEADER areas and clusters of small businesses as proxies for entrepreneurial spirit. Separate maps of these conditions were combined to represent a measure of entrepreneurial spirit as described in the workshop. An in-depth description of the translation of territorial capital into maps assessing the development options of intensive agriculture, off-farm employment, rural tourism and conservation is provided for the different options below and in Supplementary material appendices 2.A–D.

Table 2.2. Territorial capital identified during the workshop characterising assets and constraints for intensive agriculture, off-farm employment, rural tourism and nature conservation in Europe.

Territorial capital		**Assets and constraints for agricultural intensification**
Intensive agriculture		
Rural policy and agricultural regulations	*Assets*	Modernisation incentives
	Constraints	Restrictive planning instruments (e.g. landscape protection – hedgerows); agriculture effluents, standards for noise, smell and nitrates; and equalisation payments creating less pressure for intensification[b]
Demand/ accessibility	*Assets*	Demand for high volume standardised food production (i.e., supermarketisation)[a]
Existing funds or investment opportunities	*Assets*	Availability of credit or own funds for investments in technologies, skilled labour, production inputs (fuel, chemicals, seeds) and land
	Constraints	Land prices, complex land tenancy arrangements and absence of credit or own funds
Reorientation flexibility/ existing human capacities	*Assets*	Diverse skills through high education levels can increase capacity to orient to market demands Younger farmers tend to be innovative initiators and able to obtain capital due to their future earning potential The presence of a successor creates incentive for operation expansion and opportunities for future generations
	Constraints	A local tradition of extensive farming can foster unwillingness to change farming systems Farming system inelasticity (equipment, buildings); cost of production reorientation e.g. dairy farming infrastructure
Favourable biophysical condition	*Assets*	Productivity potential related to climate and soil suitability[b] Climate predictability. In cases of variable rain, irrigation is an important asset Slope is an asset as less effort is expended for management of soil erosion[b] Resilient landscapes have a higher threshold for chemical inputs and use capacities
	Constraints	Climate variability

Off-farm employment

Demand/attraction/accessibility	*Assets*	Urban accessibility creates opportunities for light industries related to the agriculture sector or light manufacturing (e.g. house construction)[b]
Rural policy and regulations	*Assets*	Rural diversification policies in sectors other than agriculture (public sector investment)
	Constraints	Biofuels policy increases agricultural production instead of sector diversification
		Ecological protection limits access to some natural resources[a]
Entrepreneurial spirit	*Assets*	Individuals and companies willing and able to start businesses (small business)[a]
		Public, private partnership promoting investments and innovation[a]
		NGOs and active civil society create business opportunities through promotion and cooperation[a]
Reorientation flexibility/ existing human capacities	*Assets*	Skills outside the agricultural sector
		Gender equality – women are involved in off-farm work enterprises in support or initiatory roles
	Constraints	Culture of inflexibility and unwillingness to change
Favourable biophysical conditions	*Assets*	Natural resources[b] – possibilities for industries (e.g. wind, water)
Infrastructure	*Assets*	National grids (e.g. electricity generation requires ties to existing electrical grid)

Rural tourism

Existing infrastructure	*Assets*	Hotels, tourist attractions[a], camping sites[b], golf courses, etc.
		Farm buildings – possible alternative uses (e.g. experience tourism)
Symbolic capital (sense of place)	*Assets*	Heritage value is often a tourist attraction (e.g. Sherwood Forest – Robin Hood)[a]
		Marketing of rural tourism; identity creation (related to broadband access for promotions, NGOs and branding)[a]
		Tourist board/tourist office – promotion, organisation and marketing of tourism
		Location specific regulations (*Appellation d'Origine Controlee* (AOC), *Indicación Geográfica Protegida* (IGP))[b]
Demand/attraction/accessibility	*Assets*	Landscape aesthetics oriented to urban demand (tranquility). This makes accessibility and symbolic capital important[a]
		Local and high quality products linked to the regional uniqueness, identity and ecological character of the region[a]
		Allotments/green belts that can produce spin-off landscape uses
	Constraints	Inaccessibility and poor landscape aesthetics limits demand[a]

Reorientation flexibility/Existing human capacities	*Assets*	Education/training – oriented to tourist sector (e.g. hotel management, guide)
		Skills (heritage preservation) – cultural heritage attraction
		Entrepreneurial spirit -locally operating small-scale tourist business and service[a]
Favourable biophysical conditions	*Assets*	Capacity of the land to sustain human uses (e.g. dunes are fragile to human uses which prevent intensive use)
Nature conservation		
Demand/attraction/ Accessibility	*Assets*	Water needs from cities
		Societal valuation of ecosystem services through uses of cultural and natural landscapes
Rural policy and regulations	*Assets*	Legal instruments – planning, financial incentives that promote a natural landscape
Biodiversity	*Assets*	Intrinsic importance of existing species and natural areas for rare species[a]

[a]Territorial capital link to spatial data: indirect; [b]Territorial capital link to spatial data: direct.

Intensive agriculture

The capacity for intensive agriculture is defined in this study as the development or continued use of capital intensive inputs in agriculture in combination with operation expansion for high agricultural production. Accessibility, climate, slope, soil fertility, water availability, land tenure (i.e., consolidation of large holdings) and policy restrictions (Natura2000 site, protected areas, nitrate directive) were all agreed in the workshop to be important for the development of intensive agriculture. The potential productivity represents the influence of climate and soil conditions as an indicator of territorial capital. Other factors determine if the assets of high potential productivity can indeed be capitalised upon. An index of the potential productivity is multiplied with indices indicative of the constraints encountered in achieving these levels of productivity (Table 2.3) following:

$$I = P * M * R * A * J * Q \qquad (2)$$

where I is regional capacity for development or continuation of intensive agriculture; P is potential agricultural productivity (arable and grass-land); M is the constraint for mechanisation; R is restrictive policies; A is the access to productive land; J is the potential to irrigate; and Q is the proximity to markets. The multiplication of these factors ensures that the result is an index between 0 and 1 and that constraints cannot compensate each other.

Table 2.3. Description of spatial proxies for territorial capital of intensive agriculture.

Territorial capital	Spatial characteristics	Spatial proxies
High potential productivity	Positive climate and soil conditions	Potential productivity for arable and grass lands
Potential for mechanisation	Constraint for mechanisation	Slope – flat, rolling
	Decreasing ease of field maintenance	Slope – hilly and mountainous
Restrictive policies	Limitation for nitrate application and scale enlargement	Nitrate vulnerable zones, protected areas, Natura2000 zones
Access to productive land for production and scale enlargement	Absence of physical barriers (i.e., hedgerows)	Open landscape
	High land prices or complex tenancy arrangements as a constraint for increasing land holdings and/or physical barriers to mechanisation	Peri-urban, mosaic and forest landscapes
Irrigation and/or potential for irrigation projects	Access to irrigation	Irrigation equipment location and water need based on precipitation
	Biophysical potential for irrigation	Proximity to fresh water and flat or rolling topography
Proximity to demand nodes	Access to market and processing industries	Travel time to small, medium and large urban centres and harbours

Policy restrictions that limit application of nitrates, alteration of the landscape and the protection of biodiversity all act as constraints for intensification. These restrictions limit operation expansion and application of fertilizers and pesticides, which are assumed to be positive assets for intensive production. Steep slope is a constraint for ploughing and mowing (Podmaniczky et al., 2007), which is assumed to indicate suitability for mechanisation. Water availability (irrigation equipment) is an asset for intensive agricultural production (Wriedt et al., 2009). Without irrigation equipment, regions with precipitation deficits have serious constraints for agricultural intensification. Access to productive land for agricultural operation expansion is assumed to be an asset for agricultural intensification (Zimmermann, 2006). Land tenure systems cannot easily be mapped. Instead, to partially capture the ability for agricultural expansion, we assume that open homogenous agricultural landscapes are more favourable for intensification than mosaic and forested areas. These landscapes may pose physical barriers (i.e., hedgerows) to the movement of farming equipment, restricting enlargement of the scale of operation. Finally, access to important markets, urban areas and international export hubs (harbours), is an asset for intensive production in terms of access to inputs and low transport costs.

Off-farm employment

The capacity for off-farm employment is defined as the possibilities for employment in rural areas that is not in the agriculture sector. Important contributions for developing off-farm employment in rural areas were revealed to be natural resources, industry, demand for rural goods and services, accessibility and an established entrepreneurial spirit, which is connected to the ability of the population to create business opportunities. The presence of primary industries related to natural resources, secondary industries related to light and heavy manufacturing and urban demand are combined to indicate the assets of the region. The ability to capitalise on these assets is influenced by accessibility and entrepreneurial spirit (Table 2.4) following:

(3) $$O=A*S*E$$

where O is the capacity for off-farm employment; A is accessibility to/from urban centres; S is the supply of rural employment in natural resources, industry and manufacturing sectors; and E is entrepreneurial spirit.

Table 2.4. Description of spatial proxies for territorial capital of off-farm employment.

Territorial capital	**Spatial characteristics**	**Spatial proxies**
Urban demand for rural goods and services	Degree of access to market and processing industries	Travel time to small, medium and large urban centres and harbours
Supply of rural services and products	Urban fringe industries (services and manufacturing)	Distance to urban centres based on size
	Primary industries	Mineral mines, productive forest
	Secondary industries	Waste disposal sites and industrial areas
Entrepreneurial spirit	Local cooperative networks (PPP)	Protection designation of origin (PDO)
	NGO operation and cooperation	LEADER areas
	Small business dynamic	Clusters of camping sites

Forestry and mining are primary sectors that provide rural work in the EU (FAO, 2008). The locations of mines and highly productive forests are used as a proxy for off-farm employment. The presences of manufacturing and waste disposal sites offer rural employment in the secondary sectors. It is also assumed that the outer edges of urban areas are locations of light rural industries as urban demand has created spinoff opportunities here. Larger urban centres have greater demand and therefore larger boundary edges/fringes for the location of these rural industries. Entrepreneurial spirit is a territorial capital where rural inhabitants engage in activities that improve economic prosperity (Courtney & Moseley, 2008; Haugh & Pardy, 1999). It is approximated here as public–private partnerships (PDO locations), development experience (LEADER program participation), and the formation of small businesses (clusters of camping areas). Such activities may be indicative of elements of human and social capital (Courtney & Moseley, 2008; Terluin, 2003). Finally, accessibility of rural areas from urban areas gives an indication of the demand for goods and services (Jongeneel et al., 2008).

Rural tourism

The capacity for rural tourism is defined here as the ability of the region to provide tourist activities that take place outside urban areas and involve overnight stays. In the workshop, the capacity for rural tourism was explained as tourist demand related to tourist attractions and 'symbolic capital'. Symbolic capital is a collective sense of place and/or place identity (Courtney & Moseley, 2008; Terluin, 2003). The example given in the workshop was

Sherwood Forest. The association with Robin Hood makes it a popular tourist destination. Symbolic capital influences the tourist demands indicating whether regions can capitalise on their given territorial asset.

In this study three types of tourism are accounted for: (1) sun, sand and sea tourism, (2) winter tourism and (3) nature tourism. The assets for each of the tourist destinations are averaged to indicate the total capacity for rural tourism. Regions that have assets for different types of tourism therefore obtain high values. This value is multiplied by an index of symbolic capital (Table 2.5) following:

(4) $$R=Avg(S,W,N)*C$$

where R is the capacity for rural tourism; S is assets of sun, sea and sand tourism; W is winter tourism assets; N is assets for nature tourism; and C is a representation of symbolic capital.

Table 2.5. Description of spatial proxies for territorial capital of rural tourism.

Supply of 'Sun, sand and sea'	Biophysical conditions	Coastal areas, beaches, temperature
	Tourist infrastructure	Coastal camping sites
Supply of winter tourism attractions	Positive biophysical conditions	Winter precipitation, temperature topography
	Accessibility	Travel time from urban centres and transport hubs
	Non-aesthetically pleasing landscapes	Open agricultural lands
Supply of attractions for camping tourism	Biophysical conditions	Water bodies, forests, landscape variation (topography), limited human disturbance associated with tranquility (forest, mosaic, agricultural and peri-urban landscapes)
	Policy instruments	Protected areas, Natura2000 sites
	Tourist attractions	UNESCO sites, Natural monuments (IUCN), High nature value farmland – cultural heritage attraction
Symbolic capital	Local cooperative networks (PPP)	Protection designation of origin (PDO)
	NGO operation and cooperation	LEADER areas

Sun, sea and sand tourism is often associated with large tourist spending (Claver-Cortés et al., 2007), however, winter sports and nature tourism are also significant (Richards, 2002). The supply of sun, sea and sand is determined by combinations of coastal areas, beaches, high temperature and beach accommodation (coastal campsites). Number of months with above 15 degrees weather is multiplied by all other coastal assets to give an indication of how strong the tourist draw is. Winter tourism is largely determined by climatic conditions and accessibility (Unbehaun et al., 2008). Skiing, which draws large numbers of tourists, is dependent on topography (Unbehaun et al., 2008). It is also assumed that winter tourism benefits from aesthetically pleasing landscapes (forests, mosaics) so open agricultural landscapes are excluded. The supply of attractions for nature tourism is similarly related to aesthetically pleasing landscapes. Forests, water bodies, variation in the landscape and protected areas are suitable assets related to nature tourism, which has been confirmed in empirical studies (Goossen & Langers, 2000). Attractions like UNESCO sites and natural monuments complement these landscape features. Tranquility, another tourist attraction, is approximated by the degree of proximity from urban areas (i.e., inaccessibility). Literature addressing symbolic capital suggests that local marketing, niche products and aesthetic perception can influence a regional sense of place and identity (Alessa et al., 2008; Evans & Ilbery, 1992; Sharpley & Vass, 2006). We assume that public-private partnership and development experience can cultivate symbolic capital and represent the entrepreneurial spirit of the region.

Nature conservation

The capacity for nature conservation is defined here as the potential for the protection of important and iconic species and habitat. During the workshop, the identification of territorial capital supportive of nature conservation was limited to the mentioning of increasing societal valuation and intrinsic value of biodiversity. European indicators for biodiversity are used to approximate the demand and valuation of natural features. The ranges of plants and mammals at risk are combined with important ecological corridor areas as an indicator of conservation capacities. Fragmentation and human disturbance influence the ability for providing habitat. Important species' ranges are multiplied by indexes of the degree of both fragmentation and human disturbance (Table 2.6) following:

$$C = S * F * H \tag{5}$$

where C is the capacity for nature conservation; S is the ranges of important species and habitat; F is the degree of fragmentation; and H is the degree of human intervention in the landscape.

Table 2.6. Description of spatial proxies for territorial capital of nature conservation.

Territorial capital	Spatial characteristics	Spatial proxies
Societal demand for protection of biodiversity	Presence of high intrinsic value species	The ranges of plants and animals at risk
	Important ecological corridors	Major ecological corridors of the EU
Space for the movement of animals and seeds	Degree of fragmentation by human infrastructure	Average travel time to high traffic areas (small, medium and large urban centres)
Degree of human disturbance for plants and animals	High instance of point sources of pollutants, noise and competing human uses	Peri-urban and open agricultural landscapes
	Relatively low instance of point sources of pollutants, noise and competing human uses	Mosaic and forest landscapes

Combining the ranges of plants and mammals at risk as defined by the Eionet database, gives the location of habitat where a number of plant and mammal species would be protected if conservation efforts were made. Important corridors likewise are areas that promote the protection of animals and plants. Corridors are the rivers, forest and high nature value farmland along designated routes. The degree of habitat fragmentation is a territorial variable influencing the movement of animals and germination of plants (Ewers & Didham, 2006; Jump & Penuelas, 2006). Proximity to roads is used to approximate barriers to species movement. Human uses are also disturbances to natural processes as point sources of pollutants, noise and competing activities. Peri-urban areas and open agricultural landscapes are assumed to have more disturbances, a negative factor for the nature conservation capacity.

2.3.2 Maps of rural development options

The maps resulting from the assessment of the capacity for different development options are shown in figure 2.1. In these maps the capacities are aggregated to administrative units that combine NUTS 2 and 3 units in different countries for presentation. Larger versions of the maps, with a 1 km^2 resolution, are provided as supplementary material (Appendices 2.E–H). These maps are used for the actual analysis as they capture the spatial heterogeneity better.

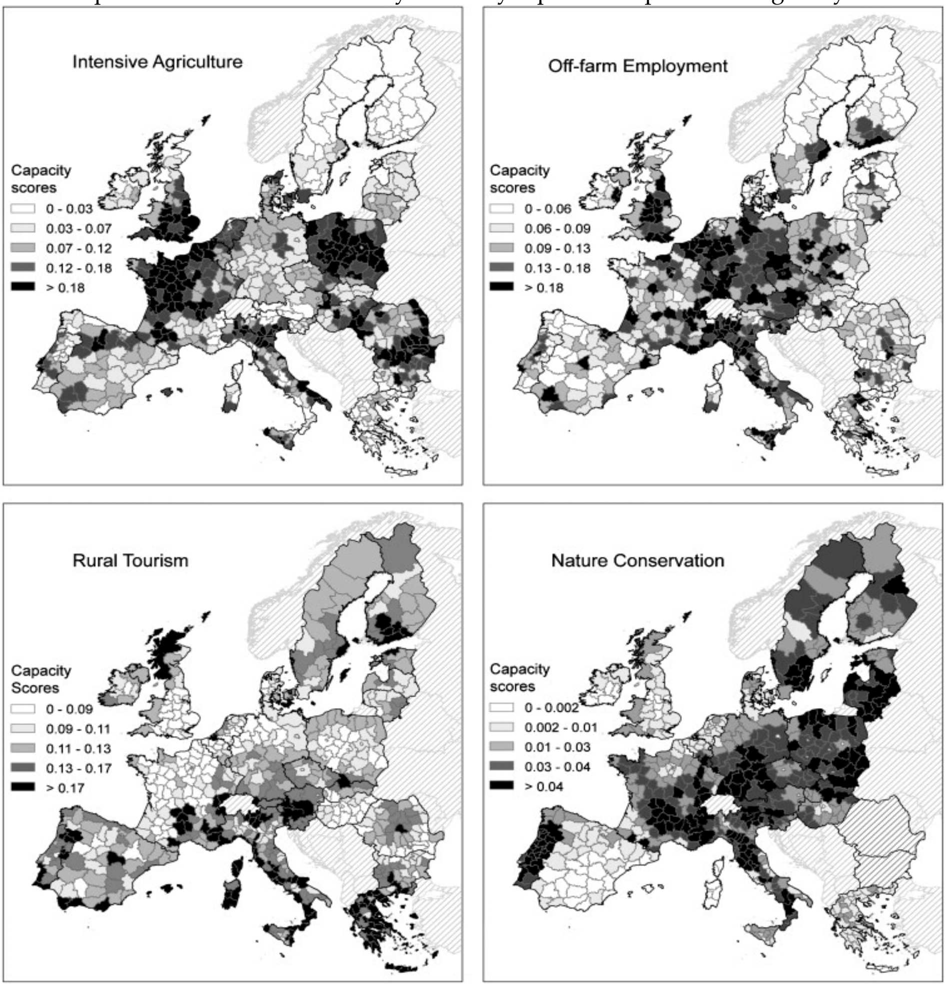


Figure 2.1. Map of rural capacities in European Union countries.

The map of the capacity for development of intensive agriculture shows that strong restrictive policies may limit continuation or development of intensive agriculture in the countries of Denmark and Germany. The counties are assessed to contain only 14 and 12% of land with a high capacity for intensive agriculture production respectively (greatest 35% of assessed capacity). At the moment these countries have a high proportion of intensive agricultural. Countries without restrictive policy that have high capacities for intensive agriculture are Poland (46%), and Romania (36%). They also benefit from favourable climatic and soil conditions. The Netherlands, Belgium and the UK (namely England) likewise benefit from positive growing conditions and accessibility to high demand markets and export hubs. These countries' highly productive agricultural areas are located on average closer (mean travel time 68 min) to important markets, urban areas and international export hubs, than productive agricultural areas in France, Spain and Portugal (mean travel time 108 min). Several regions of Spain and Portugal overcome low precipitation in the major growing months with ample irrigation equipment, which increases productivity. This is unlike many agriculturally productive areas of Romania and Bulgaria where irrigation infrastructure is lacking.

The map for the capacity to develop off-farm employment strongly favours urban proximity where dense population and road infrastructure benefit rural areas in the countries of Belgium, the Netherlands, the UK and Germany (mean travel time of 71 min to urban areas and harbours for all these countries). Forestry potentials are noticeable in Finland, Sweden, Portugal and Romania but still this is highly influenced by accessibility. The influence of entrepreneurial spirit is visible in Southern European countries in locations like the Duro Valley in Portugal, Cantel, Aveyron and Lozere in France, Tuscany and Isernia in Italy and in Thessaloniki and Kilikis in Greece where the indicators of entrepreneurial spirit have high values and coincide with natural and industrial territorial capitals.

The map of the capacity for development of tourism indicates well-known tourist sites throughout Europe. Areas with high capacity include Southern Germany (38% of area classified as high capacity) and Austria (67%). Both have favourable accessibility, skiing conditions and nature tourism draw. Central Romania and Bulgaria are two good examples of a yet unrealised potential with similar nature and winter sports capacities. Inaccessible northern regions score low except in forested areas near urban centres. The western extent of the United Kingdom excluding Northern Ireland is also a tourism hot spot due to assets in nature tourism. Symbolic capital is noticeable in southern regions that score high in this asset.

The map of the capacity for developing nature conservation indicates high potential in more remote regions of Europe but also some Central European areas where there is a high instance of biodiversity. Hot spots of species at risk are located in Southern Germany (mean of 12.4 species at risk), France (Massif Central: 7.3) and Italy (mountainous area: 13.7). Factors of limited human influence, fragmentation and some specific threatened northern species (e.g., arctic fox, wolf, pyrenean and forest dormouse) allow Scandinavian countries to score high for the conservation option. However, it should be noted that there are relatively few species at risk in northern regions. Portugal is highly represented due to a large number of species at risk (mean of 13.1) and low fragmentation as a result of the low population density in the north of Portugal. Hungary and Slovakia similarly score high as a number of species at risk are localised in their mountainous areas. Ireland, the UK and Spain may be underrepresented due to what is expected to be low certification of species at risk in relation to other European countries. Romania and Bulgaria were absent in the Eionet database and therefore do not appear in the assessment.

2.3.3 Multifunctionality

Figure 2.2 indicates the number of development options that have a high capacity at the same locations. Locations are classified as high capacity if they belong to the highest 35% of the calculated capacities. Mono-functional areas with high capacity in one function have the value 1, while areas with no single function above the high capacity threshold score zero.

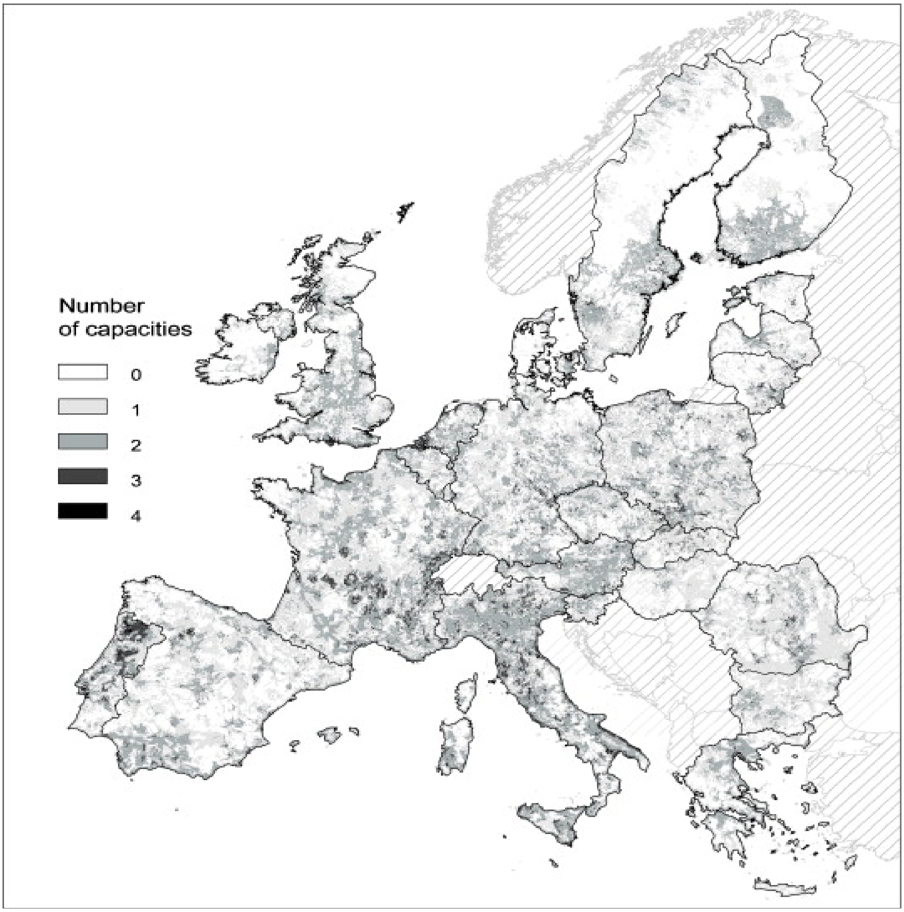


Figure 2.2. Map of the capacity for multiple functions.

The map of the multifunctional capacities show high values in the French Massif Central, Southern Germany, Northern Portugal, and Italian Tuscany. These regions can be classified as mosaic landscapes that tend to have agricultural, tourism and off-farm employment capacities. Poland is also distinctly represented with hot spots throughout the country. Intact forest reserves give both a tourist and off-farm function here. The mountainous areas in Romania (Carpathians) and Bulgaria may support multifunctional use due to the natural beauty (tourist draw) of the areas and primary resources (off-farm employment). Distinctive clustering of multifunctional capacity can be seen around large urban centres. Rural areas in proximity to London, the Randstad, Brussels, Antwerp, Madrid, Copenhagen, Stockholm and Helsinki each have high values due to urban demand for multiple rural services.

The literature regarding multifunctionality and workshop findings suggest that the territorial capital necessary for multifunctionality is much more nuanced than the simple representation in Figure 2.2. Synergy between rural activities is an important asset for multifunctional development (Van Huylenbroeck et al., 2007; Wiggering et al., 2006). It allows for mutual re-enforcement of activities, for example, when conservation of a landscape provides habitat and a tourism attraction (Nelson et al., 2009; Willemen et al., 2010). Conversely, conflicts can occur between rural activities where one activity hinders another, for example with intensive agriculture that can repel tourism and harm habitat. In interpreting the results of Figure 2.2 one should consider that these interactions are not addressed.

Table 2.7 provides the correlation coefficients between the capacities of the different development options giving a hint of the complementarity of development options (i.e., synergies) at the level of individual 1 km^2 pixel and the level of administrative NUTS unit. Intensive agriculture and rural tourism are negatively correlated indicating little synergy, while off-farm employment and intensive agriculture are moderately correlated indicating a complementary relationship. Nature conservation is not substantially correlated with the other development options. However, for the sub-regions of Western Europe and the British Isle nature conservation is related to tourism. Similar regional differences are found for each of the sub-regions evaluated, indicating that differences in conditions between regions determine whether development options are complementary or not. The table also indicates that at the pixel scale there is little correlation between the development options suggesting that multiple functions can be better distinguished at the regional and landscape scale.

Table 2.7. Correlation coefficients for rural development options at the pixel (1 km2) and administrative unit (NUTS) level.

	Pixel	**Administration unit**					
	EU	**EU**	**Western**	**Eastern**	**Southern**	**Northern**	**British Isle**
Int. Agr./Off farm	0.259**	0.354**	−0.10	0.076	0.521**	0.541**	0.552**
Int. Agr./R. Tour.	0.10**	−0.592**	−0.561**	−0.768**	−0.524**	−0.224*	−0.536**
Int. Agr./N. Con.	0.042**	−0.08*	−0.334**	−0.33	0.146*	−0.142	0.020
Off. E./R. Tour.	0.072**	0.001	0.179*	0.187**	−0.087	0.443**	−0.509**
Off. E./N. Con.	0.018**	0.145**	−0.110	0.212**	0.314**	−0.067	−0.298*
R. Tour./N. Con.	−0.055**	0.13**	0.533**	0.029	−0.030	−0.255*	0.247

*Correlation significant at the 0.05 level (2-tailed).**Correlation significant at the 0.01 level (2-tailed).

2.3.4 Validation

Table 2.8 and Table 2.9 show the logistic regression models explaining the locations of ski resorts and campsites respectively. A comparison of the empirically estimated results for the determinants of nature and winter tourism with the expert-based weightings indicates an overall agreement. However, the estimated coefficients also indicate some new and in some cases contradictory influences for the tourism option. Factors suggested by experts for winter tourism included winter temperature, elevation, and precipitation, which were similarly found in the logistic model. In the regression model more land cover types were included as constraints for the occurrence of ski resorts. Accessibility was used in the expert map but was not significant in the regression model for the winter tourism option. For the nature tourism maps factors suggested by experts also significant in the regression included forests, water bodies (lakes and rivers) and mountains. However, model coefficients show that accessibility is important for campsite location while inaccessibility was predicted by experts as a nature tourism asset (tranquillity). Landscape classification of open agricultural land, mosaic landscapes and peri-urban areas were not significant in the logistic model, while they were used to predict the degree of landscape aesthetics in the expert-based maps. Non-significance was also found for Natura 2000 sites and cultural (UNESCO sites) and natural monuments (IUNC sites). Experts suggested that these sites would contribute to the tourist draw. It is suspected that human disturbances in Natura 2000 areas are restricted, resulting in fewer camping sites. The model did confirm that entrepreneurial spirit is significant for the nature option.

Table 2.8. Beta values for logistic regression of the spatial distribution of ski resorts (winter tourism).

Variable	Beta[1]	Std. Beta
Precipitation (mm)	0.0006	0.1978
Winter Temp.	−0.0146	−1.0530
Elevation (m)	0.0003	0.2037
Urban area	−0.4708	−0.1317
Arable land	−2.2100	−1.2116
Pasture land	−0.3515	−0.1763
Wetlands	−2.1111	−0.3471
Permanent crops	−2.3420	−0.4308
Irrigated arable land	−2.4780	−0.2323
Sparsely vegetated area	0.7863	0.2390
Water bodies	−0.2174	−0.4171
Constant	−0.7698	
ROC 0.787		

[1]All variables significant at $p < 0.01$.

Table 2.9. Beta values for logistic regression of the spatial distribution of camping sites (nature tourism).

Variable	Beta[1]	Std. Beta
Inaccessibility	−0.0001	−5.8783
Average precipitation (mm)	0.0006	0.1948
Elevation (m)	0.0006	0.3280
Entrepreneurial spirit	0.0212	0.5953
Water bodies (2 km buffer)	0.8944	0.5612
Pasture land	1.0330	0.5840
Urban	1.5020	0.6506
Forest cover	3.8080	0.2433
Sparse vegetation	−8.6400	−0.1061
Constant	−0.8481	
ROC 0.752		

[1]All variables significant at $p < 0.01$.

Figure 2.3 gives the probability maps for ski-resorts and campsites based on the logistic models. Visual comparison of the two empirical based maps with the expert-based rural tourism capacity map shows similar geographical distributions. All three maps highlight well-known aesthetically beautiful landscapes including the French Massif Central, Alps, Pyrenees, Bavaria, the Carpathians and the north of the UK. The regression derived maps show high capacities for winter tourism in far northern areas. However, this seems unlikely given accessibility, which is shown in the expert derived assessment. The empirical nature tourism map indicates that Western European countries have higher capacities than those in the East, which is unexpected given the number of natural assets in Eastern countries. This natural asset is portrayed in the expert-based maps with high capacity numbers in Eastern Europe. For a number of regions, the difference in capacities can be explained by the different meanings of both maps. While the empirical maps are based on observations of currently exploited locations for tourism, the expert-based maps indicate locations that have the capability to sustain or develop tourism.

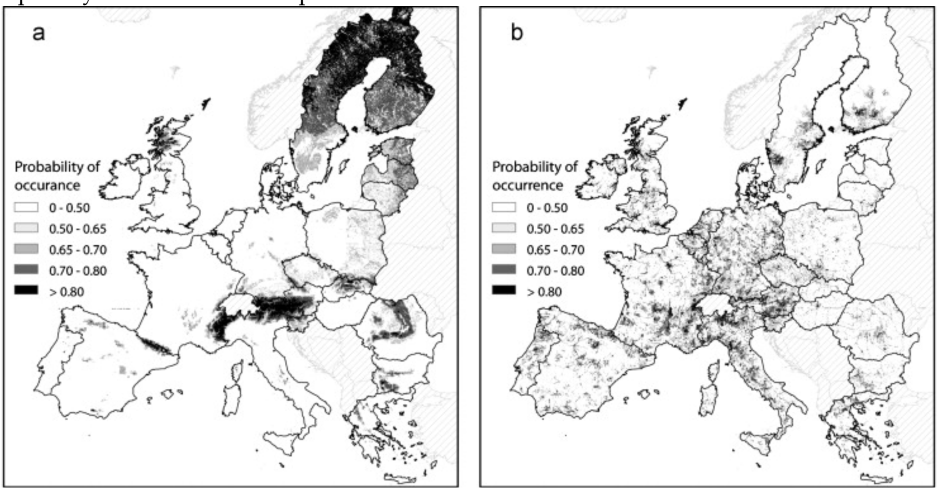


Figure 2.3. Empirical maps of probability for winter tourism (a) probability for nature tourism (b) suitability.

2.4 Discussion

In this paper we present an assessment of rural development options in terms of territorial capital at the European Union scale. The approach draws upon a number of theoretical and descriptive studies and expert knowledge which is translated into rural development capacities and presented in maps. The high spatial resolution of the approach makes it possible to account for the spatial diversity in European landscapes, as well as, for the different socio-economic conditions across the EU. Studies based on administrative unit data cannot account for this diversity. The results indicate that for many rural development options the capacity varies largely within administrative units due to high spatial variation of both environmental and socio-economic conditions. Although it is common to make policy analysis and recommendations at the level of administration units this analysis shows that this may obscure important territorial characteristics.

The assessment provides policymakers with insights into the variation of assets across the EU relevant to rural development implementation and may help to identify where competitive areas are found. The results indicate the territorial capital needed for successful and efficient implementation of rural development policies and reveals region-specific constraints for such developments. Understanding of the variation in territorial capital and the potentials for different directions of rural development can help to design measures that assist regions in using their specific assets for further development.

Central and Eastern European countries are competitive due to their highly productive agricultural conditions and limited restrictions. Incentives for modernisation of agricultural production in Poland, Hungary, Romania and Bulgaria may enhance agricultural production in these countries and maintain rural employment options. Peri-urban areas in Germany, the UK, Belgium and the Netherlands that benefit from urban demand for rural products and industries show high capacity for multiple functions and can thus be targeted with sector diversification funds. Identified tourism assets in Eastern European countries have yet to be largely exploited and so can be targeted for tourism development. Similar tourism development policies can be applied to Southern European countries with their abundance of natural assets (attractive climatic conditions, aesthetic beauty, traditional landscapes). Payments for ecosystem service provision are positive policy options that could be utilised to preserve these natural assets and ensure continued provision in these regions (Turner & Daily, 2008). Conservation may be similarly stimulated in Italy, Germany and France, which all have an abundance of species at risk.

The maps presenting the results of our study indicate the potential for the rural development options given the current conditions. Some of these conditions, for example accessibility or restrictive policies, land cover, may change and thereby influence the capacity for different options. The potential for development as indicated in this paper should therefore not be seen as a static characterisation of the landscape, but rather as a potential for development given the current physical, socio-economic and policy context. Future processes will influence the potential of the development options, with some trajectories less reversible than others.

The current assessment analyzes the development options separately. Trade-offs between rural activities will, however, influence future development choices. Table 2.7 gives an indication of possible development trade-offs. For instance, a region with high capacity for intensive agricultural production that continues with modernisation of management practices and enlargement of farm scale will be less able to engage in tourism or nature conservation. The Po valley is an example of a region where high agricultural production limits the ability for tourism and conservation. The same trade-off is apparent in mosaic landscapes with small holdings and hedgerows that impede high agricultural productivity. Intensification often results in the cutting of hedgerows and consolidation of land holdings for improved production capacities. Such landscape changes are likely to influence the capacities of the landscape for other rural development options.

The results in Table 2.7 also indicated that capacities at the level of individual pixels are not strongly correlated at the European scale. However, when analyzed at the scale of administrative units correlations are much stronger. This result indicates that multi-functionality varies across scales. Within somewhat larger regions certain capacities for rural development tend to cluster while this is less evident at the scale of individual pixels. Both research and policy design should account for these scalar dimensions.

The assessment method presented in this paper is based on expert weighting of territorial capital. The literature and our findings in the workshop gave little evidence of the importance (weight) of individual characteristics. Therefore weighting of the territorial capital was a largely expert-driven exercise using current systems knowledge and interpretive licence. Experts tended to provide feedback according to their own regional or disciplinary backgrounds, which made determining general rules for all EU rural areas difficult in the assessment. The uncertainty of expert weighting was evaluated to some extent by comparing expert-based weighed values for rural tourism with statistical estimations based on the locations of current tourism facilities. Data limitations precluded similar empirical evaluation of the other development assessments as no suitable alternative spatial indicators were available.

Further validation of the maps was only partially possible as few comparable studies assessing the development options investigated have been conducted for continental Europe. A number of ESPON studies do address similar development options in NUTS scale thematic maps (ESPON, 2006). Visual comparison of intensive agricultural maps as produced by ESPON and our map suggests high level of correspondence. Other maps that depict rural competitiveness, cultural tourism and economic typologies use coarse resolutions and categories that are not comparable (Jarva et al., 2006). Studies of landscape functions are more comparable. Kienast et al (2009) investigate tourism and recreation of which many regions are predicted similarly in both studies.

A qualitative validation also indicated that the spatial assessments are robust. Comparisons of rural expert's in-depth assessments for case study areas across Europe with the assessment maps were correct in 3 of the 5 case studies. Poor prediction of development capacities was mainly due to omitting factors related to local conditions and processes (such as a poor management) that are difficult to capture with spatial data at the continental scale. While overall patterns in the map may be valid one should take care with interpretations at the local level as local factors are not accounted for. A number of studies have found local nuances that determine the capacity for a number of development options (Burton, 2004; O'Rourke, 2006). The method introduced in this paper is also suitable for assessing local or national capacities for development. The added benefit of fine resolution and more extensive data availability would allow for a more nuanced assessment.

2.5 Conclusion

This paper uses the concept of territorial capital to integrate environmental and human capacities when assessing rural development potentials. It is a promising theoretical foundation that considers regional competitiveness accounting for spatial distinctiveness. We have presented an approach to operationalise this concept with spatial data resulting in EU-wide, high resolution maps of a number of important rural development options. It offers policymakers an alternative perspective to target rural development policy and by understanding diverse rural potentials for multiple and mono-functionality uses.

