COOPERATION AND COORDINATION FOR LANDSCAPE SCALE CONSERVATION

QUALITATIVE AND EXPERIMENTAL ECONOMICS APPROACH

by

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ABSTRACT

Researchers have highlighted the need for landscape scale management for biodiversity and other services such as recreation and pollination. Ecological networks have been proposed as a tool to deliver *multifunctional* services. Despite public policy interest, implementation of this tool is difficult because, as other public goods, ecological networks require land managers to be paid; in addition the creation of the spatial configuration of the network requires land managers' cooperation across holdings.

This thesis presents a methodological framework to test an economic incentive called '1-2-1 coordination bonus' to stimulate cooperation. It also analyses existing cases of cooperation and the potential of adaptive co-management (ACM) to develop ecological networks. The research carried out in the Dee catchment, North-East Scotland, suggests the existence of processes that echo ACM, however this ACM-potential is hampered by the lack of local ecological knowledge, power-sharing and evaluation cycles. Attitudes to conservation suggested the identification of three clusters of land managers based on land tenure: estates, tenants and smallholding owners. Cooperation was more frequently found within each group than across groups.

The methodological framework proved to be innovative and informative for the design of the '1-2-1 coordination bonus' which could stimulate cooperation for ecological networks such as field margins for pollination. But if a robust network is needed then the bonus has to be accompanied by coordination through third parties and/or spatial targeting of the incentive to achieve a specific desired network-pattern.

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LIST OF ABBREVIATIONS AND ACRONYMS

AC – Aberdeenshire Council

ACC – Aberdeen City Council

ACM – Adaptive Co-Management

AES – Agri-Environmental Schemes

AM – Adaptive Management

ATN – Actor-Network Theory

BAP – Biodiversity Action Plan

BCT – Birse Community Trust

CAP – Common Agricultural Policy

CART – Classification and Regression Trees

CBD – Convention on Biological Diversity

CNPA – Cairngorms National Park Authority

EN – Ecological Networks

ES – Environmental Service

EU – European Union

FAO – Food and Agriculture Organisation

FC/FCS – Forestry Commission/Scotland

FS – Forestry Scheme

GAEC – Good Agricultural and Environmental Conditions

HQP – High Quality Parcel

LAG – Local Action Group

LQP – Low Quality Parcel

MEA – Millennium Ecosystem Assessment

NFU/NFUS – National Farmers Union/Scotland

NGO – Non-Governmental Organisation

NIE – New Institutional Economics

NPF2 – National Planning Framework 2

NTS – National Trust of Scotland

NVZ – Nitrate Vulnerable Zones

OECD – Organisation for Economic Co-operation and Development

PBR – Payment-by-result

PES – Payments for Environmental Services

RSPB – Royal Society for the Protection of Birds

SE – Scottish Executive

SEPA – Scottish Environment Protection Agency

SFP – Single Farm Payment

SG – Scottish Government

SLDT – Short Limited Duration Tenancy

SNH – Scottish Natural Heritage

SPA – Special Protected Areas

SRDP – Scotland Rural Development Programme

SSSI – Site of Special Scientific Interest

WFD – Water Framework Directive

WTO – World Trade Organisation

CHAPTER 1

INTRODUCTION

The UK has seen a dramatic transformation take place in the way the countryside is seeing and experienced. The way land is used has changed, and there has been a shift from the traditional model of land use, which focused solely on food production, to a more multifaceted approach which takes into account biodiversity conservation, recreation, provision of food, housing, issues associated with climate change and many other services. In rural areas, conservation measures associated with agriculture have acquired an increasing importance in the face of both national and international environmental commitments for the provision of biodiversity and the mitigation of climate change.

This change has led to the problematic identification of the countryside as a provider of 'services', such as food and timber production, biodiversity conservation, water supply for agriculture and human needs, recreation, and mitigation of climate change through carbon storage. This perception of the countryside is troubling as, even if we agree with the idea in principle, we are forced to acknowledge that the countryside is a limited resource, and that the delivery of these demands, which are not fixed but change over time, is difficult. From both an ecological science and a policy/land management standpoint, strategies that are directed at the level of the single holding are insufficient for the provision of biodiversity and climate change mitigation. In order to ensure the delivery of multifunctional services, it may be necessary to adopt a landscape scale approach.

This research assesses the potential for cooperation and coordination to influence land managers' decisions and change land use patterns at the landscape scale. It aims to develop a methodological framework which can be used to inform the design of public policy tools to incentivise the development of cooperation. Such cooperation is essential to the provision of biodiversity at the landscape scale. This research utilises a combined approach; it employs research methods from the social sciences, namely qualitative data from interviews with land managers, with experimental economics to test the potential of economic incentives to promote cooperation amongst land managers for landscape scale conservation. While this thesis does address a multi-disciplinary audience and engages with literature on landscape and conservation ecology, it mainly addresses an applied social science and environmental economics audience with a view to inform public policy.

Both the literature on environmental sciences and current policy directives propose the implementation of ecological networks as a means of addressing biodiversity conservation (e.g. Lawton et al., 2010; Jongman and Pungetti, 2004,). This introductory chapter will first discuss the following key terms from both the policy and academic perspective: delivery of multifunctional services; conservation, biodiversity; landscape scale; ecological networks; cooperation and collaboration; payment for environmental services. The concepts presented and discussed in this chapter will form the foundation for the ideas presented in the wider dissertation. Following this preliminary discussion, the research aims and objectives of this study will be presented.

In this research, I used the implementation of ecological networks for biodiversity conservation to frame my investigation on cooperation and collaboration at the landscape scale and to examine the design of economic incentives for landscape scale applications.

The interdisciplinary nature of this study has necessitated that the layout of this dissertation depart from the classic format; rather than presenting a separate theoretical and methodological chapter at the beginning of the text, each chapter contains its own literature review and methodology relevant to the specific issues addressed. Given the combination of different theoretical and methodological approaches explored in this study, such an iterative approach seemed the most appropriate structure. Thus, the structure of this dissertation is as follows: chapter 2 outlines the study area; chapter 3 and 4 address the question cooperation and collaboration for landscape scale conservation first from the point of view of 'Adaptive Co-management' (ACM) and then from that of land managers' attitudes and decision making using mainly qualitative sociological data while in chapter 5 I use experimental economics to analyse land managers' decisions in a hypothetical scenario of an economic incentive for coordination to establish ecological networks.

At the same time, while each chapter addresses these complementary approaches, the introductory theoretical section in each chapter establishes the link between chapters and highlights the overall argument of the thesis. Given this approach, this general introduction acts as a foundation for the dissertation as a whole.

1.1 MULTIFUNCTIONAL COUNTRYSIDE: CAN WE DEMAND EVERYTHING?

The countryside is defined by the Cambridge Dictionary as 'land not in towns, cities or industrial areas, which is either used for farming or left in its natural condition'.[1] The Cambridge Dictionary goes on to give the following examples for the meaning of the word 'countryside':

> 'The countryside around there is lovely; The mansion is set in 90 acres of beautiful, unspoilt countryside; Every summer thousands of people flock to the countryside' (Cambridge Dictionary Online).

This definition incorporates a number of ideas which, although conflicting, appear in both policy and academic discussions regarding the shaping and treatment of the countryside, past, present and future. The definition of the countryside quoted above reflects the dichotomy between cities and rural areas; this division between cities and countryside was particularly popular in the mid-twentieth century. In the mid-twentieth century, the role of the countryside was essentially seen as supplying food and fibres to cities. In the UK the development of the countryside was framed by the Town and Country Act of 1947, the Agricultural Act of 1947 and the Forestry Acts of 1947 and 1949. As in many other countries, the main objective attributed to rural areas of the UK was an 'increased production through efficiency and stability in agricultural operations' (Johnson, 1948: 178). Rural areas were synonymous with agriculture and Curry suggests, 'planning legislation [was] […] remarkably successful at resisting development in the countryside' (Curry, 1993: 7). Legislation in the period was a response to a high demand for food and fibers due to the constant growth of cities: the already high demand was exacerbated after the Second World

[1] Cambridge Dictionary Online, http://dictionary.cambridge.org/dictionary/british/countryside [Accessed on 01/12/2012].

War. Scholars (Ilbery and Bowler, 1998) often refer to this period as the ‘productivism’ era; this term describes the way intensive agricultural production was carried out alongside policies of subsidization, price guarantees and protectionism. Other characteristics of these production systems were the destruction of natural habitats and species loss. Biodiversity declined sharply during this period (Tilzey, 2000).

The dichotomy between cities and rural areas left the latter associated with a romantic idea of nature. This notion is reproduced in the definitions of the countryside given by the Cambridge Dictionary: ‘[…] left in its natural condition’ [2]; ‘[…] beautiful, unspoilt countryside’. As Curry (1993:7) underlines, the ‘countryside has remained an idyllic image for most people’. This idyllic image has played an important role in the conception of ‘conservation’, as I shall present in section 1.3.

The examples given in the Cambridge Dictionary reflects yet another idea of the countryside: the transition from the dichotomy between country and urban areas to the current situation, where there is an absence of clear boundaries between urban and rural areas. Moreover, the examples incorporate the idea that land use has diversified away from solely agricultural production to a more multifaceted land-use model. Counterurbanisation and the increase of rural populations, due to people from urban areas moving to the countryside without participating in the agricultural economy, have provoked an increasing demand for more diverse benefits from the countryside (such as leisure activities, a healthy environment, habitats for biodiversity, landscape aesthetics, amenity etc.). These changes in the countryside and the shift from the production of commodity to non-commodity outputs provoked an academic discussion in the 1980s and 1990s; this discussion focused on

[2] It is unclear if this idea of areas left in their natural condition refers to the undeveloped areas as such or to a romantic idea of ‘nature’. In any case, in Europe researchers do not talk anymore about ‘natural areas’ as these do not exist anymore but refer to ‘semi-natural’ areas/habitats.

whether these processes constituted a 'post-productivist' era (Mather et al., 2006; Marsden, 1995; Wilson and Wilson, 1997; Halfacree, 1997; Symes, 1992). However, 'post-productivism' has been a contested concept (Wilson, 2001; Evans et al., 2002). It has been used as a generic term to describe processes of extensification, dispersion and diversification in agriculture and countryside land use (Evans et al., 2002). However, for some the conceptualization of 'productivism vs post-productivism' is too simplistic and cannot explain the dynamics occurring in the countryside (Bjørkhaug and Richards, 2004).

To overcome the controversy associated with post-productivism, authors and policy makers have adopted the term 'multifunctionality' to refer to changes occurring in agriculture and rural societies. This term is not without its own problems: some authors have questioned whether 'multifunctionality' is fundamentally different from post-productivism (Bjørkhaug and Richards, 2004), while others attempt to legitimate both terms by arguing that post-productivism is a transitional step between productivism and multifunctional agriculture (Wilson, 2001).

I adopt the term 'multifunctionality' as my research is not concerned with how to describe changes in the landscape, but rather with how different products and services are delivered from the countryside. In this sense, this term aptly describes the situation in the study area of the Dee Catchment (see chapter 2). The notion of multifunctionality is also consistent with my choice of category, which focuses on land managers (as opposed to the generic category of 'farmers' found in many studies on Agri-environmental Schemes).

According to Wilson (2001), 'multifunctionality' refers to the diversity, non-linearity and spatial heterogeneity which takes place in agriculture and rural society and encompasses productivism and post-productivism. Within this multifunctionalist approach, the production of commodities is as important as other non-commodity products, such as biodiversity and other use values. Potter and Burney (2002), refer to multifunctional agriculture as producing food but also sustaining rural landscapes, protecting biodiversity, generating employment and contributing to the viability of rural areas.

In Europe, Pillar I and II of the Common Agricultural Policy (CAP) have been reformed (2003) to achieve multifunctional land use by shifting from pure commodity production to increasingly joint production. The term 'multifunctionality', however, has been used more often in reference to the multiple outputs that an economic activity can have; therefore, it contributes to several societal objectives at once (Vejre et al., 2006). These other outputs or functions are often called externalities, secondary outputs, coupled outputs, public goods (or 'bads') or services (Vejre et al., 2006).

One reason why multifunctionality has been successful in policy environments is the joint production characteristic, which allows the continuation of payments of economic incentives under the 'Green Box' of the World Trade Organisation (WTO). 'Green Box' is the terminology used in WTO to identify subsidies that are permitted under the agricultural agreements. Direct payments to support traditional markets and products were considerably changed to subsidies that are identified as non-trade distorting i.e. in tune with the so-called 'Green Box compliant' schemes.[3]

There has been extensive academic debate surrounding the idea of putting monetary values to non-commodity products, such as biodiversity. Some academics argue that a

[3] 'Other schemes are part of the 'Amber Box' which are forbidden subsidies and the 'Blue Box' for subsidies that are tied to programmes that cap production.

commodification of ‘nature’ has taken place, and that multifunctionality is another step in this process towards the liberalization of agriculture (Yliskyla-Peuralahti, 2003; Heynen and Robbins, 2005; McCarthy, 2005). Others authors address the methodology of how to allocate monetary value to non-commodity products and how to internalize externalities (Wiggering et al., 2006 in Mader et al., 2007: 2). There is a general assumption that people demand non-commodity products and services from the countryside; however, more research is needed in order to better understand what people demand and how they value it (in monetary values or not).

Despite these critiques, the concept of multifunctionality has been adopted by policy makers and subsidies are currently paid in accordance with this idea. Multifunctional land use helps to merge economic, social and environmental foci, by emphasising the rule that economic action is accompanied by ecological utility: commodity outputs (e.g. yields) are paid for on the market, but non-commodity outputs (e.g. landscape aesthetics) are public goods with no markets (Wiggering et al., 2006 in Mader et al., 2007: 2).

Land use is the key activity in determining the performance of landscapes with respect to socio-economic functions such as land-based production. Moreover, land use determines the degree of integration between socio-economic functions and environmental functions, including natural resource protection (Wiggering et al., 2006 in Mader et al., 2007). According to Selman (2012), multifunctional landscapes are more resilient and will cope better with changes.

Multifunctionality depends on land use patterns, landscape systems and how they are managed at different scales and times. Countries around the globe are gradually developing their own public policies, with the aim of achieving multifunctional land uses that go beyond multifunctional agriculture.

In the context of this study, ‘The Land Use Strategy Scotland’ is a key document. Published in 2011, this text is a response to the Climate Change (Scotland) Act of 2009 and constitutes a policy-umbrella under which multifunctional land use is to be achieved. It sets three national objectives, related to the economy, environment and communities, establishing the desired outcomes for land use and the multiple functions and benefits land use can deliver (Land Use Strategy, 2011).

Land use is influenced, but not directly decided, by government policy. Indeed, land use represents a mirror of land managers’ decision making. These decisions are based on economic, environmental, social and political variables. Top-down public policy, property rights and bottom-up social and cultural variables are embedded in specific environmental conditions. These conditions offer a finite number of options from which land managers must choose when making their decisions. Conversely, in the context of fragmented property rights and multifunctional land use, specific environmental outcomes are dependent on land managers’ decisions: this is the case whether these outcomes are demanded by society and requested by government or not.

A scale mismatch also complicates the issue of policy intervention. While multifunctional countryside and land uses are defined at large scales, land managers’ decision-making takes place at the field or farm scale. Conservation and biodiversity are processes which require much larger units than those corresponding to the field scale. However, this begs the question, what is the scale to be taken to address these issues? In the next section, I discuss this subject and present the scale approach taken in this research.

1.2 Landscape & Scale: The Imaginary Boundaries.

Spatial patterns and place are the key concepts of geography (Gregory, 1994). The relevance of human techniques in shaping the landscape can only be addressed in the context of a specific place (Spedding, 1994; Simmons, 1994). Spatial and temporal scales are at the core of physical geography; moreover, most authors would suggest that they are also key to human geography. Boundaries of scales, time and landscapes do not exist *per se* but are constructed. Where these boundaries are set depends on the subject studied and the approaches taken. The setting of boundaries is also dependant on the fact that each discipline has a different perspective of these concepts and different idea of where boundaries should be set. At this point it is necessary to present a short summary of some of the extensive academic discussion surrounding the about the concept of 'scale' and 'landscape'. These concepts will be presented from the perspective of both social sciences and ecology.

Regarding the concept of 'scale', Gibson et al. (2000), argue that all scientific work has to include, implicitly or explicitly, a 'scale'. These authors defined 'scale' as 'the spatial, temporal, quantitative or analytical dimensions used by scientists to measure and study objects and processes' (Gibson et al., 2000: 219). Since scientists investigate and explain patterns, the scale used is an inevitable step in the definition of the subject of study. The scale taken in research will define the patterns observed. This seems an obvious statement for some sciences; however, researchers in ecology and natural sciences are more familiar with issues of 'scale' than those working in the social sciences. The study of ecology addresses a number of hierarchical ecological processes; in particular, landscape ecology focuses on ecological processes and spatial patterns (in their spatial and temporal dimensions). Scale is fundamental to ecological studies as smaller ecological systems are generally nested within larger ecological systems, and so on. The study of particular individuals, populations and species, for instance, is never isolated from the interaction they share with the habitats they occupy or the other species they have contact with (as the food chain demonstrates). In ecology, scale has two main dimensions: the 'grain' which refers to the resolution of observations, and the 'extent' which refers to the total area or time under study (Cumming et al., 2006). In contrast, in the social sciences the conception and awareness of 'scale' is less clear, especially within certain disciplines such as anthropology. However, within the social sciences, physical geographers, economists and political scientists are more aware of issues pertaining to scale. According to Marston et al. (2005), human geography should not take a 'scale' approach as there is no consistent theory or consensus on how to define scale within the discipline. Moreover, Marston suggests that the justification for using the concept of scale is theoretically weak (Marston et al., 2005). However, other authors argue that in the social sciences the concept of scale refers to social structures: the relationship of individuals to organisations and social institutions such as policies and cultural norms (Cumming et al., 2006). According to Cumming et al. (2006), the disparity between these different interpretations, understandings and organisations of 'scale' creates a scale mismatch between the scale of management and the scale of the ecological processes being managed. Gibson et al. (2000), call for more focus on establishing a common understanding and a clearer definition of 'scale' across disciplines, especially in the light of global environmental change, where research between natural and social scientists is essential.

Socio-ecological systems represent one approach that unites social and ecological sciences for the study of natural resources management. The issue of scale is central to such an approach (management is conceived across scales and across levels). Because the natural component unquestionably is affected by the scale of observation, even in the absence of agreement in social sciences, it was necessary to define a scale for the present study.

In this research scale and landscape are central concepts. I adopted the definition given by Gibson et al. (2000), mentioned above. Therefore, for the purposes of this research, 'scale' should be understood in a very pragmatic way. The Catchment scale here as the unit that allowed me to measure and study processes.