Chapter 3

"I don't know how to make bread in the traditional way with the communal ovens. My mother does it each week and give us several loafs"

Anonymous stakeholder (Field research, Castro Laboreiro)

Identifying assets and constraints for rural development with qualitative scenarios: A case study of Castro Laboreiro, Portugal

Emphasis on rural development by the European Commission has renewed the need for tools that can help in determining local development options. Incentives that encourage multifunctionality would be aided by ascertaining the strengths and weaknesses of a region. This article provides a methodological framework for identifying local development capital using scenario storylines, maps and visualisations of possible development outcomes to prompt discussion with local stakeholders about regional potentials. Result from a case study in Northern Portugal show that these tools are particularly suited to gaining a richer understanding of development assets and constraints and for providing insight in the role of spatial variation within regions, which is rarely addressed in scenario studies. The spatial heterogeneity of human, policy and environmental factors are shown to determine where different types of rural development are possible. We conclude that these tools can be used by local government agencies and land managers to develop policy interventions that consider local human capacities, willingness and environmental considerations.

Based on Van Berkel, D.B., Carvalho-Ribeiro, S., Verburg, P.H, Lovett, A., 2010. Landscape and Urban Planning Volume 102, Issue 2, Pages 127–141

3.1 Introduction

Rural development has received greater attention in the European Union during the past two decades (EC, 2005; Lowe et al., 2002). The decline of the traditional agricultural sector in rural Europe has resulted in lower incomes for many farmers, and for some regions economic and social marginalisation (FAO, 2006, MacDonald et al., 2000; Pinto-Correia & Breman, 2008). Decreases in Common Agricultural Policy (CAP) subsidies for agricultural production (Pillar 1) and enlarged budgets for rural development (Pillar 2) do hint at greater opportunities for rural regions with service-oriented assets like aesthetic beauty, specialty products and important habitats for biodiversity. The environmental determinants for providing these services have been widely investigated. However, the specific local human and natural capital that activate these capacities have received less attention (Bryden & Bollman, 2000; Terluin, 2003). Understanding these capacities requires investigation of local level processes. Tools that address the spatially diverse assets and constraints for local economic development by engaging stakeholders would therefore help to improve the effectiveness and targeting of rural development incentives.

The progressive funding shifts in agricultural subsidies within in EU since the Agenda 2000 reforms and current policy options as outlined by CAP2020 have increased the significance of the CAP for non-agricultural sectors (Lowe et al., 2002). In real terms, this will mean a transfer of funds from agricultural production subsidies (single farm payments), known as the first pillar of the CAP, to the second pillar, which funds sub-national rural development programs and EU sponsored initiatives like LEADER. Supporters suggest that such policy orientation allows for the retention of rural social and cultural life through promotion of multifunctionality where old mono-functional productionist models have failed (Marsden & Sonnino, 2008; Renting et al., 2009). The CAP shift is also in line with ideas about the payment for the provision of ecosystem services, which have received attention with regard to landscape sustainability and human well-being (Antrop, 2006; Turner & Daily, 2008). The intuitive appeal of rural economic diversification for improved rural well-being, however, often overshadows the actual spatially differentiated success of rural development policies (Courtney & Moseley, 2008; Watts et al., 2009) and continued marginalisation of some rural areas (Pinto-Correia & Breman, 2009).

These changes have resulted in calls for a more place-based coordinated approach to rural development, which considers local environmental and human capacities or capital (Courtney & Moseley, 2008; OECD, 2001). For instance, a number of studies have found that policy efficiency would be increased by considering local conditions in development interventions (O'Rourke, 2005 and Burton et al., 2008). Tools are needed for gaining this local insight, which are understood by stakeholders themselves (Soini, 2001). A number of assessment methods for rural development exist that engage stakeholders to elicit understanding of local and regional capacities (Chambers, 1994; Scoones, 2009). However, these often do not address the diversity of development options that are possible in the rural areas of Europe due to different endogenous and exogenous processes.

As an alternative, scenarios that reflect the possible diversity of development options can allow for a deeper investigation. Scenarios can be defined as "… descriptions of possible futures that reflect different perspectives on past, present, and future developments" (Van Notten et al., 2003, p. 242). Although employed in a diversity of ways, scenarios have most widely and prominently been employed for coming to terms with uncertain future events (IPCC— Nakicenovic et al., 2000 and MEA, 2003; Prelude— Volkery et al., 2008 and Verburg et al., 2006). For this reason stakeholder participation is often a key element of scenario exercises where expert and, increasingly, lay perspectives are drawn upon for scenario parameterisation (e.g. SRES-IPCC), in dialogues about scenario outcomes (e.g. MEA) and for actual scenario conceptualisation (e.g. Prelude). This has caused scenario practitioners to evaluate and develop different tools for communicating scenario results (Vervoort et al., 2010). Narrative texts (Westhoek et al., 2006), visualisations (Soliva et al., 2008) and other forms of visual media (Delden & Hagen-Zanker, 2009) can be used to make modelled simulations and projections of the future understandable for a broader range of non-expert stakeholders. This allows for, and has been required, to broaden the knowledge sources that contribute to storyline development, increase social learning and enhance the legitimacy of such exercises (Alcamo, 2008). However, increasing stakeholder involvement has also increased the need to assess stakeholder judgements, where values and assumptions can have a strong influence on workshop outcomes (Rounsevell & Metzger, 2010). The attention that is paid to this aspect is often limited to observations of workshop procedures and stakeholder evaluations.

In this study we focus on the polarising effect of scenarios to gain information about both current and future challenges for development. To this end the experiences of studies employing photo-realistic visualisations that contrast different landscape developments are drawn upon (Al-Kodmany, 1999; Soliva, 2007; Tress & Tress, 2005). Such communication media are recognised to create stakeholder buy-in as well as cognitive and emotional involvements that can generate discussions regarding depicted outcomes (Dockerty et al., 2005, Lovett et al., 2009; Vervoort et al., 2010). For instance, Tress and Tress (2003) confronted local residents with contrasting visuals and storylines for industrial farming, recreation and tourism, nature conservation and residential expansion in a rural Danish community. The images were able to illicit strong reactions from respondents. However, reactions were not further investigated and information about the development options not reported.

The objective of this paper is to introduce and illustrate a method for using qualitative scenarios as a means of identifying natural and human capital to help assess the assets and constraints for different forms of rural development. The proposed methodology uses purpose-built exploratory scenario storylines based on local interviews along with photo-realistic images that contrast development trajectories to prompt stakeholders to discuss these different outcomes. It is hypothesised that such discussion can lead to a richer understanding of local constraints and assets. By imbedding scenario investigations within a broader understanding of the local context, gained through interview and local contact, we are able to understand stakeholder judgments and therefore workshop outcomes better. To illustrate the approach the Portuguese parish of Castro Laboreiro, located within the municipality of Melgaço, is used. The region can potentially benefit from CAP Pillar 2 funding for diversifying rural economies due to a number of environmental and cultural assets. Currently the northern mountainous agricultural region is undergoing land abandonment and village depopulation indicating local barriers to development and diminishing rural functionality (Carvalho-Ribeiro et al., 2010; Firmino, 1999; Pereira et al., 2005).

3.2 Description of the case study region

Castro Laboreiro is located in the northern Portuguese municipality of Melgaço in the Laboreiro mountain range (Figure 3.1). The parish is some 9200 ha in extent with peaks and valleys ranging in altitudes from 400 to 1300 m above sea level. Due to this relief there are three distinctive climatic zones stretching from north to south; the high plateau in the north, a middle valley zone and a third lower section with a Semi-Mediterranean climate. In 1971 Castro Laboreiro was included as part of the Peneda Geres National Park (*Parque Nacional da Peneda-Gerês*) due to the aesthetically pleasing natural and cultural landscape with associated native flora and fauna. Prior to the 1940s the valleys and gentle slopes of the mountainous region were used for small-holding mixed agriculture (smaller than 2 ha). These holdings were in the lower zones of Castro Laboreiro where farmers had winter housing (*Inverneiras*) taking advantage of the milder valley climate and better growing conditions (Domingues & Rodrigues, 2008). The land use produced a patchwork of arable meadows interspersed with oak forests in various stages of succession (Moreira et al., 2001). In the summer months the plateau was used as common pastureland (*baldios*). Strong social ties supported an annual transhumance with the entire village population moving from valley to plateau settlements (*Verandas ou brandas*). Pastoral activities on the plateau were maintained through regular burning of scrubland. The resulting plateau shrub and grasses supplied fodder for the grazing of cattle (*Cachena*, *Barrosã*), pony (*Garrano*), goat and sheep herds (Domingues & Rodrigues, 2008).

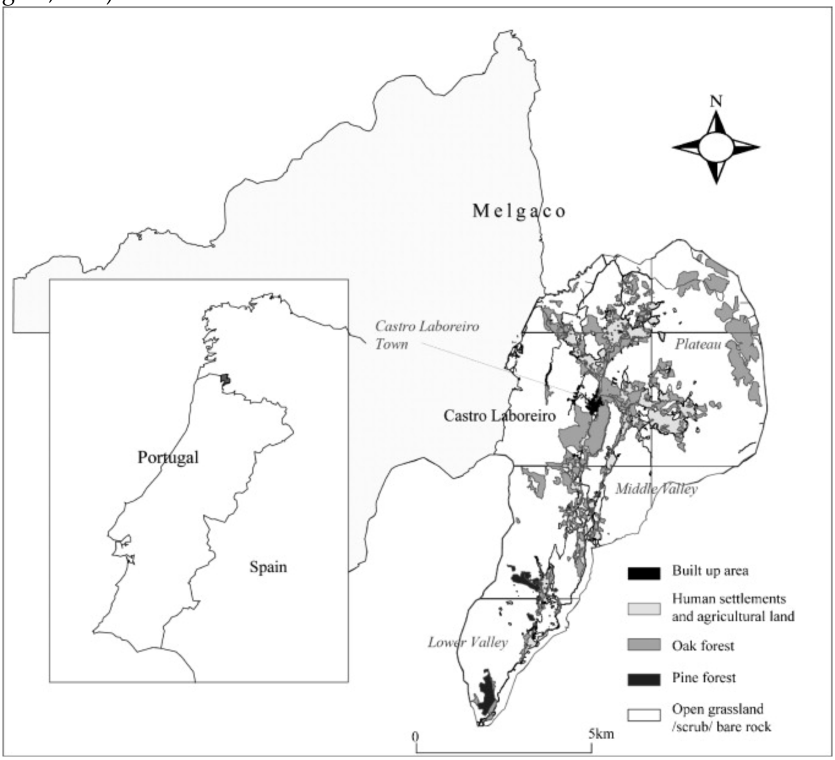


Figure 3.1. Land use map of the case study area.

Political and socio-economic changes, beginning in the 1940s, caused significant land use changes in Castro Laboreiro, especially land abandonment. Programs of afforestation in the Minho region, which further decreased income earning possibilities, triggered many to leave when grazing limitations were set for the communal lands (Moreira et al., 2001). Male out-migration to areas where income earning possibilities were much higher was prevalent in two waves from 1960 to 70 and 1980 to 90 (Edwards & Fernandes, 1999; INE, 1981). Those people that stayed in Castro Laboreiro, a large number of them women, continued agricultural activities.

Today, few people are still interested in farming as environmental conditions limit production potential. At present, the plateau, which generally has poor acidic soils, is mostly used for grazing cattle, sheep and goats. Cultural traditions are changing as ageing farmer communities discontinue the annual transhumance instead preferring to stay in well-established plateau houses (Aguiar et al., 2009; Domingues & Rodrigues, 2008). Residents have largely abandoned valley homes, which are increasingly in disrepair. The valley is still used for fodder production but some fields are being left to re-wild (Aguiar et al., 2009; Domingues & Rodrigues, 2008). A number of newcomers have come to the region and they mainly work in the tourist industries or own hobby farms and vacation homes.

Currently there is local and policymaker concern that if current agricultural management is stopped or altered then the agro-environmental habitat and regional aesthetic character will change in such a way that a potential tourist asset would be squandered. This is acknowledged in newly implemented policies for Castro Laboreiro that focus on payments for ecosystem service provision in the special 'integrated territorial interventions' (ITI) zone of the National Park. The plan subsidises and regulates certain agricultural management practices and is administered by the rural development program of Portugal (MADRP, 2007). Payment of subsidies is dependent on the total area of land managed and the maintenance of certain livestock carrying capacities with greater funds allocated to local livestock breeds (*Cachena*, *Barrosã* cow breeds). In cooperation with EU programs (LEADER) and co-financed through the European Union's rural development program (EAFRD) residents can also receive funds for farm diversification and small business loans. The National Park protective mandate, likewise, makes the park authority a strong stakeholder in Castro Laboreiro. With considerable planning power, including residential zoning, architectural specifications and landscape management, any development projects must comply with national park stipulations (Edwards, 1990; Melgaço Government document, 2008). This has influenced the current development path.

3.3 Methodology

3.3.1 Overview

Fieldwork was carried out in the summer of 2009. Field observation (including photo documentation), interviews and two separate workshops were conducted in this period. Interviews were carried out with stakeholders at various governmental levels, with NGO representatives, rural experts and local interests groups. From these interviews participants were selected for two focus group meetings. The first workshop initially used researcher-produced exploratory storylines to prompt discussion. Subsequently stakeholder groups were encouraged to create their own scenarios of future development for Castro Laboreiro. In the second workshop photo-realistic montages and 3D model images of these scenarios were used to stimulate and support critical discussion. At the end of each workshop a questionnaire was administered, which assessed the workshop and the use of storylines and visualisations. Figure 3.2 presents a diagram of the research method.

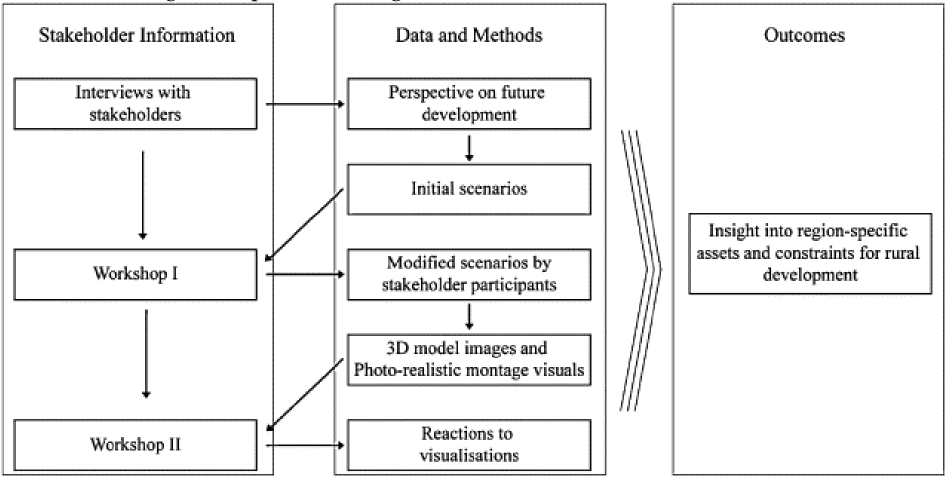


Figure 3.2. Overview of the research methodology.

2.3.2 Interviews and construction of initial scenarios

To begin the research, semi-structured interviews were conducted. The flexibility of the technique allowed for quick and systematic identification of current issues in the local community and assessment of conflicts, master plans and ambitions for regional development (Chambers, 1994; Soliva et al., 2008). This ability to gain a quick overview was especially effective for framing later inquiry and development of initial exploratory storylines.

Policymakers, NGO representatives and rural experts at regional and national levels, and local farmers, entrepreneurs and tourists in Castro Laboreiro were identified and interviewed. In most cases interviews were recorded. For some in-field interviews notes were jotted down after conversations. Often this alleviated angst and mistrust, or was requested due to the sensitivity of the local issue being discussed. Considerable time was invested in gaining rapport with return meetings, help with work and social contact in order to conduct field interviews. The topics covered included respondents' perceptions of local economic and social developments, living conditions, landscape suitability, multifunctionality, community cohesion and policy sector cooperation. Emphasis was placed on the spatial determinants of local development given the different landscapes across the study area. For this spatial perspective, land use maps and panoramic photos of the region were used as interview prompts. Visuals are useful when discussing spatial topics as they give orientation, prompt spatial associations (Alessa et al., 2008; Soini, 2001) and convey rich meanings that are not easily communicated through interview questions alone (Lovett et al., 2010).

Fifteen formal desk interviews and 15 in-field interviews were conducted. After each successive interview, categories of responses were refined to encompass the diversity of aspirations and conceptualisation of future developments anticipated by the stakeholders. This procedure is akin to grounded theory and the methodology developed by Glaser and Strauss (1967) for qualitative data collection.

Interview responses were developed into three exploratory storylines of future development in Castro Laboreiro for discussion in the first workshop. The main perceptions were identified and formed into plausible storylines for 25 years into the future by (i) using stakeholder suggestions for rural development; (ii) extrapolating expert and stakeholder observations about local processes; and (iii) creating coherence and scenario logic through researcher input. Researcher input further enabled us to include features and situations that were thought might prompt discussion leading to better understanding of specific local development issues. This approach of initial scenario definition by the researcher differs from the participatory scenario development approach that commonly allows creative freedom to stakeholders in scenario development (Patel et al., 2007; Rotmans et al., 2000). Our alternative approach was chosen to investigate the contradictions, anomalies and differences encountered in interviews related to regional development and further explore certain trajectories regarding constraints and assets. Scenario storylines used controversial subject matter like development of clean energies, the continued resilience of the region despite re-wilding and the development of sensitive ecological areas to activate and elicit responses from respondents. Controversial future development options were also thought to trigger comments about the local assets and constraints for these developments. In addition, the scenario storylines included descriptions of current trends to further explore different underlying processes and socio-economic and environmental challenge. For instance, one of the scenarios described depopulation in an attempt to prompt stakeholders to discuss reasons and motivations for out-migration. This data collection element is not included in most scenario studies that have mainly focussed on creative problem solving and mutual learning in participatory processes (Al-Kodmany, 1999; Tress & Tress, 2003).

3.3.3 Workshop I

Workshop I was held in the parish community centre with thirteen participants selected from interviewed respondents. Stakeholders were chosen based on their policy and planning influence in Castro Laboreiro, and their interest and regional expertise in different local sectors (see Appendix 3.A). Care was taken that the different perspectives for development were all represented in this selection. Workshop proceedings were video recorded for later consultation. A PowerPoint presentation was used to structure the workshop and illustrate the exploratory storylines. One facilitator directed discussion while two others helped with logistics and mediated scenario development. The three scenario storylines developed based on the interviews were read aloud while maps and pictures depicting the described changes were projected. After each scenario description, stakeholders were asked to write on 'post-it' notes the present constraints and determinants that might impede or facilitate the proposed future and these were placed on a poster. This was followed by a discussion that addressed the answers written.

After presenting the stakeholders with the exploratory storylines, stakeholders were asked to think creatively and make their own scenarios with the same timeline. Workshop participants were split into two groups with representatives of interest groups divided evenly. The groups were provided with poster paper, markers, and photos of the local 'potentials' and given the option to use the materials to illustration of their future. To structure their scenarios, they were asked to fill out a form with the name of their scenario, the infrastructure, projects, government strategy and philosophy needed for the described future. Each group was also requested to draw the landscape changes of their scenario on a panoramic photo that pictured Castro Laboreiro and a land use map of the parish. This specifically addressed the issue of spatial heterogeneity and targeted land units for interventions. After the session each group presented its scenario. This prompted discussion and debate about the possibilities for the area.

3.3.4 Workshop II

Development of visualisations for workshop II

The two stakeholder scenarios created in Workshop I were then translated into photo-realistic montages (PRM) and 3D model images (3DMI) depicting landscape changes and new rural activities for discussion in Workshop II. For the PRMs a panoramic format was chosen with views of the plateau and valley of the study area. This captured the two most distinctive landscape types and covered the study area thoroughly. Panoramic images were created in Photoshop® by inserting and merging additional images of rural activities and landscape elements described by the stakeholders in the first workshop. 3D visualisations were chosen to depict land cover and use changes with reference to the topography of the region, which was known to be important for spatial variation of farming and wooded areas. Land use maps drawn to depict the separate scenarios in Workshop I by the stakeholder groups were digitized in ESRI ArcMap™ and visualised in the ArcScene™ software. To achieve the 3D effect the land use/cover maps were draped over a digital elevation model of Castro Laboreiro. The 3DMI were presented in the workshop by fading from the current landcover/use maps to those illustrating the scenarios and by "flying through" the landscape to highlight the topographic differences. A storyline describing re-wilding, used in Workshop I, was also selected for visualisation as a counterpoint to stakeholders' scenarios of maintained functionality and a depiction of National Park views, which is influential in regional development (Figure 3.3, Figure 3.4 and Figure 3.5).

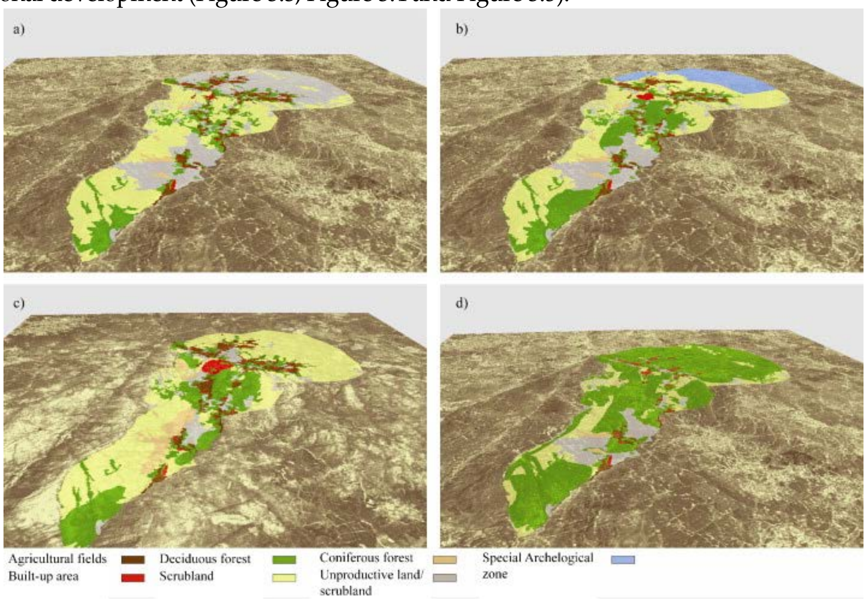


Figure 3.3. 3DMI maps used for workshop II of (a) current land use; (b) new communalism; (c) territorial sustainability; and (d) Nature Return.

Figure 3.4. Photo-realistic montage of the Castro Laboreiro plateau depicting the current (a) landscape; and scenarios (b) territorial sustainability; (c) new communalism; and (d) nature return.

Figure 3.5. Photo-realistic montage of the Castro Laboreiro valley depicting the current (a) landscape; and scenarios (b) territorial sustainability; (c) new communalism; and (d) nature return.

The translation of storyline descriptions made by stakeholders into PRM images required some creative interpretation. For instance one scenario described decreasing agricultural functionality and increasing tourism in the valley with a continued agricultural function on the plateau. This was translated into an image with an open plateau landscape shown through increased livestock numbers and grasslands. In the valley there was expansion of forests and additional tourist activities, for example horseback riding. The second scenario included the maintenance of the cultural landscape as a tourist attraction through increased agricultural functionality. The photo was altered to illustrate this through mimicking traditional agricultural walls and placement of fields between forests in the valley (i.e., mosaic landscapes). Increased residential function in the scenario was depicted through duplication of houses in urban areas. The re-wilding scenario with its greater nature function portrayed expansion of forests in all parts of the landscape. Decreased residential function was represented through less housing and activities limited to research and ecotourism. Not all suggestion could be incorporated into the visualisation due to photo extent and resolution. For example, a new road into Castro Laboreiro, could not be depicted as the proposed location was outside the photomontage viewpoint.

Workshop proceedings

Workshop II was conducted with 11 participants from the first workshop and three substitutes as 3 of the previous ones were unavailable. This did not alter the participant composition significantly as the substitutes chosen represented similar policy and sector domains.

The scenario storylines developed in the previous workshop were presented to the group. After this, participants were split into two groups to view the two visualisations separately. Both groups had 30 min each to view the 3DMI and PRMs and then a questionnaire was administered to assess stakeholders' impressions of the visualisation media. After a lunch break, participants were engaged in a general discussion about the scenario storylines and the visualisations. Questions under themes of cooperation, the spatial elements of development and practicality of imagined futures were used to frame the discussion. It was anticipated that the maps and visualisations would trigger more discussion on the role of spatial variation in the assets and constraints not considered previously. In addition, specific questions were raised that remained unclear from the first workshop. The facilitator, for example, led an inquiry into the poor integration of local agricultural producers with the local service sector, which was an issue that came up in the previous workshop regarding local cooperation. The group was also asked what practical actions could be taken to increase cooperation between sectors in Castro Laboreiro. Another example of a question regarding spatial changes addressed oak encroachment in the area, asking if this is necessarily negative. The pictures of the consequences of this process provided more nuance to the discussion than was possible without the visualisations. Structuring the workshop this way sought to draw out specific local stakeholder knowledge about the area and their attitudes towards future changes.

3.4 Results

3.4.1 Interviews and development of initial scenarios

The majority of respondents (28 out of 30) agreed that the natural capital of the different locations in the region was a major tourism attraction. This included the aesthetic natural beauty, open picturesque traditional farmland, pristine landscape, quietness and relaxed lifestyle in different parts of the area. Multiple ideas were presented about activities that could utilize these natural assets creating tourists demand for Castro Laboreiro, "We could do trout fishing like they do in Canada. Canoeing is also an option in the stream…" (respondent 17). The perspective that natural assets could be used for economic diversification was shared by many of the local entrepreneurs. This was reflected in the exploratory scenario storyline *Return to rural: realising multiple potentials* (RR) (see Appendix 3.B for a detailed description of all the initial scenario storylines). In this scenario, multiple activities were included that were related to the local natural capital including the mountainous relief (mountain sports), wildlife (hunting and fishing), maintenance of the landscape (agriculture) and clean energy production (biomass digesters, photovoltaics).

Another prominent perspective mentioned by half of the interviewees as a local asset during interviews was the cultural landscape resulting from farming practices, local products and a strong attachment to the traditional local agricultural lifestyle. This local human capital was seen as important for creating tourist demand. The wish to develop culturally based tourism was a perspective shared by respondents representing NGOs and local government. One response typified the perspective saying,

> *"The small extensive farmers create the beautiful landscape and this is what Castro Laboreiro is known for, it is well-known in Portugal so we can use this…we should try to attract tourists seeking quality experiences and products. Farmers can provide this sort of thing at the local market and through farm visits." (r. 10)*

The scenario storyline developed to reflect these ideas was called *Adapted Silva-pasture management and open mountainous conservation* (ASM). It included revitalizing traditional agricultural practices by passing on current know-how to young farmers. Like the RR scenario, the storyline featured tourism as a main development option; however, the type of tourism differed between the two scenarios. The RR scenario focused on wilderness and adventure, while ASM emphasized cultural tourism. Because the ASM scenario included tourists coming to enjoy the cultural landscape by engaging in traditional practices and buying local products, it also addressed farmers' willingness for interaction with outsiders. A new Protected Designation of Origin for a regional product was included to emphasize in the discussion agricultural production in the largely subsistence and productively constrained area.

Forest encroachment at the expense of the agricultural landscape, a perspective of a likely development trend shared by many respondents, was incorporated into a scenario of re-wilding labelled *Nature Return* (NR). The majority of the local stakeholders (22 of 30) believed that this would reduce local rural functionality. For the National Park representative however, the development was seen as an opportunity to reduce tourist numbers and improve certain ecosystem and knowledge functions, *"My thought is that we can have day trips in the park – no hotels. Tours can be run by scientists so people can learn about nature….We can also have a research station for the area where scientists can study the unique biodiversity." (r. 4)*

It was already apparent that certain local resident ambitions for development resulted in conflicts with the National Park, which was an issue that could be further explored with the scenario. It also addressed the apparent contradiction of the National Park perspective that a 'living community' could be maintained despite reduced economic activity. Table 3.1 provides a description of the major difference in perspectives derived from the interviews as translated into the exploratory scenarios.

Table 3.1. Key features of the exploratory scenario storylines gathered in interviews.

Scenario name	Nature Return (NR)	Adapted Silva-pasture management and open mountainous conservation (ASM)	Return to rural: realising multiple potentials (RR)
Description	Re-wilding occurs as population declines. Some opportunities arise for wilderness tourism	Young farmers take-up semi-traditional agricultural activities creating new dynamism and allowing for cultural tourism	The rural economy is diversified through energy production, tourism and conservation. The agricultural sector is maintained by supplying the local area
Population	–	±	+
Where people live	The main village; weekenders in the valley	The main village; weekenders in the valley	The main village with a few villages that have remained competitive in the valley (*Brandas*).
Landscape characteristic	Both plateau and valley covered by oak forests. Common oak grows below 700 meters; Pyrenaica Oak 1000 m	Valley covered by common and Pyrenaica Oak; Plateau annually grazed and burned with resulting shrubs and grasses	Mosaic landscape. Mixed farms in the valley and grazing on the plateau. Biomass harvesting also helps with maintenance of the landscape
Types of activities	Hobby farming and vacation homes; guided tours; restaurants; two or three outdoor activities (e.g. canoeing, rock climbing)	Specialised goods production (PDO), specialty product sales (e.g. honey, ham); 'farming experience' tourism; cooperation between farmers and restaurants to provide specialised regional foods	Biomass energy generation; canoeing; rock climbing; market oriented farming; hunting, guiding; river guiding; climbing guiding; marketing and sales of local specialty products (honey, bread, ham, kid goat); camping
Territorial competitive advantage	Unlike Spain and Melgaço, Castro can offer a natural pristine oak forest. It can also offer a more wild and isolated experience,	The transhumance cultural tradition is unmatched in the whole of Portugal. No other region has the tradition of double house annual migration. This	The mountainous terrain, streams and rivers in tandem with forested areas make Castro L. unique in comparison to Melgaço and Spain and a

	which cannot be had in places like Gerês, a similarly forested part of the national park	cultural feature is an advantage over Melgaço, Gerês and Spain which do not have such a rich cultural past	strong attraction for people. Mountain streams provide good kayaking and high altitude rock climbing.
Marketing approach	Pristine wilderness visit; Selling ecosystem services to the public sector (clean water provision, knowledge)	PDOs—creating an image of agriculture and production quality; Experience the traditions of Portugal	Creation of a Castro L. image—Along with PDOs outdoor activities, leisure areas, pristine wilderness, clean energy production (photovoltaic, biomass)
Environmental impact	Low on the woodland ecosystem due to less human interference	Low-moderate due to livestock-grazing fire regimes that maintenance the open mountainous ecosystem	Moderate on the open mountainous ecosystem due to population and use pressures

3.4.2 Workshop I

The use of exploratory scenario storylines in the first workshop added nuance to the understanding of local development assets and constraints by recording reactions to the different situations described. The scenarios acted as prompts in workshop discussions uncovering facts not discovered through interviews. Table 3.2 summarises some discussion points that can be linked to the issues raised in the scenario storylines. While discussions evolved organically with stakeholder interactions prompting other discussion topics, the scenarios were often able to frame what was actually discussed.

Table 3.2. New insights obtained through stakeholder interactions on scenario features.

Scenario prompt	New insights
Livestock raising on the Plateau (ASM)	The introduction of foreign livestock breeds (beef cattle) has occurred due to the fact that farmers prefer easily managed livestock that grow fast. This has resulted in fewer traditional livestock (goats, endogenous cattle) being grazed on the plateau
Agricultural subsidies (ASM)	Farmers use production subsidies for modernisation (e.g. tractors) rather than the maintenance of traditional livestock (mountain ponies) and management
Protective designation of origin (ASM, RR)	Failure of some small-businesses funded by LEADER due to poor urban linkages/networks and business know-how. The failure of PDOs due to neighbouring competition and local 'lock-in' with other cattle breeds
Biomass digester (RR)	Impractical nature of clean energy production (biomass digester, wind) due to facility size, landscape aesthetics, local biomass production capacity and park objections
Local production chains (ASM)	A lack of entrepreneurial spirit with large segments of the aging farming population who are primarily subsistent farmers
Agricultural production levels	Few linkages between farmers and local businesses, traditional practices of subsistence farming, large farmer savings creating little incentive for marketing, harsh environmental conditions
Forest encroachment (NR)	Spread of the forest often increases forest fires
National government subsidies (RR)	Mistrust of government projects due to funding and regulation variability

The scenarios produced by the stakeholder groups, *New communalism* (NC) and *Territorial sustainability* (TS), likewise gave new insights with their representation of ideal/desired development trends. The storylines described local improvements that dealt with specific constraints. For instance both groups created scenarios featuring increased cooperation between levels of governing bodies and local actors, which was noticed by participants to be prominently missing in Castro Laboreiro. This was an aspect that was absent in the initial scenarios. Both scenarios also featured decentralisation of decision making, which was viewed as being limited since Castro Laboreiro was included in the National Park, indicating a preference for participatory development projects. The sale of local agricultural products was included in the scenarios, acknowledging the absence of short production chains and limited amount of market orientation amongst famers. Scenario components included PDOs, the marketing of existing assets of the region (archaeological sites, valley houses), new roads and tourist infrastructure making the region more accessible to tourists as strategies to create demand for local agricultural products and the tourism sector. (See Appendix 3.C for a detailed description of the scenario produced by the stakeholders.)

The questionnaire used to evaluate the first workshop indicated that all stakeholders enjoyed the meeting, felt able to contribute freely and thought that the discussion was useful. When asked if the initially developed scenarios were credible, 8 of the 12 stakeholders found the scenario depicting the traditional cultural landscape (ASM) convincing. Seven stakeholders found the re-wilding scenario (NR) and 6 the scenario depicting a multifunctional landscape (RR) to be convincing. This approval of all the initially developed scenarios and the dissimilarity between the two stakeholder group scenarios suggests stakeholder uncertainty about future development. It also implies different preferences between stakeholders for future development of the region and a more conservative outlook on the future. Although forest encroachment as depicted in the re-wilding storyline (NR) was not extensively present in stakeholder scenarios, re-wilding was still a likely option in their minds as demonstrated in interviews. The respondents found a multifunctional option the least credible development suggesting that they see barriers to a future with multiple rural activities. In the general comments section of the workshop questionnaire stakeholders indicated that they were mostly positive about the workshop. Eight of the twelve appreciated the practicality of the workshop and four prized thinking about the future. They also saw the value of including local perspectives (4) and building their own scenarios (4). Negative comments included workshop logistics like the arrangement of the room or tables and the lateness of other participants. One comment also suggested that storylines should be printed for stakeholders to follow along with.

3.4.3 Workshop II

Photo-realistic montages (PRM)

The use of PRM (Figure 3.4 and Figure 3.5) was generally appreciated by workshop stakeholders with a majority finding it useful to differentiate between scenarios (75%). The afternoon discussion addressed activities depicted in the photos and responses reflected on the situations shown. For instance, livestock grazing on the plateau pictured with local cow breeds (*Cachena*, *Barrosã*) raised the subject of whether the production of this livestock type was a profitable endeavour for farmers given competition with other regions. The images of the tourists also prompted debate about possible attractions, with stakeholders commenting that new activities would be needed to sustain current tourism businesses. While there are a number of hotels and rental homes in Castro Laboreiro, there are few tourist attractions outside of the natural beauty of the park. This is recognised by one respondent saying, "Gil A local hotelier can't run his hotel and provide his occupants with activities at the same time" (r.18). These images of tourism were able to trigger extensive discussion regarding community cooperation and entrepreneurial activities. For many stakeholders the landscape was seen as a tourist attraction that needed to be preserved. This discussion led to a debate regarding the suitable land management types that could maintain the cultural landscape and not threaten biodiversity in the park.

3D model images (3DMI)

The discussions prompted by the 3DMI related to topographic and spatial differentiation of development assets and constraints. A majority of stakeholders found the 3DMI visuals to be complementary to the PRMs in explaining the scenarios. The delineation of an archaeological reserve, as was described by one stakeholder group, was recognised as a creative strategy for attracting tourists to the Plateau area where Celtic megalithic structures are located. The visualisation of a protective boundary was not possible with PRM, which could not provide such broad regional overview. Seeing the 3D image also elicited responses about the local topography. It was pointed out that farmers would abandon steep field first, due to their unfavourable management requirements. There was also debate regarding the growth of forest on the plateau, which was depicted in the Nature Return 3DMI. One stakeholder questioned whether this was possible due to the elevation limits of the indigenous oak species in the region.

The questionnaires administered in Workshop II mainly addressed stakeholders' perceptions of the visualisations (Table 3.4). Like Workshop I general comments were positive. Stakeholders appreciated the integrated methodology used (6), some acknowledging the positives of gaining a local perspective, with others valuing the communication potential of the method. One negative response was that there was insufficient rural expertise represented in the workshop as participants were drawn from the local area.

3.4.4 Summary of research findings

Table 3.3 summarises the outcomes of the study by describing stakeholder-determined local development constraints and assets for agricultural, nature and cultural-aesthetic functionality. The development of these rural functionalities was believed to be complementary with agricultural activities and local know-how, which are beneficial for the maintenance of the cultural landscape. Some potential conflicts were noticed as well; for example, the increasing tourism spill-over from a neighbouring parish, which could hinder nature-based functionality.

Table 3.3. Summary of the development assets and constraints for rural functionality in Castro Laboreiro.

Agricultural production function

Assets

- Traditional know-how is a human capital that allows for agr. production despite environmental constraints
- Pastoral common lands are suitable for livestock grazing
- New subsidies for management of the cultural landscape give incentive for farmers to continue farming
- Farmers' networks serve as social capital where cooperation and information sharing increases farm management efficiency
- Demand for high quality and organic products which are associated with extensive production can bring larger economic returns for farmers
- Protected designation of origins create demand for agricultural products of the region
- Global economic downturns have little influence in the region due to few extra-local economic linkages. This offers stability for those engaging in subsistence lifestyles

Constraints

- Natural conditions are not optimal for agricultural production (harsh climate, poor soils and steep slopes) in comparison to other regions
- Demographic trends: ageing farmer and retiring population threatens local agricultural know-how
- Few farming newcomers due to a poor image of the agricultural sector and outmigration
- Farmers have little financial need for increasing production as they are financially stable and nearing retirement
- Farmers lack entrepreneurial spirit as they are content with current lifestyle and production methods. This is a strong contributor to a lack of market integration
- Land-managers that are uninformed about subsidy possibilities or illiterate causing them to miss subsidy funding
- Ageing farmer are less inclined to keep labour intensive herds (i.e., women prefer sheep as they have smaller grazing ranges)

Habitat provision function

Assets

- The National Park which holds strict restrictive powers that prevent environmentally harmful activities and regulates the protection of habitat and animal and plant species
- Natura2000 protection
- Demographic trends with a decreasing population in the park that can reduce human activity and interference of natural processes
- Existing important endemic and endangered species
- Increasing awareness of the significance of natural areas in Portugal
- Ecotourism demand

Constraints

- No specific policy related to subsidy incentives for habitat and species protection
- Local ambitions for development that can bring increased tourist demand and environmental impact
- Increasing number of vacation houses and newcomers that are not bothered with the maintenance of the landscape for continuation of current valley meadow ecosystems
- The aesthetically appealing landscape, which is a natural draw to the region, can increase use and impact to natural systems
- Increased funds for small-business investment

Cultural-aesthetic function

Assets

- Rich traditional know-how (communal oven, bee keeping, handicrafts, cultural traditions)
- Demand for cultural landscape and activities associated with cultural-agricultural traditions
- Increasing demand in Portugal for vacation homes, which can be a migratory pull factor for the region
- Local tradition of unique culinary dishes well-marketed and preserved in small but strong restaurant sector
- Realisation and revitalization of key cultural symbols and cultural traditions (Castro Laboreiro Dog, Museum)
- New functionality for old traditional buildings that use the local architecture as a template
- Spill-over of tourism from neighbouring parishes (Vinho Verde region of Melgaço)
- Spanish tourists who have good transportation routes to the region
- Increasing number of community and cultural events
- Constraints
- No young people to carry on with traditional agricultural-management activities (associated with urban pull)
- No educated young people to realise new business opportunities
- Limited education level and training for farm diversification
- Strong attachment to valley housing and little financial incentive for selling that limit opportunities for new functionality
- No local networks and linkages with urban areas for marketing of local traditional products
- Poor cooperation between key stakeholders in the region
- A lack of associative spirit between newcomers and locals, which has stunted cooperation
- Power struggle regarding communal lands subsidies, which has resulted in decentralisation of decision making and less cohesion of regional development planning
- Modernisation of some buildings that do not reflect traditional architecture and character of the region (National Park gate, town development)
- Competition of neighbouring parish for tourist draw
- Municipal focus on successful regions with CL being left out

3.5 Discussion

In this paper we have demonstrated a qualitative method for investigating local assets and constraints for rural development using interviews, scenario storylines and visualisations. The approach innovatively uses scenarios for addressing with stakeholders the spatial, landscape and territorial trends of their region, so achieving a richer understanding of rural development issues. Each method used in this study revealed more nuance about local explanatory determinants of development. At the culmination of the research no new insights from the various stakeholders were uncovered and the researchers felt that a reliable picture of preferences and bottle-necks for future developments had been uncovered. Such an outcome implies that the approach could be used by local rural planners and policymakers to test the suitability of development projects by uncovering determinants such as resident know-how, sectoral cooperation, attitudes and willingness to engage in different rural development options. A lack of human capital often causes rural development projects to be ineffective. Therefore, an in-depth assessment and discussions with stakeholders can help to identify which measures need to be taken to make rural development more effective, by providing development projects with direction and targeting incentives.

The initial interviews achieved a categorisation of development perspectives and a list of perceived territorial capital that could be incorporated in the exploratory storylines. The incorporation of location-specific details and inclusion of local perspectives was invaluable for developing credible storylines acceptable to stakeholders, which was noticeable in subsequent stakeholder appreciation during Workshop I. Interviews enabled assessment of respondents' suitability for the stakeholder workshop beforehand, ensuring a balanced and knowledgeable stakeholder mix. The whole interviewing process also had the added importance of creating stakeholder buy-in with face-to-face contact, which personalised the research for the stakeholders. Insight was also gained into the judgements of different stakeholder groups. Often scenario exercises are not imbedded in this context specific information, which can be important for understanding workshop outcomes (Rounsevell & Metzger, 2010; Soliva, 2007).

The use of maps in interviews was effective for prompting spatial discussion, with respondents often referring to them whether asked or not. However, for some respondents the maps were ineffective for inquiries regarding spatial heterogeneity as they were unable to orient themselves and identify towns or their own location. With such respondents the use of photos to refer to specific landscape features was a successful alternative. In such cases, respondents could point to specific locations identifying, for example, local assets with good agricultural conditions, locations that had particular constraints due to policy restrictions and areas that were likely to change in the future with oak encroachment and farm abandonment. Accounting for spatial heterogeneity in both interviews and workshop sessions is something that is not considered in most scenario studies that do not specify geographical differences.

Prompting stakeholders with exploratory scenario storylines developed by the researchers was effective for revisiting contradictions and anomalies encountered in interviews and addressing issues that were interesting for further inquiry in a group setting. This was especially successful in assessing the different sector interests for local development initiatives, which has been recognised in other studies (Sheppard & Meitner, 2005, Soliva et al., 2008; Zoppi & Lai, 2011). Service sector participants viewed rural diversification as an important development option, National Park representatives favoured less human influence and local government authorities advocated development projects based on the cultural landscape illustrating the different perspectives on the future of the region.

The initial storylines also offered a list of features that stakeholders could use to develop their own storylines and a framework for stakeholders unfamiliar with the technique. A number of studies have commented that information provided in presented scenarios and visualisations must be carefully balanced as to not influence stakeholder responses (Kok et al., 2006; Patel et al., 2007). In the Portuguese context bias was not apparent as differences between the provided and created storylines were noticeable and provided useful information for further discussion. In fact stakeholders commented that some features and situations depicted in the exploratory storylines were wrong, adding to the learning process of the researchers in identifying assets and constraints to rural development. For example a biomass facility was assessed as unachievable due to little political will and neighbouring parish competition, and the development of adventure tourism was dismissed due to a lack of sufficient local training. The use of exploratory storylines also addressed the fact that stakeholders were unfamiliar with developing their own scenarios. That stakeholders are naturally able to create coherent conceptualisation about the future is often assumed in exercises using qualitative scenario development (Kok et al., 2006; Rasmussen, 2005). The rejection of certain presented features further validates the hypothesis that scenarios can balance goals of giving enough information for framing and prompting stakeholder discussions, while avoiding biased responses.

The distinction between exploratory and normative scenarios is often made in scenario literature (Rounsevell & Metzger, 2010). In this study the scenario method is less clearly distinguishable. Exploratory scenarios were based on ideal regional developments as learnt in interviews while stakeholder scenarios reflected desirable local outcomes. These normative targets were then tested for robustness instead of addressing how desired outcomes could be achieved in a backcasting exercise. In dealing with highly uncertain processes, associated with social changes and rural development, scenario practitioner will increasingly need to come to terms with stakeholder personal judgements about the future (Metzger et al., 2010; Rounsevell & Metzger, 2010). As a consequence, scenario exercises will be required to address normative ideals while dealing with the uncertainty of achieving those goals, which can be aided by using aspects of both exploratory and normative scenario methods.

The study suggests that the two types of visualisation used contributed to a better understanding of the scenario storylines by providing participants with additional information on the consequences of rural development options. While the 3DMIs provided an effective picture of land cover and the shifts that can occur on a whole-landscape scale, the PRMs were better at giving an idea of the consequences of landscape changes for livelihoods. One noteworthy finding is that educational background did influence the preference for visualisations as those more familiar with spatial planning (staff from the national park, municipality and agricultural ministry) better understood the 3DMI models, while farmers and local government authorities favoured the scenario storylines in PRM format. However, there was also agreement that both visualisation techniques were helpful for the discussion. Table 3.4 summarises the general reaction to the visualisations indicating the different utility of 3DMI and PRM representations. The use of two or more visualisation media for giving different perspective on the same region is increasingly being used in scenario studies (Lovett et al., 2009) and may be an avenue for eliciting responses from different stakeholder types.

Table 3.4. Summary of workshop participants views on the visualisation techniques used.

Strengths	Weaknesses
3D model image	
Gives an overview of the whole region and clearly defines the transformations likely to occur • *"3D gives you much more information (synthesizing) about land cover change for the scenarios under consideration; allowing one to understand the factor of that change"* • *"We have a global vision of the land use giving a view of the patterns"*	**Less detail about rural activities** • *"We couldn't see the different activities that were implicit in the scenario storyline. For example honey production…in a forest landscape."*
Illustrates the proportion of the changes quantitatively • *"The proportion of the forest and agriculture mosaic in relation to the entire area"*	**Confusion about what is being shown** • *"It is confusing. You don't get the perception of reality"*
Photo-realistic montage	
Specifically shows rural activities at suitable location. • *"I can understand much better.* • *"I saw honey production, tourism activities"*	**It is static. The transformations and the transition process involved in the scenario implementation are not reported** • *"It gives an immediate perspective but less profound (gives a snapshot)"*
It contextualised the ideas of the scenario in one picture, setting the frame for the discussion • *"It contextualised the ideas in one picture"*	**It may not show some relevant aspects of the area as it focus on one point in the landscape** • *"Does not show all the aspects of the scenario storyline"*

An important aspect of workshop participation in a rural setting like northern Portugal is that those with more flexible working hours can more easily attend. The number of farmer representatives present at the workshop was low despite local farmer interest in participation. While some farmers simply were reluctant to join due to angst, mistrust or an attitude that 'nothing will change', others simply had no time due to farm management obligations. This farmer absence was combated with a large number of farmer interviews and return visits to reassess farmers' opinions of visualised scenarios. The lesson learned is that care and effort must be invested in making the workshop format accessible for stakeholders, like farmers, with irregular working hours. Certainly farmer insights in the workshop setting can be valuable, given their influence and knowledge about landscape management, which is important in such areas where the cultural landscape is a defining feature. Farmers can also benefit from workshop discussion as was evident with one farmer participant who learned of a possible rural development subsidy that applied for him through interaction with a representative of an agricultural government authority.

3.6 Conclusions

This paper has introduced a method of using qualitative scenarios for assessment of rural development assets and constraints. The approach helps in understanding local territorial capital by engaging local stakeholders in spatial and long-term thinking, asking difficult questions about realistic development potentials. While most participatory scenario exercises focus on the process of stakeholder interaction, they were used here to obtain insights into the barriers and possibilities related to human capital for rural development. While the scenarios dealt with uncertain future outcomes, addressing possible options also prompted discussion about current rural development difficulties. EU rural policy in the future will inevitably be confronted with many decisions about possible rural functionalities, and methods that deal with potentials in proactive ways are useful for effective development planning. Practically, local decision-makers may use a similar method to discuss with residents the challenges and opportunities for future development in their region.

Areas that have valuable cultural landscape, associated history, traditional products, and that provide important human-managed habitat may sustain rural livelihoods in the future. These possibilities will be dependent upon identifying competitive niches, marketing, innovation and increasing demand for local amenities. However, the realisation of multifunctionality is influenced by local coordination, attitudes and possibly policy and subsidy interventions. A future with less cultural-aesthetic functionality may squander a distinctive traditionally multifunctional socio-environmental system, but must not be overlooked given socio-economic, political and local trends. The methods applied in this paper offer a valuable combination of tools to obtain insights valuable to both research and policy stakeholders for addressing the future challenges of rural areas.

Chapter 4

"You can't go to a farmer and say we have to change these regulations. They will always be against them. But if you consult them about the regulation and ask what they think about it they are willing to work with you."

Anonymous stakeholder (Arnhem, Provincial Office)

Combining exploratory scenarios and participatory backcasting: using an agent-based model in participatory policy design for a multi-functional landscape

While the merits of local participatory policy design are widely recognised, limited use is made of model-based scenario results to inform such stakeholder involvement. In this paper we present the findings of a study using an agent based model to help stakeholders consider, discuss and incorporate spatial and temporal processes in a backcasting exercise for rural development. The study is carried out in the Dutch region called the Achterhoek. Region-specific scenarios were constructed based on interviews with local experts. The scenarios are simulated in an agent based model incorporating rural residents and farmer characteristics, the environment and different policy interventions for realistic projection of landscape evolution. Results of the model simulations were presented to stakeholders representing different rural sectors at a workshop. The results indicate that illustration of the spatial configuration of landscape changes is appreciated by stakeholders. Testing stakeholders' solutions by way of model simulations revealed that the effectiveness of local interventions is strongly related to exogenous processes such as market competition and endogenous processes like local willingness to engage in multifunctional activities. The integration of multi-agent modelling and participatory backcasting is effective as it offers a possibility to initiate discussion between experts and stakeholders bringing together different expertise.

Based on Van Berkel, D. & Verburg, P., 2012. Landscape. Ecology Volume 27, Issue 5, Pages 641-658

4.1 Introduction

Rural areas have long been recognised for their multifunctional character 'supplying' the goods and services that sustain human societies (MA, 2005). However, disturbance of natural systems due to intensive agricultural production, alteration of cultural landscapes and land abandonment highlight problematic trajectories for rural environmental sustainability and social functioning. The prevention of these developments has become increasingly linked to effective management of human and natural resources at local scales (Van der Ploeg et al., 2000; Marsden & Sonnino 2008; Wilson, 2010). Yet despite this, there has been little investigation of tools that help communities plan and manage local assets for gaining the most benefit from their multifunctional provisioning while maintaining natural capital (O'Farrell & Anderson, 2010).

An important attraction of 'bottom up' participatory planning design is the ability to integrate local perspectives into development strategies (Pinto-Correia et al., 2006; Stenseke, 2009; Shucksmith, 2010). Development planning may become more efficient and effective through inclusion of local knowledge for increased sensitivity to place-specific conditions including social conventions, landscape character and environmental characteristics (Tress & Tress, 2003; Soliva, 2007; Zoppi & Lai, 2011). Often participation establishes local legitimacy as stakeholder involvement gives a sense of community ownership (Sheppard, 2005; Shearer, 2005). Yet, there is also wide agreement that for local plans to be effective different processes occurring at different spatial, temporal, jurisdictional and management scales must be taken into consideration (Cash et al., 2006; Biggs et al., 2007). Complexity originates from different societal demands, rural actors' decisions, policy and institutional settings and environmental capacities that determine the feasibility of wished developments. Knowledge of these spatial and temporal processes is an important part of understanding regional trajectories and, therefore, for formulating sound interventions in the face of problematic trends (Wilson, 2010).

One typical approach to include local stakeholder knowledge is backcasting. Backcasting is a scenario technique where normative targets or unwanted outcomes are defined by a group for the purpose of formulating ways in which such goals can be achieved or avoided (Robinson, 2003; Carlsson-Kanyama et al., 2008; Van Asselt et al., 2010; Quist et al., 2011; Kok et al., 2011). The focus is placed on possible solutions to current and future problems rather than prediction of future events. Backcasting can give direction and integrate stakeholders in development planning formulation. One drawback of backcasting is that it may not account for ongoing regional change driven by exogenous processes (Kok et al., 2011). To account for such processes forecasting scenarios can be used, either developed by stakeholders or based on model simulations (Nakicenovic et al., 2000). Model simulations that simplify exogenous and endogenous processes are often used to forecast future trends and help inform about driving factors of development. They have been effective in elucidating the underlying drivers of land use changes (Verburg et al., 2008) aided in the ex ante testing of rural policy options (Kathrin et al., 2011) and been revealing regarding problematic development trajectories (Volkery et al., 2008). Although forecasting and backcasting approaches have strong complementarities, there have been few examples where they are used together despite recognition that such integration can help in the effective co-production of development plans (Robinson, 2003; List, 2004).

This study explores how backcasting and forecasting approaches can serve complimentary roles in participatory development planning. We address two main research questions in reporting our case study experience:

(a) Are models useful for improving participatory backcasting formulations in stakeholders workshops; and

(b) What insight can be gained in using forecasting models to test solutions derived from backcasting exercises?

Encouraging open dialogue about model results and using the results in a participatory backcasting exercise is believed to create conditions that stimulate discussion between scientists, decision makers and local stakeholders about rural development planning. By simulating stakeholder suggestions for local intervention, formulated in backcasting exercises, an evaluation of the ideas and strategies for regional development can be made.

4.2 Materials and methods

4.2.1 Description of the case study region

The study was carried out in the Dutch rural region of the Achterhoek where policymakers and NGOs are seeking to effectively utilize the region's multifunctional character for rural development. The presence of a unique cultural-landscape is seen as a tourism development asset and unique agri-environmental habitat, which has motivated the introduction of measures for its preservation. However, an ageing farmer population combined with decreasing numbers of farmers and simultaneous intensification of agricultural production may threaten multifunctionality by hindering other rural functions.

The Achterhoek is an agriculturally dominated region, located in the eastern part of the Netherlands, which has retained much of its pre-industrial landscape (Figure 4.1). This so-called coulissen landscape (bocage) is characterized by interlinking hedgerows, small agricultural plots and historical farm settlement patterns (Wildenbeest, 1989). It is valued for it aesthetic beauty and cultural significance. In part this has contributed to the region's tourism appeal with an estimated 3.4 million day-trips and 3.7 million overnight stays annually (CBS, 2007). However, the cultural landscape also hinders agriculture productivity. Features like hedgerows and tree lines create shadows decreasing production while narrow fields inhibit movement of modern machinery (Wildenbeest, 1989; Bont et al., 2007). A number of reallotment projects have improved agricultural conditions in some areas. Still, local government authorities are concerned that CAP reforms that reduce direct agricultural production payments will result in large farm cessation in unfavourable areas while stimulating intensification in those that are more productive. Increasing numbers of rural residents not primarily engaged in agriculture (>27% of rural population) will also play a larger role in the future of the region (CBS, 2008). Empirical evidence suggests that while they own a small proportion of rural areas, their impact on the landscape is high due to their large numbers and tendency for landscape alteration (Kristensen, 2003; Præsholm et al., 2006; Pinto-Correia et al., 2006).

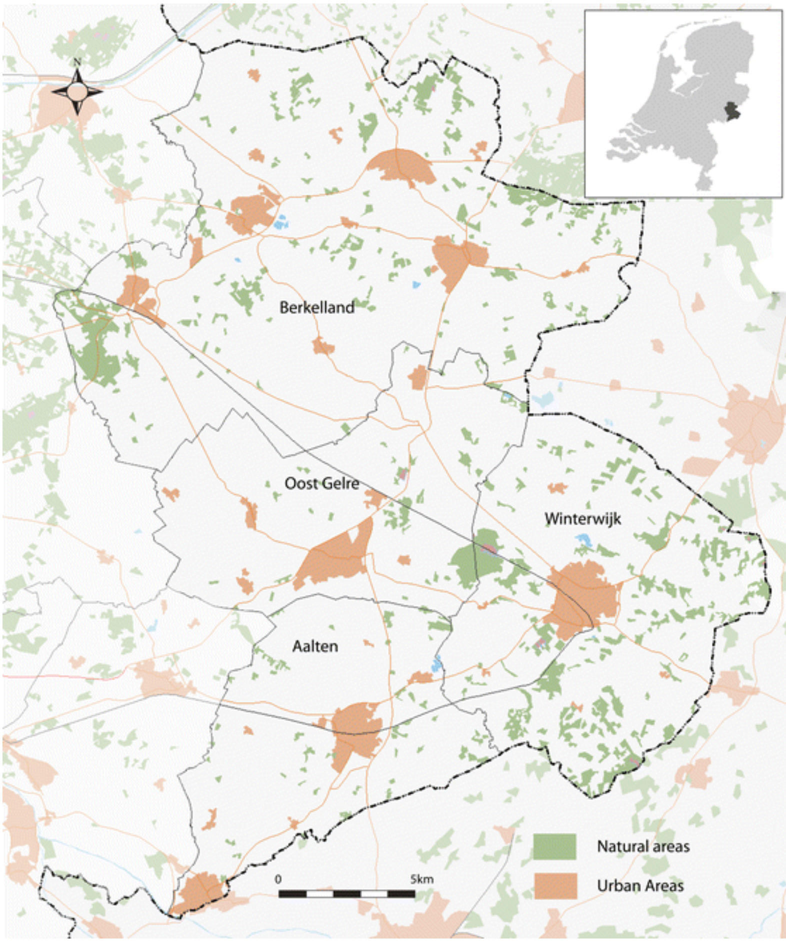


Figure 4.1. Map of the study area

Planners and authorities are exploring options for regional development that retain the unique landscape with the help of EU rural development funds (PG, 2007; Polman & Slangen, 2008). A policy pilot area, located in the Municipality of Winterwijk, has been established giving land managers (farmers) subsidies for maintaining the cultural landscape (Dienst Landelijk Gebied, 2010). It is believed that tourism will be enhanced and biodiversity improved resulting in higher incomes and quality of life for rural residents.

4.2.2 Methodology overview

At the start of the research, scenarios were defined with the help of local experts and data of current regional trends and development processes. An Agent Based Model (ABM) was constructed to simulate policy scenarios relevant to local stakeholders' concerns. A stakeholder workshop was held to discuss challenges for different regional developments given the emergent trends depicted in model simulation. Local interventions were jointly defined that could be used to achieve the desired landscape services for the future. Finally, workshop ideas for interventions were added to the model framework to test how they could alter current trajectories. Figure 4.2 gives the sequences of the research depicting both forecasting and backcasting elements.

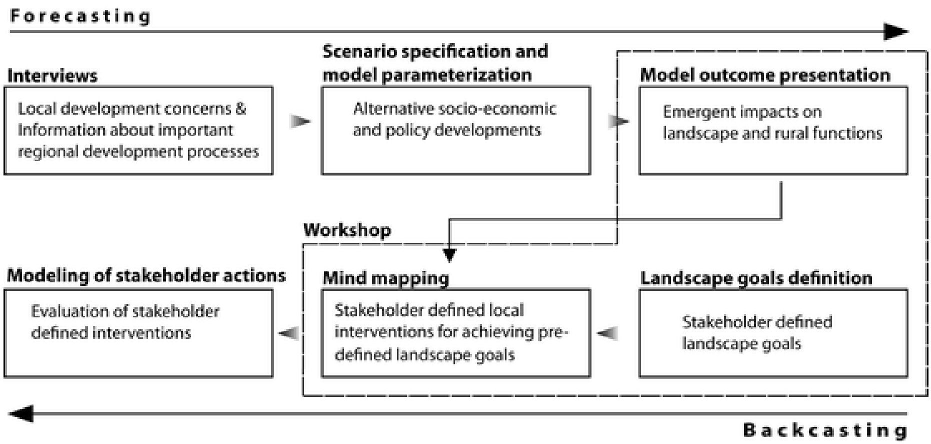


Figure 4.2. Conceptual model of integrated backcasting and exploratory scenario methodology

4.2.3 Interviews and scenario specification

New exploratory scenarios for a period of 25 years in the future were defined to address stakeholders' concern about CAP policy reforms. The majority of respondents were concerned that market liberalisation, currently being considered by the European commission, would drastically alter traditional landscapes and social function in the region. In contrast, respondents felt that payments for landscape service (i.e., maintenance of hedgerows, cultural features and tree lines) and subsidies for small farmers would improve local functioning by attracting more tourism and sustaining the social fabric of the region. Therefore, scenarios that reflect two opposing policy and subsidy options for the case study region were chosen: (i) More balanced, targeted and sustainable support (BTS); and (ii) Abolishment of market and income support (AMIS). A description is given for each scenario.

Balanced, targeted and sustainable support

The scenario BTS outlines reforms aimed at balancing the economic, environmental and social dimensions of rural areas for creating or maintaining synergies between these domains (EC, 2010). Several reforms to the direct payments scheme are proposed that affect the case study in a number of different ways. A basic flat rate subsidy for all famers would be established. This results in less pressure for small farmers and non-expansionists to increase production through farm expansion. However, the basic rate cap also results in decreased income for both milk producers and large farms leading to fewer resources for production expansion (De Bont et al., 2006). A small-farm subsidy leads to a lesser chance that small farms (farms <10 DSU) will sell their holdings due to favourable earning possibilities. Compulsory aid for the provision of 'green' public goods results in a decreased probability that landscape elements will be cut in protection zones (habitat directive areas). In these same zones incentives for landscape elements, such as hedgerows and tree lines, will increase planting or restoration of such features. Furthermore, a focus on rural development will increase subsides for rural residents wishing to diversify. These subsidies are targeted to Local Action Group zones where the LEADER programme is active. LEADER is an EU sponsored programme where farmers receive technical and financial support for (i) the use of new know-how and new technologies; and (ii) best use of natural and cultural resources. The resulting increases in landscape aesthetics leads to increased tourist demand.

Abolished market and income support

The scenario AMIS moves away from income support; instead focusing on a limited amount of environmental and climate objectives (EC, 2010). The European Commission predicts that such a policy scenario would lead to a significant reduction in production levels, farm income and number of farmers; as well as, increases in land abandonment and production intensification. Farming businesses are sensitive to environmental conditions, selling off or abandoning non-competitive parcels. Productive parcels are purchased for farm expansion given their competitive advantage. The phasing out of all direct payment results in a production price–cost squeeze for all farmers, forcing small farmers to either increase production size or sell their land to expansionists. Cross-compliance subsidies are expected to result in the maintenance of special landscape areas only, with nature organisations buying up ecologically significant locations. To increase productivity many farmers choose to cut their hedgerows and tree lines increasing heavy equipment accessibility and reducing tree shadows.

4.2.4 Model parameterization

In this study, an Agent Based Model (ABM) is employed to simulate possible changes in the landscape for the coming 25 year period (2005–2030). The modeling technique is chosen as it is able to represent local human decisions, institutional settings and the environment, which is not possible with mechanistic large-scale models (Axelrod, 1997). This representation of local nuance is assumed to increase stakeholder acceptance of outcome, which is often a criterion for successful knowledge transfer (Sheppard, 2005; Shearer, 2005). ABM systemise the behaviour of different actors based on their personal characteristics (life stage, management type), location (environmental conditions, other actors) and reaction to different policy changes (Voinov & Bousquet 2010; Valbuena et al., 2010). Agents act independently in an approximation of real world conditions having the ability to interact with other actors through learning and cooperation. Their choices and decisions result in changes to the landscape over time. For this reason ABMs have also been widely used for policy analysis (Valbuena et al., 2010; Kathrin et al., 2011) and in participatory modeling exercises (Guyot & Honiden, 2006; Becu et al., 2008). Yet, there have been few examples of ABMs used in decision support (Lempert, 2002; Matthews et al., 2007).

A model framework developed by Valbuena et al (2010) was used. The original model simulates farmers' decisions regarding production expansion, retirement and landscape management. Landscape structure and composition were simulated based on the farmers' and rural residents' land choices. Agents' willingness, abilities and decisions are parameterised based on actual characteristics of rural residents (Jongeneel et al., 2008) and georeferenced according to land holdings. This allows for spatial accuracy of the simulated regional trends (see Valbuena et al., 2008 for a detailed description). A conceptualisation of the model is provided in Figure 4.3. Policy and environmental conditions influence the decisions that agents make. Agents' characteristics including their management type, life-stage (age), multifunctional activities and landscape management preference influence their options and decisions. Their actions result in different regional developments, which influence the supply of landscape services. Each year farmers (agents) decide whether to expand, contract or sell their business to other famers or rural residents. In the same step agents decide whether to retire or continue their farming activities and if they will cut, keep or plant landscape elements.

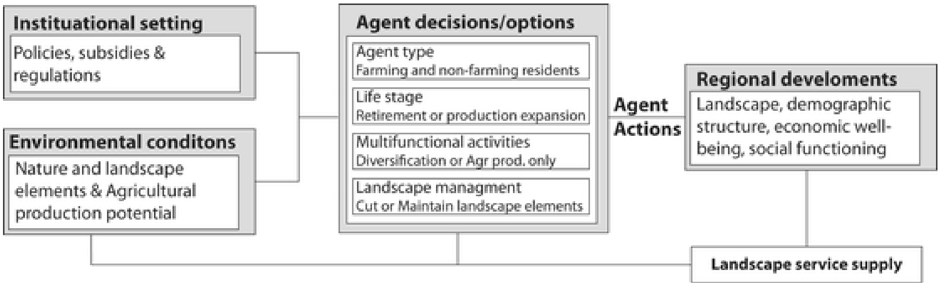


Figure 4.3 Conceptual framework representing the interaction between policy, environmental, demand and rural actors for simulating regional processes

Farmer decisions are parameterized according to the scenario assumptions (see supplementary material- appendix 4.A). For example, in the BTS scenario, multifunctional farmers benefit from landscape and nature management subsidies in landscape protection zones, which results in less farm cessation. Farm cessation is further determined by management type and age. Farm expansion is simulated in a similar way. For instance, expansionist farmers in the AMIS scenario are more likely to increase production in areas with few policies restricting intensive production practices (landscape protection). The probability for protecting and planting landscape elements increases in the BTS scenario for all management types. In the BTS scenario landscape management subsidies increases the chance for planting landscape elements. Cutting is probable in locations where there are no restrictions.

To be able to implement the defined scenarios and account for the information obtained during the interviews a few modifications were made to the model. The modifications are based on information provided by local experts and updated policy and demographic projections. Steep farmer population decline (CBS, 2010) is incorporated in the model with younger retirement ages and an aggressive land market. Increasing demand for rural estate housing is included by increasing the probability of small aesthetically appealing estates being purchased by urban migrants. Local experts also pointed out that rural residents, hobbyfarmers and retiring farmers have distinctly different land management practices and this is now included in the model. New development zone planning has also been incorporated. Regions earmarked for agricultural development receive an increased probability for farm scale production enlargement, while nature development and wildlife corridors (habitat directive) have lower probabilities. Spontaneous development of these zones by farmers has also been included approximating the observation that diverse farmer types engage in nature stewardship. A further detailed description of the model can be found in supplementary material following the ODD framework for documenting agent-based models as introduced by Grimm et al (2006).

To check model modifications for stability a sensitivity analysis was conducted (n = 50) for each of the scenario runs. Key model parameters were varied to analyse the sensitivity of resulting regional demographics, land use and amount of nature and cultural elements (see supplementary material 4.A).

4.2.5 Stakeholder workshop

A one day workshop was held in the Municipality of Winterswijk with participants chosen from interview respondents, suggestions made by regional contacts and snowballing. The 13 stakeholders that attended represented different policy and planning domains (i.e., water board, local spatial planers, and rural development authorities) and regional expertise in different local sectors (i.e., famer cooperatives and nature and development NGOs). We define stakeholders as those actors who are directly or indirectly affected by an issue, and who could affect the outcome of a decision making process regarding that issue, or are affected by it (World Bank, 1996). Due to the importance of overlapping governmental bodies in the Netherlands, care was taken to represent different vertical and horizontal administrative levels, with local regional provincial and national representatives. While care was taken in the selection of stakeholders, scheduling conflicts and interest level limited our flexibility in dictating stakeholder composition. Still, a broad range of perspectives was represented in the workshop with different age categories and genders. Workshop discussions were video recorded for later consultation. One facilitator directed workshop proceeding while three others helped with group exercises.

Landscape goal definition

Workshop proceeding began with an exercise to determine stakeholders' goals for future landscape and functioning in the region, which is a common methodology procedure in backcasting techniques (Robinson, 2003; Van Asselt et al., 2010). Stakeholders were shown a list of landscape services on a poster and asked to allocate ten stickers to indicate how important they perceived them to be (Figure 4.4). They were also allowed to add a service if they felt the list was incomplete. Participants were free to allocate all stickers to one or two services or show a more multifunctional ambition by allocating their stickers across the different services. This was followed by addressing some individual answers, which gave the opportunity for clarification of the different interests represented.

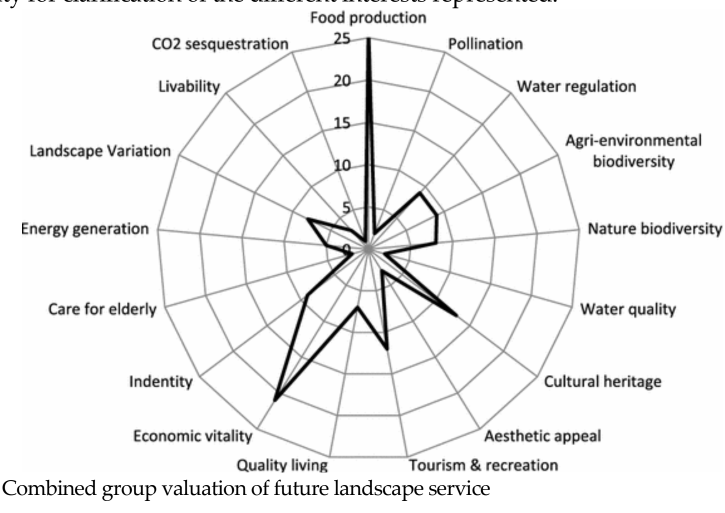


Figure. 4.4. Combined group valuation of future landscape service

Model outcome presentation

The stakeholders were then presented the results of the model simulations. These model results depicted different landscape outcomes for the two policy scenarios from 2005 to 2030. It was believed that this would further frame and inform workshop participants' understanding about the feasibility of their goals given the temporal and spatial projections of rural actors' (farmers, rural resident) landscape choices. Model results were presented to the group using a number of different indicators including demographic change and structure, availability of economic opportunities, and environmental conditions (Table 4.1). Maps depicting changes in landscape elements and nature for the two scenarios were presented to stakeholders, highlighting and comparing a number of spatial temporal changes (Figure 4.5). These maps were also overlain with current wildlife habitat ranges and popular tourist sites to indicate possible future landscape service trade-offs. Specific attention was paid to explaining the causality between the ongoing socio-economic processes and the simulated landscape changes to achieve an understanding of the challenges faced by the region. Participants could visually compare and react to the presented results.

Table 4.1. Simulated indicators of quality multifunctionality

	BTS			**AMIS**		
	2005	Simulated	Change	2005	Simulated	Change
Total number of farmers	1705	1230	−475	1705	1204	−501
Average farm size (ha)	14	31	17	14	31	17
Total agricultural area (ha)	45765	45254	−511	45765	44075	−1690
Percentage of multifunctional/diversified farmers	31	16	−15	31	16	−15
Percentage of rural resident not primarily engaged in Agri.	38	40	2	38	40	2
Percentage change in the length of Landscape elements			+24			−20
Semi-natural areas (ha)	5045	5612	567	5045	6915	1870
Average distance to farthest parcel of land (km)	15	19	4	15	19	4

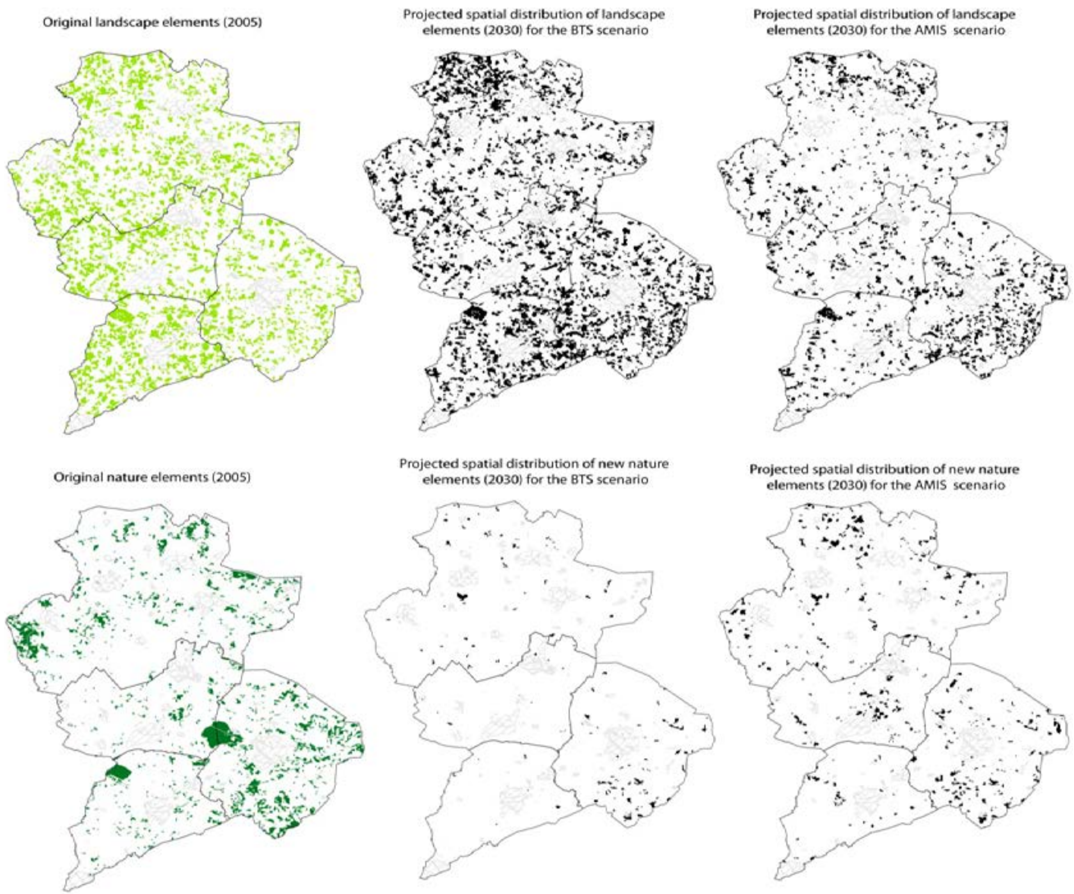


Figure 4.5 Model simulations of landscape change possibilities for the year 2030

Mind mapping

After the presentation the stakeholders were split up into three subgroups with the goal to formulate actions to be taken in order to achieve wished rural functionality while accounting for the ongoing developments simulated by the model. The exercise was carried out using mind maps. Cognitive or mind maps are widely used in workshop settings to structure and systematize group understanding of key concepts and/or issues (Soini, 2001; Evrekli et al., 2009; Kok et al., 2011). The groups were given poster paper, markers and Post-Its™ and asked to formulate their ideas for achieving the predefined landscape services goal. A facilitator helped organise stakeholders' ideas by printing discussion points on the paper and aided in action formulation by way of verbal prompts and inquiries. Often in backcasting exercises the goal is to limit researcher influence on stakeholder developed outcomes to induce creativity and ensure stakeholder representation (Van Vliet et al., 2010; Kok et al., 2011). However, in this technique we prompt participants with information based on model projections. The mind mapping exercise allowed us to ascertain if stakeholders' accounted for the endogenous processes depicted in the model.

Each stakeholder group was then asked to present their mind maps, followed by a discussion about the different suggestions. It was also explained that the suggested intervention would be evaluated by way of model simulation after the workshop. This would offer the stakeholders insights regarding how local interventions would influence regional outcomes. At the culmination of the workshop a questionnaire was administered testing workshop satisfaction, the perceived utility of the different techniques employed and perceptions about different policy options for the development of the region.

4.2.6 Modeling of interventions suggested by stakeholders

Three proposed policy interventions based on the workshop outcomes were added to the model to evaluate their effectiveness. The policy interventions are simulated by adding agent rules, varying the intensity of key variables (e.g., constraint limits) and including a sub model to approximate a stakeholder observed actor interaction. The different simulated scenario results were then compared (i.e., demographic changes, economic opportunities, and environmental condition). Maps of the resulting landscape evolution were also compared with the original projected changes (Figure 4.6). The use of model simulations for testing local interventions is increasingly been seen as a way to aid in policy makers deliberation about implementation (Pannell, 1997; Lempert, 2002; Matthews et al., 2007). For this reason a detail report explaining the result of the simulation outcomes was made and sent to workshop participants for their evaluation and information.