The concept of 'landscape' has been understood and used in different ways: as land or a portion of the physical environment, as a territory, as a scenic view and, of course, as an artistic reproduction of said view. The common usage of the word in English tends to conflate these different meanings. In the academic usage, 'landscape' is treated as an analytical concept and definitions vary hugely, even within one single discipline. As Michael Jones suggests in his review of the concepts and approaches used in landscape research, there is an 'elusive reality of landscape' and the nature of landscape as an academic concept is 'chaotic' (Jones, 1991: 229). Whole volumes have been written, and are still being published, about landscape in geography, history of art, archeology, anthropology and even philosophy (for instance, Daniels and Cosgrove, 1988; Tilley, 1994; Berque, 1995; Hirsch and O'Hanlon, 1995; Schama, 1995; Adams, 1996; Tilley 2008; Roger, 1997; Arnasson et al., 2012, to mention but a few). Therefore, I do not pretend to encompass this vast literature in my research, but only wish to draw out some of the main positions and debates surrounding the use of the concept of landscape and to clarify my own usage of the word.

The various conceptual positions on landscape oscillate in a wide spectrum, from landscape as the physical environment of a determined area to landscape as a cultural image more or less associated with a specific place. It is this inherent duality of landscape which prompted Carl Sauer, one of the main contributors to the development of North American geography, to propose the concept of 'cultural landscape', as distinguished from 'physical landscape', as the cultural reading of transformations to the physical environment (see discussion in Olwig, 1996). Thus, Sauer's notion of 'cultural landscape' reflects how landscape is understood by art historians (the scenic view of landscape paintings and their aesthetics, see Cosgrove and Daniels, 1988 or Roger, 1997, for instance) and some cultural anthropologists. For instance, in the discussion on landscape in the field of French social sciences, cultural geographer Augustin Berque (1995) and social anthropologist Philippe Descola (2005) coincide in their insistence that it is a tautology to speak of a 'cultural landscape'. They suggest that landscape is cultural by definition and that using the words 'environment' or 'milieu' would be more accurate than the notion of a 'physical' landscape). However, most geographers and social anthropologists would agree that the productivity of landscape as a concept for the social sciences is that it encompasses the relationship between a specific physical environment and social and cultural experiences thereof, and how both the environment contributes to shape these experiences and likewise how cultural models contribute to transform and shape an environment into a particular ecological-historical construct resulting of these interactions between nature and society.

In a seminal introductory chapter, Hirsch (1995:4) revived the debate on landscape within anthropology by proposing a definition which has gathered some consensus within the discipline: landscape as an analytical concept refers to the tension between foreground, the actual environment as it is observed, experienced and known through practice, and background, that is both the cultural readings of and the idealized projections onto that environment (e.g. the Western projections of the Judeo-Christian iconography of the biblical Garden of Eden onto the idea of sublime 'nature' unspoiled by mankind).

Similarly, in human geography there has been a critique of the privilged understanding of landscape as a scenic view; this approach is rooted in the Western artistic tradition of landscape aesthetics. For instance, Olwig (1996) reminds us that the etymology of landscape in Northern European languages pre-dates the later Renaissance impact of landscape painting aesthetics on how we use the word today. In its Germanic roots, *lanskap*, *lanschap* etc., the term 'landscape' was used to refer to a traditional communal territory and its meaning encompassed both the land and the community that inhabited and controlled this specific territory. Olwig invites us to reassert what he calls the 'substantive meaning' of landscape as a political entity. Other authors in archeology and anthropology call for a phenomenological approach to landscape (e.g. Tilley, 2008; Ingold, 2000). This latter position identifies landscape as simply the environment as it is experienced by people in their movements and practices through and in that environment.

What is to be retained from these debates is that, from a social science perspective, landscape is the result of interactions between nature and society; as such, the identification of landscapes in specific areas is the result of historical and socio-cultural processes. This is why the aesthetic, economic and cultural values of landscapes can be so violently contested between different societies or sub-groups (of class, ethnicity, user groups etc.) within one given society. The example of the controversy surrounding windfarms provides an appropriate example of this issue (see Van der Horst and Lozada-Ellison, 2010). From a social and cultural perspective, landscape boundaries must be clearly identified on paper and by legislation. Without such identification, landscapes are not clearly defined units but are rather the expression of subjective perceptions and judgments surrounding specific places and environments. The numerous issues surrounding the term ‘landscape’ mean that there is no clearly defined generic ‘landscape scale’ from a social point of view.

Selman (2006), defined landscape as a holistic entity where natural and human processes merge and economic, social and ecological objectives can be balanced. Selman (2012) also argues that social, cultural and ecological dimensions of the landscape have been disconnected and that there is a need to reestablish a connection which will allow multifunctional and resilient landscapes. Landscape reconnections draw from different disciplines to understand cultural, social, ecological, urban landscapes (Selman, 2012). These arguments suggest that although there are no specific boundaries at the landscape scale, there are processes that must be understood when addressing connectivity between different landscapes. However, the difficulty associated with such an approach return us the fundamental question posed earlier: what landscape scale and what scale should be adopted for this research?

This lack of clear boundaries for the concept of ‘landscape’ from a social science point of view converges with the use of the term ‘landscape’ in ecology. As in social science, in ecology the definitions of ‘landscape’ and ‘landscape scale’ are widely and subjectively defined. There are no clear boundaries as this depends on the ecosystems and/or species studied or the approach taken. As such, landscape ecology tries to study landscape not only from a cultural or human point of view but also from the point of view of other species.

Landscape ecology is a complex discipline because it studies interactions in 'space' and 'time' and neither of these dimensions has clear limits. Sharov (1996) gives the following definition of the sub-discipline: 'landscape ecology studies regional large-scale ecosystems with the aid of computer-based geographic information systems'.[4] Within landscape ecology, landscape can also be defined as,

> 'the interacting mosaic of elements (e.g. ecosystems) relevant to some phenomena under consideration (at any scale). Landscape is an area of land (at any scale) containing an interesting pattern that affects and is affected by ecological processes of interest. It involves the study of these patterns, the interaction among the elements of these patterns, and how these patterns and interactions change over time. It involves the application of these principles in the formulation and solving of real-world problems'.[5]

Landscape ecology includes the study of spatial patterns observed in the environment; it describes the effect of the pattern and the associated ecological processes. When passing from 'landscape ecology' to 'landscape' the definition becomes even wider, as I have discussed. These differences in the understanding of the term 'landscape' have created confusion (Antrop, 2001) and limited the advantageous outcomes that different disciplines could deliver working together.

One last remark must be made on the use of landscape in the policy arena. Landscape has progressively been construct as a policy category with an aim to designing particular funding streams for the protection of designated areas. This has been formalised at a European level in the Florence Convention, also known as the European Landscape

4 (http://www.ento.vt.edu/~sharov/PopEcol/lec1/whatis.html)
5 (http://www.umass.edu/landeco/about/landeco.pdf)

convention signed in 2000.[6] At a European and national level, policies derived from the Landscape Convention are mainly applied to protected areas, scenic areas and various special denominations in specific areas selected for nature conservation (as well as cultural or historical heritage areas or features). In Scotland this is most directly illustrated by the 'national scenic areas' (as is the case of the Cairngorm Mountains in the upper reaches of the Dee Catchment) as selected and monitored by the public body Scottish Natural Heritage (SNH). However, outside these specific protected areas, there are practically no landscape-specific policy measures in place: this is particularly the case for policies regarding agriculture. Indeed, as I will show later, landscape-specific measures are absent from Agri-environmental Schemes, which are translated into national policy from the European Common Agricultural Policy (CAP). Because these Agri-environmental Schemes are increasingly framed by conservation objectives, the lack of a landscape dimension often appears inconsistent with the objectives of the schemes, as present ecological understanding indicates.

Having acknowledged the difficulties with setting objective boundaries, in this study I take the ecological approach to defining a landscape scale, that of an ecosystemic unit chosen for the specific purposes of the research. Given the discussion about landscape, I decided to take a catchment area as the foundation to define 'boundaries' to my study area. Although the catchment is particularly important to the study of hydrological processes, I decided to use this catchment because it defines a coherent ecological unit (beyond the water system as such) which is relevant for diverse conservation purposes. Also, as I show in

[6] The Convention's definition of landscape is a very general one: "Landscape" means an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors', European Landscape Convention – Article 1. Definitions, http://conventions.coe.int/Treaty/en/Treaties/Html/176.htm consulted 4 March 2013.

chapter 2, the Dee catchment is a highly connoted cultural landscape known as 'Royal Deeside', which makes this a coherent landscape scale both from both an ecological and social point of view.

As I shall address in the following section, for conservation the questions of scale and boundaries are central issues. As Adams (2004: 6-8) discusses with the example of the Parc National des Volcans in Rwanda, the definition of boundaries for protected areas is a complex political process: conservation has very little 'naturalness' to it and is very much a political process. The idea of 'conservation' has a long history, as does the way science and policy are used and applied. The following section answers a number of questions, including, what is conservation? At what scale should conservation take place? How is conservation defined by ecological science?

1.3 Conservation and Biodiversity: Reversing Extinction?

From a historical and social science point of view, the concept of conservation has a very specific cultural history which is rooted in Western ideas about nature. Indeed, well before the emergence of scientific ecology as a unified academic discipline, the conservation movement of the mid to late nineteenth century attempted to create the world's first nature reserves in North America. Moreover, this movement formed the basis for Western environmentalism.

Theorists such as Henry Thoreau and John Muir posited the idea of a 'sublime nature' which North America was in danger of losing. They positioned this idea on the political agenda and highlighted the need for governmental protection of specific areas of wilderness. The creation of the world's first national nature park in Yellowstone (1872) represented a translation from the map to the terrain of the idea of 'nature' as untouched wilderness thought of as entirely separate of humans' influence, let alone civilisation[7]. As they were increasingly encroached upon and threatened, it was considered necessary to set these 'natural' areas aside from direct use including by expelling the remaining indigenous population and removing them to federal reservations.

Conservation policy was thus borne out of the conceptual separation between nature and society or nature and culture characteristic of Western thought, as anthropologists would emphasise (Ingold, 2000; Descola, 2005, for instance). This approach allowed some form of protection to be given to distinct isolated islands of what was considered 'wilderness'; however, it also enabled unchecked exploitation and possibly the destruction of the environment and its resources in the rest of the nation's territory (Adams 1996).

In Europe, the institution of national parks has been more recent due to a number of historical and cultural reasons. Moreover, the idea of an opposition between nature as 'wilderness' and culture/civilisation has been less stark, in part because there were only few areas of "unspoilt" nature in Europe and due to the consideration of such 'unspoilt nature' as 'wasteland' in pre-romantic times. However, despite this, initial conservation policies in Europe followed a similar ideological paradigm of mapping, zoning and segregating areas. This approach dedicated some areas to economic development and others to the preservation of nature or specific landscapes.

In the UK, discussions and attempts to create conservation areas began in the early twentieth century and were finally transcribed into policy in the National Parks and Access to the Countryside Act of 1949, which permitted the creation of conservation areas. Since

[7] Anthropologists would underline that this denied the historicity of America's First Nations and their subtle yet very real alteration of local ecosystems and landscapes (Selmi and Hirtzel, 2007: 10-11).

then, various statutory documents have been produced that protect different features of the countryside. Two of the most important documents of this type are the Countryside Act of 1968, which enables the provision of grants to land managers to protect areas outside the National Parks, and the Wildlife and Countryside Act of 1981, which considers issues related to access and recreation. In parallel to these statutory documents and the corresponding increase in protected areas, the twentieth century saw the creation of numerous charities and organisations with active members supporting conservation activities in the countryside (Adams, 1996). However, despite the increasing number of supporters aiming to protect the countryside, rural habitats were rapidly deteriorating. 'Conservation' represented a common currency that governmental institutions organizations and charities used to exchange ideas, rather than a set of actions that permitted the protection of the countryside. As suggested earlier, changes in agricultural production towards mechanisation and intensification in the 'productivist' era, played a major role in natural habitat decline and consequent species loss. Land use is a key human activity which alters ecosystems. Estimates of the expansion of cropland and pasture over the twentieth century range from 70% to 80% (Klein Goldewijk, 2001). In addition to agriculture there were other factors, notably mineral extraction, that contributed to biodiversity loss and had an impact on even the new, protected areas of landscape, such as the Sites of Special Scientific Interest (SSSI) (Adams, 1996).

A new shift in the way 'conservation' was considered occurred in the 1990s. First, 'biodiversity conservation' and 'biodiversity loss' were adopted as general terms to talk about nature, different species and habitats. Secondly, the way in which 'biodiversity' was protected in practice changed. According to Adams (1996), business management thinking was applied to biodiversity conservation. This approach refers to the idea of allocating scarce resources efficiently, which means targeting the use of money to conserve priority (and single) species or habitats. One of the problems with this approach is that conserving a single species or habitat may neglect other species or habitats and abandon them to destruction or extinction. Allocating financial resources to some species means there will not be resources available for conserving other species or habitats (see, for example, Adams, 1996). Despite the problems associated with this approach, conservation in the UK currently follows this targeted path of protecting single species or habitats according to the Biodiversity Action Plan (BAP). This trend is not only apparent in the UK, but is happening worldwide (Adams, 2004). The BAP was the result of the UK Government signing the Convention on Biological Diversity (CBD) in 1992 in Rio de Janeiro. The UK was one of the first countries to produce a national approach for biodiversity conservation; the Plan provided information about the resources available and offered a detailed plan for their conservation.

Since the BAP has been central to the biological conservation policies and practices which are part of the object of this study (the question of whether one agrees with them or not being set aside), for the purposes of this research I decided to adopt the CBD's definition of biodiversity: 'the variability among living organisms from all sources including, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems' (CBD, 1992).

Along the same lines, in this research biodiversity conservation should be understood as the conservation of biodiversity as CBD defines it and achieved by conserving ecosystems and population processes (such as balance between birth rates and mortality of different species). Incidentally, according to the literature in ecology, as I shall present in section 1.3.1 and 1.4, ecological networks are a tool to achieve biodiversity conservation.

Implementation of BAP and other conservation policies are seen as top-down approaches; however, how these policies are implemented also depends on bottom-up decision-making. Those who own and manage land are as important as institutions in implementing conservation policies. As Adams (1996: 137) rightly underlines: 'If conservation is to be successful, we need to re-integrate conservation onto the local economy. Just as we need to reach out beyond the confines of protected area into the whole landscape, we nee to build links between protected areas and the needs and economic lives of the communities around them'.

If ecological continuity on a landscape scale is needed for conservation, and farmland (private property/owned individually) creates fragmented management of the landscape, then farmland represents an issue for conservation ecology. This raises the following questions addressed: how is conservation to be managed or achieved in farmland? What are the gaps between conservation and land management? What are the major concerns in conservation ecology in relation to farmland? The following paragraphs attempt to offer some answers to these questions and justify the choice of 'ecological networks' as the object of this research in terms of landscape scale conservation and collaboration between land managers.

It is important to note, however, that it is not farming *per se* that creates biodiversity loss but rather the way farming activities are carried out and the way conservation is conceived and practiced. That is, if farming activities were carried out not solely as commodity production but as part of an ecological system, as is the case in other societies such as among the indigenous populations in Mexico (Toledo, 1985) or New guinea

(Rappaport, 1968) then perhaps there would be no need to ‘protect’ and ‘conserve’ species and habitats (without a romantic idea of these societies, authors have documented interesting farming-conservation systems). Such an approach would also tackle the current discrepancy which exists between areas of the countryside where biodiversity is in sharp decline and others where biodiversity is preserved or recreated. According to Adams (1996), conservation of protected areas makes a holistic approach to countryside conservation more difficult, as it creates the perception of conservation as a sector or land use. Adams (1996) also mentions that this vision of segregation makes policy integration difficult: if conservation sets targets by conserving areas, then once the target is met there is no need for transversal policies in different economic sectors. In this sense, ecological networks do not offer new ideas but rather aim to develop extended conservation areas or connected conservation areas: they aim to replicate the same patchwork logic in a network. The concept of ecological networks is in line with the way conservation is envisioned in the UK (and not only in the UK but many other countries). However, for this study I have taken the approach of ecological networks as an object of study (rather than as a conceptual framework); this approach offered me the opportunity to study cooperation and conservation at the landscape scale (as defined previously) in the context of private land tenure, where land managers can choose to do whatever they want with their land.

Landscape ecology demonstrates that ecological systems can be studied at different scales and that ecological processes are often not confined within the boundaries of conservation areas. It shows that designated areas are affected by the surrounding environment and cannot be considered ecological ‘islands’ with self-contained processes. Landscape ecology also helps in thinking about species adaptation to climate change via tracking the shift of their ‘climate space’. Landscape ecology has, therefore, helped drive the vision of conservation in the UK and has spurred the arguments for the creation of ecological networks, as I present below.

1.3.1 Conservation and Landscape Ecology.

If biodiversity conservation is understood as the conservation of biodiversity as CBD defines it and achieved by conserving ecosystems and population processes (such as balance between birth rates and mortality of different species), then species representation, taxa and habitats are vital to the study of ecological processes for conservation. However, processes are not isolated and happen at different scales (of space and time) depending on the species (for instance, lifecycle processes for insects involve a smaller scale and shorter time period than those of higher mammals). Interaction between species forms part of the processes of a system and, conversely, systems are affected by species behaviour and species extinction. Research on species and habitats constitutes one approach to the study of ecological processes and has had a strong influence on the way conservation is practiced in the UK. In line with such research, conservation policies are then developed with an aim to halting biodiversity loss and species extinction.

Diamond et al. (1989) studied human-caused extinction and identified a number of human-related factors which could have adverse affects on the environment: these included, overhunting [8], effects of introduced species, habitat destruction, and secondary ripple effects and human growth. Sala et al. (2000), found land-use changes responsible for the largest

[8] Hunting is sometimes the reason for over killing at a rate above the 'maximum sustainable yield'. There are two types of populations that are especially vulnerable to overkill resulting from hunting: species with low intrinsic rates of increase because these have a little bounce-back built into their dynamics (for instance elephants and whales are emblematic cases in the world).

effect on terrestrial ecosystems, followed by climate change, nitrogen deposit, biotic exchange, and elevated carbon dioxide concentration. For the case of the UK, Thomas et al. (2004) mentioned that causes of extinction are related to the major clearance of primary vegetation leading to degradation and fragmentation of habitats. According to their study, climate warming has had the positive effect of intensifying the net capacity of ecosystems to support butterfly and, perhaps, plant and bird species. At the same time however, a few exotic species have colonized British ecosystems and have had a damaging impact on many less robust communities.[9]

These cases represent the major identified trends of extinction; however, it is difficult to know exactly how many species are in danger of extinction because of a lack of baseline information about species of animals, plants and microbes living on Earth. In population dynamics very little is known about the role individual species play in maintaining ecosystems. According to May (2007), information about behaviour and ecology is available for fewer than 5% of the identified animal species. With this in mind, Thomas et al. (2004) proposed the use of butterflies as representatives of extinction rates for other taxa. Birds are, according to the authors, imperfect model organisms because they represent just 0.6% of the world's described species[10], and because the assumption that mammals and birds serve as indicator groups for wider species loss is untested. The authors note that the impressive loss of butterflies may indicate similar 'declines in birds and plants, because insect populations typically respond more rapidly to adverse environmental change' (Thomas et al., 2004: 1880).