Figure 4.6. Model simulation of projected nature and landscape element changes (2005–2030) with stakeholder groups' interventions suggestions

4.3 Results

4.3.1 Interviews and model parameterization

Interview responses revealed considerable local understanding of regional development processes. Respondents discussed how the historical evolution and environmental condition had influenced current landscape patterns. This was linked to the cultural-heritage function, agricultural production conditions and the provision of important ecosystem services like water quality and wildlife habitat. Appreciation and understanding of these local processes indicated strong local governance capacity. This was confirmed by respondents who explained that strategic rural development meetings between policymakers, municipal planners, NGOs, agricultural cooperatives and academic institutes were frequent. Respondents had similar ideas about regional challenges and how best to tackle problematic developments. They cited the aging farm population, increasing agriculture production intensification and depopulation as areas of concern. Furthermore, decreases in farm subsidies was thought to increase the vulnerability of small farm businesses and expected to interfere with the identity and character of the region. To represent these developments the Abolished Market Support (AMIS) scenario was developed. A majority of the respondents felt that payments for public goods were an important part of maintaining the landscape and therefore increasing the development opportunities for the Achterhoek. For this reason a scenario with payments for ecosystem services and small farm protection was developed (BTS). Respondents also told about increasing numbers of urban residents purchasing small farms in the region, and this was added to the model.

4.3.2 Model simulation results

The model simulations of the two scenarios revealed distinctive differences in landscape evolution, but, surprisingly, little difference between the projected socio-economic indicators. In both scenarios similar farmer population decline was apparent suggesting an emergent trend of decreasing social function through depopulation (Table 4.1). A decrease in the proportion of diversified and conventional farmers in comparison to expansionist indicates a decreasing number of the smaller production systems types. Increases in average farm size in both scenarios show concurrent processes of farm expansion, which is persistent despite subsidies for small-farms and a direct payment cap in the BTS scenario. This is driven by large proportions of farm expansionists that due to their market orientation are similarly successful in both simulations. The similarity of simulation outcomes between the two policy scenarios shows that different policy interventions may not substantially influence these socio-demographic pressures (Jongeneel et al., 2008; Wilson, 2010).

Although similar changes in socio-demographics occur in both scenarios, simulations did indicate substantial difference in landscape evolution between the two policy scenarios. In the AMIS scenario there are significant increases in semi-natural area in comparison to current patterns. Landscape protection areas, habitat corridors and wildlife protection zones all experience agricultural abandonment as farmers take these parcels out of production or nature organisations purchase them for nature development (Figure 4.5). In the same scenario there are significant decreases in the coulissen landscape as farmers choose to increase production efficiency through tree line and hedgerow removal for land consolidation. Figure 4.5 depicts the spatial distribution of these landscape changes in areas that are earmarked as agricultural development zones and where the landscape has been more significantly rationalised. In the BTS scenario the number of landscape elements increases. Economic incentives for the management of cultural and agri-environmental habitats induce land managers to protect these landscapes and in some cases plant new elements. As a result of landscape management subsidies there is limited agricultural abandonment with farmers choosing to capitalise on the subsidy earning possibilities. The survival of market oriented farmers drives these landscape alterations as they are more prone to economic optimization than diversified farms (Table 4.1). However, the results also show an increasing number of rural residents with non-agricultural incomes indicating that these actors will be major contributors to future landscape dynamics.

4.3.3 Workshop

Future landscape service definition

The results of the exercise for determining desired landscape services revealed that stakeholders wish to have a mix of functions for the future, with the majority of stakeholders (n = 8) spreading their votes equally amongst the proposed landscape services (Figure 4.4). However, two distinctive opinions about the role of agriculture for such multifunctionality were apparent. One segment of the workshop participants viewed agriculture (n = 9) as key to future rural functionality while another saw nature services and high quality living as more important (n = 5). This split was revealed in the group discussion with several respondents advocating less funding for agriculture as a way for encouraging new non-traditional land uses. One participant described their wishes for development illustrating this perspective, "We need to focus less on subsidies for farmers and be open to new and innovative uses of the region". The other segment cited the maintenance of the agricultural landscape as interrelated with the identity and character of the region thus requiring government support for its retention. This was evident in discussion about alternative functions with a participant expressing concern for conservation of the landscape, "It's the unique cow breeds and land management that gives this region a rich colour and character…that is why tourist come here, that shouldn't be lost". Despite differences in opinion about which functionalities should be pursued for the future, there was agreement between stakeholders that continuation of agricultural functionality while balancing the economic vitality and nature quality of the region was a positive endeavour. Participants verbally agreed with the statement of one participant when saying, "Any development must adhere to the local character of the landscape for it to achieve a benefit for the region". This finding suggests that while the technique used allows for quantification of the different opinions represented it is also an acceptable way to synthesize the different wishes for further discussion of future planning. Stakeholders' evaluation of the exercise were split with seven participants agreeing that the technique helped in understanding the different stakeholder perspectives represented in the workshop and seven neither agreeing or disagreeing on the Likert scale.

Model outcome presentation

Stakeholders' evaluation of the usefulness of the model outcomes for better understanding regional processes was mixed. The discussion after the presentation of the model results was interesting and focussed on the causality of the processes underlying the results. However, ten out the thirteen respondents neither agreed nor disagreed that they better understood how CAP policy reform would alter their community, with only three agreeing. A similar result was recorded for understanding how demographic trends would affect their region (4-disagree; 5 agree/disagree; 3-agree) and future implication for the different rural economic sectors (4-disagree; 4-agree/disagree; 4-agree). Nonetheless, respondents did answer that they learned more about the role that different actors play in forming the landscape with seven agreeing that they better understood this endogenous process (1-disagree; 5-agree/disagree). Stakeholders also said that they learned more about the spatial dynamics of the region with nine respondents agreeing that they better understood these processes (3-agree/disagree; 1-disagree).

Mind mapping

The mind mapping was better appreciated with 11 respondents finding that the exercise was helpful for bringing structure to group ideas and 11 respondents finding it good for developing solutions to development challenges (2-neither agreeing or disagreeing). It resulted in a number of ideas about actions for achieving the landscape functionality as indicated by the sticker exercise (i.e., continuation of agricultural functionality while balancing the economic vitality and nature quality of the region).

The groups defined similar local development challenges linking these to both endogenous and exogenous pressures. For instance global food competition was linked to homogenization of the landscape through the need for agriculture production intensification. Eutrophication of waterways was likewise related to this market pressure. Abandonment of old farm buildings and loss of traditional landscape was associated with ageing and depopulation. This was further linked to future long-term issues related to the erosion of the local tax base, which would limit the governance capacity. The inclusion of processes shown in the model simulation in all mind maps was a confirmation that stakeholders recognise similar challenges to those depicted in the model.

Many similar suggestions were made between the three groups for local interventions to solve development issues (Table 4.2). All agreed that intensive farmers should be encouraged to leave locations in sensitive landscapes while encouraging small and multifunctional farming in nature and landscape protection zones. One respondent said this plainly, "We need the right farmers in the right place". The groups suggested reallotment schemes, zoning restrictions and location specific subsidies for cultural landscape and nature management to achieve this goal. Attracting tourist was also viewed as a positive development. To increase tourist numbers stakeholders suggested maintaining the landscape, which again was interrelated with clustering multifunctional farmers in pre-existing cultural landscape. Public–private partnership was seen as a policy option for creating income diversification opportunities in tourist hot-spots like organic products produced by multifunctional farmers. Many suggestions also focused on making the region more attractive for entrepreneurs and economic investment. An advertisement campaign to promote a competitive image, a programme for investing in or removal of abandoned farm buildings and the installation of high speed internet cable were suggestions made for attracting new people and business. Disagreement occurred with suggestions for increased economic output by way of targeted subsidies for new economic sectors like energy generation. One stakeholder warned that market orientation would result in the homogenisation of the landscape and loss of landscape richness. There was agreement that any development or innovative function would need to adapt to the surroundings of the landscape to maintain the landscape character. For this, cooperation between local government and entrepreneurs and between farmers was agreed to improve the ability to create synergies between economic sectors. For example, offering complimentary tourist activities by neighbouring farmers or cooperating with local policymakers to set up larger diversification projects (community lead initiatives).

Table 4.2 Stakeholder derived policy intervention for the realisation of wished landscape service

Activation of positive process	**Local measure interventions**
Re-zoning of farm management types to appropriate environmental locations	Land reallotments schemes Restriction and zoning based on landscape profiles (attractiveness, environmental robustness) Nature farming in environmentally sensitive areas Economic valuation and remuneration of nature services Regulate synergies between functions Targeted subsidies for different environmentally appropriate uses Communication between different stakeholders
Attract tourist	Increase cooperation between entrepreneurs and policymakers Maintenance of the landscape (promotion of diversified farms) Organic and local products
Attract entrepreneurs	Invest in local social cohesion Promote the region to outsiders (Advertising campaign) Prevent degradation of landscape aesthetics while allowing for some restructuring to help develop new functions Continual adaption of zoning plans to stay in step with new innovations (e.g. Solar-panels)
Increase economic output/ diversification	Promote new economic sectors through correct economic incentives (e.g., niche markets in organic products) Develop appropriate infrastructure for entrepreneurs (e.g. fibre optics) Targeted subsidies for business types that fit the local character Macro-credit for large projects Landscape restructuring (e.g. empty barn/building schemes) Innovation assistance—smart non-partisan solutions Consider other incentives than subsidies A decentralised communal funds for community lead initiatives
Develop an energy landscape	Create a synergistic cycle where small scale farms produce material from hedgerows, which supply on farms bio-digester giving incentive to maintain the landscape for fuel that in turn attracts tourism

4.3.4 Simulation experiments

Not all interventions proposed could be simulated given limitation of model functionality and available data. Three possible solutions raised during the mind-mapping exercise were selected: land use zoning, increased tourism demand in conjunction with cooperation between farmers, and increased in-migration. The measures for re-zoning farm management types to appropriate environmental locations was achieved by restricting intensive expansionist farmers from expanding or bequeathing their farms in landscape protection areas, habitat directive areas and cultural landscapes. Instead these actors are required to sell their parcels to multifunctional famers, rural residents not primarily engaged in farming or a nature conservation organisation. The interventions were simulated both in the AMIS and

BTS scenarios. The alteration results in sharp declines of intensive agriculturalist in zones where the landscape and nature is highly protected. In Winterswijk, for example, for the AMIS and BTS scenarios there is a 56 and 63% decline in this farm type respectively in comparison to original projections. Figure 4.6 shows the landscape evolution of the different policy actions simulations in comparison to both the original scenario projections. For the land zoning measure there is increased agriculture abandonment as there are too few multifunctional farmers willing to buy up land in highly regulated zones. This is significant in the AMIS scenario with clusters of agriculture abandonment around protected areas but less pronounced in the BTS scenario. To simulate cooperation and tourism, the model was modified to include stakeholder interactions. Agents assess the management techniques of their ten nearest neighbours, and cooperate with them in diversification activities. Such management strategies are related to increased demand for nature friendly products and tourism observed in the region and elsewhere (Præsholm et al., 2006; Jongeneel et al., 2008; Wilson 2010). Non-multifunctional farms can adopt multifunctional techniques if there are four multifunctional farmers nearby and they are located in an area with tourist assets (Nature, hedgerows, attractions). With 10% cooperation and 10% increase in tourism demand there is a 17% and 8% increase of multifunctional farmers in comparison to the original BTS and AMIS projections without the intervention respectively. The difference in cultural landscape comparing the policy action to the original projections is small. However, in Winterswijk there are fewer landscape changes as multifunctional farm numbers increase and landscape elements are better protected (Figure 4.6). A programme to attract urban in-migration was simulated through increasing demand for smaller rural residencies and decreasing requirements for aesthetically pleasing landscapes around the potential housing locations. The procedure did not result in significant difference in numbers of new rural residents in comparison to both scenarios projections despite increasing the probability of purchase to 100%. The availability of small farms determines the number of urban migrants settling in the region. Still, there is a clustering of rural residents not primarily engaged in farming in aesthetically pleasing areas resulting in fewer changes to the landscape in comparison to original projections (Figure 4.6). Interventions are in general less effective in the AMIS scenario as land abandonment increases or a monofunctional agricultural landscape is developed. Market competition leads rural land managers to adhere to market pressures more than local intervention in this case.

4.5 Discussion and conclusions

4.5.1 The role of exploratory scenarios in backcasting

In this article we explored the possibility of employing an ABM to support stakeholder discussion and a backcasting exercise. The results of the stakeholder process were evaluated with the same model. Often model and stakeholder-based assessments are disconnected and separate activities. Examples of approaches that integrate stakeholder and model based techniques include the joint definition of scenarios with stakeholders that are modelled afterwards (Etienne et al., 2003) or role playing games where agents assume different roles from which model parameters can be tested or collected (Voinov & Bousquet, 2010). Model results are then used to explore and discuss likely challenges emerging from alternative future events. Unlike these approaches, stakeholder participation in this paper is achieved by way of goal and solutions formulation placing emphasis on supporting stakeholder deliberation of sound development strategies. The backcasting enables examining goals for the future in the context of developing trends simulated by the model (Potschin et al., 2010). Discussion between experts and stakeholders helped in assessing the desirability of future outcomes while bringing together different expertise and knowledge of how desirable outcomes can be achieved (Robinson, 2003). As the successful development or maintenance of multifunctionality relies on understanding and anticipation of complex processes and local reaction to these processes such novel approaches will be increasingly required if rural communities are to be able to gain wider benefits from their multifunctional provisioning.

The results indicate that model forecasts helped stakeholders to formulate rural development ideas that incorporate aspects of endogenous, spatial and temporal processes affecting their region. This was evident by the acceptance of model outcomes and by the inclusion and discussion of these processes by stakeholder groups in the backcasting exercise. While the model was appreciated for illustrating the spatial dimension of issues affecting rural development, the policy changes that were addressed were less provocative for stakeholders. This is likely due to the translation of abstract processes already understood by stakeholders like policy reforms and demographics change into concrete spatially explicit illustrations. When asked if the workshop added to the current debate about development planning, several of the participants agreed citing the novelty of using the models. One participant summed up this group appreciation saying, "The model shows [in the maps] what we were concerned about explicitly; we thought that market liberalisation would be problematic for the cultural landscape and that was the result". Likewise, participants were pleased with the inclusion of different management types, with many recognizing the importance of the spatial heterogeneity of different decision-making actors for the landscape. In group discussion participants were interested in the make-up of their particular municipality and made inquiries regarding how one management type was defined in relationship to the others. They gave examples of their experiences with different actors that fit, and in a few cases did not fit, with the management type characterisations used in the model. Stakeholders' suggestions for restricting intensive farmers from sensitive environmental zones is evidence that spatial issues were considered and related to management types. The use of an ABM model allowed for the inclusion of these different management types.

Testing different proposed policy actions through model simulations likewise can further help decision makers and stakeholders understand the implication of interventions beforehand. For instance, the model outcomes demonstrate that the promotion of in-migration will require a stock of housing that is suitable for urban migrants to purchase. Zoning policy must also consider the willingness of farmers to engage in certain management styles, as was illustrated by increased agriculture abandonment with the intervention. Intervention can also have distinct spatial consequences where zoning can marginalise certain activities (intensive production) and valorize others (multifunctional). This can result in a clustering of different land uses increasing intensification, whether that is tourism or agriculture. Comparison of interventions across the two scenarios indicates that endogenous economic processes influence the effectiveness of local policy interventions to improve socio-economic conditions at the local scale. Local intervention may be nullified with increasing market competition as farmers are motivated by production efficiency.

4.5.2 Models in a joint-learning process

The issue of knowledge transfer and learning effects has been highly debated in both scenario development and modeling literature (Vervoort et al., 2010; Lagabrielle et al., 2010; Pettit et al., 2011). The result of the questionnaire and discussion, however, did not unequivocally demonstrate a learning effect (Figure 4.4). While it is often ubiquitously stated as an advantage of participation, these findings suggest that learning is particular to each stakeholder's understanding of local processes (Sheppard, 2005) as stakeholders were largely aware of demographic and policy change challenges. Given that there was no 'zero-measurement', where the learning outcomes without the use of the model can be compared to, it is difficult to gauge to what extent model outcomes improved the mind-mapping exercise. Beyond learning, the goal of the approach was to focus stakeholder discussions and structure the mind-map exercise, which was agreed to be the case by the participants.

The perceived legitimacy of model outcomes by stakeholders in model-aided decision support is widely recognised as a requirement for the success of learning and solution development. If stakeholders feel that model results are not adequate or incorrect, the participatory process can grind to a halt (Lagabrielle et al., 2010). Often this can occur when stakeholders are not involved in the modelling process (Voinov & Bousquet, 2010). In our study, stakeholders expressed confidence in the model output during the workshop. The inclusion of local expert knowledge about local processes helped in creating this legitimacy, as processes and actors well known by local stakeholders to influence regional development were included. However, the creation of model credibility may have led to the situation where stakeholders were not forced to 'think outside the box' regarding alternative trajectories, regional challenges and policy action solutions (Xiang & Clarke, 2003; Vervoort et al., 2010). This was evident with many similar suggestions made by the different groups in the mind mapping exercise. Still stakeholders were well aware of model limitations questioning model validity and suggesting that air photos, from the past and present could be used to increase the credibility of projected results.

4.5.3 Participatory policy design in practice

In this study we demonstrate a method of participatory policy design that could be used in practice. While the single case limits the wider applicability of our findings for policy design, several practical lessons can be drawn from our experience. The experience of the workshop led to the realisation that terms used for presenting model findings and in stakeholder exercises needs to be understandable and relevant to stakeholders. Stakeholders found the terminology characterising the landscape services in the sticker exercise ambiguous and incomplete, which may have contributed to the poor assessment of the technique in the questionnaire. Still it did activate a rich debate about what constitutes a landscape service and how such provision could be harnessed for regional development. Two key alterations can be suggested for increasing stakeholder appreciation (a) terminology may be simplified and oriented toward local planning and decision discourses; and (b) emphasis can be placed on the synthesis forming aspect of the exercise. Such an approach could be used in backcasting exercises when time constraints prevent drawn-out group deliberation for goal definition (Kok et al., 2011).

The use of maps and visuals to enhance stakeholder discussions in participatory decision support has been growing in the last decades with the acknowledgement that spatial representation can aid in finding solutions that are appropriate to location-specific conditions

(Van Berkel & Verburg, 2011; Arciniegas et al., 2011). In our study, stakeholders were required to visually compare regional maps depicting scenario outcomes for the better understanding of regional development. Empirical evidence suggests that stakeholders often find it difficult to think in spatial terms preferring instead an issue-based discussion (Etienne et al., 2003; Lagabrielle et al., 2010; Pettit et al., 2011). This raises the question: how important are spatial representations for stakeholder dialogues? The findings in this study demonstrate that landscape processes including variation, structure and function are important to understand when considering development and that stakeholder appreciate the description of them in model visualisations.

In the Dutch context, local policymakers are often required and/or frequently requested to join different (science-policy) workshops as stakeholders of their policy field. This is especially the case in the study region where a multitude of workshops have been conducted over the past years. Repeated interaction with nature organisations, scientists and other policy bodies in these exercises can stimulate innovation, but also result in a situation where workshops become a routine for participants. Combating apathy caused by common workshop procedures and results is an important consideration in workshop design. Packaging model results within alternative formats of interactive workshop exercises is one way to prevent workshops from becoming mundane.

One noteworthy benefits of using such methods for increasing stakeholder participation is that it helped to clarify the different opinions held by the participants regarding alternative development options and solutions (Valkering et al., 2010; Van Berkel & Verburg, 2011). The sticker exercise gave a picture of different values represented at the workshop. Such inventory is often overlooked in participatory exercises, while still recognised as an important aspect of overall workshop outcomes (Soliva, 2007; Metzger et al., 2010). Individual sticker allocation helped in distinguishing two groups of stakeholders, giving context to the suggestions made in the mind map sessions, and offering insight into the different perspectives regarding regional development.

This is an important feature of such participatory method as often there are competing and conflicting interests for development, which was evident in the workshop. Although there was agreement between different policy and planning stakeholders that a multiple function strategy should be pursued, this did not translate into consensus about in which form and how to achieve this. Participatory exercises where different perspectives are represented, like the tools demonstrated here, can help clarify the differences and similarities about future development wishes. The exercise shows that there are tradeoffs, both between different functions but also between different stakeholder groups.

4.6 Conclusions

Increasing decentralisation of decision-making in many EU countries invariably means that local decision-makers will become more involved in formulating local interventions (Shucksmith, 2009). Investing in local capacity for thinking long-term about landscape, demographic and policy evolution can help in the identification of problematic trajectories for multifunctional provisioning. To aid stakeholder participation and provide well-informed discussions innovative tools are needed to structure decisions about complex issues such as landscape functionality. Decision about future functionality will include multiple trade-offs between functions, spatial and temporal scales and different stakeholders. This paper has shown that participatory methods can integrate tools like an agent based model by helping anticipate locations where emergent changes can occur and testing different ways to alleviate identified problems. From this understanding intervention can be tailored to specific management types and geographic locations that are efficient in providing the desired functionality.

Chapter 5

"We have been coming to this region for twenty years now. We just love it here. You can really relax. We come here for the beautiful landscape and friendly people."

Anonymous stakeholder (Field research, Winterswijk)

Spatial quantification and valuation of cultural ecosystem services in an agricultural landscape

While the spatial and economic quantification and valuation of ecosystem services is becoming increasingly recognized as a way to communicate the importance of ecosystem conservation, little attention has been given to cultural services of the landscape. Cultural services form an important part of tourism amenities in agricultural landscapes. In this study we present a methodology for quantifying cultural services. To gain understanding of the services valued by cultural service users, a survey was conducted with tourists in the municipality of Winterswijk. The survey collected data on landscape preferences for individual landscape features, and the structure and composition of the landscape as a whole. This was linked to respondent appreciation of the landscape functions of recreation, aesthetic beauty, cultural heritage, spirituality and inspiration. To give a monetary estimate of the value of these services a willingness to pay (WTP) exercise was conducted using photo manipulations depicting likely landscape changes. Increased residential infill, the removal of landscape elements for improved agricultural production and rewilding due to agricultural abandonment were simulated. Complementary to this estimate, a travel cost estimate of the value of landscape service was done based on respondents' travel time to reach the region. The monetary value of the cultural services is placed between €86 (WTP) and €23 (travel cost) per tourist/year. The achieved understanding of the spatial heterogeneity of service provision in the region, as well as, the monetary valuation of the assets delivered by the landscape can help in prioritizing areas, as well as, landscape features and structure for maintenance/restoration, while demonstrating the importance of conserving cultural service delivery.

Based on Van Berkel, D. & Verberg P., (*In Press*). Ecological Indicators

5.1 Introduction

Humans benefit from the numerous services that rural ecosystems deliver whether that is the provision of food, the regulation of clean water or the inspiration invoked by a beautiful landscape (MA, 2003). In Europe, many agricultural landscapes are hot spots of ecosystem service delivery (Pinto-Correia et al., 2006; Solymosi, 2011; Stenseke, 2009). Such agricultural landscapes are often denoted as cultural landscapes, which are typically defined as landscapes managed by traditional agricultural techniques, locally adapted and historic, by family and/or subsistence methods (IEEP, 2007). Often they contribute to a unique aesthetic character and support a co-produced human–ecological system. Yet, due to processes of agricultural intensification, occurring in many parts of Europe, cultural landscape are being transformed in ways that negatively affect the delivery of cultural ecosystem services (Zimmermann, 2006).

Over the last decades there has been much attention given to maintaining spatial and economic synergies between ecosystem functions in rural areas as part of development planning. This is generally thought to allow local communities to better cope with the various endogenous and exogenous pressures that can threaten livelihoods in these landscapes (Marsden & Sonnino, 2008; Knickel et al., 2004; O'Farrell & Anderson, 2010; Renting et al., 2009; Wilson, 2010). Promotion of tourism and recreation, based on the existing features and traditions, is a preferred rural development option (Van Berkel & Verburg, 2011). It enables income generation outside of agricultural production intensification and promotes the preservation of existing assets (Buijs et al., 2006; Marsden, 1999). Tourism attractions are related to people's awareness and perceived importance of aesthetic beauty, cultural heritage, spirituality and inspiration (Brown, 2006). Such characteristics are non-material benefits related to land management and therefore non-exclusive. Failure to provide enough incentives for the maintenance of cultural landscapes may result in their loss and/or degradation (Swinton et al., 2007). The quantification of the cultural services provided by landscapes both in monetary and spatial terms can contribute to understanding options for future development that retain tourism assets.

Major contributions have been made to the understanding of both the monetary costs and benefits of ecosystem service delivery. Studies mapping ecosystem services have offered policymakers insight into priority locations for service delivery (Egoh et al., 2008; Lautenbach et al., 2011; Nedkov & Burkhard, 2011; Nelson et al., 2009; Willemen et al., 2008). These studies are often limited to examining provisioning and regulatory services based on readily available biophysical data. The normative nature of cultural services and the heterogeneity in valuation of societal actors has made their quantification more difficult (Ryan, 2011). Most studies evaluating ecosystem services have been limited to quantifying recreation and tourism, leaving out the intrinsic qualities that are interrelated with tourism in the cultural service category. Still, a number of techniques have been developed for the localisation of services valued by stakeholders, including cultural services, through participatory mapping (Alessa et al., 2008; Brown & Raymond, 2007; Bryan et al., 2010; Dramstad et al., 2006; Raymond et al., 2009; Sherrouse et al., 2011). The identification of locations of high service delivery has been helpful for understanding the spatial determinants of fortuitous ecosystem delivery, and its associated value to society.

One particular challenge for participatory mapping has been describing the monetary value of the identified services, which is the focus of economic valuation of ecosystems. Revealed preference techniques have been useful in estimating the actual and direct uses cost incurred by service users (Geoghegan et al., 1997; Hein, 2011; Ma & Swinton, 2011; Martín-López et al., 2009; Santana-Jimènez et al., 2011). While based on a number of broad assumptions, such techniques avoid respondent bias for instance with warm glow responses (Hanley et al., 2001). Stated preference techniques, including contingent valuation and discrete choice, have been more widely used for valuations of non-use services like biodiversity (Birol et al., 2008). Such studies reveal the societal values placed upon intrinsic characteristics while perhaps overestimating the actual costs that individuals would pay (Hanley et al., 2001). While debates abound regarding the accuracy and reliability of derived prices, results have had major policy impact where ecosystem goods and service are now being considered seriously in ecosystem management (Kinzig et al., 2011).

This study adds to this body of literature by integrating both a spatial quantification and economic valuation of cultural services. We consider both individual landscape features and landscape structure. This is then related to tourist experience and appreciation of recreation, aesthetic beauty, cultural heritage, spirituality and inspiration in the landscape. By characterizing preferences of stakeholders, a spatial localisation and analysis of landscape services is made. In addition, monetary valuation gives an indication of how important these services are for the regional economy itself.

The research is conducted in the Achterhoek region of the Netherlands, which has a well-developed tourism industry based on the cultural landscape and nature attractions. The eastern areas have retained much of their preindustrial character due to unique historical circumstances that prevented farmers from reorganising small parcels into large agricultural plots (Wildenbeest, 1989). The landscape is presently characterized by a network of interlinking tree lines and hedgerows called the coulissen landscape. Tree shadows created by tree lines reduce agricultural production and are a hindrance for modern farming equipment. This in conjunction with an aging farmer population and the price production squeeze has resulted in some landowners removing landscape elements for agricultural production scale enlargement.

5.2 Methodology

5.2.1 Method overview

The main aim of the study is to locate and quantify the cultural services provided by the landscape and provide a monetary valuation of these services. A differentiation of the contribution of individual elements of the landscape and the landscape composition and structure to the provision of these services is made. Empirical data was collected in the eastern most municipalities of the Achterhoek (Figure 5.1) by way of a questionnaire survey in the summer of 2011. Statistical analysis was employed to identify groups of respondents with similar appreciation of landscape functioning and to ascertain their preference for landscape features, structure and evolution. Preferences were then translated into maps showing hot spots of cultural service provision. Respondents' willingness to pay (WTP) for landscape maintenance is provided to give an estimate of the potential value of landscape services in the region, under conditions of ongoing change. A travel time/cost estimate is made of the revealed value of these landscape services to compliment the WTP estimate.

Figure 5.1. Map of the study area

5.2.2 Survey

The questionnaire was administered in the municipality of Winterswijk by an experienced survey team. Respondents were interviewed in person at campsites, agri-campsites, recreation areas (lakes, nature areas and popular tourist locations) in both the Dutch and German language. This allowed for targeting the majority of tourists in different locations that contribute to the tourist function of the region. The face to face survey method increased response rates as compared with mail-in surveys which are difficult to administer with tourists that do not reside in the region. In total 115 respondents took part in the survey. The average age of the sample was 53 with many visitors nearing retirement age or retired (50% older than 55). The average net income per respondent's household was near the Dutch national average of 2315€ per month. The mean educational attainment was preparatory and secondary vocational education (MBO, HBO). The sample group was comprised of both ‘recreants’ and ‘tourists’. Recreants are defined as those respondents living within a half an hour of their leisure activity (n = 17) and tourists are all those living further away (n = 98). The average travel time to reach Winterswijk was 1 h 23 min, which is approximately the time needed to reach the destination from the central part of the Netherlands. The total sample size is comparable to other ecosystem service mapping studies (Bryan et al., 2010; Dramstad et al., 2006) while being smaller than national preference surveys employing mail-in questionnaires (Brouwer & Slangen, 1998; Soliva et al., 2010).

5.2.3 Survey method

The questionnaire consisted of three parts: (1) personal data was collected for analysis of the sample group and application of the travel time/cost method; (2) respondents’ appreciation for different landscape features, structure and landscape changes were taken; and (3) a monetary valuation of the current landscape was estimated by asking respondents their WTP for landscape preservation considering likely landscape changes. Preferences were obtained through respondents' evaluations of photos and photo manipulations (Figure 5.2 5.3 and 5.5). Photos of individual landscape elements representing different local landscape features (forest, tree lines, recreation facilities, cultural buildings, etc.) and aerial photos of landscape structure and composition were used (representing different amounts and configuration of agricultural, forest and hedgerows/tree lines). A number of studies have successfully employed photos comparing landscape changes for collecting empirical data about landscape aesthetic preference (Howley et al., 2012; Mari Sundli, 2009; Ode et al., 2009; Soliva et al., 2010) as well as, more abstract notions like preferences for different landscape and land use developments using photo manipulations (Soliva et al., 2008; Tress & Tress, 2003; Van Berkel et al., 2011). Photo-realism can produce accurate responses due to image precision and believability (Dockerty et al., 2005; Lovett et al., 2010). This realism was thought to trigger emotional reactions regarding the intrinsic qualities that respondents associate with the landscape. The photos were collected from Google Earth™ and through infield documentation allowing us to represent a diversity of locations in the study area. To ensure that visual aesthetic preference did not play a role in respondent evaluation of the images, different photos of the same feature or landscape change were shown (Figure 5.2 and Figure 5.5). Respondents were asked to choose from the top three preferred and important landscape features and best landscape structure depicted in the photos.

5.2.4 Mapping cultural services

Two maps were created for mapping cultural service provisioning. One was based on the preference for individual landscape features, the other based on preferences of landscape structure and composition. Preferences for the landscape were translated into maps by allocating the number of respondents that chose a particular feature or structure depicted in the photos to map layers representing them. Participatory mapping has become an increasingly popular way to identify locations valued by society for better informing planners and policymakers (Brown & Raymond, 2007; Dramstad et al., 2006). Such techniques have made use of maps where respondents can place and draw directly on the map non-monetary values for indicating important service delivery locations. Aggregating individual assessments gives an indication of the societal importance for location specific services rather than an accurate monetary valuation (Alessa et al., 2008; Brown & Raymond, 2007; Sherrouse et al., 2011). Unlike these techniques we translate respondents' evaluation of photos to mapped layers. Empirical data collection using maps was considered unsuitable given that tourists may or may not be familiar with the geography of the region. Different map layers representing the features and structure depicted in the photos were collected from various provincial databases (Provincie Gelderland, 2010).

For the feature preference map, respondents' preferences were allocated to the locations indicated when the landscape elements shown in the photo occur in the map (Figure 5.2). Preferences for cultural buildings, recreation areas, landscape elements (25 m buffer around tree lines and hedgerows), forests, marshes and other land cover types were allocated separately and an aggregate sum calculated to determine hotspots of total preference. For the feature 'animals' spatial localisation was more difficult as data was limited to the habitat range of iconic animal species (Water fowl, meadow butterflies, bats and ring snakes). To approximate these preferences a viewshed calculation, from biking and walking paths to the locations of these habitats, indicating where there was a possibility to view wildlife, was made. Sight lines (180°) were calculated for the horizon to the surrounding countryside with barriers like tree lines and forest determining the view extent. The observer height was assumed to be 1.5 m given an average of bikers' and walkers' view. The viewable area was categorised as high, low and medium according to the number of observer points where the habitat range could be seen.

For the landscape structure map, the aerial photos used in the questionnaire were analysed to determine the proportion of agriculture, tree lines and forest depicted. This was done in Photoshop by classifying and calculating the amount of these structures. For instance, the 'forest photo' was composed of 79% forest, 21% agricultural land and 0% of tree lines. To translate the proportion of these elements depicted in the photos to mapped layers, a neighbourhood calculation was done using separate maps of tree lines, forests and agricultural land cover. The neighbourhood dimensions were the same as the extent of the photos to ensure comparability. A fuzzy membership calculation was then conducted on resulting layers to represent how close each layer fit to the proportions of these landscape structures to that which was depicted in photos. The separate layers were combined to create maps representing the 6 different photos that respondents could choose from. Finally, a weighted overlay was made to combine these different maps. Weights were determined based on the amount of respondents who preferred the individual photos illustrating areas of preferred landscape structure and composition (Figure 5.3).

To assess the role of the individual cultural services provided by the landscape respondents were asked to rate the landscape in terms of recreation, aesthetic beauty, cultural heritage, inspiration and spirituality on a five point Likert scale (with 1 being unimportant and 5 really important). It was hypothesised that respondents with different landscape appreciation would prefer different structures and features. To test this, a principle component analysis (PCA) was done to identify groups of similar landscape appreciation. A PCA was chosen as it was expected that respondents would value multiple cultural services provided by the agricultural landscapes. Examination of individual responses (eigen values) allowed for determining this overlapping appreciation, which was not possible with other clustering techniques. These groups were then analysed to ascertain unique preference using an ANOVA independent t-test. This is a common approach for determining socio-economic and political factors contributing to landscape preferences (Philip, 1984; Soliva et al., 2010; Van den Berg & Koole, 2006). For instance, preference has been linked to gender and age categories (Soini et al., 2012) urban–rural differences (Howley et al., 2012) and cultural background (Soliva et al., 2010). However, there are no studies known to the authors assessing intrinsic appreciation as a determinant for landscape preferences. Maps of cultural service appreciation were developed by applying the preferences of these subgroups to the different layers representing different landscape features and structures in a similar way as for the lumped survey results.

5.2.5 Landscape monetary valuation

Monetary valuation techniques

A number of methods are available for estimating the monetary value of environmental and cultural services including both stated (willingness to pay: WTP) and revealed preference techniques. Techniques for estimating WTP include discrete choice and contingent valuation (Swinton et al., 2007). In discrete choice experiments respondents are asked to compare different options of services delivery given the costs of policy intervention. Services are described and often visualised on cards where respondents can choose service delivery according to the various prices indicated (Campbell, 2007). Contingent valuation uses scenarios that describe a threatened service provision requiring policy interventions to ensure continued delivery (Brouwer & Slangen, 1998; Colombo et al., 2006; Ready et al., 1997). Respondents are asked what amount of money they would be willing to pay for interventions to maintain or enhance service delivery. While discrete choice experiments appear to more accurately determine WTP in comparison to stated valuation, discrete choice exercises are often cognitively strenuous in terms of choice options and time requirements (Hanley et al., 2001). Revealed preference techniques estimate the approximate expenditures that are involved in engaging in activities like tourism. Revealed preference techniques include travel cost and hedonic pricing, as well as, various techniques for substituting expenditures related to remediation or production improvement of the service in question (Swinton et al., 2007). Travel cost estimates determine the value of a location-specific service by assuming that travel expenditures influence demand (Hein, 2011; Martín-López et al., 2009). Hedonic valuation is a technique where land price are compared to location-specific characteristics. Difference in land prices are used to approximate the value of services like scenic views and proximity to water (Campbell, 2007; Cavailhès et al., 2009; Swinton et al., 2007).

Of the available monetary valuation techniques, we have chosen a stated contingent procedure. The method was considered to be suitable for the sample group (less time consuming and cognitively challenging) as tourist are often more interested in leisure time than taking part in a questionnaire. In addition to this stated preference estimate we calculate the revealed preference by using a time/cost estimate, asking where respondents have travelled from, to approximate the actual expenditures of travelling to the region to enjoy the cultural services.

Stated preference value estimate

The WTP exercise was developed to allow respondents to compare possible landscape changes for assessing the importance and worth of landscape maintenance sustaining cultural ecosystem services. Panoramic photos of existing landscapes including the traditional agricultural, coulissen landscape and extensive grazing lands were altered using Adobe Photoshop™. This ensured that weather conditions and ambient light were constant between the photos, preventing that these extraneous factors play a role in choice preferences. Three important processes that will likely change the landscape character in the future are assessed: (a) increased residential infill with increasing urban in-migration; (b) the cutting of tree lines and hedgerows for scale-enlargement in agricultural production; and (c) rewilding due to agricultural abandonment (Figure 5.5). New features like meadow grasses, housing and tractors were introduced as novel landscape elements representing the changes while in some photos tree lines and hedgerows were taken out.

In addition to the visual comparison, respondents were also given an explanation of the processes leading to these landscape changes. This was to establish a payment vehicle by which respondents understood how their contribution would contribute to landscape conservation (e.g. by clarifying that a yearly contribution from their taxes would go to farmers as a cost for maintaining the landscape). It was explained that many farmers were experiencing financial difficulty due to the current economic climate and potentially reduced subsidies. As part of farm survival strategies, some were presumed to resort to agricultural intensification while others were presumed to stop farming all together. These farmer decisions were linked to the landscape changes depicted in the photos. A landscape maintenance subsidy was proposed as a way to augment farmers' income and maintain the current landscape aesthetics. Respondents were asked how much they would be willing to contribute each year to such a landscape maintenance fund.