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[9] It is important to mention that regulation of collecting and hunting as well as targeted conservation measures have reversed the former declines of several species (Thomas et al., 2004).

[10] Thomas et al. (2004), present the results of research conducted in the past 20 and 40 years on plants, birds and butterflies in Britain. They found that 28% of native plant species have decreased over the past 40 years, that 54% of native bird species have decreased over the past 20 years, and that in the past 20 years 71% of butterfly species have declined.

With the rise of 'ecological networks' as both an academic and policy proposal for conservation, mapping exercises have been carried out to identify where such networks should be established. Ecological networks focus on which habitats should exist for species-specific conservation objectives (based on a set of conditions species need to feed, survive and reproduce). However, Lindenmayer and Hobbs (2007) observe that the term 'habitats' is loosely used in landscape ecology and conservation biology. The authors identified two different main usages: a) a species-specific entity – the environment and all the conditions suitable for a taxon; b) a more general usage that typically refers to the amount of native vegetation cover (Lindenmayer and Hobbs, 2007: 96).

Habitats become deteriorated, fragmented or eliminated as a result of changes which are dependent on the species in question. The most common example is the cutting down of a patch of forest: this constitutes habitat destruction for species specific to the forest habitat, but for native vegetation the habitat is transformed but not eliminated (and is then available for other species). In most cases habitats are fragmented.

The argument for ecological networks within ecological science relies heavily on the notion of metapopulation (see below). The study of metapopulation structure is relevant because it represents the conceptual framework for managing a population whose habitat is fragmented. Furthermore, it offers an ecological base to the policy-makers' argument that ecological networks are necessary.

Metapopulation can be defined as a 'spatially structured population' (Hanski, 1998: 41) or as a 'population of populations' (Caughley, 1994). Metapopulation dynamics 'covers any spatial dynamic' (Hanki, 1998: 41).

A precursor to this concept was Levins's patch dynamics model (Levins, 1969). The principal question for this approach is the condition under which a metapopulation persists[11] when habitat area is lost and the remaining habitat becomes increasingly fragmented.

According to Hanski and Gilpin (1991, in Green et al., 2006), the theory of metapopulaiton 'deals with the colonization and extinction of individual species within archipelagos and patchy environments. The idea is closely linked with processes such as population turnover extinction and establishment of new populations' (Hanski and Gilpin 1991, in Green et al., 2006: 86). Metapopulation implies a landscape scale approach in fragmented habitats and reflects the processes that occur with the ecosystem rather than with the population only.

According to Hanski (1998), 'the essence of spatial ecology is that the spatial structure of ecological interactions affects population as much as do average birth and death rates, competition and predation' (Hanski, 1998: 41). In this sense, it is important to take into account the entire structure of ecological interaction rather than only empty or full 'islands' or patches. According to this perspective, where local extinctions are recurrent events the population survival will depend on the interaction with the surrounding populations. Therefore, different patches and islands should be connected to allow species movement. It has been suggested that if re-colonization of new patches happens easily it will lower the probability of extinction (Goodwin and Fahrig, 2002: 552).

Landscape connectivity in ecology is defined as 'the degree to which the landscape facilitates or impedes movement among resource patches' (Taylor et al., 1993, in Goodwin and Fahrig, 2002). Because the landscape is strongly altered by farm management, the

[11] Persistence is given by the equilibrium of 'deaths' (local extinction) and 'births' (establishment of new population at unoccupied sites).

degree to which landscape facilitates or impedes the movement of species will strongly depend on the type of management within each farm.

Following this approach, land managers have an important role to play as the interaction between the landscape structure (set by landscape composition and configuration) and animal movements (set by behaviour) will determine the ability of animals to move through a landscape. Anthropogenic habitat loss increases habitat isolation (decreasing landscape connectivity). Connectivity or isolation is recognised as a fundamental factor in determining species distributions. Landscape connectivity has been measured by interpatch distances, immigration rates and dispersal success. However, research is needed to determine if simple measures of landscape structure can be used as a measure of functional connectivity for the landscape. Furthermore, according to Goodwin and Fahrig (2002) there is no evidence for the relation between landscape functional connectivity and landscape structure. This is because structural properties do not guarantee that individuals of a species will actually traverse the landscape. However, the landscape structure represents the area where land managers are most able to influence species-extinction. The decisions land managers take can potentially improve the quality of habitats and, therefore, increase the number of species interacting in that habitat, as well as allowing the movement of species. By giving the characteristics of habitats according to the parameter of 'attractiveness' for specific species, the probability is that 'colonization' and 'migration' will occur at a wider landscape scale and increase landscape connectivity.

1.4 ECOLOGICAL NETWORKS: RECREATING NATURE?

Landscape ecologists have proposed ecological networks (in order to increase habitat connectivity) as a valuable tool for biodiversity conservation, because these are supposed to enable species to move and re-colonize new habitats (e.g. Turner et al., 2001). Although the idea is not new, policy makers in continental Europe and recently the UK have adopted this approach as one tool for conservation (Lawton et al., 2010; Bennett and Mulongoy, 2006; Forest Commission, 2010). In the UK the approach has attracted more attention for implementation. Within the European Union, the Habitats and Species Directive proposes ecological networks as one way to achieve biodiversity conservation (European Commission, 2012[12]).

As noted in the previous section, the basic idea of ecological networks is that they connect isolated habitats in order to increase the viability of local species population (e.g. connecting designated areas). The implementation of ecological networks has been advocated by many researchers (e.g. Tiemann and Siebert, 2009; Jongman and Pungetti, 2004; Bennett and Mulongoy, 2006; Simeonova et al., 2009; Turner et al., 2001). However, despite a rich literature on the subject, there are fewer cases of effective implementation (Bennett and Mulongoy, 2006; Jongman and Bogers, 2008; Leibenath et al., 2010) than studies on proposals in theoretical papers and maps.

The theories surrounding ecological networks are well articulated on paper but are not sufficiently tested in practice. Despite the lack of vigorous evidence, there is an important amount of research that supports and values habitat connectivity as a tool for maintaining biodiversity (Vos and Opdam, 1993; Turner, 1989; Forman, 1995; Bennett,

[12] http://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm (Accessed 10/11/12)

1998) and for delivering other additional services, such as recreation (Gimona and van der Horst, 2007), pollination (Carvalheiro et al., 2010), or other ecosystem functions (Devoto et al., 2012) including multifunctional landscapes (Selman, 2012). As various authors have emphasised, ecological networks are multifunctional by definition (Jongman and Pungetti, 2004).

However, some critiques to this approach relate to the danger of habitat connectivity acting as a network for diseases, invasive species or spreading disturbance (Simberloff and Cox, 1987; Noss, 1987). This calls for an evidence-based assessment of these risks (Postnote, 2008). One example of this problem is the case of the grey and red squirrel in the UK. Red squirrels are listed in the UK Biodiversity Action Plans as a key priority species, but grey squirrels are displacing them. Grey squirrels were introduced into the UK in the late nineteenth century. They now out-compete the native red squirrels for food. They are also carriers for a deadly pox virus which does not affect them but which is a threat to red squirrels (Shaw and Thompson, 2006:155). The creation of ecological networks with habitats for red squirrels will also favour grey squirrels and carries the risk of the latter taking over red squirrels: this is already the case in some areas of England and Wales. In fact, this is also an issue in Deeside where measures to control the incursion of grey squirrels moving up the river from the city of Aberdeen are being implemented (as I could observe in the field). Another potential example is the recent spread of Ash dyeback due to a fungine parasite.

The lack of evidence for the effectiveness of ecological networks for conservation is perhaps due to the difficulty associated with creating ecological networks, especially on privately owned land. The planning system has been the most promising way to implement ecological networks (Selman, 2012; Jongman and Pungetti, 2004). Indeed, the few existing cases of implementation have been carried out through planning systems. For instance, in a survey, Ahern (2004) found that in the USA 48% of states supported the idea of greenways, 48% did not know about greenways, and only 24% of states had a plan for the development of greenways. In the Netherlands the development of a National Ecological Network has been set as an objective by the Dutch government. However, the network is not large enough to sustainably maintain flora and fauna (Bolck et al., 2004). Despite this, the Netherlands holds one of the best examples of the implementation of ecological networks. Another good example of implementation is the case of the Estonian Ecological Networks, which are at national scale. Based on the land use planning system and developed during the era of the socialist state, this network has been conceived using a pragmatic approach that focuses on delineating networks with characteristics that can be mapped and are deliverable through the planning system and that are also socio-economically significant (Selman, 2012). It is likely that these characteristics, especially the socio-economic soundness, have played a key role in the successful implementation of the network.