Revealed preference value estimate

The estimate of revealed preference was made by calculating a time cost demand curve for the sample group. This approach assumes that there is decreasing demand for visiting the region due to travel cost. A similar pricing procedure has been employed in other revealed preference valuation studies (Hein, 2011; Martín-López et al., 2009). Respondents' travel costs are calculated according to a 34 eurocent/km rate, which has been used in other valuation studies in the Dutch context (Hein, 2011). An average hourly wage of 14.70 euro is applied for travel time based on the average income of the sample and a 40 h work week. Travel time is calculated according to estimates in Google Maps. It is assumed that visitors travel by car to the area. Out of the sample group, the majority of respondents travelled by car (84%) while some respondents also travelled by public transport and bicycle (recreants). The demand curve is modelled based on the proportion of respondents visiting the region from different travel cost zones (Table 5.3). The total population of the different distance zones is divided by actual visits. The distribution of demand of the sample is assumed to represent total annual visits of all visitors to camping site and bed and breakfast as obtained from municipal records. From this visitation curve an estimate of the cost function can be extrapolated assuming that current visitation represents total demand. The demand curve was calculated using a simple linear extrapolation of increased travel cost. Based on this demand curve extrapolation, consumer surplus could be estimated by calculating the area under the curve.

5.3 Results

5.3.1 Respondent characteristics and preferences

Cycling and walking are the main activities that attract tourists and recreants to the case study area (Table 5.1). Respondents often qualified this expressing that the attractiveness of the landscape enhanced their enjoyment of such activities. Tranquility and rest was also an activity mentioned by a number of respondents. Tranquility scored high despite not being an option from the list of activities on the questionnaire. Swimming, shopping and eating were also often chosen and indicated as side activities to biking and walking. The results of the photo assessment of preferred landscape features are shown in Figure 5.2. Cultural buildings and tree lines were rated high and were often immediately recognised as distinctive for the region. Respondents also appreciated 'natural' features including brooks, forests and the knowledge that wild animals lived in the area. Respondents assessment of landscape structure revealed that forest patches interconnected with tree lines was most preferred (n = 56). A similar landscape structure with slightly less forest patches was second most preferred (n = 26). Those seeking leisure in the region were not overly interested in forest dominated landscape (n = 11) indicating a preference for a natural mosaic landscape (Figure 5.3).

Table 5.1 Respondents' assessment of tourist attractions for the Achterhoek region

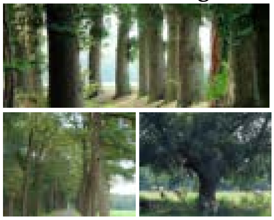
Activity	Top	Second	Third	Weighted value
Cycling	68	18	8	248
Walking	12	41	7	125
Swim	13	11	4	65
Tranquility and Rest	9	5	8	45
Shopping	0	9	14	32
Eat and Drink	0	4	20	28
Farm-based camping	2	4	6	20
Unique landscape	1	3	6	15
Visit family	3	0	5	14
Region specific recreational activities	2	2	1	11
Festival	1	1	4	9
Other	5	4	5	
Nothing	0	4	18	

**Note – Respondent were required to pick the top three activities that attracted them to the region. The weight value is calculated by applying a score of 3 to top answers, 2 and 1 to the second and third answers respectively.*

Cultural buildings

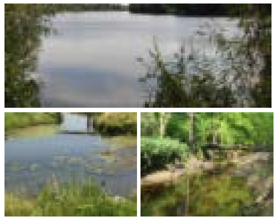
First choice	22
Second choice	26
Third choice	21
Weighted value	**139**

Tree lines and Hedgerows



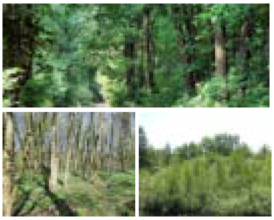
First choice	24
Second choice	17
Third choice	11
Weighted value	**117**

Lakes, streams and brooks



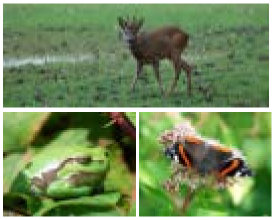
First choice	15
Second choice	8
Third choice	24
Weighted value	**85**

Forests



First choice	15
Second choice	14
Third choice	10
Weighted value	**83**

Wildlife Animals



First choice	9
Second choice	17
Third choice	10
Weighted value	**71**

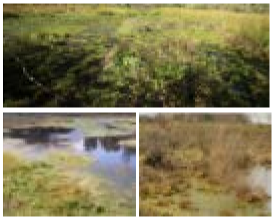
Villages

First choice	8
Second choice	13
Third choice	12
Weighted value	**62**

Agricultural lands

First choice	9
Second choice	10
Third choice	10
Weighted value	**57**

Marshes



First choice	4
Second choice	3
Third choice	7
Weighted value	**25**

Recreation areas

First choice	*3*
Second choice	*3*
Third choice	*4*
Weighted value	***19***

Heathlands

First choice	3
Second choice	3
Third choice	3
Weighted value	**18**

Stone Quarry

First choice	**3**
Second choice	**0**
Third choice	**2**
Weighted value	**11**

Figure 5.2. Respondents' assessment of important landscape features for the Achterhoek region

Mostly Forest

Forest 79%
Agriculture. 21%
Landscape elements. 0%
n = 11

Mixed forest with tree lines

Forests 38%
Agriculture 52%
Landscape elements 10%
n = 56

Mixed tree lines with some forest

Forests 19%
Agriculture 64%
Landscape elements 17%
n = 26

Only tree lines

Forests 8%
Agriculture 72%
Landscape elements 20%
n = 11

Tree lines with open landscape

Forests 3%
Agriculture 84%
Landscape elements 13%;
n = 6

Open landscape

Forests 0%
Agriculture 95%
Landscape elements 5%
n = 3

Figure 5.3. Respondents preference for landscape structure and composition in the Achterhoek region

5.3.2 Cultural service maps

Preference hot spots

The map of preference for landscape features indicates a number of hot spots where numerous features that are preferred by respondents are located (Figure 5.4). The municipality of Winterswijk and borders of Berkellend and Oost Gelre are areas with high values. This is due to the coincidence of numerous landscape features including tree lines, forests, cultural buildings and animal habitats in these locations. In the centre of map values are lower. These cold spots can be characterized as locations where there is an absence of visible animal habitat and where the landscape is dominated by open agriculture land and modern large scale farm businesses. In the map depicting preference for landscape structure a similar pattern is apparent. The similarity indicates that there is substantial overlap between the locations of landscape features and the landscape structure and composition that are valued by tourist respondents. Notable exceptions are areas that are dominated by forests. While in the features map, forests are indicated with moderately high values, the same areas in the structure map have low values. Respondents appreciate forest as landscape features but in terms of landscape structure they prefer mosaic landscapes with smaller areas of forest. Such difference cannot be distinguished in the analysis based on landscape features alone as the coincidence of forest and wildlife habitat contributes to higher scores in the landscape feature map.

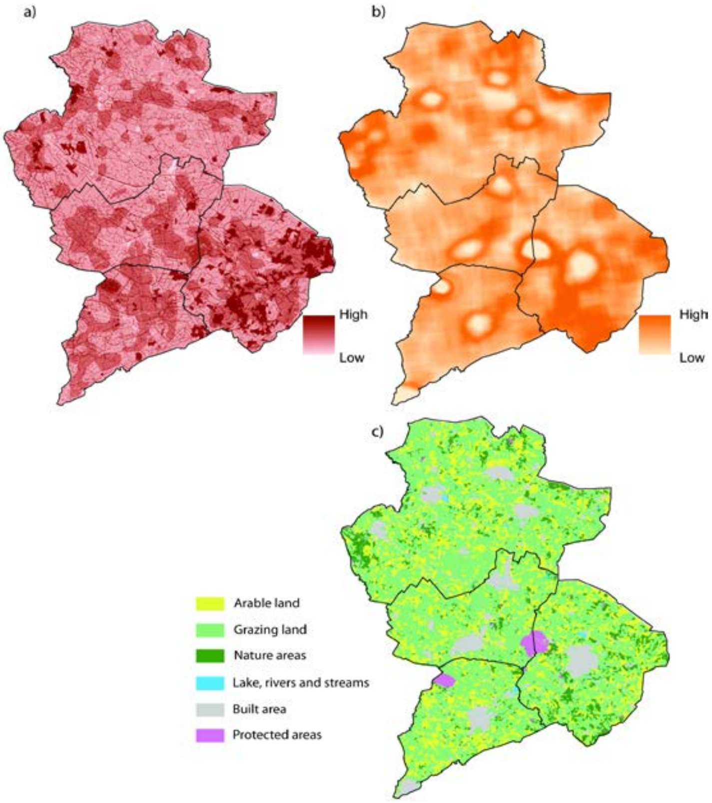


Figure 5.4. Maps depicting preference for landscape a) features b) and structure and composition as indicator of the values of cultural service; and c) land use of the case study area

5.3.5 Respondent groups and cultural services

Respondents' assessment of the landscape function showed that aesthetic beauty ($\bar{x} = 4.70$) and recreation (**Error! Bookmark not defined.Error! Bookmark not defined.**$\bar{x} = 4.16$) are highly valued services provided by the landscape in the region. Cultural heritage ($\bar{x} = 3.70$), inspiration ($\bar{x} = 3.27$) and spirituality ($\bar{x} = 2.38$) where rated less important. Statistical exploration of all responses revealed a number of determining factors for landscape appreciation. An independent t-test indicated that respondents living within 30 minutes of the case study area valued recreation ($\bar{x} = 4.59$), spirituality ($\bar{x} = 2.83$) and inspiration ($\bar{x} = 3.72$) higher than those living further away ($\bar{x} = 4.01$; $\bar{x} = 2.23$; $\bar{x} = 3.12$ *respectively*) ($t = 3.54$, $p < 0.001$, $n = 81$; $t = 1.93$, $p < 0.1$, $n = 113$; $t = 2.59$, $p < 0.01$, $n = 58$). For Dutch respondents ($\bar{x} = 3.83$) cultural heritage is more important in comparison to Germans ($\bar{x} = 2.60$) ($t = 3.33$, $p < 0.01$, $n = 18$). Similarly those visiting agri-camping sites appreciate cultural heritage ($\bar{x} = 4.50$) more than those staying in traditional camping sites ($\bar{x}$ = 3.45) (t = 3.26, p < 0.01, n = 80). Age also plays a role as respondents older than 50 appreciate the aesthetic beauty ($\bar{x}$ = 4.83) of the landscape more than younger respondents ($\bar{x}$ = 4.53) (t = 3.10, p < 0.01, n = 113). Repeat visitors to the area (>10 times) tended to have a higher appreciation of the cultural services.

The exploration of responses by way of a PCA uncovered three groups of like respondent preferences using the quartimax rotation method. Three components were retained despite the third component's low eigenvalue (0.85) as commonalities were adequately high for all variables (< 0.7). A total KMO revealed a mediocre fit (0.65); however, the Bartlett's test result was significant (<0.001). As the PCA was primarily used to group like clusters of respondents these results were deemed acceptable. A strong component score for each component also demonstrated useful groupings (Table 5.2). The first component is a group of respondents who rate inspirational and spiritual highly (total variance (tv) 30.4 %). The second component comprised respondents that score aesthetic beauty and cultural heritage highly (tv = 29.4%). The third component is made up of respondents who highly appreciate the landscape as a site for recreation (tv = 20.65).

Table 5.2. Principle component analysis of landscape function appreciation.

	Component		
Landscape function	1	2	3
Recreation	.064	.000	.983
Aesthetic beauty	.204	.825	.128
Cultural heritage	.147	.848	-.122
Inspiration	.847	.221	-.096
Spirituality	.857	.140	.159
Eigenvalues			
Total	*2.103*	*1.066*	*.852*
% of Variance	*42.061*	*21.329*	*17.037*
Cumulative %	*42.061*	*63.390*	*80.427*

The ANOVA t-test on the component groups revealed that there was substantial variation regarding preferences for landscape features (supplementary material-5.A). Respondents appreciating the spiritual and inspirational qualities of the landscape rated tree lines significantly higher ($\bar{x}$ = 1.40) than all other respondents ($\bar{x}$ = 0.83) (t = 2.35, p < 0.05, n = 76). Those with a strong appreciation of the aesthetic beauty of the landscape and cultural heritage value forest ($\bar{x}$ = 1.08) and animals ($\bar{x}$ = 0.92) more than the other groups ($\bar{x}$ = 0.55; $\bar{x}$ =0.47) (t = 2.47, p < 0.05, n = 113; t = 2.32, p < 0.05, n = 113). They have no regard for recreation facilities in the landscape ($\bar{x}$ = 0) comparing all others ($\bar{x}$ = 0.71) (t = -2.14, p < 0.05, n = 113). Respondents valuing the recreation possibilities provided by the landscape find an agricultural landscape much less important ($\bar{x}$ = 0.30) in comparison to the other groups ($\bar{x}$ = 0.61) (t = - 1.70, p < 0.10, n = 113). There was no difference between the groups concerning preference for landscape structure and composition.

5.3.4 Stated value

The mean WTP per year for landscape maintenance in Winterswijk is €86.18 per person (std. dev. 125.87) removing extreme outliers (1 respondent with a WTP more than 7% of his/her total net income was removed). Respondents most valued the conservation of the coulissen landscape. They were on average WTP €33.30 (std. dev. 83.37) to prevent farmers from cutting landscape elements to improve agricultural productivity. The conservation of the other landscapes was valued slightly less. Respondents would contribute €27.30 (std. dev. 59.56) to conserve traditional agriculture landscapes from increased residential infill and €23.87 (std. dev. 57.01) to prevent that extensive farming landscapes become overgrown and wild. Low WTP for the conservation of extensive farmland is attributed to the fact that respondents did not find the rewilding scenario problematic. When asked to rank the attractiveness of the landscape changes depicted in photo-manipulations, rewilding was rated highest by 62% of the respondents (Figure 5.6). Increased urbanisation at the expense of the traditional landscape was viewed as least attractive by 57% of respondents. The picture depicting a landscape with removed tree lines for increased agricultural productivity was ranked in the middle (60% of responses). This result contradicts respondents WTP for preserving the coulissen landscape, which received the largest monetary value. Of the total sample, 50% (n = 57) of the respondents were not willing to pay for the maintenance of the landscape. Many of those respondents were protest bidders who stated that they valued the landscape but were unwilling to contribute to its conservation. Respondents cited different reasons for their protest bid including a mistrust of government spending, low income, a conviction that current budget could cover landscape incentives and the uncertainty that investment would yield described services.

Figure 5.5. Case study photos and photo manipulations depicting landscape processes of i) Residential infill in the landscape ii) Removal of landscape element due to intensive agricultural production iii) Rewildng of extensive pasture lands

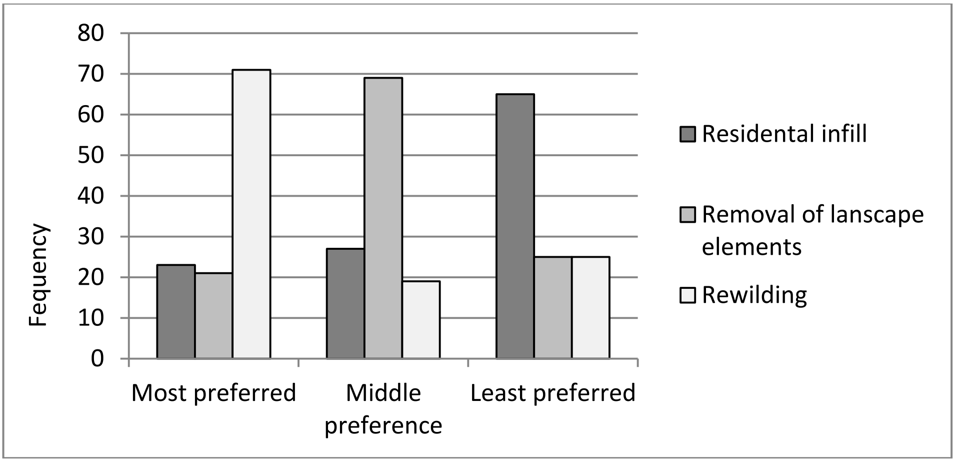


Figure 5.6. Respondents' preference for landscape evolution processes.

5.3.5 Revealed value

Based on the total number of visit per year presented in Table 5.3 and the assumption that our respondent sample is representative of total annual visitors trips of campers and those staying in bed and breakfast (n = 36,755), the relation between travel cost and visit rate is calculated. Eq. (5.1) describes the visit rate as a function of the travel cost for the municipality of Winterswijk.

(5.1) $$\text{Visit rate} = 16.804\, e^{-0.043 * \text{cost}} \qquad (R^2 = 0.85)$$

The demand function is calculated assuming that expenditures for travel are viewed as the cost to experience/partake in the services located in the study area. This does not include expenditures associated with lodging, which can be considered part of total cost of staying in the area to enjoy the cultural services. The resulting demand curve is presented in Figure 5.7. The area under the curve equalling the lower bound consumer surplus of the landscape services is approximately €850 000/year. This equals around €23 per visit.

Table 5.3. Visitor rates and travel costs to Winterswijk

Zone	Percent of respondents	Estimated total visit/year based camping visits	Zone population	Annual visit / 1000 people	Average Travel costs (€)
30km	16	5907	243 772	24.23	6.70
30-60km	16	5907	1 133 989	5.21	30.44
60-100km	23	8532	7 660 047	1.11	46.43
100-150km	13	4594	12 275 825	0.37	66.67
150-200km	23	8532	13 219 904	0.65	87.21
200-250km	9	3282	14 814 175	0.22	111.45
Total	100	36 755	49 347 712		

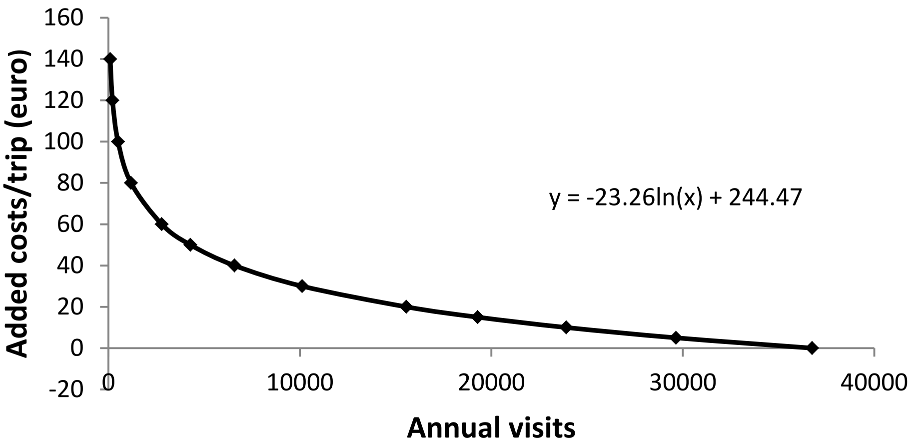


Figure 5.7. Demand curve for tourists visiting Winterswijk

5.4 Discussion

5.4.1 Overview

In this paper we have demonstrated a method for mapping and quantifying the provision of cultural services at the regional scale. By collecting indicators that could be linked to cultural services we were able to show spatial hotspots of cultural service delivery and make a lower boundary monetary estimate of services originating from the landscape. These different valuation techniques are rarely combined (Naidoo & Ricketts, 2006; Willemen et al., 2010), despite recognition that spatial monetary valuation is important for effective land management (Daily et al., 2009). Often, studies include spatial monetary values of services based on simple per hectare estimates derived from meta-analysis of case studies and/or national/global approximations (Lautenbach et al., 2011; Naidoo & Ricketts, 2006; Willemen et al., 2010). Per hectare values are then translated to pixel or administrative units. In our study we differentiate how landscape features and the structure of the landscape are valued. Based on these preferences we are able to discriminate between highly valued landscapes and less valued landscapes as well as, being able to understand the influence of individual landscape elements and their spatial structure. Contingent monetary valuation was also based on location specific characteristics. This spatial specificity of regional assets is important for balancing planning initiatives by allowing for the specification of suitable areas for developments and tailoring tourist amenities to specific groups.

The results show that regions that retain landscape features like cultural buildings, tree lines, lakes and rivers, forests and wildlife viewing are appreciated by visitors. Semi-managed landscape structures composing of forest patches interlinked with hedgerows have likewise been identified as important. The monetary estimate of these services, based on travel cost, place the lower bound value at €850 000/year for the municipality of Winterswijk alone. An estimate for the conservation of the landscape based on respondents WTP for maintaining current landscapes is €3.2 million. Given respondent bias such as warm glow (i.e. overestimation of WTP based on social stigma), the actual value of service might be more realistically placed somewhere in between these figures. It should be noted that these estimates only include the assessed cultural services. The landscape provides multiple functions in addition to cultural services. A total expenditure estimate for the income produced from tourism is probably much higher. In the study we do not account for lodging and other tourist expenditures such as those in the restaurant and entertainment industries.

To give an estimate of the cultural services for the entire case study region we extrapolate landscape preferences from Winterswijk to the other municipalities. We assume that landscape preference is related to the monetary values derived for the WTP exercise, as wells the travel cost estimate. Table 5.4 gives the per hectare value of the landscape distributing the total estimated value of cultural service as proportion of the feature valuation map. A comparison of the monetary value of cultural service for the different municipalities indicates that there is heterogeneity in assets. The municipality of Winterswijk has the highest value per hectare due to the abundance of appreciated landscape features and composition. Aalten, Oost Gelre and Berkelland are less valued. Such empirical evidence indicates that proposed incentives for landscape maintenance in Winterswijk are justified if they are successful in preserving these cultural services.

Most ecological indicators are based on ecological characteristics (i.e. species numbers, landcover), while not often considering societal preference for the associated services of these ecosystems. Societal preferences can dictate ecological processes in agricultural landscapes through human management of ecosystems. The integration of societal preferences into ecological indicators is a step toward providing policymakers insights into these ecological drivers (MA, 2003).

Table 5.4. Total and per hectare estimate of the monetary value of ES per municipality

	Estimate of monetary value of ES based on WTP (Total)	Estimate of monetary value of ES based on travel cost (Total)	Estimate of per hectare monetary value of ES based on WTP	Estimate of per hectare monetary value of ES based on travel cost
Winterswijk	850000	3.2 million	0.62€/h	2.31€/h
Aalten	490000	1.8 millon	0.50€/h	1.90€/h
Oot Gelre	510000	1.9 millon	0.46€/h	1.74€/h
Berkelland	1.1 million	4.2 million	0.42€/h	1.63€/h
Total	2.95 million	11.1 million	0.50€/h	1.90€/h

5.4.2 Quantifying cultural services

Many studies stress the importance of the quantification of cultural services while actual valuation is often limited to tourism amenities (Egoh et al., 2008; Nelson et al., 2009; Willemen et al., 2008). This is due to the difficulty in estimating how respondents value intrinsic characteristics like inspiration. Our investigation revealed that cultural heritage, aesthetic beauty, spirituality and inspiration play a role in attracting different tourists and recreants. Economic valuation studies have not been able to address this differentiated valuation of intrinsic qualities. Monetary estimates are usually given to broader environmental (Brouwer & Slangen, 1998) and tourist services (Martín-López et al., 2009) where intrinsic qualities are assumed to be valued and included. The danger of ignoring these differences is that characteristics associated with intrinsic qualities (cultural buildings, tree lines) are not valued for the important contribution that they make to total services delivery.

While our findings show that groups appreciate intrinsic qualities differently, only a weak link could be made to landscape features appreciated by them (supplementary material). Groups could not be differentiated according to their appreciation of the structure and composition of the landscape as indicated by their mapped preferences (Figure 5.8). This was also the case in the evaluation of the appreciation of the different trajectories of landscape evolution (Figure 5.7). High homogeneity in preferences and aversion to certain developments is likely the cause of this result. It may well be that when more subtle differences between landscape evolution would be evaluated there would be more difference between the groups. Howley et al. (2012) for instance found that a number of different socio-economic factors contribute to difference in the preference for small differences in landscape structure. This raises the question: can intrinsic qualities be usefully parameterised with spatial proxies? A number of spatial studies have addressed intrinsic service localisation (Alessa et al., 2008; Brown & Raymond, 2007; Sherrouse et al., 2011). Findings by Alessa et al. (2008) show that local community members demonstrate a highly developed sense of place for which they can differentiate locations with high capacity for intrinsic qualities like spirituality and inspiration. In the same study there was variation between communities in locating these areas, suggesting a highly spatial component in respondents' assessments where awareness and familiarity are important (Soini et al., 2012). In our study we aimed at defining more generic features using landscape photos, where spatial familiarity is not necessary. In contrast to residents, tourists are often much less familiar with maps of the region and are therefore less capable to indicate on maps locations with high value. Our method demonstrates a first step in unravelling how landscape function appreciation can be related to landscape features and structure and composition (see also Howley et al., 2012) and their location (Dramstad et al., 2006). The results also clearly illustrate that both individual features and the overall structure of the landscape are important and address different aspects of appreciation. Maps based on either of these approaches showed therefore, in some areas, contradicting results, providing more insight in the actual landscape characteristics and determinants of landscape value.

A drawback of assessing landscape value based on spatial criteria is that this does not consider rural dynamics where different processes and actors influence change in the landscape (Wilson, 2010; Van Berkel et al., 2011). It likewise does not provide information regarding the value placed on conserving a landscape in relation to the policy input needed. The WTP assessment gives an indication of the trade-off that societal actors are willing to make for the conservation of certain landscapes. Landscape managers and planners are often confronted with the dilemma that local budgets take precedence over maximisation of societal benefit. Understanding which landscapes are more valued is useful for targeting resources efficiently. In the Dutch case study, rewilding was not seen as overly problematic and this is supported by preference for semi-managed landscape structure. Recent findings likewise suggest that medium and high levels of succession with less human intervention are appreciated (Howley et al., 2012). The results of landscape composition and structure appreciation however indicate that large scale rewilding, leading to larger patches of natural vegetation may not be preferred. Such results indicate that while preventing re-wilding may not need policy priority, large scale forest regrowth will need attention.

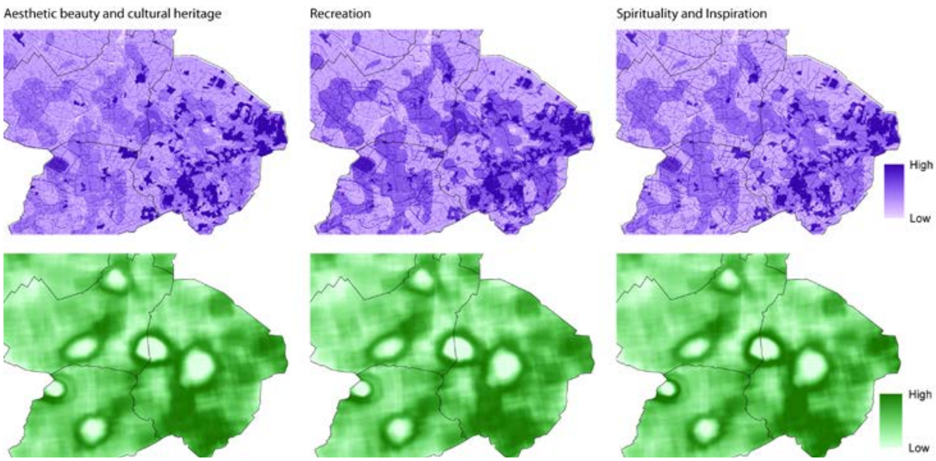


Figure 5.8. Comparison of different group preference for landscape features (Top row) and landscape structure and composition (Bottom row)

A drawback of assessing landscape value based on spatial criteria is that this does not consider rural dynamics where different processes and actors influence change in the landscape (Wilson 2010; Van Berkel et al., 2011). It likewise does not provide information regarding the value placed on conserving a landscape in relation to the policy input needed. The WTP assessment gives an indication of the trade-off that societal actors are willing to make for the conservation of certain landscapes. Landscape managers and planners are often confronted with the dilemma that local budgets take precedence over maximisation of societal benefit. Understanding which landscapes are more valued is useful for targeting resources efficiently. In the Dutch case study, rewilding was not seen as overly problematic and this is supported by preference for semi-managed landscape structure. Recent findings likewise suggest that medium and high level of succession with less human intervention is appreciated (Howley et al., 2012). The results of landscape composition and structure appreciation however indicate that large scale rewilding, leading to larger patches of natural vegetation may not be preferred. Such results indicate that while preventing re-wilding may not need policy priority, unless it is occurring at large scale.

5.4.3 The use of photo and photo-realistic montage as respondent prompts

It was hypothesised that photos would give an added dimension to questionnaire inquiry by helping in eliciting honest responses regarding respondent's ideas and feelings about the landscape. Photo and photo manipulated images are increasingly employed in participatory planning for helping in creating stakeholder buy-in (Lovett et al., 2010; Soliva et al., 2010; Van Berkel et al., 2011), and to illicit preference for landscape aesthetics (Dramstad et al., 2006). In this study they were effective. Photo of features were easily recognisable for respondents and they often commented that they enjoyed the exercise of ranking and comparing images. Representing landscape structure through aerial photographs was similarly accepted by respondents (see also Fagerholm & Käyhkö, 2009), despite reservation that the aerial view would be confusing for those unfamiliar with such spatial representations. The popularity of Google Earth/Maps may account for this. We also found that the landscape photos depicting the landscape evolution conveyed rich meanings that respondents could decipher. This was evident in respondent comparison of current and predicted photos. They often made specific comments about the features that had been added or taken away addressing issues such as the density of introduced housing, the extent of rewilding and the perspective of farmers for landscape management. The findings of this study suggest that using photos of ecological characteristics is an effective way to integrate societal preferences for landscape characteristic into ecological indicators.

The reliability of the accuracy of obtaining aesthetic preference by way of photos could not be judged, but findings are similar to other studies assessing visual preference for landscapes (Howley et al., 2012; Ode et al., 2009). Bias in responses is often an issue in preference and valuation studies. Weather condition and relaxation influence respondents' answers (De Groot & van den Born, 2003). In our assessment with tourists this bias may have been an issue. However, respondents did acknowledge that they appreciate local assets more in good weather conditions, suggesting that their responses took this into account.

5.5 Conclusions

The future of cultural landscapes is uncertain as both endogenous and exogenous processes will play a role in their future functionality. This study demonstrates that there is societal demand for the cultural services that such agricultural landscapes provide. Their continued resilience will require understanding the demands for service so that processes that might hinder their provision can be intervened upon. Spatial understanding of the assets delivered by the landscape can help in prioritizing areas for maintenance/restoration strategies while demonstrating the importance of conservation of cultural service delivery.

Chapter 6

"How can the farmers up here in Castro Laboreiro compete with those farmers in the valley with their good soils and easy access to the market....and for that matter how can we compete with farmers in the UK."

"We tried to set up the transport of our local goods to the market with everyone funding a monthly transport truck. But that didn't work because the cooperation broke down and people started to quibble about who had to pay for what."

Anonymous stakeholders (Castro Laboreiro, Workshop)

General discussion and conclusions

6.1 Mapping, modelling and discussing rural development options

The objectives of this dissertation were to analyze and quantify spatial and temporal aspects of rural development potentials, and to add insight into methods that represent the spatial variability and dynamics of rural change for stakeholder decision-support. These are aspects that have scarcely been addressed from a rural development perspective. The preceding chapters answered the following research questions using the European Union as a case study area:

1. How can rural assets related to different development options be identified and mapped?
2. What landscape characteristics determine the value of the landscape in providing cultural services?
3. How can spatial and temporal representations frame stakeholder dialogues to include understanding of the variability and dynamics of rural development potentials?
4. What tools can help in eliciting context-specific understanding of development options in terms of temporal dynamics and spatial variability?

In this concluding chapter an overview of the main findings of the above-mentioned sub-questions are discussed and reviewed as to whether they adequately answer the main aims of this thesis. These findings are examined in the context of the most relevant recent literature to evaluate their scientific relevance. The societal relevance of the finding is examined and the applicability of study is further discussed. Finally, this chapter ends with a brief synopsis about areas of research that could be investigated given the challenges and insights gained during the course of this study.

6.1.1 Overview of findings

Chapters 2 addressed how rural assets related to different development options could be identified and mapped. The concept of territorial capital was used to assess development options of intensive agricultural production, rural tourism, conservation, off-farm employment; and a combination of all of these for multifunctionality. Proxies of assets and constraints where combined to gain a picture of regions with favourable characteristics for the potential to develop these different sectors. The results indicate strong variation in rural development potentials. In Western Europe, regions with high rural tourism probability also share a high potential for conservation, while opportunities for intensive agriculture and off-farm employment are generally low. In other parts of Europe these correlations are less pronounced. Several regions offer limited potential in all four considered functions while few regions have potential in all four functions. Chapter 5 likewise showed that development potentials are spatially variable at a more detailed scale. This suggests that promotion of development will not have similar success everywhere. Evidence of the heterogeneity of sub-regional development potentials suggests that policymakers should account for this spatial variation in their local development interventions.

Chapter 3 and 4 investigated how spatial and temporal representations could help stakeholders understand and talk about rural development variability and dynamics.

Representations including maps, visualisations, photorealistic montages, scenarios and models were also tested for the ability to elicit from stakeholders context-specific information about the temporal dynamics and spatial variability that impact development potentials in their region. In *chapter 3* this was done using scenarios and visuals of possible land use and landscape changes as depicted in photorealistic manipulations and 3D maps. The technique allowed for discussing how landscape change in one location might feedback to alter possibility for other functionality within the region. Such specificity allowed for spatial comparisons between sub-regional locations. This is not often addressed in participatory decision support.

In *chapter 4* an agent based model (ABM) was used to simulate demographic, agricultural management and landscape dynamics under different policy options for the coming 25 years. This representation of future landscape dynamics was likewise used for discussion in a stakeholder workshop. By representing variation in behaviour and decision making of different agents inhabiting the region, stakeholders could view spatial changes that might occur given various responses to different policy incentives. The spatial variation of actors is not often explicitly considered in rural development evaluations. The use of ABMs advanced the portrayal of variation and dynamics of rural developments for stakeholders as it represents both environmental and social variability. The techniques used in chapter 3 and 4 each contributed to better contextualizing development options in the context of processes occurring inside and outside the region. This allowed for evaluation of the possibilities for development and the chance to formulate realistic intervention to valorize these potentials.

Chapter 5 looked closer at a representative landscape in order to better understand what characteristics of the landscape contribute to one of the most important rural development potentials of that region; namely, cultural ecosystem services for tourism and protection of cultural heritage. A survey was conducted to ascertain preferences for landscape composition and the conservation of certain landscape types. These preferences where translated into maps indicating the spatial variability of preference for cultural services. The achieved understanding of the spatial heterogeneity of service provision in the region and the monetary valuation of the assets delivered by the landscape each help in prioritizing specific locations for conservation. It can also aids in designing optimal strategies for maintenance or restoration of landscape features and structure that contribute to the provision of these services.

Each of these methods of mapping, modelling and the interactions with stakeholders contributed to understanding the spatial variability of environmental and human characteristics that influence development options. Such understanding helps the design of rural development measures that are adapted to the local potentials. At the same time, the methods to involve stakeholders in the process of identifying the potentials of the region may give incentives for stakeholders to engage in such participatory activities. Such participation can help in formulation of ideas that better activate the existing rural development potentials by incorporating stakeholder contribution in the design of rural development measures.

6.2 Scientific relevance

In this section the scientific relevance of the methodologies used for understanding development options is discussed. The methods employed originate from different disciplinary traditions that have not previously dealt with development options. While the different methods used enriched the understanding of different development potentials, their use in the development context posed a number of challenges. On the whole, discussions with stakeholders, modelling of rural processes and identification of development assets enhance the understanding of territorial capital.

6.2.1 Mapping and quantifying territorial capital and ecosystem services

A major component of this study has been the spatial identification of development options. While a number of studies have demonstrated that rural development potentials are unequally distributed, there are few spatial characterisations that explicitly address its analysis and representation. Most research has focused on describing rural development variability through descriptive text (Knickel et al. 2004; Van der Ploeg et al. 2000; Marsden 1999) or mapping traditional socioeconomic (Van Eupen et al. 2012; Blunden et al. 1996; ESPON 2006) and biophysical indictors (Piorr et al. 2009). 'Potentials' have scarcely been addressed due to disciplinary reluctance (Woods 2011) and difficulties with linking supply and demand for services (Nedkov & Burkhard 2011; Grêt-Regamey et al., 2010; Kienast et al. 2009; Willemen et al. 2010). In this dissertation a methodological framework has been presented that can help further investigations into the spatial representation of development options by mapping areas that can potentially be useful for society (i.e. functions). The methods address both the human and environmental dimensions of rural development by looking at preferences and values for landscape functions and the ability of the landscape to supply these services.

Methodologies for mapping and quantification

The methods applied in this dissertation for mapping development options can be described as 'supply' and 'demand' side approaches. Supply relates to the spatial configuration of assets that can be useful for society (i.e. functions) (Kienast et al. 2009), while demand refers to the characterization of benefits and services that are valued by society for rural functioning. This takes a utilitarian view of ecosystem service supply by explicitly investigating beneficiaries or society's demand for services. In chapter 2 the supply of various spatial characteristics were mapped to indicate the suitability for the development of different environmental and economic sectors. In chapter 5 societal preference of cultural service was collected for linking this demand to the structure and composition of the landscape and indicating locations suitable for the option of tourism. Methods for mapping supply and demand are diverse and related to scale and aim of study (Nedkov & Burkhard 2011; Grêt-Regamey et al., 2010).

Supply side mapping approaches have mostly dealt with the quantification of ecosystem services. These studies represent biophysical characteristics that indicate ecosystem service supply directly or indirectly. Different methods have been used for representing supply including the monitoring and georeferencing of biophysical processes. The monitoring of river discharge is an example of such quantification, indicating water extraction possibilities (cubic/m^2). Other techniques for mapping supply include representation of spatial proxies where causal relationships of ecosystem provision can be inferred. These generic rules are often based on expert opinion and literature consultation (Kienast et al. 2009; Norton et al. 2012). For instance different land cover/use can be weighted as to suitability for different ecosystem services (i.e. open farm land is a positive for agricultural production). Expert input allows for contextual representation of diverse spatial locations and different rural sectors. Often these techniques are transparent, allowing for easily understood and coherent logic of the relationship being described. Another method for describing generic rules is based on statistical inference of actual ecosystem service supply (Willemen et al. 2010). Association between observed ecosystem service supply and spatial data are made to identify important landscape determinants of such supply. These can be powerful tools for extrapolating generic relationships to location where there is limited information.

The mapping of supply conducted in this dissertation applied each of these different methodologies. Monitored biophysical data directly indicated biophysical service supply. For instance, the distribution of animal habitat provided by the Article 17 database (see chapter 2) allowed for the mapping of conservation potentials. In this capacity monitored data is a satisfactory indicator of one aspect of the total ecosystem service supply that results in function. Monitoring data was limited and/or unsuitable for indicating the contribution that human make in this supply (i.e. management of functions). Proxies representing the rural functions considered cannot be measured with such a simple one to one relationship. Instead numerous datasets that could approximate various aspects of territorial capital were used to understand these capacities. To produce these generic relationships experts were consulted. At the continental scale this was effective as experts could be relied upon for evaluation of multiple criteria of a broad array of factors (Kienast et al. 2009; Alcamo 2008). Stakeholders representing 10 EU countries combined to give an accurate picture of critical territorial capital for the functions investigated. The challenge of expert consultation was measuring personal, regional and disciplinary bias. Whether unconsciously or consciously experts will offer information that is representative of their area of expertise, consistent with their values, or particular to their given geographical understanding. This may result in the inclusion of biased or omitted factors. A statistical approach was used to validate these generic assumptions to avoid this bias. Maps could be produced for comparison using the locations of camping sites as proxies for attracting tourism based on associated landscape characteristics. However, here again data limitations restricted the ability for making deductive estimations for other services. Such approaches appear suitable for validating maps of ecosystem service supply. Options for improving this data limitation include crowds sourcing or wide scale questionnaires across multiple cases in Europe that test preference for tourism attraction like that done in chapter 5.

Methods for mapping demand side have mostly examined preferences and values attached to environmental services using social and monetary estimate techniques. Monetary estimates are based on econometric techniques like hedonic pricing which is similar to the model extrapolations described above (Cavailhès et al. 2009; Ma & Swinton 2011; Vanslembrouck et al. 2005). In these type of studies supply and demand are modelled as land price is related to proximity to different ecosystem services (e.g. lakes, scenic landscape) to indicate a monetary value of such service. Direct estimates based on actual market demand including observation of visitor rate to a region (travel/cost estimates) have been similarly used (Hein 2011; Martín-López et al. 2009). Willingness to pay estimates based on respondent evaluation are employed to make monetary estimates of non-market goods like conservation of species (Campbell 2007; Brouwer & Slangen 1998; chary-Bernard & Rambonilaza 2012). The mapping of these monetary estimates of the value of ecosystem service has often been done with rudimentary methods. In most cases direct prices are simply applied to spatial proxies of the service examined (value transfer methods) (Costanza et al. 1998; Naidoo & Ricketts 2006). Social valuation techniques include landscape preference determination through visual and map evaluation of different services (Soliva et al. 2010; Howley et al. 2012). Respondent evaluation of landscape characteristics help in understanding general criteria of visual preference (Soliva et al. 2010; Mari Sundli 2009). However, these generic preferences related to landscape characteristics have not been mapped (Dramstad et al. 2006). Participatory mapping is a technique where respondents can indicate a value for a location and service directly on a map (Alessa et al. 2008; Bryan et al. 2010). Such mapping techniques are useful for determining intrinsic values while often being biased towards individual sense of place (Alessa et al. 2008; Brown & Raymond 2007).

In this dissertation the mapping of demand was a challenge due to the scale of examination and inability to account for feedbacks that change demand. Current research has similarly had difficulty with mapping ecosystem supply and the associated demand with the exception of a limited number of studies (Nedkov & Burkhard 2011; Grêt-Regamey et al., 2010). Efforts are being made to map both supply and demand as this gives a more accurate picture of the beneficiaries of ecosystem services and the effective management of ecosystems. In chapter 2 proxies were used to give an indication of demand for better representing the supply of services. For instance, proximity to an urban area was used to indicate the services that are demanded by urbanites (e.g. light industry and horsi-culture). As there is no measure of potential demand (i.e. 'needed'/'requested') at this scale, this continental scale assessment represent actual supply rather than the potential supply. In chapter 5 an accurate description of societal and monetary valuation of cultural service was achieved using visitors' preference for landscape composition and structure, as well as, the conservation of the different landscape types in the Achterhoek. Again spatial description of demand for services enabled a better description of the supply of these services where generic rules based on preference could be applied to ecosystem service supply maps. The mapping of demand is difficult as it is determined by different stakeholder interests and values as demonstrated by chapter 5. Effort needs to be placed on finding proxies that represent the intricacies of demand while also being practical to map especially at global and continental scales (Grêt-Regamey et al., 2010)

The specific contribution to mapping and quantifying approaches achieved in this dissertation includes the mapping of proxies that indicate certain types of human and social capital; mapping at multiple scales, from large scale patterns to detailed variations; and within region-mapping of cultural services based on an empirical analysis of both features and structures of landscape contributing to these services.

Traditional mapping investigations of rural development have examined simple indicators related to human aspects of development including GDP change, accessibility, population, demographic structure, education levels (ESPON 2006). Such thematic based studies represent economic aspects of development while addressing social and environmental factors in rudimentary ways or not all (Van der Ploeg et al. 2012). Intangible factors such as entrepreneurial spirit, regional symbolic capital, cooperation, amongst other factors, are increasingly recognised as territorial capital related to development potentials. These factors are highly spatially variable and difficult to measure in spatial terms (Putnam 2001; Coleman 1990). The mapping of protective designation of origin (PDOs) and NGO cooperation in rural development initiatives (i.e. LEADER), achieved in chapter 2, signifies a conceptual step forward in representing these capacities spatially. To improve descriptions of rural development similar techniques for representing human and social capital can be used, as there are few sources of social data that would adequately capture such capacities.

The use of high resolution data likewise contributes to better differentiation of spatial factors contributing to development potential, especially regarding continental scales. In the EU, mapping at the continental scale is usually done using the NUTS administration level (Kienast et al. 2009; Blunden et al. 1996). This administrative boundary obscures the spatial variation of different environmental and human factors within regions. The use of several high resolution datasets allowed for better spatial accuracy. A comparison of different representations of the tourism development options explored in chapter 2 and 5 illustrate the achieved specification (Figure 6.1). NUTS scale representations classify Winterswijk uniformly. However, the 1km^2 and local scale 25m^2 resolution maps indicated heterogeneity in rural development potentials for tourism. A comparison of these different scale representations does illustrate that scale of comparison is important when visualising potential. EU wide representations are more applicable for EU policymakers for management of the entire territory, while the regional level better distinguishes subscale potentials.

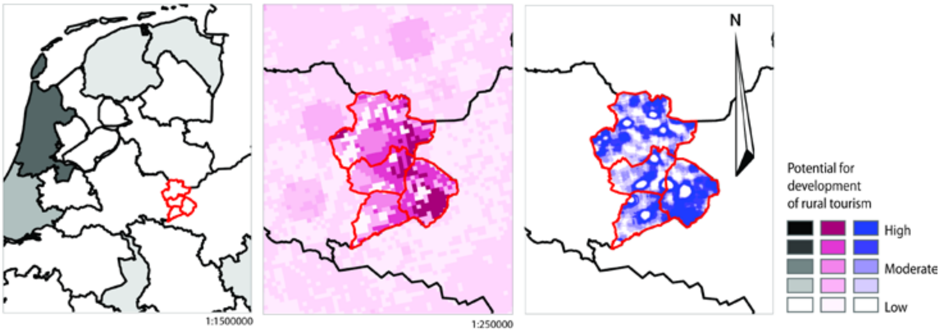


Figure 6.1. NUTS representation of rural development potential at continental scale and NUTS resolution (Left); continental scale 1km2 resolution (middle), local scale 25 m2 resolution (right).

In recent years, the number of studies that demonstrate methods for mapping and quantification of ecosystem services has increased. However, the analysis of cultural services remains basic. Quantification of cultural services has mostly been done by way of respondent preference in participatory mapping (Alessa et al. 2008; Brown & Raymond 2007). These methods require understanding of the spatial configurations of a location by respondents. The method demonstrated in chapter 5 addressed this by collecting non-spatial preference and translating these to spatial layers. Pictures of landscape features and structure and composition could be easily evaluated by survey respondents without the need to be familiar with the region. Such methods are important for their ability to develop generic relationships that are representative of different stakeholder evaluations of the services that landscapes provide. The method contributes to the advancement of techniques for the mapping and quantification of cultural services.

A challenge encountered in the mapping and quantification of ecosystem service was representing trade-offs between potentials. Such trade-offs are increasingly recognised as key to understanding societal and community level resilience and development (Wilson 2010; Cash et al. 2006; Haines-Young 2011). Trade-offs occur when certain developments exclude others. Increased agricultural intensification may exclude tourism, while conservation can be problematic for high agricultural production. The mapping of cultural services and development potentials gave a representation of options for development and favourable locations for conservation. However, the contributing factors that determine these options and societal preference often change over time as they are part of dynamic social and ecological processes. For instance, a positive image of a region can change, infrastructure such as a road network can be developed and different policy measures can be implemented that cause other land management practices. Ecological processes are likewise dynamic as forests grow, climate is variable and weather seasonal. These issues could not be addressed in the mapping approaches used in chapters 2 and 5 as these interactions were not simulated. To achieve a better analysis of these dynamics, model and scenario assessment were employed.

6.2.2 Methods for assessing future developments options with stakeholders

While often used in the context of decision support for rural issues and landscape planning, scenario and model assessment techniques have not been directly employed in rural development studies (Woods 2011). An overview of model and scenario exercises using scenarios and models is challenging due to the diversity of their usage. Each is tailored to diverse needs related to research question, disciplinary perspective and degree of computational mechanisation. Model-scenario based studies can be categorized into two groups; those that aim to make robust projections of future change and those that focus on stakeholder engagement and creative problem solving (Rounsevell & Metzger 2010; Alcamo 2008).

Model based projection studies focus on representing and simplifying the complexity of development through simulating scale interactions, policy alternatives and land use/cover change processes (Verburg et al. 2006c; Shaw et al. 2009). Scenario design in these studies strive for coherence and internally consistent assumptions from which future driving forces and relationship can be parameterized in quantitative simulation (MA 2003). In such cases, assumptions of socio-economic processes driving continental or global changes are used (Gerald 2006; Westhoek et al. 2006). The EURuralis (Verburg et al. 2008) and FARO-EU projects (Hermans et al. 2010) are examples where qualitative storylines and quantitative modelling of scenarios enabled land use change analysis. These and other studies focus on the driving factors of ecological (Wigley & Raper 1992) and human systems (Volkery et al. 2008; Rounsevell et al. 2006) at global and continental scales. Model based studies examining local smaller scale focus on how exogenous drivers (i.e. policy changes, economic markets) influence local processes (i.e. farmer/land manager decisions). Scenario construction is often based on the traditional axes method first developed within the SRES IPCC project, which separates economic policy in terms of degree of market regulation (free-market- regulated market) and scale of governance (local-global). This is done to achieve coherence and simplicity. However more place specific policy options have also been tackled where simulation of different regulations and intervention are used for policy evaluation (Kathrin et al. 2011; Valbuena et al. 2010). The utilization of stakeholder participation in scenario and model development is also increasing (Alcamo 2008). The degree of stakeholder involvement varies, including scenario formulation and role playing games for model parameterization (Voinov & Bousquet 2010).

The integration and engagement of stakeholder in model-scenario exercises for assessments of the future change is often less concerned with the predicative qualities of modelled projections. Often such studies focus on stakeholder learning, the communication of uncertainties and helping stakeholders step out of traditional ways of thinking (Xiang & Clarke 2003). The construction and design of scenario in these cases can include a spectrum of expert and non-expert input. For instance, the Bioscene project was only expert based (Soliva et al. 2008) while in the SCENES project stakeholders largely developed scenarios (van Vliet et al. 2010; Kok et al. 2006). Expert formulated scenarios have been helpful in determining landscape change preferences (Soliva et al. 2010; Dockerty et al. 2006) and with initiating discussion regarding long term development (Lindborg et al. 2009; Tress et al. 2005). The growing number of studies that fully rely on stakeholders to create scenarios use different techniques for model parameterisation including nominal (i.e. fuzzy cognitive mapping) and creative methods (collages, post-it session and storyline description) that connect stakeholders' contribution to model parameters in relatively straightforward ways. Other studies have been more decision support oriented using backcasting approach to help explore robust decision about an uncertain future (Carlsson-Kanyama et al. 2008; Kok et al. 2011; Quist et al. 2011). These studies are primarily concerned with participatory evaluation of future developments.

In this dissertation these different assessment methods were combined. Scenarios aided in coming to terms with unknown development pathways while models gave foresight about the complex processes driving rural dynamics. In the scientific debate surrounding assessment of future development there is often tension between these two methods. Model based projections can be seen as overly path dependent extrapolations that do not consider alternative development pathways (Van Asselt et al. 2010). Model based methods are also criticised for their inability to represent nonlinear developments. On the other side of the debate assessments based on stakeholder inputs are questioned for their accuracy. It is argued that the processes driving future change including scale interaction, different decision making actors and non-linear developments may be fundamentally misunderstood (Cash et al. 2006; Gibson et al. 2000). Stakeholder bias may also enter scenario formulation where self-interests, norms and values, which may or may not reflect future paradigms, can be represented (Metzger et al. 2010). The findings of this study and other studies, however, suggest that such tension is unnecessary (Salter et al. 2010; Shaw et al. 2009; Robinson 2003). In chapter 4 the two methods were mutually helpful in assessing future developments.

In addition, the presentation of scenarios, visualisation and model simulated results aided in ascertaining different stakeholders' values and interests for future developments. This stakeholder analysis is often neglected in participatory scenario development and stakeholder scenario evaluation. Evaluation of stakeholder values and interests is helpful in understanding judgments and actions that will drive local changes and subsequently affect future development potentials (Metzger et al. 2010).

In the introduction the use of scenarios to represent the multiple trajectories that are often possible in the European context was highlighted as benefit of their use. By juxtaposing different alternative developments stakeholders could evaluate the different ecological, social and economic trade-offs that might occur with different development pathways (Soliva et al. 2010; Tress & Tress 2003; Dockerty et al. 2005). For instance, re-wilding of the landscape in the Portuguese study was viewed as squandering a tourist asset. Agricultural intensification was likewise seen in the Dutch case as problematic for the standard of living and tourism. Many studies using scenarios are primarily concerned with evaluation of preferences for landscape aesthetics (Soliva et al. 2010; Dockerty et al. 2005). The challenge with decision support of rural development is that public preference is only one factor driving rural change. Stakeholder interests often drive local changes at these scales and therefore it is important to understand these sometimes competing goals. Issue based studies often do not explore these different interest thoroughly and are often limited to comparing different land development projects only (Tress & Tress 2003; Soliva et al. 2008). Insights from local actors were essential for describing where conflicts exist between stakeholder groups and how these play out over space and time.

In this dissertation scenario design can be described as 'mixed' as it included input from local stakeholders, experts and the researchers themselves. This approach was chosen as a way to contextualize scenarios for greater representativeness of local processes and accounting for issues of local concern. This consultation allowed for including processes in the scenarios that were familiar to the stakeholders participating. Researcher input was used as a means to create coherence in scenarios. It also allowed for inserting issues that appeared relevant for the development of the region, which through their representation could help in triggering discussion about these issues. In participatory scenario and model design expert input is often avoided on the grounds that this could overly influence the stakeholder process (Xiang & Clarke 2003; Van Notten et al. 2003). In model based projections that involve stakeholder input, stakeholder suggestions are often not integrated in model simulation parameterization due their high contextual specification or difficultly in parameterization (Verburg et al. 2006a; Voinov & Bousquet 2010). The mixed approach demonstrated in this study may be one technique to integrate these seemingly disparate perspectives together. Bayesian belief networks may likewise be employed as a technique to bridge modellers and stakeholders (Haines-Young 2011; McCloskey et al. 2011), as well as, fuzzy cognitive maps (Van Vliet et al. 2010) by systemizing stakeholders' parameters for models .

Discussing spatial and temporal processes with stakeholders is challenging as there are varying capacities for understanding these more abstract processes. The results of this study suggest that visualisations are helpful for conveying spatial information for eliciting reflection about location-specific characteristics. Maps, photos and photo manipulated visualisations were used effectively for engaging stakeholders in these more abstract discussions about the changes that can occur to a region. Challenges remain in ascertaining how visualisation composition can introduce bias into responses.

Model projections

The use of computer model simulations is a powerful tool for assessing multiple system dynamics where multiple small events and their broader combined implications can be understood. These causal relationship are the driving forces of social (Coleman 1990) and environmental systems (Foley et al. 2005). Different modelling techniques are available for making projections, each with their advantages and disadvantages (Verburg et al. 2006a). In this dissertation an agent based model was chosen over a cellular automata optimisation technique as it allowed for the simulation of ecological processes, decision-making and agent interactions. It also allowed for the representation of different decision making actors in comparison to mechanistic optimisation models that are based on analysis of the spatial structure of land use (Matthews et al. 2007; Valbuena et al. 2010). This local sensitivity was required for presenting findings to stakeholders highly familiar with local processes.

The use of ABM simulation for making projections about the future has been highly debated. Uncertainties related to nonlinear processes and paradigm shifts are often cited as arguments for limiting any predictive conclusions that result from models in general (Messina et al. 2008). ABMs in particular address highly uncertain social factors and processes. Human decisions about management, relationships of cooperation and attitudes that shape management strategies that drive ABM are highly unpredictable. For this reason, many authors have limited ABM projections to short time scales to avoid making overly deterministic projections (Matthews et al. 2007; Messina et al. 2008). These same uncertainties have also resulted in scarce use of ABM for decision support (Kathrin et al. 2011).

However, a number of authors have suggested that ABM are particularly suited to this decision support role (Matthews et al. 2007). Participatory modelling for instance has been one area where ABMs have aided in decision making about resource management (Etienne et al. 2003; Guyot & Honiden 2006; Becu et al. 2008). The prospect of dealing with future uncertainty using the inductive and deductive reasoning that is possible with ABMs is promising (Matthews et al. 2007; Axelrod, 1997). Deductive understanding based on empirical data of the inertia and constraints caused by current system dynamics can be mimicked and visualise using ABMs. Stakeholder evaluations of the behaviour of agents and scenario assumption can contribute to inductive reasoning incorporating visions of the future (Potschin et al. 2010). Interventions can be tested in model simulations beforehand to evaluate possible challenges for implementations of development goals. The findings of the study suggests that such an evaluative framework using ABMs can offers a systematic assessment of socio-ecological systems from which different expertise can evaluate wishes for the future and incorporate constraints in development planning (Robinson 2003).

When using agent based models for assessing future development the difficulty with interpreting and validating results should be considered. The simulation of multiple processes (policy interventions) agents (decisions, values) and the environment (heterogeneous space) often leads to difficulty in understanding which of these aspects is driving modelled outcomes (Messina et al. 2008). Sensitivity analysis is a method that can be utilized for understanding these dynamics (Pannell 1997). Such model simulation experiments are often revealing for understanding emergent properties of the system examined. The validation of model results is a challenge when working with ABMs. Different strategies include expert validation and calibrations based on observed land use/cover and social change data. In this study the model results were validated by experts, however data limitation prohibited a more systematic evaluation. An interesting prospect lies in validating the processes simulated with future observed landscape changes (Messina et al. 2008). In addition to making accurate predictions, models utility lies in exploring possible development pathways.

Model simulations are often credited with their ability for helping in informing policy-makers for decision support and for provoking discussions amongst stakeholders about modelled systems (Arciniegas et al. 2011; Verburg et al. 2010). However, model results can also be confusing and misunderstood by stakeholders (Voinov & Bousquet 2010). Such confusion can lead to scepticism, which is not conducive to constructive discussions. Technical complexity can also be viewed by stakeholders as superior to their own understanding of processes and lead to uncritical acceptance of model results. This has the potential for preventing necessary evaluation of results with contextual understanding of development processes (Sheppard 2001). Transparency of modelled results is often suggested as an important way to aid in stakeholder understanding of model assumptions (Van Notten et al. 2003). Different methods for creating transparency have been employed including stakeholder integration in model building (Patel et al. 2007), uncertainty analysis and open source model scripts (Valbuena et al. 2010). The findings of chapter 5 suggest that models that are largely expert driven and that address local concerns by including processes understood by stakeholders can likewise lead to such critical discussion. In the Dutch case, the model elicited discussion regarding development trends and results were critically examined. Participant's familiarity with the use of models for decision–making due to their planning background, may have contributed to their appreciation of the tool. Educational background and experience with these methods appears to be a contributing factor in acceptance of model outcomes. Results of the Portuguese study likewise indicated that governmental and NGO stakeholders appreciated 3D models, while farmers and entrepreneurs found them less interesting. The use of model results therefore should be tailored to the participating stakeholders as the perception of complexity may impede meaningful discussions. In cases where stakeholders are less technically trained photos depicting change may be a better tool for encouraging discussions (Lovett et al. 2010) as chapters 3 and 5 indicate.

6.2.3 Conceptual implications

Linking territorial capital, multifunctionality and ecosystem services

Territorial capital, multifunctionality and ecosystem service share many complementary conceptual underpinnings, however there has been limited theoretical integration. In the introduction, integration was conceptualised using the cascade model developed by Haines-Young and Potschin (2010) which was later modified by De Groot et al. (2010). It was argued that formulations addressing rural development require greater accounting of human capacities in transforming natural/environmental capital as these interaction determine the quality and quantity of ecosystem service supply (Verburg et al. 2009). In this dissertation each concept was used with complementary results. Mapping biophysical structures and process and the human capacity that influence these structures and processes indicated the functions and services obtained from ecosystems (Figure 1.1). The social and monetary valuation of these services can offer an understanding of the market and public value of these benefits. Identification of territorial capital gave an indication of the capacity for supplying different quality and quantities of ecosystem services and what limits apply to service provision. Evaluation in terms of multifunctionality offered the opportunity for understanding how the social, economic and environmental composition of rural areas is balanced. This gives an indication of the long-term resilience of these systems managed and used by society. While the introduction offers a brief conceptualisation, more research could be done on connecting these complementary concepts. This would add to integrated research approaches that examine social-ecological systems.

Need for more integration of social science and natural science methods

There is increasing acknowledgment that an integrated understanding of human management and organisation of resources, as well as, the competing interests and perspectives of stakeholders is needed to understand developments (Potschin et al. 2010; Lambin et al. 2001; Voinov & Bousquet 2010). This requires understanding of human and environmental processes involved. The challenge with this type of integrated work is that there is limited opportunity for in-depth investigation of each area of the system dynamic for individual scientists. Strategies to generate a more in-depth understanding of these human and environmental interactions have often relied upon multidisciplinary and interdisciplinary collaborations. Such projects strive to combine different disciplinary expertise with knowledge of these systems. The drawbacks of such an approach is that often methods and terminology employed in different disciplines is incompatible with one another (Verburg et al. 2006b). This can lead to disintegrated research applying pre-existing perspectives.

The research method chosen in this dissertation used different disciplinary methods, which are not commonly combined. Determining preferences and demands as well as evaluation of development options, required data collection methods usually applied in the social sciences. Different qualitative methods were used, which included interviews, surveys and stakeholder workshops. Methods usually reserved to natural sciences were also used including linear modelling, spatial modelling, mapping and photo manipulation. This aided in identifying and modelling development options and coming to terms with these complex processes. The combination of these methods allowed for a more complete picture of rural development both representing socio-economic and ecological drivers.

The further challenges of unravelling the complexity of social-ecological systems will require both deeper investigations of human and ecological processes, and research that brings these insights together for generalised understanding. This requires scientists familiar with methods and techniques from both social science and natural science perspectives. Different disciplines offer unique insights in finding solutions to these different challenges. Remaining closed to different techniques for understanding these complex issues would be a detriment to uncovering effective management solutions.

6.3 Societal relevance

Over the past 50 years rural areas have undergone a number of socioeconomic changes that have threatened the vitality of many rural communities. The displacement of agricultural production, for instance, and changing societal demands for rural services has resulted in lower incomes and challenges associated with rural restructuring in some regions. Weaker economic performance has been driven by out-migration of younger and better educated people, low public provision of services and overdependence on subsides (Ward & Brown 2009; Wilson 2010). In addition, many rural areas have experienced environmental degradation as a result of increasing intensification of agriculture and resource extraction. These developments threaten the resilience of socio-ecological systems as human activities erode the ability to produce the goods and services that sustain us (Kinzig et al. 2011; Henle et al. 2008). The examination of different development pathways is of fundamental societal relevance in anticipating what rural areas will look like in the future and evaluating how society can maintain fortuitous supplies of goods and services in sustainable ways (Van der Ploeg et al. 2012).

The importance of understanding these rural dynamics is increasingly being recognized as evident by the number of research projects that now consider rural issues and long-term thinking. In Europe alone the number of integrated studies exploring issues related to rural resilience is large: RUFUS - *Rural Future netwoks*; DERREG - *Developing Europe's Rural Regions in the Era of Globalization*; PLUREL - *Peri-urban Land Use Relationships*; ETUDE – *Enlarging Theoretical Understanding of Rural Development*; CAP-IRE -*Assessing the multiple Impacts of the Common Agricultural Policies on Rural Economies*; FARO - *Foresight Analysis of Rural areas Of Europe*. In addition to understanding rural dynamics, these studies, have focused on addressing societal and policy relevant questions. This dissertation is an example of a study that is highly applicable as it offers analysis, as well as, tools for the evaluation of rural development options.

6.3.1 Application of methodology and results

In the introduction a more integrated holistic strategy for managing rural areas was suggested as a better way to understand development processes. Holistic approaches have been widely supported in rural development literature with the concepts *leitbild*, multifunctionality and sustainable development (Potschin et al. 2010; Wilson 2010; Van der Ploeg et al. 2012). At the core of these concepts is the understanding that decision making is better served by more integrated development assessments. Integrated assessments as it applies to rural development often includes: 1) collecting and analyzing knowledge of local assets and constraints for development; 2) formulating visions for development that reflect characteristics and processes influencing the local community; and 3) the planning of and implementation of interventions that can generate development goals. Each of these criteria is fulfilled by the methods presented in this dissertation. Continental scale mapping of development assets and constraints contributed to gathering knowledge about development options. Consultation with experts and stakeholders in the different case study regions about local processes and evaluation of preference for cultural service likewise each served in this role. Scenario formulation with stakeholders and model parameterisation enabled vision formulation and testing of the feasibility of these wishes. Finally, policy-maker and stakeholder engagement allowed for the joint formulation of ideas about possible local interventions for such developments.

Tools for policy decision making support

Maps of assets and preference related to developing different rural sectors can help policymakers through their spatial specification of development options. Such maps enable targeting development intervention to locations based on regional potentials. For instance, regions with high potential for agricultural production based on biophysical condition may lack local capacity and technology for increasing production. Funds for improving agricultural practice through new technologies and educational programs may be appropriate in such cases. Likewise, regions with tourism and conservation potential may need funds for adequate promotion and management of these resources. Maps of development potential likewise can be used to increased efficiency of the management of natural capital throughout the EU. By providing incentives for environmental goods and services in locations that are competitively advantaged with these assets and discontinuing incentives for agricultural production in already productive areas, better use of policy budgets for providing societal service would be made (van Eupen et al. 2012; Verburg et al. 2010).

The methods tested in local case studies can also be used in practice by local decision-makers for integrated assessment of development plans. Such tools help in determining the feasibility of their local development plans from local stakeholder preferences, as well as, improving plans by integrating local knowledge. They represent a suite of tools that are especially useful at the community scale for engaging stakeholders in deliberation about which development pathways are possible and for helping in weighing local preferences, interest and values for development alternatives (Potschin et al. 2010). Scenario development based on local stakeholder input is a simple inexpensive method for presenting alternative development possibilities for wider community consideration in the development of visions for future development of the community by stakeholders. The inclusion of visualisation is more time consuming and expensive requiring considerable expertise. Model simulations likewise take considerable expertise and therefore may be difficult for local practitioners to implement at local scales. The possibilities that these methods create for creating community engagement is valuable in the context of local development planning. Engagement contributes to local capacity building through social learning and developing a proactive outlook to challenges encountered at the local level (Sheppard (Shaw et al. 2009). Often development success is determined by human and social capital, where local capacity is important for anticipating and responding to different exogenous pressures. Local responses are therefore closely linked with the resilience of rural communities (Wilson 2010).

Potential for rural development

A number of substantive conclusions can be made regarding potentials for rural development based on the investigation of the methods presented in this dissertation. The analysis of the spatial and temporal characteristics of the EU and two case study regions revealed different explanatory assets and constraints that contribute to rural development.

At the EU scale, the heterogeneity of development assets affects development potentials, which will result in divergent development pathways. High global demand for food will result in continued agricultural production in regions where climactic, topographic and accessibility reduces market costs for food and fibre production (e.g. the Netherlands, Po valley). The distribution of strategic factors for agriculture, while favouring currently strategic areas, may also be possible in Eastern Europe that have similar assets but where accessibility and landscape fragmentation are comparative disadvantages. Landscape restructuring and improving road networks could very well increase opportunities for increased agricultural production in these regions. The development of tourism will certainly be a major force shaping rural regions in the future. Western European countries will benefit from high demand due to comparatively larger urban populations. South and Eastern Europe, where agricultural modernisation has altered the landscapes less (Zimmermann 2006), can offer tourism attractions related to their natural landscapes and appealing climactic conditions. The development of conservation likewise has more potential in regions where human influence on the landscape has been less. The development of manufacturing, now a major contributor to rural incomes (Terluin 2003), will likely be competitive within regions near urban areas (Zasada 2011). Off-farm work may be enhanced in these locations while resource rich areas will also offer employment opportunities (Van der Ploeg et al. 2012).

Prospects for multifunctionality will likely be different for different regions. Proximity to urban areas will cause high demand for various services and this can result in multiple functions. Factors such as mosaic landscapes will provide habitat and possibly niche agricultural functions (Van der Ploeg et al. 2012). However, case study results also suggest that the quality with which these multifunctional landscapes develop will be determined by local human capacities (Wilson 2010). Results of chapter 3, 4 and 5 indicate that the development of multifunctionality as it relates to community resilience is more accurately described at local scales where the interaction and synergies between these domains can be detected (Wilson 2010).

The two different case studies offer the possibility to compare different prospect for multifunctionality. In each region (under)development has occurred where the ecological function has been preserved. The presence of these environmental assets is often viewed as important for developing multifunctionality (Wiggering et al. 2006; Cairol et al. 2009). The case study regions similarly have attractive cultural landscapes based on traditional agricultural management, unique biodiversity and a nationally recognised image related to these features. This is viewed as an opportunity to increase tourism in both cases (PRODER 2007; Dienst Landelijk Gebied 2010). The provision of subsidy incentive for management of the landscape is seen as a way for farmers to increase their income while providing a public good efficiently. Each region also shares challenges related to an ageing farming population and outmigration of young and educated people. The regions are divergent in terms of their adaptation to external pressures, which threatens the multifunctional character of each. Agriculture production capacity in Portugal is limited by biophysical constraints with the mountainous topography and poor soils. In the Dutch case study landscape elements are constraints to increased agricultural production. This has caused agricultural abandonment in Castro Laboreiro, while in the Dutch case study area the option of removal of landscape elements has allowed for increases in agricultural productivity.

The prospect of the regions for retaining their multifunctional character will likely be determined by the local human capacity for responding to these outside pressures. Market integration in the Dutch setting will increase individual farm income while, at the same time, also presenting a threat to environmental and cultural functions through increased production inputs and modernisation. The presence of strong governance from local institutions and NGOs, and their efforts to preserve local landscapes may limit the move towards monofunctionality. This capacity can additionally facilitate the reorganisation of farm management types to locations where agricultural intensification will not hinder ecosystems, while clustering more stewardship oriented farmers in unique landscapes. The Portuguese case study area on the other hand lacks mechanism for market integration, and there are few incentives for carrying on traditional management to preserve the landscape. The aging population, while preservers of the rich local traditions, are less inclined to engage in long-term community development and there are few who want take this up. The breakdown of this traditional social function will likely cause landscape change affecting the traditional functions of the area. In cases such as these, transition might be reasonable, encouraging biodiversity and tourism for development of an alternative social function (Pinto-Correia & Breman 2009).

Multifunctional success in the EU will likely be determined by regions that are able to activate their existing (endogenous) location-specific assets like a positive image of the region and local human capacity (Ray 1998; Shucksmith 2010). Chapters 3 and 5 indicate that effort should be placed on marketing local distinctive character like a unique agricultural landscape, cultural heritage or traditional production methods. Success in marketing will be determined by human and social capital for creating demand for local products and managing local resources for long-term viability. Payments for ecosystem service may also play a role and CAP policy reforms will likely include these incentives in the future (EC, 2010). Certainly incentives for land management and stewardship can be one option for convincing market oriented farmers to engage in practices that preserve cultural heritage and ecological elements for development or continued vitality of tourism related to these qualities. Programmes like LEADER+ can likewise stimulate multifunctionality through stimulation of niche markets and promotion of cooperation between policymakers, NGOs and rural stakeholders (Nardone et al. 2010).

6.4 Perspectives for further rural development research

The results of this dissertation uncover a number of questions for further inquiry and need for additional exploration of encountered methodologically challenges. One concept that could be further investigated is social capital in the rural development context. While social capital is often cited as an important determinant of rural development there have been few empirical studies that have attempted to measure its influence (Shucksmith, 2000; Nardone et al. 2010; Tisenkopfs et al. 2008). Jongeneel (2008) for instance examined trust of the government as indication of social capital in his study examining why farmers go multifunctional. However, the use of a single indicator ignores qualities of cooperation, social trust and shared values and behaviours, which contribute to such social capital (Capello et al. 2008). No studies have measured social capital in a spatially concrete way. Several examples were found where cooperation and trust were important for the success of the development of a certain sector or linked to failure as a result of a lack of cooperation. The mapping of rural actor social networks could be one way to track the influence of these interactions. Network analysis is increasingly being used for understanding qualities of social learning (Hermans, forthcoming). The use of agent based model may also be helpful in simulating the long-term effects of the social capital for rural development. There is scant investigation of actor interaction simulations in this rural development context.

Mapping and quantifying ecosystem service also revealed a number of challenges that need to be resolved. Data is especially challenging with few sources that can be linked to human capacities and preference for ecosystem service supply. Improving the quality and quantity of socioeconomic data collection would enhance possibilities for better indentifying development assets and these capacities. For instance, while education level and composition is widely known to be an important factor for local adaptation, in the EU this data is only available at large scale administrative levels and often differs by assessment criteria from country to country (Eurostat 2009). Other factors that cannot be easily linked to socioeconomic proxies, for example preference for landscape aesthetics (demand) and social capital, will need more innovation. In this regards crowd sourcing may be utilised. The analysis of the spatial distribution of uploaded photos to Google Earth for instance could be a valuable source of georeferenced data. This can help in determining the societal preferences for different landscape aesthetics. The vast amounts of data that is available from computer social networking sites may likewise be a source of data that can be utilised. Analysis of connection between actors can give an indication of cooperation and innovation possibilities through these social networks between regions.

One area that has yet to be thoroughly explored in this dissertation is the feedbacks caused by the development of different functions. For instance, economic studies often recognise competition as an important factor in the success of regional development. Surroundings functions can exclude, reinforce or hinder market advantage (Capello et al., 2007; Pfeifer et al. 2009). In land use science the notion of teleconnections likewise investigates the spatial feedbacks of land management decisions. For example, multifunctionality has been recognised as zero sum development where its establishment in one region might require increased food production, through monofucntionality, in another to meet global food demand (Wilson, 2009). The use of multiple scale models may be useful in capturing these different interrelations and feedback mechanisms. For this, standard agent-based model could be used to simulate development in different locations of the world and these results scaled up to endogenous decision-making models at national levels. This would help in understanding the global impact and feedback of local decisions for the development of different functions.

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Summary

Societies have always relied on the surrounding countryside to provide the benefits and services that sustain them. Services including food, raw materials for production, freshwater and inspiring landscapes have contributed to the well-being of people. Human activity has responded to spatial variability of assets related to these different services and modified landscapes to enhance their provisioning of services. A good example of such modifications is the construction of roads to transport food to urban markets. While these developments have improved human well-being, new and changing societal demands, population growth and increased resource extraction have caused a number of challenges for rural areas and communities. Rural areas face environmental degradation due to increasing intensification of agriculture. At the same time globalisation of markets has made the production of food less profitable in regions with natural handicaps. Rural restructuring has resulted in poverty and population out-migration in some communities and economic growth and growing pains in others. Uncertainty about how rural developments will impact environmental and human systems and the need to solve challenges faced by rural areas has required investigation into the factors that contribute to rural development. While there is high level of understanding about these processes, information on the distribution and dynamics of rural functioning to support management is scarce. Such understanding can enable effective management of rural areas that ensures continued benefit from rural areas.

Capacities for development are unequally distributed over space. To adequately manage rural functioning stakeholders and policymakers can benefit from knowing where different development options are likely to have success. Current rural literature lacks methods that articulate this spatial distribution of rural development capacities. One difficulty is that current maps depict traditional economic and social indicators like GDP, population growth, migration and education levels that tell very little about the potential of a region to develop agriculture or tourism. Human capacities and intangible factors are increasingly being implicated in the capacity for development, but these are not taken up in these maps. There is also a lack of detailed understanding of the distribution of potentials for development at local scales. Such development potentials are determined by different processes that change over time. Policy changes that alter subsidies can give different incentives to farmers and land managers. This type of development can also alter the function of different rural areas by for instance encouraging intensive agriculture, and improving the livelihood of some farmers. While this would increase food production other functions such as recreation and biodiversity that benefit wider society would be hindered. Often these trade-offs are not explicitly considered in development planning and there are few discussion support tools to help in deliberation regarding these spatial and temporal trade-offs. Therefore the objectives of this dissertation are to analyze and quantify spatial and temporal aspects of rural development potentials, and to add insight into methods that represent the spatial variability and dynamics of rural change for stakeholder decision-support.

This requires investigation of both social and environmental systems using different disciplinary perspectives and methods that are suited to such understanding. By linking the services that are obtained from rural areas with human management and the different interests regarding those services a more integrated understanding of development can be achieved. While the aim of the dissertation is the development of methodologies, a number of

substantive lessons and practical tools that aid local and continental scale decision making regarding the development of rural areas are obtained. The multi-scale approach is applied to the European Union and in two case studies that typify issues of restructuring in the European Union. Rural regions in the EU have experienced a diversity of challenge driven by multiple interrelated socio-economic, policy and environmental processes with multiple, and often conflicting, claims on land resources.

Chapter 1 gives a brief overview of the most relevant research that relate to this study. In *Chapter 2* a methodological framework is presented to identify development potential at the continental scale. The concept of territorial capital is presented as a way to assess both human and environmental assets related to the development options of intensive agricultural production, rural tourism, conservation, off-farm employment, and a combination of all of these for multifunctionality. As no comprehensive understanding of assets and constraints related to territorial capital are available these were determined through expert consultation. Different proxies were used to convert the responses into mappable layers and each layer was summed to give an indication of potentials in these sectors. The results indicate strong variation in rural development potentials. In Western Europe, regions with high rural tourism probability also share a high potential for conservation, while opportunities for intensive agriculture and off-farm employment are generally low. In other parts of Europe these correlations are less pronounced. Several regions offer limited potential in all four considered functions while few regions have potential in all four functions. Chapter 5 likewise showed that development potentials are spatially variable at a more detailed scale. This suggests that promotion of development will not have similar success everywhere. Evidence of the heterogeneity of sub-regional development potentials suggests that policymakers should account for this spatial variation in their local development interventions.