In the UK policy arena, the Lawton review (Lawton et al., 2010) strongly supports the creation of ecological networks as one way to enhance species persistence and a number of other ecosystem services. Although plans exist to use and develop this tool in different areas of the UK, at present there is no implementation of significant ecological networks. The Cheshire Regional ECOnet is one of the first cases to be developed in the UK where the planning system has, in part, achieved the implementation of ecological networks on private land (Postnote, 2008). In Scotland there are cases where plans or implementation are in the initial stages of development, such as the Lothians and Fife Green Networks, Central Scoltand Green Network and the Scottish Wildlife Trust's National Ecological Network proposed in coordination with the Royal Society for the Protection of Birds (RSPB) as part of the National Planning Framework 3.[13]

It is true that ecological networks from a conceptual point of view do not represent a challenging idea to conservation policies in the UK, as they protect or recreate specific habitats for specific species. Although ecological networks, properly understood, are areas of landscape with low use intensity and multifunctional benefits. However, the notion offers a further step into landscape scale conservation. Most importantly for this research, it offers me the opportunity to study conservation policy issues at a scale larger than the holding and consequently requires the study of cooperation and collaboration amongst land managers.

Lawton et al. (2010) also acknowledge that land managers are likely to play a crucial role and advocate partnerships as an avenue to their inclusion. This implies not only participation, but also cooperation and collaboration as network spans multiple properties. However, there has been very little work regarding how this cooperation might be achieved.

As Selman (2012) argues, there are two main problems when connecting landscapes (included the creation of ecological networks): the first relates to perceptions of the landscape and the potential conflict between the preferences of the public and those of the land managers; the second relates to the practical issue of how to implement policies and other mechanisms to successfully unite physical systems across areas that are under multiple landownership -including tenancy- (Selman, 2012: 141). In chapter 3, I will discuss the potential of the "Adaptive Co-Management" proposal as a framework for action (Colfer, 2005; Armitage et al., 2007; Olsson et al., 2004) to address these issues. Research has indicated that the desirable ecological networks in Deeside are woodland corridors for birds

[13] http://scottishwildlifetrust.org.uk/what-we-do/policy-and-campaigns/nen-conference-presentations/ (Accessed 20/01/2013).

and for recreation (Gimona and van der Horst, 2007). However, land managers in the area may not support all species or woodlands identified in the ecological networks. Land managers could, if they wished, contribute to the creation of woodland networks by planting broadleaves and coniferous trees on part of their property. Yet, as I shall present in this research, land managers' preferences are diverse and the creation of robust ecological networks is unlikely to happen without an existing business interest or another form of personal motivation in place. However, in all other cases an economic incentive could help to create narrow habitat corridors which are easier to implement, such as networks of field margins to encourage insects for pollination.

At times, the need for woodland corridors identified by ecologists and the business interests of some land managers coincide. This is the case for the creation or enhancement of riparian woodlands (this example is discussed in the analysis of interviews in chapters 3 and 4). From an ecological standpoint, the creation of riparian woodlands serves several purposes in relation to water quality and conservation of protected species such as the freshwater pearl mussel (*Margaritifera margaritifera*). At the same time, land owners with an interest in salmon fishing (be it business or personal) will be keen to cooperate with agencies and neighbours to achieve these corridors which will favour the salmon (some of the land managers interviewed are already supporting the implementation of these corridors).

Another example is that of woodland habitat management for the conservation of black grouse (*Tetrao tetrix*) and capercaillie (*Tetrao urogallus*). In this case there is no direct business interest (although there are some grants), but several of the land managers in the areas concerned (especially estates in the upper reaches of the catchment) not only expressed willingness but were actively engaged in conservation practices and coordination with neighbours and public agencies. While some grant schemes (for instance participation in the

European Life+ project) were available to encourage land managers' participation, it must be stressed that several estates and some smallholding owners in the area wanted to participate in these management practices because of an interest in the species as an iconic part of Scotland's wildlife. As the wildlife manager of one estate expressed explicitly, although there is no economic gain in black grouse or capercaillie (unlike commercially exploited species such as red grouse or deer), having these species gave the estate's public and commercial image extra prestige. This may eventually lead to a new economic income in the form of 'wildlife tours', but this activity is very marginal in Deeside compared to the Speyside area in the north of the Cairngorms National Park. Without going into details here, conservation practices for these species included actions such as connecting up areas of forest to create more extensive habitats and removing deer fences to enhance the connectivity between forest areas. This is an interesting example of how land managers can contribute to ecological networks' implementation. In this case, the connectivity already exists from a vegetation point of view but the habitat is still fragmented from the point of view of the species to be protected due to specific land uses (here the fences for deer management for sports stalking).

The few national and international examples of full-scale implementation of ecological corridors show that centralised planning systems, partnerships, cooperation and coordination must be utilised alongside economic incentives in order to succeed with the implementation of ecological networks. For instance, in the Netherlands one of the projects currently developing ecological networks, the Green Connections, has succeed by implementing the networks via provinces and, most importantly, through municipalities and water boards that carry out a coordination role (Bolck et al., 2004).

This research also shows that for the case of Deeside ecological networks could be implemented on privately owned land through economic incentives, the creation of partnerships and coordination by third parties. In the following section I present the discussion related to economic incentives.

1.5 Payment for Environmental Services

The question of introducing an economic incentive to achieve landscape scale delivery of environmental services raises the issue of 'public goods' and Payment for Environmental Services (PES). In many countries – and certainly in the study area - land managers ultimately control the delivery of public goods deriving from land use. Therefore, without a process to define objectives and economic incentives to enhance land managers' participation, public policy for the delivery of biodiversity at the landscape-scale is unlikely to be successful.

As noted earlier, biodiversity is defined here as 'the variability among living organisms from all sources including, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems' (CBD).[14] Following this definition, biodiversity is established as a public good, as I shall discuss in chapter 5. For now, it is important to note that as a public good the provision of biodiversity at the landscape scale does not exclude people from benefiting from it at the local or global scale. Hence, land managers carrying out conservation related changes to their land management are delivering a public service.

[14] Source: http://www.cbd.int/convention/articles/?a=cbd-02 (Accessed 26/04/2012)

Inevitably biodiversity in the UK is also found on private land. Under the current approach of partial protection of biodiversity by law, and in a context of private property rights, it is necessary to compensate land managers for providing this service. One approach is to pay for these services by using voluntary economic incentives, known as Payment for Environmental Services (PES) or 'PES-like' payments as is the case of Agri-environmental Schemes (AES).

PES is defined as the '*voluntary* transaction in which a *well-defined* environmental service (ES), or a form of land use likely to secure that service, is bought by at least one ES *buyer* from a minimum of one ES *provider*, if and only if the provider continues to supply that service (*conditionality*)' (Wunder, 2005). Figure 1.1 shows the rationale of PES.

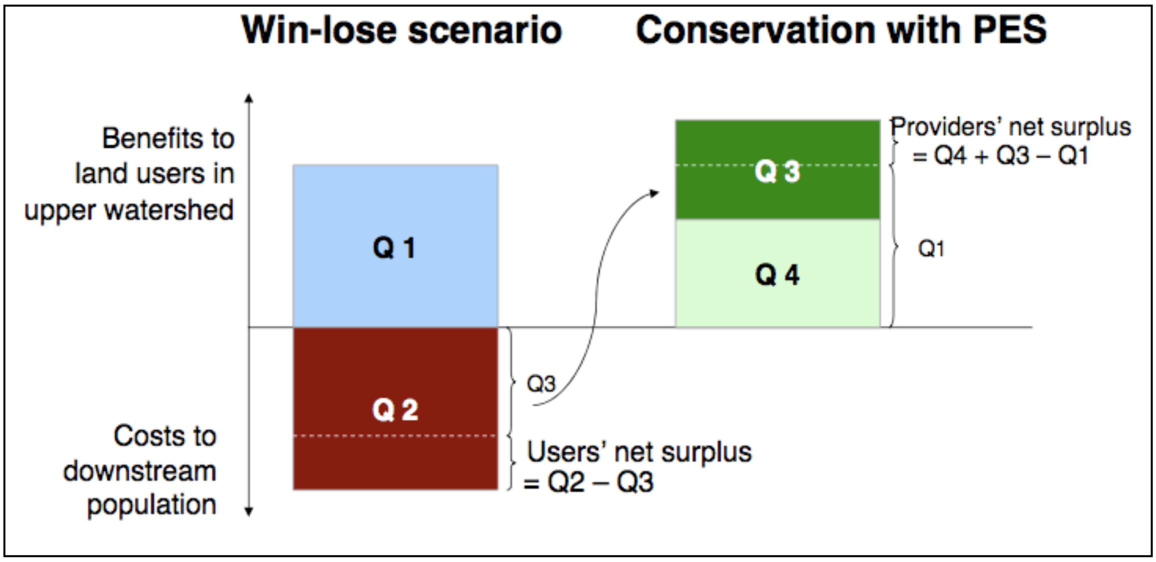

Figure 1.1. Source: Wunder, S. at PhD Course Copenhagen, 2009. [Q1 Most profitable land use (e.g. deforestation); Q2 External effects from Q1 (e.g. decline in capercaillie habitats); Q3 PES paid by users; conditions: Q3<Q2 and Q3 + Q4> Q1; Q4 Service-friendly land use (e.g. agro-forestry, pure protection)].