Subsequent chapters explore the local determinants of development that are not visible at the continental scale of examination. Chapter 3 and 4 investigated how spatial and temporal representations can help stakeholders understand and talk about rural development variability and dynamics. Representations including maps, visualisations, photo-realistic montages, scenarios and models were also tested for the ability to elicit from stakeholders context-specific information about the temporal dynamics and spatial variability that impact development potentials in their region. *Chapter 3* uses a number of qualitative techniques including interviews and stakeholder workshops to ascertain the assets and constraints for different rural developments in the Portuguese parish of Castro Laboreiro. Storyline descriptions of possible rural developments are constructed based on interview responses collected beforehand and presented to stakeholders in a workshop discussing spatial and temporal dynamics of rural developments. Photo-realistic montages depicting the expected landscape changes are used to complement storylines by giving a visual indication of possible landscape change that would affect the aesthetic character and function of the area. The use of these representative tools allowed for discussing how landscape change in one location might feedback to alter possibility for other functionality within the region. Such specificity enables spatial comparisons between sub-regional locations. This is not often addressed in participatory decision support.

In chapter 4 and 5 separate studies are conducted using the same case study location of Winterswijk. C*hapter 4* presents the findings of a study using an agent-based model (ABM) to help stakeholders consider, discuss and incorporate spatial and temporal factors driving development in their region. The agent based model (ABM) was used to simulate demographic, agricultural management and landscape dynamics under different policy options for the coming 25 years. Results of the model simulations are presented to stakeholders representing different rural sectors at a workshop. Stakeholder suggestions for development interventions based on the backcasting exercise are incorporated into the model to evaluate their effectiveness. By representing variation in behaviour and decision making of different agents inhabiting the region, stakeholders could view spatial changes that might occur given various responses to different policy incentives. The spatial variation of actors is not often explicitly considered in rural development evaluations. The use of ABMs advanced the portrayal of variation and dynamics of rural developments for stakeholders as it represents both environmental and social variability. The techniques used in chapter 3 and 4 each contributed to better contextualizing development options given processes occurring inside and outside the region. This allowed for evaluation of the possibilities for development and the chance to formulate realistic intervention to valorise these potentials.

Chapter 5 demonstrates a method to map and quantify the cultural services of a rural region. It examines a representative landscape in order to better understand what characteristics of the landscape contribute to one of the most important rural development potentials of that region; namely, cultural ecosystem services for tourism and protection of cultural heritage. Many studies quantifying ecosystem services limit their investigation of cultural services to mapping tourist potential. In rural areas intrinsic factors such as cultural heritage, inspiration and spirituality are important services that these landscapes provide. In the study we survey visitors to a Dutch rural area that is well known for its cultural landscape. Both a social and economic estimation is made of the value of the cultural service provided by the agricultural landscape. These are mapped to indicate important locations where the structure and composition of the landscape is valued. The achieved understanding of the spatial heterogeneity of service provision in the region and the monetary valuation of the assets delivered by the landscape each help in prioritizing specific locations for conservation. It can also aids in designing optimal strategies for maintenance or restoration of landscape features and structure that contribute to the provision of these services.

In the concluding chapter (6) the methodological contributions of the dissertation are discussed in relation to other approaches. As rural development research often lacks a spatial component, this thesis presents a first step towards understanding current and future spatial variability of development capacities. Each of these methods of mapping, modelling and the interactions with stakeholders contributed to understanding of the spatial variability of environmental and human characteristics that influence development options. Such understanding helps the design of rural development measures that are adapted to the local potentials. At the same time, the methods to involve stakeholders in the process of identifying the potentials of the region may give them incentive to engage in such participatory activities. This participation can help in formulation of ideas that better activate the existing rural development potentials by incorporating stakeholder contribution in the design of rural development measures. The dissertation is also an example of a study that is highly applicable as it offers analysis, as well as, tools for the evaluation of rural development options by stakeholders and policymakers. A number of substantive conclusions are made about the development of multifunctionality and future rural prospects based on case study findings.

The dissertation is also an example of a study both offering analysis and tools for the evaluation of rural development options by stakeholders and policymakers. The results are applicable in designing policy and planning interventions while the tools provide options to extent the approach beyond the case studies described in this dissertation. A number of substantive conclusions are made about the development of multifunctionality and future rural prospects based on case study findings. The heterogeneity of development assets will result in divergent development pathways throughout Europe. The distribution of strategic factors for agriculture, while favouring currently strategic areas, may also be possible in Eastern Europe that have similar assets but where accessibility and landscape fragmentation are comparative disadvantages. South and Eastern Europe, where agricultural modernisation has altered the landscapes less, can offer tourism attractions related to their natural landscapes and appealing climactic conditions for tourism and conservation. The development of manufacturing will likely be competitive within regions near urban areas. Prospects for multifunctionality will likely be different for different regions. Proximity to urban areas will cause high demand for various services and this can result in multiple functions. Factors such as mosaic landscapes will provide habitat and possibly niche agricultural functions. However, case study results also suggest that the quality with which these multifunctionality landscapes develop will be determined by local human capacities

Samenvatting

Samenlevingen hebben altijd vertrouwd op het omringende platteland voor een grote verscheidenheid aan diensten. Deze diensten, zoals voeding, grondstoffen voor productie, zoet water en inspirerende landschappen dragen bij aan het menselijk welzijn. Als reactie op de ruimtelijke variabiliteit die verband houdt met deze verschillende diensten hebben menselijke activiteiten landschappen veranderd om de levering van diensten te verbeteren. Een goed voorbeeld van deze aanpassingen is de aanleg van wegen om voedsel te transporteren naar markten. Hoewel deze ontwikkelingen het welzijn van de mens verbeterd hebben, zijn de maatschappelijke behoeften in de loop der tijd ook veranderd. Bevolkingsgroei en de toegenomen winning van grondstoffen zorgde voor een aantal uitdagingen voor gemeenschappen op het platteland. Plattelandsgebieden ervaren onder andere een aantasting van het milieu door intensivering van landbouw. Tegelijkertijd heeft de globalisering van de markten de productie van voedsel minder winstgevend gemaakt in gebieden met natuurlijke beperkingen. Rurale herstructurering heeft in sommige gemeenschappen geresulteerd in toegenomne armoede en de emigratie van de bevolking in tegenstelling tot economische groei in andere gemeenschappen. Onzekerheid over hoe de ontwikkelingen op het platteland van invloed zijn op het ecologische en sociale systemen, en de noodzaak om de problemen van het platteland op te lossen vereist onderzoek naar de factoren die bijdragen aan plattelandsontwikkeling. Hoewel er een hoge mate van inzicht in deze processen is, is de informatie over de verdeling en de dynamiek van het platteland ter ondersteuning van beleid minder vergevorderd. Dergelijke kennis kan een doeltreffend beheer van het platteland vergemakkelijken, zodat er ook in de toekomst geprofiteerd kan worden van het platteland.

Rurala Ontwikkelingsmogelijkheden zijn ruimtelijk ongelijk verdeeld. Om adequaat ruraal functioneren te verbeteren, kunnen belanghebbenden en beleidsmakers profiteren van kennis over de gebieden waar verschillende ontwikkelingsmogelijkheden waarschijnlijk succesvol kunnen zijn. De huidige literatuur ontbeert methoden die de ruimtelijke verdeling van de plattelandsontwikkelingscapaciteiten tonen. Een moeilijkheid is dat de huidige kaarten alleen traditionele economische en sociale indicatoren weergeven, zoals het BBP, de bevolkingsgroei, migratie en opleidingsniveau, die weinig zeggen over de mogelijkheden van een regio om de landbouw of het toerisme te ontwikkelen. Menselijke capaciteiten en immateriële factoren worden in toenemende mate betrokken bij de mogelijkheden voor ontwikkeling in rurale literatuur, maar deze zijn niet opgenomen in deze kaarten. Er is ook een gebrek aan gedetailleerd inzicht in de lokalisatie van de mogelijkheden voor ontwikkeling op lokaal niveau. Een dergelijk ontwikkelingspotentieel wordt bepaald door verschillende processen die veranderen door de tijd. Wijzigingen in het beleid waarbij subsidies veranderen kan leiden tot verschillende stimulansen voor boeren en terreinbeheerders. Dit soort ontwikkelingen kunnen de functies van de verschillende plattelandsgebieden ook veranderen, door bijvoorbeeld de stimulatie van intensieve landbouw en de verbetering van het levensonderhoud van een aantal boeren. Hoewel deze functieverandering zou leiden tot een verhoging van de voedselproductie, zouden andere functies waar de samenleving ook van profiteert (bijvoorbeeld recreatie en biodiversiteit) worden belemmerd. Vaak zijn deze afwegingen niet expliciet meegenomen in de

gebiedsplanontwikkeling en er zijn weinig beslissingsondersteunende instrumenten die kunnen helpen in het overleg tussen de verschillende belanghebbenden.

Het doel van dit proefschrift is daarom om de ruimtelijke en temporele aspecten van ruraal ontwikkelingspotentieel te analyseren en kwantificeren, en om zo inzicht te verschaffen in methoden die gebruikt kunnen worden met belanghebbenden om de ruimtelijke consequenties van veranderingen op het platteland inzichtelijk te maken.

Om dit inzicht te bereiken is onderzoek nodig naar zowel sociale als ecologische systemen met behulp van verschillende disciplinaire perspectieven en methoden. Door een verbinding te maken tussen de diensten die worden verkregen uit landelijke gebieden en het beheer en de belangstelling met betrekking tot deze diensten, wordt een completer begrip van de rurale ontwikkelingspotentieel bereikt. Het doel van het proefschrift was om een aantal methodologieën te ontwikkelen, maar daarnaast werden er ook inhoudelijke lessen getrokken en praktische instrumenten ontwikkeld die bijdragen aan het nemen van beleidsbeslissingen op lokaal en continentaal niveau gericht op het platteland. . Een meerschalige benadering wordt toegepast op de Europese Unie en in twee *case studies* die typerend zijn voor de herstructurering van het platteland in de Europese Unie. Plattelandsregio's in de EU hebben te maken gehad met een diversiteit aan uitdagingen, veroorzaakt door meerdere onderling samenhangende sociaal-economische, politieke en ecologische processen met meerdere, en vaak tegenstrijdige, claims op natuurlijke hulpbronnen.

Hoofdstuk 1 geeft een kort overzicht van het meest relevante onderzoek met betrekking tot dit proefschrift. In hoofdstuk 2 wordt een methodologie gepresenteerd om op continentale schaal de rurale ontwikkelingsmogelijkheden te identificeren. Het concept van territoriaal kapitaal wordt gepresenteerd als een manier om de zowel sociale als ecologische eigenschappen voor wat betreft de ontwikkelingsmogelijkheden van intensieve landbouw, plattelandstoerisme, natuurbehoud, niet-agrarische werkgelegenheid en een combinatie van deze mogelijkheden voor multifunctionaliteit te beoordelen. Aangezien er geen uitgebreide kennis van de eigenschappen en beperkingen van territoriaal kapitaal beschikbaar was, werden deze bepaald door het raadplegen van deskundigen. Verschillende proxy's werden gebruikt om de antwoorden om te zetten in ruimtelijke informatie en daarna werd elke laag opgeteld om een indicatie van de mogelijkheden in deze sectoren te geven. De resultaten laten een grote variatie in de ontwikkelingsmogelijkheden van het platteland zien. In West-Europa hebben regio's met een hoge potentie voor plattelandstoerisme ook een hoog potentieel voor natuurbehoud, terwijl de mogelijkheden voor intensieve landbouw en niet-agrarische werkgelegenheid over het algemeen laag zijn. In andere delen van Europa zijn deze correlaties minder uitgesproken. Verschillende regio's tonen beperkte kansen in alle vier de beschouwde functies, terwijl enkele regio's potentieel hebben voor alle vier. Hoofdstuk 5 laat zien dat rurale ontwikkelingsmogelijkheden ook ruimtelijk verschillend zijn op een meer gedetailleerde schaal. Dit suggereert dat het bevorderen van de ontwikkeling niet overal even succesvol zal zijn. Het bewijs van de heterogeniteit van subregionale ontwikkelingsmogelijkheden laat zien dat beleidsmakers rekening zouden moeten houden met deze ruimtelijke variatie in hun lokale ontwikkelingsmaatregelen. .

De volgende hoofdstukken verkennen de lokale determinanten van rurale ontwikkeling die niet zichtbaar zijn op de continentale schaal van het onderzoek. Voor de hoofdstukken 3 en 4 is onderzocht hoe ruimtelijke en temporele kennis belanghebbenden zou kunnen helpen in de discussie en het begrip van de variabiliteit en dynamiek van plattelandsontwikkeling.

Representaties, zoals kaarten, visualisaties, fotorealistische montages, scenario's en modellen, werden ook getest op de mogelijkheid om context-specifieke informatie van belanghebbenden te ontlokken over de temporele dynamiek en ruimtelijke variabiliteit die op ontwikkelingsmogelijkheden in hun regio van invloed zijn. Hoofdstuk 3 maakt gebruik van een aantal kwalitatieve technieken, waaronder interviews en belanghebbenden workshops, die zijn gebruikt om de eigenschappen en beperkingen voor verschillende rurale ontwikkelingen in de Portugese gemeente Castro Laboreiro vast te stellen. Beschrijvingen van mogelijke ontwikkelingen op het platteland in de vorm van verhaallijnen zijn geconstrueerd op basis van interviews en gepresenteerd aan belanghebbenden in een workshop waar de ruimtelijke en temporele dynamiek van de ontwikkelingen op het platteland is bediscussieerd. Fotorealistische montages die de verwachte landschapsverandering tonen werden gebruikt om de verhaallijnen aan te vullen doormiddel van een visuele indicatie van de mogelijke landschappelijke verandering, die het esthetische karakter en de functie van het gebied zou kunnen aantasten. Door het gebruik van deze representatie/hulpmiddelen was het mogelijk te bespreken hoe een verandering in het landschap op een locatie van invloed zou kunnen zijn op de mogelijkheden voor andere functies in de regio. Zo een specifieke benadering maakt het ruimtelijke vergelijkingen tussen de subregionale locaties mogelijk. Deze aanpak wordt nog niet vaak toegepast in participatieve besluitvormingsondersteuning.

In hoofdstuk 4 en 5 worden twee aparte studies uitgevoerd met behulp van dezelfde *case study* locatie: Winterswijk. In hoofdstuk 4 worden de bevindingen gepresenteerd van een onderzoek waarin een *agent-based model* (ABM) gebruikt is om *stakeholders*/belanghebbenden te helpen de ruimtelijke en temporele factoren die de ontwikkeling van hun regio beïnvloeden te integreren, overwegen en bediscussiëren. De ABM werd gebruikt om de bevolkingssamenstelling, het agrarisch beheer en de veranderingen in het landschap te simuleren onder verschillende beleidsopties voor de komende 25 jaar. De resultaten van de modelsimulaties werden gepresenteerd aan *stakeholders*, de vertegenwoordigers zijn van verschillende plattelandssectoren, tijdens een workshop. Suggesties van de *stakeholders* voor interventies voor de ontwikkeling van de regio werden geformuleerd in een *backcasting* oefening en later opgenomen in het model om hun effectiviteit te evalueren. Backcasting is de formulering van een optimale toekomst of meerdere toekomsten en hoe deze toekomst bereikt kan worden. Door het modelleren van variaties in het gedrag en de besluitvorming van de verschillende *agents* die in de regio wonen, kunnen beleidsmakers de ruimtelijke veranderingen die zouden kunnen optreden kunnen bekijken voor verschillende beleidsbeslissingen. De ruimtelijke variatie van actoren wordt niet vaak expliciet beschouwd in plattelandsontwikkeling evaluaties. Het gebruik van ABMs verbeterde de representatie van de variatie en dynamiek van de ontwikkelingen op het platteland voor de belanghebbenden, aangezien het zowel veranderingen in het milieu als in de sociale samenstelling worden meegenomen. De technieken die gebruikt worden in hoofdstuk 3 en 4 hebben elk bijgedragen aan een verbeterde context van de rurale ontwikkelingsmogelijkheden.Hierdoor konden de mogelijkheden voor ontwikkeling worden geëvalueerd en kan men realistische interventies formuleren door deze mogelijkheden te valoriseren.

In hoofdstuk 5 is een methode om culturele diensten van een landelijke regio ruimtelijk te kwantificeren gedemonstreerd. Het onderzoek is gericht op een representatief landschap, om zo beter te kunnen begrijpen welke landschapskenmerken bijdragen aan een van de belangrijkste ontwikkelingsmogelijkheden van de regio: culturele ecosysteemdiensten voor toerisme en de bescherming van cultureel erfgoed. Veel studies die ecosysteemdiensten kwantificeren beperken het onderzoek van de culturele diensten tot toeristische mogelijkheden. Op het platteland zijn intrinsieke factoren, zoals cultureel erfgoed, inspiratie en spiritualiteit ook belangrijke diensten die geboden worden door het landschap. In het onderzoek voerden wij een enquête uit onder Nederlandse bezoekers in een landelijk gebied dat bekend staat als cultureel landschap. Zowel een sociale als een economische inschatting zijn gemaakt van de waarde van de culturele diensten van het agrarische landschap. Deze zijn in kaart gebracht om de hooggewaardeerde locaties, op gebied van structuur en samenstelling van het landschap, eruit te lichten. Het bereikte inzicht in de ruimtelijke heterogeniteit van de dienstverlening in de regio en de monetaire waardering van de landschappelijke eigenschappen, helpen beide bij het prioriteren van specifieke locaties voor landschapsbehoud. Het kan ook helpen bij het maken van optimale strategieën voor onderhoud of herstel van landschapselementen en landschapsstructuur, die bijdragen tot de levering van deze diensten.

In het afsluitende hoofdstuk (6) worden de methodologische bijdragen van het proefschrift besproken in relatie tot andere benaderingen. Omdat er aan het onderzoek van plattelandsontwikkeling vaak een ruimtelijke component ontbreekt, presenteert dit proefschrift een eerste stap naar het begrijpen van de huidige en toekomstige ruimtelijke variabiliteit van rurale ontwikkelingscapaciteit. Elk van deze karteringsmethoden, modelleringen en de interacties met belanghebbenden draagt bij aan het begrip van de ruimtelijke variabiliteit van de omgeving en de sociale eigenschappen die de ontwikkelingsopties beïnvloeden. Een dergelijk begrip helpt het ontwerp van maatregelen voor plattelandsontwikkeling die worden aangepast aan de lokale mogelijkheden. Tegelijkertijd kunnen de methoden waarbij samen met de belanghebbenden de mogelijkheden van de regio worden geïdentificeerd hen stimuleren om mee te doen aan dergelijke participatieve activiteiten. Deze participatie kan helpen bij het formuleren van ideeën die beter de bestaande mogelijkheden voor plattelandsontwikkeling meenemen, door het opnemen van de inbreng van belanghebbenden in het ontwerp van maatregelen voor plattelandsontwikkeling.

Dit proefschrift is ook een voorbeeld van een studie die een analyse en verschillende gereedschappen biedt voor de evaluatie van plattelandsontwikkelingsopties door belanghebbenden en beleidsmakers. De resultaten zijn van toepassing in het ontwerpen van beleid en de planning van interventies, maar tegelijkertijd bieden de gereedschappen ook de mogelijkheid om de aanpak buiten de gebieden van de *case study's* beschreven in dit proefschrift toe te passen. Een aantal inhoudelijke conclusies over de ontwikkeling van multifunctionaliteit en het toekomstige plattelandsontwikkelingsbeleid zijn getrokken op basis van de *case studie* bevindingen. De heterogeniteit van de rurale ontwikkelingseigenschappen zal resulteren in uiteenlopende ontwikkelingstrajecten in heel Europa. De verdeling van strategische factoren voor landbouw, gunstig gebleken voor de huidige succesvolle gebieden, kan ook mogelijk zijn in gebieden in Oost-Europa met vergelijkbare voordelen maar waar de toegankelijkheid en fragmentatie van het landschap nadelen zijn. Zuid- en Oost-Europa, waar het landschap minder door de modernisering is aangetast, biedt een potentieel voor toeristische attracties die verband houden met het natuurlijke landschap, met natuurbehoud en met de aantrekkelijke klimatologische omstandigheden voor het toerisme. De ontwikkeling van industriële productie zal waarschijnlijk concurrerend zijn in de regio's in de buurt van stedelijke gebieden. De vooruitzichten voor multifunctionaliteit zullen waarschijnlijk verschillend zijn voor regio's. Nabijheid tot stedelijke gebieden zal leiden tot een grote vraag naar verschillende diensten en dit kan resulteren in meerdere functies. Ook andere factoren, zoals mozaïeklandschappen, zullen natuurlijke leefgebieden beïnvloeden en mogelijke niche agrarische functies mogelijk maken. Echter, uit de *case studies* blijkt ook dat de kwaliteit waarmee de multifunctionaliteit zich in deze landschappen ontwikkelt, wordt bepaald door de plaatselijke menselijke capaciteiten.

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The past four years have been a rewarding experience full of growth and discovery. It has been a tremendous journey with a number of unexpected twists and turns. While there were highs and lows, I have really enjoyed this process. I attribute this to good guidance, great friends and support from a number of tremendous people. I would sincerely like to thank those that have supported throughout this journey. A number of people have played an important role in the completion of this dissertation.

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About the Author

Derek van Berkel was born in Edmonton, Alberta, Canada in 1980. He obtained his Bachelor of Arts in Geography at the University of Calgary in 2004. In 2005 he moved to the Netherlands where he started his Master degree at Utrecht University. During his masters study Derek spent extensive time doing fieldwork in rural Cambodia. He graduated from the prestige master programme Human Geography and Urban Planning in 2007. In 2008 Derek started his PhD at the Wageningen University in the Land Dynamics research group. In 2010, he moved with his supervisor Peter Verburg to the Vrije University at the Institute of Environmental Studies. During his dissertation Derek conducted field studies in Portugal and the Netherlands. Derek's following job will be with the Appalachian forest research group in the department of Geography at Ohio State University in the US, where he will do post-doctoral research.

List of Publications

Van Berkel, D. & Verberg P., (*In Press*). Spatial quantification and valuation of cultural ecosystem services in an agricultural landscape. Ecological Indicators.

Van Berkel, D. & Verburg, P., 2012. Landscape. Combining exploratory scenarios and participatory backcasting: using an agent-based model in participatory policy design for a multi-functional landscape. Ecology Volume 27, Issue 5, Pages 641-658.

Van Berkel, D., Carvalho-Ribeiro, S., Verburg, P.H. & A. Lovett. 2011. Identifying assets and constraints for rural development with qualitative scenarios: A case study of Castro Laboreiro, Portugal. Landscape and Urban Planning 102(2): 127-141.

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The SENSE Research School declares that Mr. Derek Van Berkel has successfully fulfilled all requirements of the Educational PhD Programme of SENSE with a work load of 51 ECTS, including the following activities:

SENSE PhD Courses

- Research Context Activity: Organisation and participation in the multidisciplinary post graduate course "Land Dynamics: Getting to the bottom of Mount Kenya" and Organisation and participation in post graduate course "Ecosystem Services: integrating Science and Practice"
- Integrated Assessment of Agriculture and Sustainable Development, the SEAMLESS Model
- Biodiversity and ecosystem services in a sustainable world

Other PhD Courses

- PE&RC PhD Weekend
- Facilitation in a workshop context
- RUFUS seminars: PhD forum for discussing various rural issues
- Nederlands niveau B2
- Career perspectives, Managing your PhD. PROVU PhD Day

Management and Didactic Skills Training

- Organizing and activating the SENSE cluster XIII - Land use, spatial analysis & modelling/Ecosystem and Landscape Services
- Supervising one MSc and one BSc thesis
- Lecturing and supervising practicals for the MSc course Multifunctional Land Use, Wageningen University

Oral Presentations

- Mapping development options in Europe. EUGEO Congress, 13-16 August 2009, Bratislava
- Territorial Capital in rural Europe. EUROGEO conference, 8 May 2010, Prague
- Visualisations and scenarios as discussion support tools; and Mapping ecosystem services at the continental scale. GLP Open Science Meeting, Land Systems, Global Change and Sustainability, 17-19 October 2010, Phoenix, Arizona
- Mapping cultural ecosystem services in an agricultural landscape. ESP Conference, Ecosystem Services: integrating Science and Practice, 4-7 October 2011, Wageningen

SENSE Coordinator PhD Education and Research

Mr. Johan Feenstra

Appendices

Appendix 2.A - The weighting of assets and constraints for development of intensive agriculture

Territorial Capital	Spatial Characteristic	Proxies	Description of variable	Weight
High Potential productivity	Climatic and soil conditions for arable production	Potential for production of the crops wheat, spring barley, grain maize, rape seed, sunflowers, potatoes, sugar beets, field beans based upon soil parameters, weather information and crop factors (as modelled in the MARS project)	The combined potential for all crop types averaged and standardised	Continuous variable. 0 is no production potential; 1 is high production potential
	Favourable climatic and soil conditions for grassland productivity	Potential for grassland production based upon soil and climatic conditions		
Potential for mechanisation	Flat topography – conducive to mechanisation	Flat landscape - 0-20m elevation difference within a 10 km radius	Flat areas get full advantage due to ease of ploughing, mowing and grazing	1.0
	Rolling topography – moderately conducive to mechanization	Rolling landscape - 20-80m elevation difference within a 10 km radius	Rolling areas are moderately conducive to ploughing, mowing and grazing	0.80
	Hilly topography - Increasing difficulty for mechanization	Hilly landscape - 80-200m elevation difference within a 10 km radius	Hilly areas have strong limitations for ploughing, mowing and grazing	0.60
	Mountainous topography - limited to no possibility for mechanization	Mountainous landscape - greater than 200m elevation difference within a 10 km radius	Mountainous areas have no possibility for mechanisation	0.0

Territorial Capital	Spatial Characteristic	Proxies	Description of variable	Weight
Restrictive Policies	Limitation to nitrate application	Nitrate vulnerable zones – national designation for limitations to nitrate application. The nitrate directive is a long established policy with national and EU legislation making it a strong constraint to the use of this input for higher agricultural output. (Directive 91/676/EEC)	Nitrate vulnerable zones only	0.50
			Both Nitrate vulnerable zones that also lay within Natura2000 or other protected areas are assumed to have strong barriers for intensification	0.40
	European wide directives for protection of biodiversity	Natura2000 Site EU and nationally recognised Special Protection Areas (SPAs) for birds identified under the Birds Directive and Special and Conservation (SACs) Natura sites are only recently legislated and assumed to have moderate spatial influence. The policy is therefore weighted as less restrictive	Nature2000 sites	0.60
	National directives for protection of landscape and habitat IUNC cat. II	Other Protected areas – Include nationally protected areas, landscape and special interest sites (IUCN cat. Ia, Ib, II, III, IV, IV; Excluded landscape IUNC V code) All other protected areas fall outside EU jurisdiction and are assumed to be less stringent receiving lower weight against intensification.	Protected areas receive score as a constraint	0.70
	Absence of restrictive policies		Al other regions without restrictive policies	1.0

Territorial Capital	Spatial Characteristic	Proxies	Description of variable	Weight
Access to productive land for production expansion	Few limitations to increasing land holdings and mechanisation due to a lack of hedgerows and lack of landscape elements that limit scale enlargement	Open landscape/ agricultural landscape – Greater than 80 % of a 22.5 km^2 neighbourhood is agriculture land use	Open landscapes are assume to have the assets/ability for operation expansion	1.0
	Moderate limitation to increasing holdings and mechanisation due to hedgerows and other landcovers. Assumed complex tenure arrangements	Mosaic landscape – greater than 80% non agriculture land use disregarding urban (67% of a 9 km2 neighbourhood) and continuous forested areas (67% of a 9 km2 neighbourhood)	Mosaic landscapes are assumed to have hedgerow and tenure system that moderately limit agricultural operation expansion a s consolidation is still possible	0.70
	Limitation to increasing holdings and mechanisation due to forest landcover	Forest landscape greater than 67% forest in a 9km neighbourhood	Forest landscapes are less conducive to operation expansion but can be converted to agricultural land with large inputs	0.10
	Limitation to increasing holdings due to land use competition but chance for intensive farms	Peri-urban areas with > 25% urban/residential landuse in a 25km2 neighbourhood	Peri-urban landscapes are less conducive to operation expansion but high land prices are assumed be an incentive for high input agriculture	0.30

<table>
<tr><th>Territorial Capital</th><th>Spatial Characteristic</th><th>Proxies</th><th>Description of variable</th><th>Weight</th></tr>
<tr><td rowspan="6">Irrigation equipment access or potential for irrigation</td><td>Access to intensive management practices</td><td>Areas equipped for irrigation of all major agricultural crops in Europe</td><td rowspan="2">If ample precipitation in the main growing month (positive evapotranspiration rate) and presence of irrigation equipment assume buffer for agricultural production

If precipitation deficits for the main growing months (negative evapotranspiration rate) and irrigation equipment assume high production levels</td><td rowspan="2">1.0</td></tr>
<tr><td rowspan="2">Agricultural need for Irrigation</td><td rowspan="2">Evapotranspiration rate. Difference between precipitation and potential evapotrapiration based on average cloud cover and temperature in growing months – March to August</td></tr>
<tr><td rowspan="2">If ample precipitation in growing months and the biophysical conditions for the development of irrigation equipment then assume investments potentials (irrigation equipment) to obtain high production</td><td rowspan="2">0.70</td></tr>
<tr><td rowspan="3">Biophysical potential for irrigation</td><td rowspan="3">10km proximity to major river and with flat or rolling topography</td></tr>
<tr><td>If precipitation deficits for the main growing months and the biophysical conditions for the development of irrigation equipment then assume that large investments are needed (irrigation equipment) to obtain high production</td><td>0.50</td></tr>
<tr><td>If ample precipitation in growing months without biophysical potential for irrigation than assume moderate constraint for intensification</td><td>0.60</td></tr>
</table>

Territorial Capital	Spatial Characteristic	Proxies	Description of variable	Weight
			If precipitation deficits for the main growing months without biophysical potential for irrigation than assume large constraint for intensification	0.30
Proximity to demand nodes	Demand for agricultural products	Travel time to large urban centres and commercial hubs.	Average time/cost for urban centre >100000 (SUC), >500000 (MUC), >650000 (LUC) and Ports (Harbours) 150 ton/year The variable is measured in meters/second	Continuous 0.0 -1.0

Note: All urban areas, as defined by a 1km by 1km aggregation of the Corine land cover map developed for the EURULIAS project (Verburg & Overmars, 2009), are excluded. All mountainous areas are also excluded (see definition above) as there is a limited chance for intensive agriculture in these areas.

Beach, dunes and sands, salines and water and coastal flats are given a null score as there is no potential for agriculture on these surfaces.

Appendix 2.B - The weighting of assets and constraints for development of non-agricultural employment

Territorial capital	Spatial Characteristic	Proxies	Variable description	Weight
Urban demand for rural goods and services	Accessibility	Travel time to large urban centres and commercial hubs.	Average time/cost for urban centre >100000 (SUC), >500000 (MUC), >650000 (LUC) and Ports (Harbours) 150 ton/year. The variable is measured in meters/second	Categorical variable 1.0 – 0.1
Entrepreneurial spirit	Experience in rural development and engagement in public private partnerships resulting in small business creation. *Calculated as the average of development experience and public private partnerships*	*Development experience* The location and history of LEADER projects in rural EU countries.	New LEADER sites (1999-present). A new leader project is assumed to have little experience	0.6
			Old LEADER sites (1991-1999). Old leader project may have had experience but now lacks funding	0.8
			Long-term LEADER sites (1991-present). Long term project have both experience and funding	1.0
			With no LEADER projects we assume that there is limited entrepreneurial spirit	0.30
		Public private partnerships: Number of PDOs and	High is classified as 7 or more PDOs	1.0
			Moderate is classified as 4-6 PDOs	0.80
			Low is classified as 1-3 PDOs	0.60
		Public private partnerships: Locations of clusters of camping sites	Clusters of camping sites – neighbourhood of 4km with 2 or more campsites	1.0

Territorial capital	Spatial Characteristic	Proxies	Variable description	Weight
		All other regions		0.30
Supply of rural services and products	A supply of rural based employment. This can be urban demands for rural services, primary sector production or heavy and light industries *A region can have one of the different employment assets or not, they are not cumulative*	Urban demands for rural services. Larger centers have larger demands	Large centre (pop. >750000) have demand edge of 2 hours travel time Moderately large centres (pop. >500000) have a demand edge of 1 hour 30 minutes travel time. Moderate centres (pop. >250000) have a demand edge of 1 hour travel time. Moderately small centres (pop. >100000) have a demand edge of 30 minutes travel time. Small centres (pop. >60000) have a demands edge of 15 minutes travel time. Very small centres (pop. >25000) have a demand range of 10 minutes	Each areas receives 1.0
		Supply of natural resources for use in primary production	Mineral mines	
			Productive forests 60 percent of a 1km2 areas covered by forest	
		Heavy and light industries	Waste disposal sites dumpsites for all of Europe	
			Location of industrial areas	

Note: All urban areas, as defined by a 1km by 1km aggregation are excluded.

Appendix 2.C - The weighting of assets and constraints for development of rural tourism

Territorial Capital	Spatial Characteristics		Proxies	Variable description	Weights
Supply of Sun, Sea and Sand Calculated by multiplying weather by the assets of sand, campgrounds, and coastal areas.	Positive biophysical characteristic	'Sunny' weather	The number of months above 15 degrees Celsius	The max value of 9 months above 15 is scored 1.0. Zero months above 15 is scored 0.55 All other values are evenly distributed between the min and max. This assumes that sunny areas have a larger draw than less sunny areas	Categorical 0.55 – 1.0
		Beaches (Tourist infrastructure associated with beach tourism)	Location within 5km or 10km distance from beaches	Regions within 5km of sand beaches and within a cluster of campgrounds constitute a large tourist draw	1.0
				Regions within 5km of a sand beach or close to a cluster of campgrounds	0.90
		Coastal areas	Location within 5km or 10km distance from the coast	Regions within 10km of sand beaches are assumed to have a moderate tourist draw	0.80
	Tourism infrastructure	Clusters of Camping	Clusters of Camping sites – neighbourhood of 4km with 2 or more campsites	Coastal areas within a 5 km distance from the coast are assumed to have tourist draw	0.70
				Coastal areas within 10 km distance from the coast are assumed to have moderate tourist draw	0.6
	All other regions in the EU				0.0

Territorial Capital	Spatial Characteristics		Proxies	Variable description	Weights
Supply of attractions for winter tourism *Calculated by multiplying travel time temperature, precipitation and topography.*	Accessibility		Travel time from urban centres - Average time/cost for urban centre >100000 (SUC), >500000 (MUC), >650000 (LUC) and airports	Greater accessibility increases usage of winter assets. The variable is measured in meters/second	Continuous variable 0.0-1.0
	Positive biophysical conditions	Weather conditions	Average temperature for the main winter months (Dec, Jan, Feb and March)	Colder temperatures increase supply of winter tourism assets (i.e., snow) Winter temp. is weighted by 3 as this is believed to have a large influence on winter tourism	
			Average precipitation for Europe	More precipitation increase supply of winter tourism assets (i.e., snow)	
		Slope and topography for downhill skiing	Elevation for all of Europe (1km2 DEM)	Larger mountain and topography supply snow and ski slopes respectively.	
	Attractive landscapes		Open landscape.	Less attractive for winter activities in comparison to forested and mosaic	0.0
Supply of attraction for Nature Tourism All assets are added. The aggregate assets are standardised from 0 to 1 for comparison to the other tourism supplies	Positive biophysical conditions	Aesthetically pleasing and recreation areas	Lakes and rivers-location within 5km of lakes and 2km within rivers.	Lakes and river are a strong rural asset for tourism	1.0
		Landscape variation	Flat landscape - 0-20m elevation difference within a 10 km radius	Regions have little variation and are less attractive for tourist	0.3
			Rolling landscape - 20-80m elevation difference within a 10 km radius	Regions have moderate variation and are moderately attractive for tourist	0.5

Territorial Capital	Spatial Characteristics		Proxies	Variable description	Weights
			Hilly landscape - 80-200m elevation difference within a 10 km radius	Regions have high variation and are highly attractive for tourist	0.7
			Mountainous landscape - greater than 200m elevation difference within a 10 km radius	Regions have very high variation and are exceptionally attractive for tourist	1.0
			Very mountainous landscape - greater than 00m elevation difference within a 10 km radius	Regions are inaccessible	Null
		Degree of human interventions	Open landscape/ agricultural landscape – Greater than 80 % of a 22.5 km² neighbourhood is agriculture land use	Regions have a moderate level of human intervention resulting in moderate levels of tranquility	0.3
			Mosaic landscape – greater than 80% non agriculture land use disregarding urban (67% of a 9 km2 neighbourhood) and continuous forested areas (67% of a 9 km2 neighbourhood)	Regions have a low level of human intervention resulting in moderate levels of tranquility	0.7
			Forest landscape greater than 67% forest in a 9km neighbourhood	Regions have a very low level of human intervention resulting in very low levels of tranquility	1.0
			Peri-urban areas with > 25% urban/residential landuse in a 25km2 neighbourhood	Regions have a high level of human intervention resulting in limited tranquility	0.0

Territorial Capital	Spatial Characteristics	Proxies	Variable description	Weights
	Policy instruments	Protected landscapes	Location of Natura protection sites and national park throughout Europe are strong assets for rural tourism	1.0
	Tourist attractions	Locations within 5km of UNESCO world heritage sites and IUNC natural monuments (cat III) (natural monuments)	Natural and UN designated regions of special historical of natural significance are a tourism draw	1.0
		High nature value farmland farther than a hour and within 3 hours away from large urban centres (>600000)	High nature value farmland that is accessible by urban resident but too far few day trips can be a strong tourism assets.	1.0
Symbolic capital	Experience in rural development and engagement in public private partnerships resulting in area promotion and dynamism *Calculated as the average of development experience and public private partnerships*	*Local cooperative networks (PPP)* Number of PDOs	New LEADER sites (1999-present). A new leader project is assumed to have little experience	0.6
			Old LEADER sites (1991-1999). Old leader project may have had experience but now lacks funding	0.8
			Long-term LEADER sites (1991-present). Long term project have both experience and funding	1.0
		NGO operation and cooperation The location and history of LEADER projects in rural EU countries.	High is classified as 7 or more PDOs	1.0
			Moderate is classified as 4-6 PDOs	0.80
			Low is classified as 1-3 PDOs	0.60
		All other regions		1.0

Note: All urban areas, as defined by a 1km by 1km aggregation developed by the EURULIAS project, are excluded.

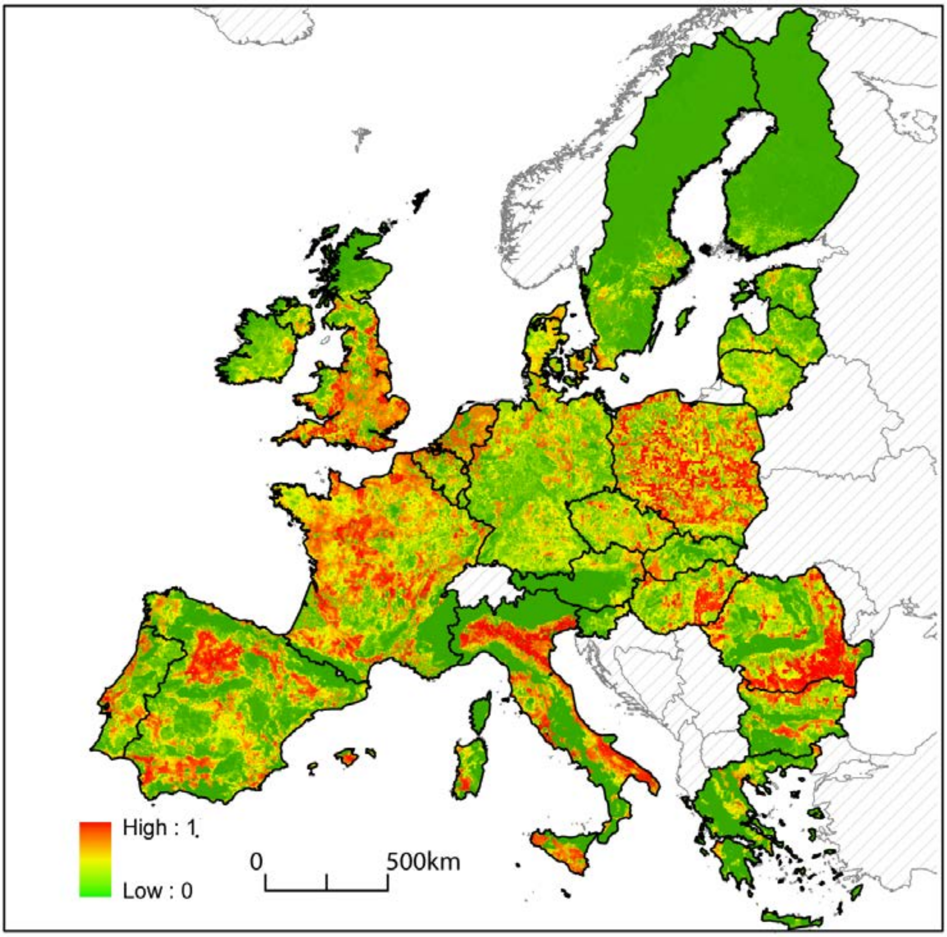
Appendix 2.D - The weighting of assets and constraints for development of nature conservation

Territorial capital	Spatial Characteristic	Proxies	Variable description	weight
Societal demand for protection of biodiversity	Presence of iconic plants and animals including habitat and areas of movement of plants and animals with a number classified as 'at risk" Average (Plants and mammals at risk + habitat corridors).	The sum of all mammals and plants ranges at risk or with a dangerous future population trend as designated by the EIOnet	The sums of plant and animal species at risk are given double weight and distributed between 0.0 and 1.0 with 1.0 being the greatest occurrence of species at risk	Categorical variable (0.0-1.0)
		Important corridors as defined by the peen project.	A 10km buffer of nature corridor is used. High nature value farmland, forest and water bodies are mask to give an indication of actual habitat along corridor routes	1.0.
Space for the movement of animals and seeds	Degree of Fragmentation	Proximity from transportation networks radiating from urban areas with population >100000 small urban centre (SUC), >500000 medium urban centre (MUC), >650000 large urban centres (LUC) and as a function of different topography The variable is measured in meters/second and is categorical	This variable weights transport methods differently with internal areas (minor road infrastructure) given more weight as these areas are less fragmented by large infrastructure. Likewise with mountainous areas less weight is given as major corridors in these regions are assumed to coincide with animal and plant movement and a major constraint to conservation.	Continuous variable (0.0-1.0)
Absence of human disturbance for	Degree of human disturbances	Each landscape is assumed to have a different human disturbance level.		

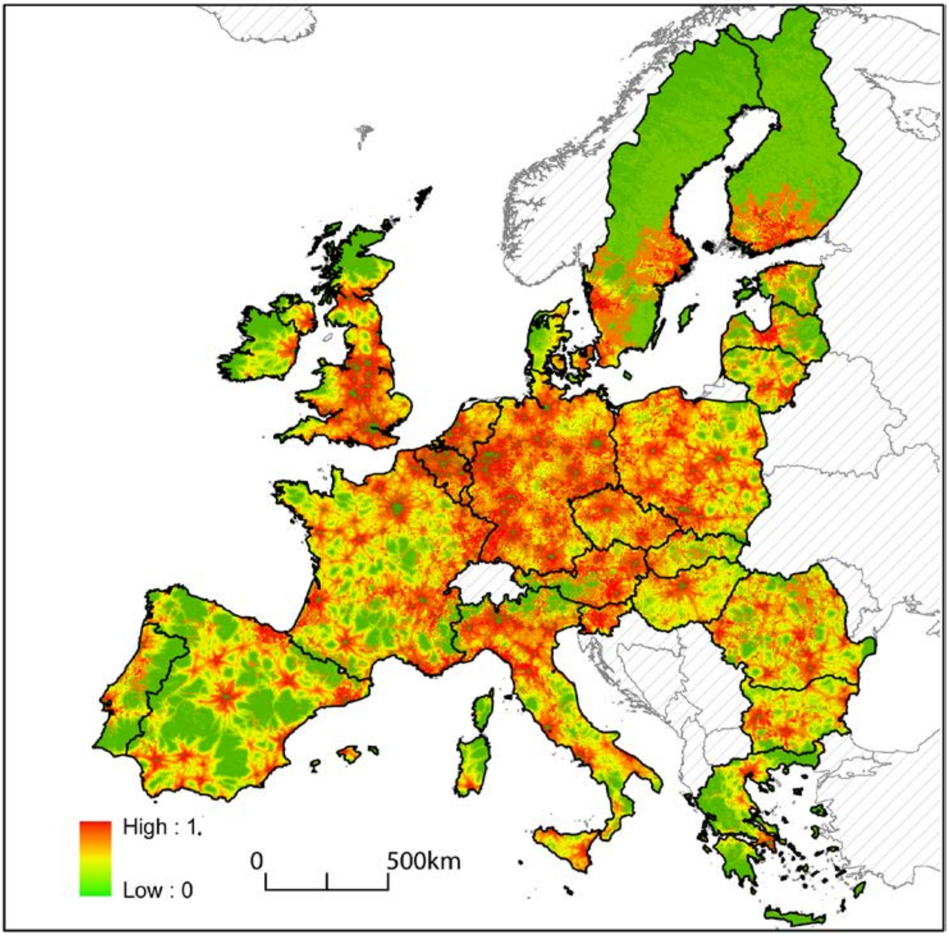
Territorial capital	Spatial Characteristic	Proxies	Variable description	weight
plants and animals		*Peri-urban.* Large source interference with natural processes (pollutants, noise, human activities Peri-urban 25% urban/ residential land use in a 25 km2 neighbourhood disregarding the urban core influence	Peri-urban areas are assumed to have a large disturbance due to industrial activities, urban expansion and large instance of human uses	0.40.
		Agriculture areas. Moderate source of interference with natural processes (pollutants, noise, human activities Open landscape/ agricultural landscape – Greater than 80 % of a 225 neighbourhood is agriculture land use	Agriculture areas have less human activity. However, agriculture activities can be point sources of pollutant that harm natural systems	0.60
		Forested areas. Limited source of interference with natural processes (pollutants, noise, human activities Mosaic landscape – greater than 80% non agriculture land use disregarding urban and forested areas	Forest areas while mainly managed systems in Europe off the least disturbance for plant an animals	1.0
		Mosaic landscapes. Absence of interference with natural processes (pollutants, noise, human activities Forest landscape greater than 67% forest in a 9km neighbourhood.	Human activities are not limited in mosaic landscapes and they tend to be fragmented. This is less suitable habitat for larger animals. However, mosaic landscapes are also unique human environments that produce high incidents of bird biodiversity	0.90

Note: All urban areas, as defined by a 1km by 1km aggregation developed by the EURULIAS project, are excluded.

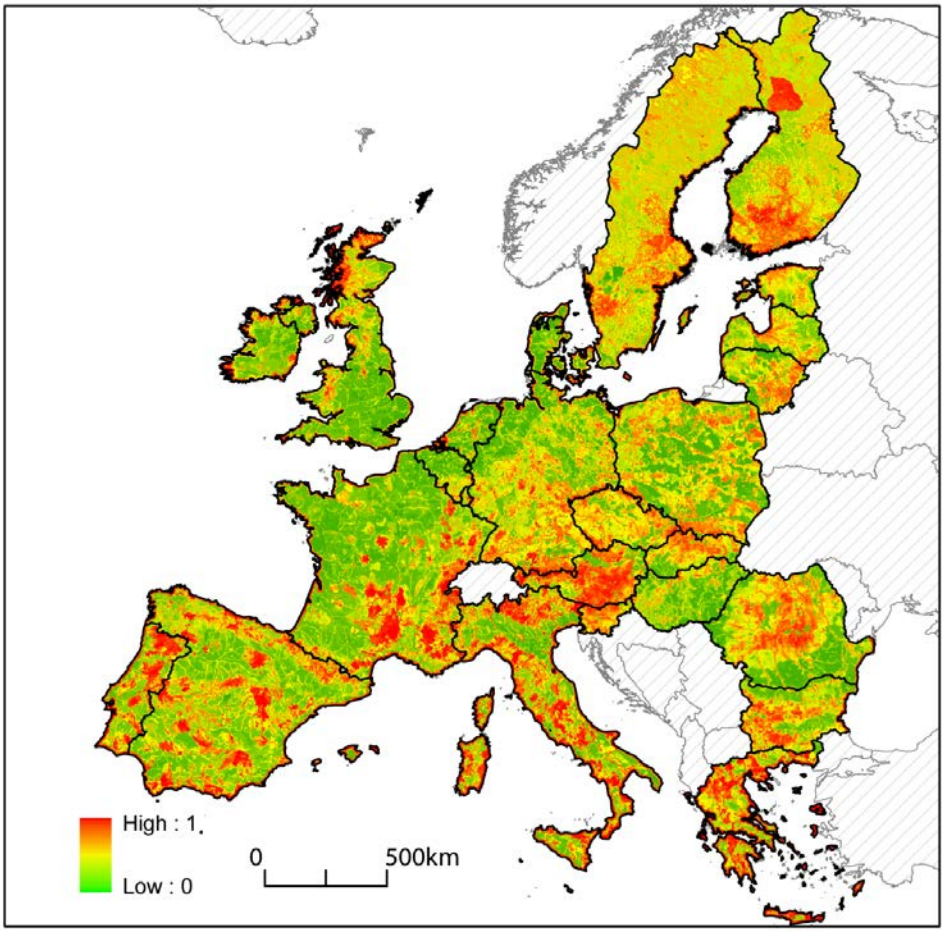
Appendix 2.E – Map of the capacity for development or continuation of agricultural intensification



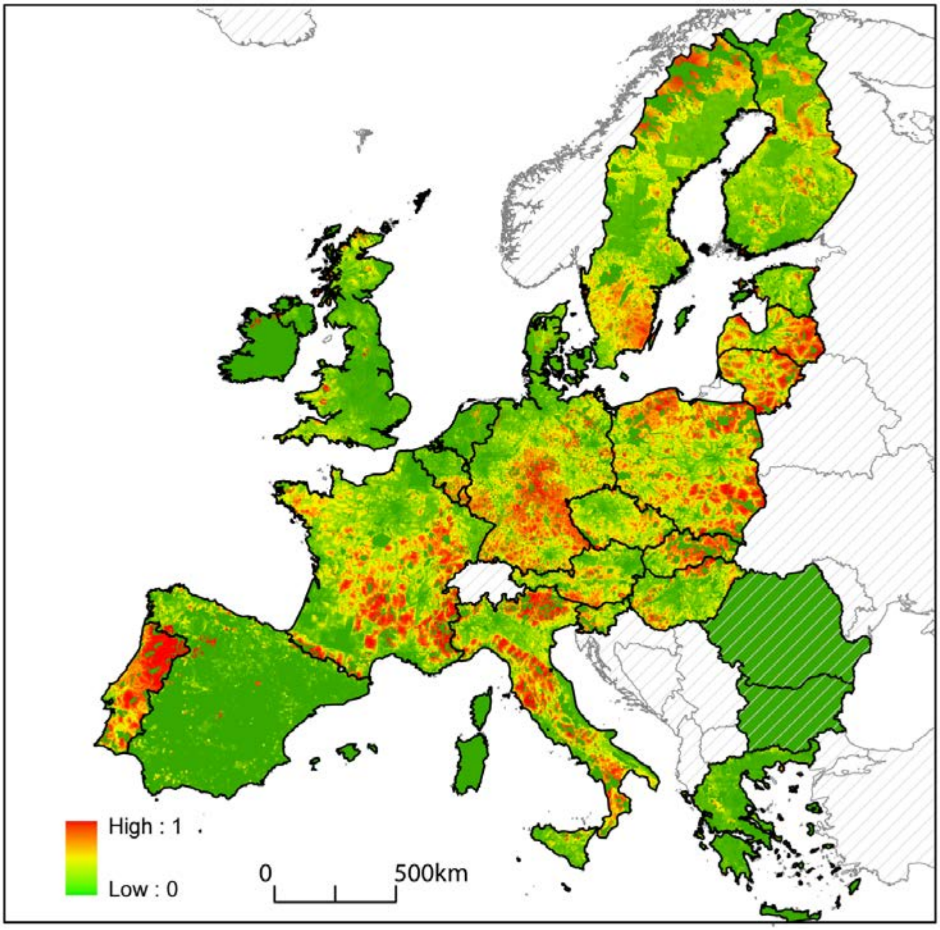
Appendix 2.F – Map of the capacity for development or continuation of off-farm employment



Appendix 2.G – Map of the capacity for development or continuation of rural tourism



Appendix 2.H – Map of the capacity for development of nature conservation



Appendix 3.A Description of workshop stakeholder participants.

Stakeholder description	Spatial interest	Workshop I	Workshop II
National park and NGO representatives	National, regional	2	2
Regional government representatives	Municipal, parish	4	2[a]
Ministry of Agriculture	National	-	2
NGO representative (LEADER)	Regional	2	1
Local entrepreneurs and land managers	Parish	6	6

[a]One parish alderman was substituted in this case.

Appendix 3.B Initial scenarios presented in the first workshop (Researcher Scenario)

Return to rural: realising multiple potentials (RR)
The landscape is a stage of multiple activities. The worldwide demand for agriculture triggers the national government to view rural areas as insurance for national interests. Small farmers benefit from public funding and maintain pastures and holdings. Demand for clean energy at EU level activates both public and private enterprises to start photo voltaic, forest biomass and wind energy projects in rural areas. The national park adopts a progressive conservation policy for Castro L. marketing clean and alternative energies in symbiosis with nature conservation. Houses are fitted with solar panels and shrubs are harvested for local biomass energy production servicing all local buildings. Open landscapes are maintained with the harvesting of biomass creating an even finer mosaic landscape in comparison to the present situation. A progressive attitude towards wildlife management through licensed hunting is established. An area in the valley is demarcated for hunting purpose and managed for wildlife like rabbits, pheasant and partridge. Growing urban demand brings tour operators to Castro L offering trout fishing, white water canoeing, rock climbing mountain biking and other outdoor activities. Tourists are attracted by an accessible diversified open landscape, which offers good sightseeing and open pasture biodiversity. A majority of villages are maintained in some capacity, of which some are even improved with traditional building styles in mind. Valley houses are converted into tourist lodging and long-stay holiday retreats. Castro grows to service the burgeoning industry. Plateau villages revitalize with new farming families. Branding and PDOs are aggressively pursued to increase agricultural earnings and websites are developed that market the area. There is increasing cooperation between the National Park, Junta, NGOs and grassroots organisations.

This dynamism combined with cheap energy bills, high standard of living and job opportunities create the conditions for a rural return. Population increases in comparison to the present.

Nature Return (NR)
Ageing populations are not replaced. Without farmer management the landscape becomes progressively wild. Forests and shrubs spread to open areas both in the Plateau and valley. The population that has not moved away concentrates mainly in Castro L. making a living from tourism and related services. The National Park maintains strict regulation on numbers of inhabitants to protect nature and assure ecosystem services. However, recent incomers will not move out and housing prices will rise considerably as people are attracted to the high quality lifestyle in the park. Most forest villages are converted to holiday and weekend retreats. Food and higher services (hospitals) will mainly come from outside stunting local business.

Visitor to the park gate will enter in Lamas de Mouro gate. There they will learn about the past silvo-pastoral system and biodiversity. At the gate guides take visitors to hike through the park (Castro L.) in a largely educational capacity. In Castro L. wilderness tourism is developed, specialising in kayaking and mountain climbing. A few restaurant and hotels will survive providing service oriented jobs for the population. Tourists coming to Castro L. are attracted to high quality kayaking and climbing and an isolated and wild area. Research and educational sites are established in the park researching transitions from open meadow to forested woodland ecosystems. The forests of Castro L. located at the bottom of Lima and Minho catchments provide ecosystem service like water quality, flood avoidance and woodland biodiversity to the urban centres of Northern Portugal located on the sea coast. The national park, NGOs and the Junta negotiate with downstream stakeholders for provision of these services. These funds are directed to research, park upkeep and service for the local population.

Adapted Silva-pasture management and open mountainous conservation (ASM)

In the near future, sons and daughters, as well as newcomers that are keen on traditional farming activities begin to move into the area. Older generations, realising that their lifestyle of substance agriculture is no longer sustainable, pass on their traditional knowledge to these people. With this know-how and newly acquired land, purchased from ageing populations, younger individuals begin agricultural activities. Grazing cattle like Cachenas becomes popular as the breed command a premium while maintaining a traditional flavour to the area. Pasture grazing becomes the most important activity on the Plateau. Some larger agricultural farms are developed that serve high quality organic and traditional goods to restaurants in Castro L. Due to market orientation smaller plots of land are consolidated making a more uniform landscape. Former patchy mosaic and narrow rock walls around fields are merged into larger fields. However, only a few productive farmers live on the plateau due to the increased production needed for their incomes. The remaining locals move to Castro or other larger centers like Melgaco.

Castro L. specialises in weekend visit where tourists can walk through the grazing agricultural landscape, learn about the silo-pastoral tradition, enjoy the open pasture biodiversity on the plateau and taste the meat and meat related products. A number of jobs are created in tourism and local services that maintain the current level of population. Entrepreneurs and farmers invest in advertising, branding the areas as a location for high quality goods. Along with this a PDO is created. NGOs in cooperation with the Junta and National park manage the cultural buildings as tourist attractions. Newcomers are concentrated mainly in the valley, but in general do not maintain the open landscape, with the exception of a few small agricultural plots. The existing oak forests begin to take over open pastures in the valley. This also creates a closed woodland biodiversity, which attracts tourism. The success of these new projects leads to a growing public recognition that Castro L. is a place that produces high quality goods.

Appendix 3.C Scenario storylines created by stakeholder groups in the first workshop

New communalism (NC)
A New form of a collective lifestyle emerged in Castro Laboreiro. Both local inhabitants and newcomers realise that individualist strategies for development will inevitably fail. As a result, private entrepreneurs and public institutions work together exploring renewable energy namely from converting traditional watermills. Agricultural activities still flourishes in Castro and clearly supports the tourist activities with good quality products in rich and varied menus offered at local restaurants. Grazing cattle is a profitable activity mainly located in the plateau and these traditional activities do not hinder touristic activities at archaeological sites on the plateau, which are a highlight of the region.

The population permanently living in Castro diminishes meanwhile there is a burgeoning fluctuant population of newcomers that frequently stay (though for short periods) in the area. The locals live mainly in Castro and in a few villages on the plateau and continue to intensify cattle grazing activities for their livelihoods. Premium touristic accommodations offered by non-local entrepreneurs and located in the valley bring more tourists to the area. However, locals and non-locals form new associations creating landmark cooperation and dynamism. Farmer sells their products in the local restaurants and specialty products such as honey in local shops. High quality handicrafts and products based on local traditional culture are also sold and showcase improving Castro Laboreiro's commercial image, which is a tourist draw. Professional training courses promoting quality tourism are frequently arranged and attended, which improves the tourism experience and enable a structured and sustainable tourist industry.

As the number of cattle in the plateau increases the once closing landscape becomes open again. Archaeological sites are promoted nationally and international and appropriate pathways, signage and interpretive centres are provided to improve site visits. In the valley, on the other hand, forests expand making wooded tourist villages.

The policies are well structured and adapted to the local reality. Institutions now work together to enhance the touristic potential of Castro. This is a complete rupture with the past (2009 and before) where the disorganization was such that European policies promoting rural development (e.g. AGRIS) opened and closed their funding opportunities without the knowledge of the most well informed local actors. There is now a regionalized and integrated territorial perspective to rural development.

Territorial sustainability (TS)
Local inhabitants together with local and regional institutions acknowledge that it is important to look at the territory of Castro with sustainable goals. In such a way, future generations will have, at the least, the same level of opportunities as the ones that the present generation do. Together they develop a territorial plan for Castro L. development based and focusing on the integration of three major pillars of agriculture, tourism and environment. These pillars are intimately integrated with each other in such a way that agriculture production supports the tourist industry that in turn supports the open mountainous environment. This makes a number of rural activities possible including honey production, mushrooms, unique habitat, and the maintenance of the cultural landscape and lifestyle. This

is possible due to improved organisation and properly structured tourism which is enabled through new training and skills.

These different activities occur differentially within the area of the parish. On the plateau extensive grazing takes place, maintaining the open landscape. In the valley touristic activities occur (accommodation in rural tourism hostels, restaurants) together with small scale farming. Pine forests expand in the valley and cork trees in Ribeiro de Baixo. As a result, in the valley a finer mosaic is created. This mosaic landscape is maintained through the many tourist activities occurring in the valley as private entrepreneur see the draw that the semi-open agricultural landscape has for tourism.

In the fixed villages (e.g. *Cainheiras*) agriculture areas expand meanwhile in the plateau some villages become completely abandoned. The abandoned villages are those where the slope is steepest, which makes agricultural activities more difficult. The younger generations begin to understand that the rural areas do have potential, bringing them back to the area. Both public schools and professional training centres educate and train "rural experts" to be able to deal with the challenge of planning for territorial sustainability. They are able to adapt to changing demands and plan for future sustainability. As part of this, good living conditions and environmental protection are marketed worldwide.

A new road is built that links Castro to Melgaço by way of tunnels avoiding longer driving times and making the area more accessible. This road is extended into Spain.

Regional and local policies frequently invest in rural development valorisation through workshops and cultural activities. Partnerships between local institutions and actors are effective. This is stimulated through administration decentralisation from Lisbon to more local actors. Local actors are more knowledgeable about the needs of the region and a local dynamic is created. As part of local initiatives the Castro Laboreiro brand is successfully created: well-being, good living conditions and environmental protection.

Appendix 4.A - ODD Model description after Grimm et al. (2006)

Overview

The model framework was parameterized in NetLogo 4.1. The simulation consisted of 20 steps or years and is based on the model developed by Valbuena et al. (2010). This overview describes amendments to the original model as details can be found in the aforementioned publication.

Purpose of the model

The objective of the model was to simulate the evolution of landscape processes related to policy and demographic trends for communicating possible emergent development issues to planning and policymaking stakeholders. To achieve stakeholder buy-in and test stakeholder derived suggestions one decision-making processes and four sub processes were added to the original model framework. These are: farm diversification, a tourism demand influence, spontaneous land stewardship, zoning regulations for different land uses and a policy rupture.

Entities, state variables and scale

Agents represent farmers (farms) and rural residents not primarily engaged in farming (estates) each with different characteristics (i.e. life-stage, multifunctional activities and landscape management preference). Rural residents and farmers are distinctly characterized as they are understood to have different decision making patterns and options. For example, farmers are characterized with an agri-business type, production scale and memory of their past land decisions (5 years). This influences their decisions and options in relation to policy, subsidies and regulations; as well as, environmental conditions. Rural residents are less influenced by the institutional setting as they are not engaged in farming activities. Their decisions and options are based on lifestyle and aesthetic characteristics. Environmental conditions like the presence of landscape elements and nature determine where they will seek to live. A number of policy zones and area characterizing the location specific assets were included. Agents located in these areas utilise different subsidies and/or be restricted to certain actions. This includes landscape and development initiative areas (Local Area Groups – LEADER scheme, spatial planning and landscape subsidy zones) and locations with tourism attractions (i.e., camping sites, Bed and breakfast, walking and biking trails, castles, organic and nature farm visits). Distance to like management types is also calculated representing the ability for agents to cooperate with one another.

Design concepts

The emergence in this model, like the original model, is represented primarily in changes to landscape structure. Adaptation is included in actors' interaction with agents whereby each evaluates their neighbours' management type in deciding whether to adopt similar practices. This is influenced by tourism demand in locations where there are tourism attractions. Tourism demand is determined by the amount of landscape and nature elements in the case study area. The distribution of multifunctional farmers throughout the case study area is assumed to allow for cooperation between different farm types if there is a tourism demand. However, the factors that influence diversification are diverse. Spatial characteristics (Pfeifer et al. 2009) attitudes (Jongeneel et al. 2008) and economic conditions (Meert et al. 2005) are each influential factors that could not be simulated. Observation is done by way of sensitivity analysis and comparison of simulation experiments. Stochasticicity is included in market demand for tourism as this is a highly variable endogenous process. The management type of new farmers is also stochastic.

Initialisation

The model is initialized as in the original framework with the exception of the inclusion of a number of new spatial data sets.

Input data

Several data sets were added to the original initialisation to enable added functionality and increase accuracy in parameterisation and projections of demographic figures. A new agri-businesses census is used to more accurately depict rural processes observed in the Netherlands with higher concentration of farmers 65 and older retaining the majority of small farms (CBS 2010). Modelled data has also been drawn upon that simulates survival of agribusiness types in different policy scenarios where farm aid was capped (De Bont et al. 2006). The scenarios tested are based on policy options currently being considered by the EU. Cadastral data was obtained from provincial spatial planning databases (PC, 2010). Agricultural development, habitat directive, corridors and protection of cultural landscapes zones and Local Areas Groups (LEADER) were initialised and used to calculate probabilities for agricultural expansion, hedgerow and tree line management and diversification for each actor. Likewise a tourist asset maps was developed to localize tourism activities contributing to diversified demands.

Submodels

Farm cessation, farm expansion, protection of landscape elements and endogenous diversification are submodels that have been added to the model. Each agent's options, initial circumstances, periodicity and parameters are unique to their actual characteristics. For each simulation experiment agent parameters were altered to adhere to the assumption described in scenarios and policy solutions suggested by stakeholders. Only the alterations to the submodels are described.

The process of farm expansion was augmented to simulate production and farm size decline in farmers older than 65, which was evident in updated national statistics. Approximating demographic/agri-business size ratios is done by decreasing the probability for expansion in farmers older than 65 that own farms larger than 50 dsu by a factor of 10% per step. Farm expansion now also includes provincial planning zones. In the AMIS scenario, expansionists located in zones earmarked for agricultural development have an increased probability (50%) for expansion while non-expansionists are less likely to expand (25%). This is less pronounced in the BTS scenario with 10% increase and 10% less likelihood respectively.

The process of farm cessation has been altered to include the geographical extent of the Local Area Group (LAG) as part of the LEADER scheme. The LEADER programme in the case study area is involved with support for i) the use of new know-how and new technologies; and ii) best use of natural and cultural resources. It is assumed that this results in less farm cessation for diversified/multifunctional farmers. This is approximated in the model by altering the survival rates of different management types. In the AMIS scenario non-expansionist are 50% more likely to stop, while in the BTS scenario diversifiers are 50% less likely to stop. Parameters determining probability for agribusiness type cessation have also been altered. Economic models that closely approximate the farm aid cap proposed by the EU are used (Bont et al. 2007). Dairy farmers are most affected in these modelled outcomes. Their chance of stopping is 10% if a flat rate cap is establish (BTS) and 15% if subsidies are phased-out at the 50 percentile mark (AMIS). The cessation action is also altered by way of an economic/policy rupture. Policy implemented by the EU in 2013 alters earning possibilities, amends potential for expansion due to different restrictions. It also simulates greater opportunity for farm diversification and survival through capacity creation schemes (LEADER) for the different agents. In the AMIS scenario opportunities for expansion is increased to 15% which also increase the chance for farm cessation in all farming agents. In the BTS scenario a 3% increase is applied, which results in less farms cessation and expansion. The AMIS scenario has fewer restrictions for expansion and protection of landscape elements in important habitat areas (habitat directive) in comparison to BTS.

Protection of landscape elements has been altered for rural resident stakeholder only, as empirical evidence and local experts indicated different landscape management for these actors (Kristensen 2003; Præsholm et al. 2006). A 30 % chance of planting landscape elements for all rural resident actors is used. This is a conservative estimate in comparison to empirical findings regarding plans for future landscape alterations for these rural actors (Præsholm et al. 2006). This conservative estimate is adopted as rural residents keep landscape elements already located within their holdings and also have the ability to plant new elements. The option for spontaneous landscape stewardship by conventional farmers is also now included to reflect the comments of local experts that diverse farmer types have adopted the practice of landscape protection in the region. Conventional famer have a 10 – 3%, depending on the scenario, of planting landscape elements.

Endogenous diversification was added to simulate suggestions made by the stakeholders in the workshop about cooperation and tourism. This can be linked to empirical finding of increasing consumption of urban residents of rural products and services for example with bed and breakfasts, farm experience activities and tourism and recreation (Jongeneel et al. 2008). Non-diversified farmers assess the management practices of their 10 nearest neighbours in deciding to diversify. It is assumed that there is a learning effect if he/she is located near four farmers engaged in diversified activities. The decision to diversify is likewise determined by tourist demand. Tourism demand is dependent upon the availability of cultural and nature elements. An increase in these elements and a stochastic outcome results in more tourism demand. Farmer-agents located in a Local Area Group zone are assumed to have an increased chance for diversification (50%), as development funds are available for diversification in these LEADER schemes areas. Endogenous diversification is possible if non-multifunctional farmer cooperate with multifunctional farmers. Their proximity to 4 multifunctional farmers is assumed to create this cooperation. Non-multifunctional farmers decide whether they will engage in more multifunctional activities given this cooperation and surrounding opportunities for tourism (landscape elements, nature and tourist attractions).

Urban migration has also been altered to reflect the findings of the interviews. Expert relayed that urban residents are increasingly moving into the region purchasing small estates with aesthetically pleasing surroundings. To reflect this, small farms (< 10 DSU) can be sold throughout the region. The probability for selling to an urban resident is determined by the presence of nature or landscape (10%) elements in a neighbourhood of 1km (circular) around the homestead.

Submodel simulation experiments

The key parameters contributing to model outcomes were varied to test their influence on model outcomes. The influence of the demographic make-up was tested by decreasing the ages of the actors by 5 year increments maxing out at 20 year. For each incremental change the average farm size decreases, with a 20 year downward shift resulting in a 10% decrease in average farm size. Younger farmer ages result in fewer retirees and therefore fewer farms and/or parcels for purchase. This prevents the purchase by individual farmers of more parcels. The large number of retirement age farmers is a major driving factor for farm scale expansion in the region as younger farmers purchase their land. The impact of market forces was tested by controlled increases in the amount of development funds available to land managers for expansion and the number of farmers stopping each year. While, purchasing power had little influence on farm size, small increases in the number of retirees resulted in larger farm sizes. For example augmenting the original cessation rate for all farmers from 0.029 % to 0.05 % in the BTS scenario resulted in a 5% and 6% increase in average farm size for intensive producers and all farms respectively. Again this indicates that farm and parcel turnover is a major driver of intensification processes in the region. Agent management types were also stochastically varied to ascertain the impact that different decision making actors had for the model outcomes. High, standard-deviation between the different model runs for the total area of landscape and nature elements shows that farm types are influential as a driver of landscapes processes.

Scenario simulation experiments

The scenarios have been developed to represent different policy actions proposed for the year 2013 (7 model steps). Both the AMIS and BTS scenarios simulate political and economic ruptures that result in local changes to management practices, farm cessation and expansion. It is assumed that alteration in farming incomes, environmental regulations and rural development schemes will induce these changes. Figure i provides the key input data for the different scenario parameters and their link to proposed policy reforms.

	AMIS (market liberalisation)	**BTS (Sustainable)**
Farm cessation (expected overall percentage of agents that stop farming between 2005 and 2020)	A cessation rate of 0.04% is applied for each turn	A cessation rate of 0.029% is applied each turn
Percentage of agents that stop farming due to EU policy changes (rupture)	Dairy farmers 15% likely to stop	Dairy farmers 10% likely to stop
Incentives for multifunctional	No, Diversifier 50% more likely to stop in agricultural	Diversifiers 10 % less likely to stop;

agriculture and small farms	development zones	Located in national landscape 50 % more likely to continue
Immigration	Yes, with small farms (>10 DSU) surrounded by more than 10% nature or landscape elements	Yes, with small farms (>10 DSU) surrounded by more than 10% nature or landscape elements
Farming expansion	Yes, intensive farmer are more likely to expand by a factor of 10%; This increases to 50% in agricultural expansion zones	Yes, diversified farmer chances expand by 50% if they located in nature and landscape protection areas due to 'green' subsidies
Land abandonment	Low production fields and fields with numerous zoning restrictions for landscape and nature protection	Some nature protection zones purchased by nature organizations
Protection influence of policies related to hedgerows and tree lines	Landscapes cannot be altered in habitat reserves. Subsides in special landscape zones	Restrictions from cutting elements in landscape protection zones, habitat and corridor areas.

Stakeholder formulated policy action simulation experiments

Three local interventions that were suggested by the mind-mapping groups were added to the model for evaluation. Re-zoning farm management types to appropriate environmental locations was achieved by restricting intensive expansionist farmers from expanding or bequeathing their farms in landscape protection areas, nature corridors (habitat directive) and cultural landscapes. Instead these actors are required to sell their parcels to multifunctional famers, rural residents not primarily engaged in farming or nature organisation. Cooperation and increased tourism were tested together. The distribution of multifunctional farmers throughout the case study area is assumed to allow for cooperation between different farm types if there is a tourism demand. Increased probability for cooperation and tourism demand resulted in increased adoption of multifunctional techniques. A programme to attract in-migration was simulated through increasing demand for smaller rural residencies and decreasing requirements for aesthetically pleasing landscapes around this housing (nature and cultural). This was done by 1) increasing the probability for the purchase of small farms incrementally; and 2) by reducing immigrants' requirements for nature and landscape elements around the available homestead (10% within a 2 km neighbourhood (circular).

Appendix 5.A – Clustered groups' mean preference values for landscape features and top tourist activities

		Spirituality and Inspiration		Recreation		Aesthetic and Cultural Heritage	
		Mean		Mean		Mean	
Forest	Y	0.74		1.08		0.65	
	N	0.71	T(113) = .102; p = 0.91	0.55	T(62) = 2.31; p = 0.03	0.76	T(113) = -0.52; p = 0.60
Brooks	Y	0.58		0.61		0.70	
	N	0.82	T(113) = -0.14; p = 0.26	0.81	T(113) = -0.95; p = 0.34	0.76	T(113) = -0.32; p = 0.75
Marshes	Y	0.08		0.05		0.14	
	N	0.27	T(113) = -1.87; p = 0.07	0.29	T(98) = -2.44; p = 0.02	0.25	T(113) = -0.87; p = 0.38
Heath	Y	0.10		0.11		0.23	
	N	0.18	T(113) = -0.66; p = 0.51	0.18	T(113) = -0.66; p = 0.51	0.11	T(66) = 0.98; p = 0.33
Animals	Y	0.66		0.92		0.70	
	N	0.60	T(113) = 0.30; p = 0.76	0.47	T(60) = 2.14; p = 0.04*	0.57	T(113) = 0.66; p = 0.51
Tree lines	Y	1.39		0.89		1.19	
	N	0.83	T(113) = 2.33; p = 0.02*	1.08	T(113) = -0.74; p = 0.46	0.92	T(113) = 1.13; p = 0.26
Agri. Land	Y	0.42		0.61		0.30	
	N	0.53	T(113) = -0.59; p = 0.56	0.44	T(113) = -0.87; p = 0.39	0.61	T(113) = -1.70; p = 0.09 *
Recreation	Y	0.08		0.00		0.19	
	N	0.21	T(113) = -1.10; p = 0.27	0.25	T(76) = -3.05; p =0.003**	0.15	T(113) = 0.29; p = 0.77
Villages	Y	0.50		0.34		0.58	
	N	0.56	T(113) = -0.31; p = 0.76	0.64	T(102) = -1.79; p = 0.08	0.51	T(113) = 0.37; p = 0.71

Stone Quarry	**Y**	**0.08**		**0.11**		**0.09**	
	N	0.10	T(113) = -0.25; p = 0.80	0.09	T(113) = 0.15; p = 0.88	0.10	T(113) = -0.44; p = 0.97
Cultural Building	Y	1.29		1.29		1.16	
	N	1.17	T(113) = 0.52; p = 0.60	1.17	T(113) = 0.52; p = 0.60	1.24	T(113) = -0.33; p = 0.75
Biking	Y	1.97		2.26		1.86	
	N	1.94	T(113) = 0.15; p = 0.88	1.79	T(83) = 2.00; p = 0.05*	2.00	T(113) = -0.58; p = 0.56
Swimming	Y	0.21		0.34		0.72	
	N	0.69	T(113) = -2.31; p = 0.02*	0.62	T(89) = -1.34; p = 0.15	0.42	T(80) = 1.45; p = 0.15
Walking	Y	1.26		1.21		1.14	
	N	1.00	T(113) = 1.19; p = 0.24	1.03	T(113) = 0.83; p = 0.41	1.06	T(113) = 0.39; p = 0.70
Farm Camping	Y	0.21		0.26		0.07	
	N	0.16	T(113) = 0.49; p = 0.63	0.13	T(57) = 1.07; p = 0.29	0.24	T(99) = -1.86; p = 0.66
Shopping	Y	0.26		0.13		0.23	
	N	0.29	T(113) = -0.19; p = 0.85	0.35	T(107) = -2.17; p = 0.03*	0.31	T(113) = -0.63; p = 0.53
Eating	Y	0.1842		0.26		0.23	
	N	0.2727	T(113) = -0.88; p = 0.38	0.23	T(113) = 0.29; p = 0.77	0.25	T(113) = -0.178; p = 0.86
Rest/ Tranquility	Y	0.3684		0.42		0.23	
	N	0.4026	T(113) = -0.19; p = 0.85	0.38	T(113) = 0.25; p = 0.80	0.49	T(108) = -1.58; p = 0.11

* significant at the 0.10 level;
Y indicates preference and N non-preference