Figure 1.1. Rationale of Payment for Environmental Services

The principle of PES is based on the so-called Coase theorem (1960) in legal and economic theory. This theorem addresses the issue of the distribution of transaction costs associated to externalities in economic activity (Engel et al., 2008). The PES approach can be illustrated by using an example of a holding with mixed farming and forest land. If the land manager decides to cut down the forest and convert it into farmland, which is more profitable (in Q1 in figure 2), he will destroy habitat that, is suitable for capercaillie (*Tetrao urogallus*). The law protects this species and it is highly valued by capercaillie enthusiasts. The destruction of the habitat will impose an external cost (habitat creation and species loss) higher than the deforestation itself (Q2 in figure 2). Therefore, people affected by the destruction of the forest have an interest in paying to maintain and keep the habitat (Q3 in figure 2). The payment should be less than the costs (Q3<Q2) and should be high enough to persuade land manager to keep the forest (Q3 + Q4). According to the PES approach, the land manager will be better off by keeping the economic activity already in place (commercial forest) and accepting the payment for managing the habitat (Q3 + Q4 – Q1= provider net surplus); the capercaillie conservationists will be better off by compensating the land manager (Q2 – Q3 = users' net surplus).

There are many examples of public policy for conservation in the world that use the PES approach, but most of these are 'PES-like schemes' that do not exactly fulfil the definition presented above (Wunder, 2007; Engel et al., 2008; Munoz-Piña et al., 2008; Barton et al., 2008; Kalacskaa et al., 2008; Lipper et al., 2009). In addition, the majority of PES are not market-based but depend on agreements between individual actors or groups (Wunder, 2007) and are sponsored by the World Bank, governments, conservationist organisations, and for-profit enterprise (McAfee and Shapiro, 2010). Some of the known critiques to this approach address problems related to: i) the potential service buyers; ii) the evaluation of Environmental Services; iii) the institutions and governance; iv) ethical issues.[15] It is also worth underlining that the PES framework is characteristic of the neoliberalisation of land conservation policies and of its ‘institutional blending’ between private property rights and instruments for the delivery of public goods as discussed by Hodge and Adams (2012).

In most existing cases, economic incentives for conservation are paid at the level of individual holdings. This creates a scale mismatch between actions taken at the farm or holding scale and the need to deliver biodiversity at the landscape scale through ecological networks (Macfarlane, 1998). This mismatch is translated into a failure to obtain the services, here biodiversity, for which the incentives are paid (either through direct or indirect payments). This suggests the need for landscape scale coordination or cooperation amongst individual holdings (Goldman et al., 2007; Franks and McGloin, 2006). The problematic of ecological networks implementation allowed me to investigate cooperation and collaboration in the Deeside. Since initiatives for the implementation of ecological networks involved an economic compensation, and biodiversity is paid for, I decided to investigate whether an economic incentive alone could stimulate cooperation (i.e. without coordination). For this part of the research I used experimental economics and took inspiration from game theory; this aspect of the research will be presented in chapter 5 of this dissertation.

The data collection in this research, including the experiments, was based on information provided by land managers in the Deeside and public agencies involved in the management of the catchment. I define land managers **as people who have access to land**

[15] For further discussion on this see McAfee and Shapiro, (2010) and Wertz-Kanounnikoff, (2006).

and are in the position to take decisions on land use and carry them out. In other words, those who have a direct influence on land use and consequently on the environment. I discuss the conceptual and methodological implications of this definition in chapter 4 (section 4.1).

As this chapter reflects, this research uses an interdisciplinary approach, working across several areas of study: ecology, geography, sociology and economics. A combination of qualitative and quantitative methods were applied in order to study landscape scale management for the provision of public goods (i.e. biodiversity) on privately owned land, and the application of AES at the landscape scale. To frame my research I used the idea of ecological networks' implementation applied to Deeside, in the North East of Scotland. This interdisciplinary project investigates social aspects relating to land managers' attitudes to cooperation and conservation. Furthermore, it tests the viability of an economic incentive to encourage the implementation of ecological networks and more general management at the landscape scale.

This chapter has highlighted a number of gaps in the literature in relation to ecological networks. This study contributes to the discussion and aims to fill some of these gaps. This research addresses the problem of landscape scale management for conservation on privately owned land. This work relates mainly to pragmatic research as it attempts to inform policy makers and assist in the development of public policy to deliver conservation at scales larger than the holding. It also contributes to the academic discussion of the following subjects: a) multifunctional land uses and provision of conservation by different types of land managers whose land uses are interlocked thus creating a specific landscape in the Dee catchment; b) the study of coordination and cooperation for conservation; c) the introduction of coordination bonus payments to assess the potential for an economic incentive alone to create a desirable spatial configuration. The aims and research questions outlined below guided my research. Each chapter presents a different angle on these subjects.

1.6 AIMS AND RESEARCH QUESTIONS.

This research was guided by the following general aims:

a) to establish whether the preconditions for collaborative action are present in my study area and to examine the potential for collaborative action to promote the implementation of ecological networks.

b) to assess the potential for cooperation and coordination among land managers to change land use patterns at the landscape scale

c) to assess factors which stimulate or constrain cooperation practices to deliver environmental services and to identify the appropriate economic incentives for stimulating cooperation at the landscape scale.

d) to develop a methodological framework which can inform the effective design of public policy tools to incentivize the cooperation necessary to the provision of biodiversity at the landscape scale.

To achieve my aims I answer the following research questions:

1. To what extent can the Adaptive Co-management framework be used to study natural resource management at the landscape scale; and could such a process be developed in the Dee Valley (North East Scotland) to coordinate land managers' decisions?

2. What are the drivers and barriers for land managers' cooperation for delivery of public services?

3. How efficient will an economic incentive be in encouraging cooperation between adjacent holdings in order to influence changes in land use patterns for conservation practices (the implementation of ecological networks)?

The main research contributions of this study are as follows:

1) more attention to property rights is needed for the study of conservation management: land managers' views and attitudes are strongly (but not only) conditioned by property rights and how these define interdependent relationships between land managers;

2) this research reinforces the findings of other researchers regarding collective action for conservation: the Adaptive Co-Management framework in its current state sets useful criteria to analyse collaborative conservation practices but does not sufficiently address issues of power relations;

3) proposes an innovative methodology which combines qualitative data and experimental economics protocols to test an economic incentive for landscape scale management. This research contributes to the applied use of game experiments as land managers playtheir own, real-life role in the scenario games.

In terms of applied research, the study of landscape scale management for conservation through the implementation of ecological networks in the Dee catchment demonstrates:

1) collaboration and cooperation as Adaptive Co-Management proposes them are not sufficient for landscape scale conservation which requires coordination by third parties (public agencies or others);

2) the introduction of an economic incentive to encourage cooperation between neighbouring land managers can be effective for the implementation of narrow ecological corridors such as buffer areas or field margins (for pollinators), but is not effective for more robust ecological networks (such as woodlands).

1.7 STRUCTURE OF THE DISSERTATION

Chapter 2 sets the context in which this research was carried out and presents the different biophysical and social landscapes of the Deeside. This is important since actors' decisions on land management are partly conditioned by biophysical, social and policy factors. As I stressed above, the landscape ecology perspective raises the question of how to manage conservation at a landscape scale (where there can be no boundaries, no owners and the ‘profit’ is not money) in a system with property rights (single owners in bounded spaces with the right to do what is most financially profitable for them). In principle this sounds completely contradictory, but as I will present in chapter 3 collective action and cooperation between land managers and public agencies represents one potential solution.

Indeed, using qualitative interview-based data, chapter 3 assesses the potential of Adaptive co-management (ACM) to develop processes of coordination and cooperation for the hypothetical case of ecological networks’ implementation. As will be explicated in chapter 3, ACM is both a conceptual framework and a pragmatic process for the management of ecosystem services which can be (and has been) combined with Payments for Environmental Services (PES). Accordingly, chapter 3 uses the ACM framework to address the issue of whether, and to what extent, the preconditions for collaborative action are present in the study area. Further to this, chapter 3 examines to what extent collaborative action could promote the implementation of ecological networks.

Central to these conditions for landscape scale collaborative action for conservation is the role of land managers’ decisions. In chapter 4, I present the results of an interview-based analysis of land managers’ views and attitudes to conservation, AES participation, existing cases of cooperation in Deeside and landscape scale approaches. I analysed existing cases of cooperation to understand when land managers are willing or not to work with other land managers and/or other actors (e.g. public agencies). It gave me insights not only into cooperation practices but also into the relationship between different land managers and other actors. I also analysed land managers' attitudes to conservation and whether these would have an impact on cooperation practices.

Chapter 5 of this research takes the results further in order to investigate whether an economic incentive could stimulate cooperation amongst land managers for the delivery of public goods (i.e. ecological networks). In order to answer this, I designed an experimental incentive which I have called 'one-to-one coordination bonus' (or '1-2-1 bonus'). This incentive was tested through a simulation game which addressed land managers' decision-making for cross-boundary cooperation. This was tested on a panel of land managers playing their own real-life role in a scenario situation; as such, it offered further insight into land managers' decision making under different hypothetical policy scenarios.

In the last chapter (6), I unite the three approaches in order to discuss their wider applications. I conclude the chapter with some remarks about the strengths and limitations of the findings of this research and its relevance for further research and policy design.

CHAPTER 2

THE STUDY AREA AND POLICY CONTEXT

2.0 INTRODUCTION

While any boundary is inevitably artificial, here I make the pragmatic choice to delineate the confines of the study area based on biophysical criteria. The boundaries of the area can then be clearly delimited by hydrology i.e. by the River Dee catchment.

In this chapter, I present the Dee catchment from different perspectives. It provides a brief biophysical and socio-economic description of the study area. First I present the natural landscape, followed by the social landscape. Finally, I describe the institutional landscape in the third part of this chapter. The aim is to set the biophysical, social and institutional context and to understand how these conditions interrelate with each other.

2.1 Natural Landscape

2.1.1 Biophysical characteristics of the Dee Catchment

The Dee catchment is situated in the North-East of Scotland (figure 2.1). It embraces all the land that is drained by the River Dee and its tributary burns (figure 2.2). The river Dee has its spring on the side of Braeriach and its mouth at Aberdeen. It reaches 1250m altitude on the west to the North Sea in Aberdeen (Smart et al, 2001). It is 136 km (85 miles) long and the catchment area covers 2136.75 km^2 according to MacDonald (1997). The main tributaries are: Geldie, Lui, Clunie, Muick, Tanar and Feuh.

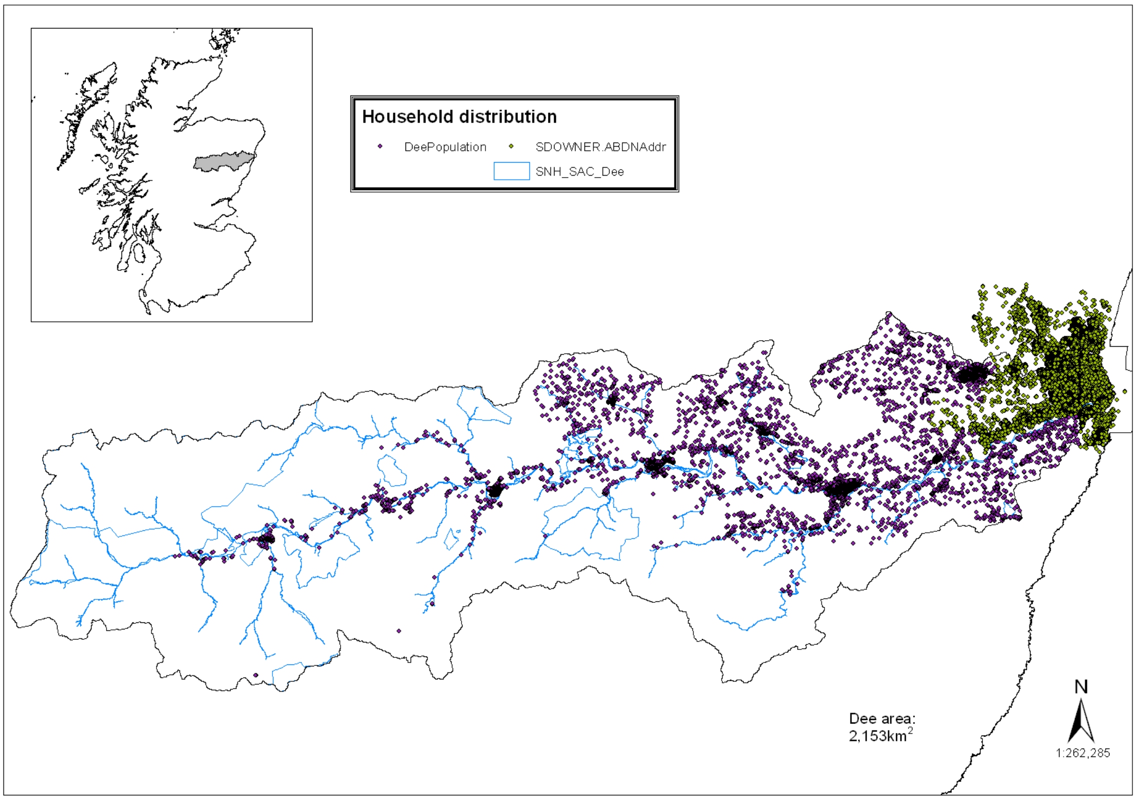

Figure 2.1 Dee Catchment situated within Scotland and households distribution. Source: Author's map using James Hutton database.

Figure 2.2 Tributary burns and the Dee Catchment **(in colour the 3 Dee Vision project areas of Kinord/Davan, Tarland and Elrick).** Source: Dee Catchment Partnership.

As for the geology of the area, the Ice Age is remarkably visible in the morphology of the catchment. The mountains in the west were smoothed and rounded by the ice and the floors of the main valleys planed flat. The Dee itself, which used to flow into the sea at Nigg (south of Aberdeen) was forced to cut a new channel further north. Loch Kinord (see figure 2.2, upper catchment) was formed from a huge hole left when a buried block of ice which has melted (Wood and Patrick, 1982). It was the case as well of Lock Davan which is home of a variety of specific water plants (Sedgwick, 2005).

The catchment falls within the north of the Highlands fault (from Arran in the west to Stonehaven in the east coast) that divides Scotland. Different types of granite stone with some patches of old red sandstone are characteristic of the highlands of the north of the fault. In contrast the lowlands area is conformed by old red sandstone. The types of soils in the area are as follow: humus-iron podzols, peaty podzols, alpine soils, peat, limestone, igneous rock and alluvial (Bruneau, 2006: 45; Smart et al., 2001).

These different types of soils mark the land use patterns (see figure 2.3). The upland area in the west of the catchment is mostly under heather moorlands, with thin peaty soils, mainly acidic parent materials and presents steep slopes (Smart et al., 2001). This area is characterised by semi-natural land cover types (mountain and alpine heath vegetation in the higher parts, the middle parts are mostly moorland and the lower slopes are predominately managed coniferous and deciduous forest). Some of the few remaining semi-natural ‘caledonian’ pinewoods in Scotland are to be found in this area of the catchment (The Ballochbuie forest).

In the lowlands of the east, between Aberdeen and Banchory where red sand stone soils dominate, land uses are mostly arable, pastoral and forestry (figure 2.3).
Soils and streams are acid-sensitive and according to Smart et al. (2001) there is evidence for post-industrial acidification of surface waters and concomitant decline in populations of acid-sensitive organisms in aquatic systems, especially in the upper catchment.

Figure 2.3 Dee Catchment showing land use and land cover types. Source: Dee Catchment Partnership.

Precipitations in the east average 700mm, whereas in the west uplands they reach an average of 2000mm with snow as an important part of the precipitations in the high altitudes (Smart et al., 2001).

The present landscape is heavily influenced by human intervention. Anthropogenic changes have impacted the natural environment for a very long time. Tree clearance has played an important role in the decline of species and habitats. Trees in Scotland have a long history. After the ice retreated, lichens, mosses, grass and scrubs were replaced by trees. Birch (*Betula spp.*) forest appeared in Scotland in 8000 BC. According to Cramb (1998), forests of birch oak (*Quercus spp.*), elm (*Ulmus glabra*), hazel (*Corylus avellana*), and pine (*Pinus sylvestris*) were slowly covering 80% of Scotland's surface after the Arctic communities were restricted to the hills. According to Wood and Patrick (1982: 15) around 3000 BC the first trees in Grampian were pine and birch. The tree line was at 800 meters with trees spreading in the lowlands. Oak, ash, elm and hazel were covering the land slowly, except where high altitude, too wet grounds and salt sea in the shore line create impossible conditions (Wood and Patrick, 1982). Apart from the Iron Age, which was a period of great forest clearance, the increases in forest clearance have been exponential especially in the last three centuries.

In Scotland, during the fourteenth and nineteenth century overgrazing, human population increases were important factors in the decline of forest as were the changes in demand from charcoal to coal and from bark from oak for tanning leather to chemicals, thus making the clearance of the trees used for these purposes possible (Cramb, 1998). Because of over-grazing for centuries and intensification of farming systems, by the mid-seventeenth century forest cover was reduced to 8% in the highlands and almost nothing was left in the Deeside (Hall, 2006: 91).

The industrial revolution reinforced this pattern. The displacement of people from the countryside to urban-industrialised cities (Glasgow mainly) was accompanied by extensive agricultural systems. Larger numbers of sheep needed extensive open areas that prevented forest from growing back. All these events accelerated the decline and loss of semi-natural habitats.

The Deeside was visited and hugely impacted by Queen Victoria in the nineteenth century who had special interest in nature, forest and shooting. In the land where the Balmoral castle was built and its surroundings (Ballochbuie, Glen Muick), primary forest has been protected and enhanced with new planting (Edlin, 1963: 21). In the early twentieth century the Forestry Commission also started planting programs. Primary forest and semi-natural woodlands have not increased significantly comparing with the crop forest plantations (Forestry Commission, 1963).

In the Deeside, forest started to recover before the implementation of ambitious national initiatives in the 1950s, which certainly helped to further increase forest areas in the catchment. Total forest surface increased during the 1950's and 1990's reaching 17% of the land cover by the end of the 1980's (Hall, 2006: 91). The Deeside is one of the most forest-covered regions in Scotland, alongside Strathspey. However an important qualification is that 12 % of such 'forests' is made up of exotic species planted at high density for commercial exploitation and cannot be considered as a recovery of semi-natural forest habitat. I present in figure 2.4, the Dee catchment showing in pink areas the Caledonian pine woodlands (semi-natural forest) and in green areas the forest plantations (planted exotic species).

Most of the standing forest today is therefore made up by commercial plantations with species of little value for conservation purposes like Sitka spruce (*Picea sitchensis*). Only around 4% has recreational and ecological value Among these, there are important woodlands which I show in figure 2.4 (the pink areas): Craigendarroch (near Ballater) at Dinnet Bridge with oakwoods, *(Quercus robur and Q. petraea*), and Glen Tanar with Scot Pine (*Pinus sylvestris*) with original patches of woods.

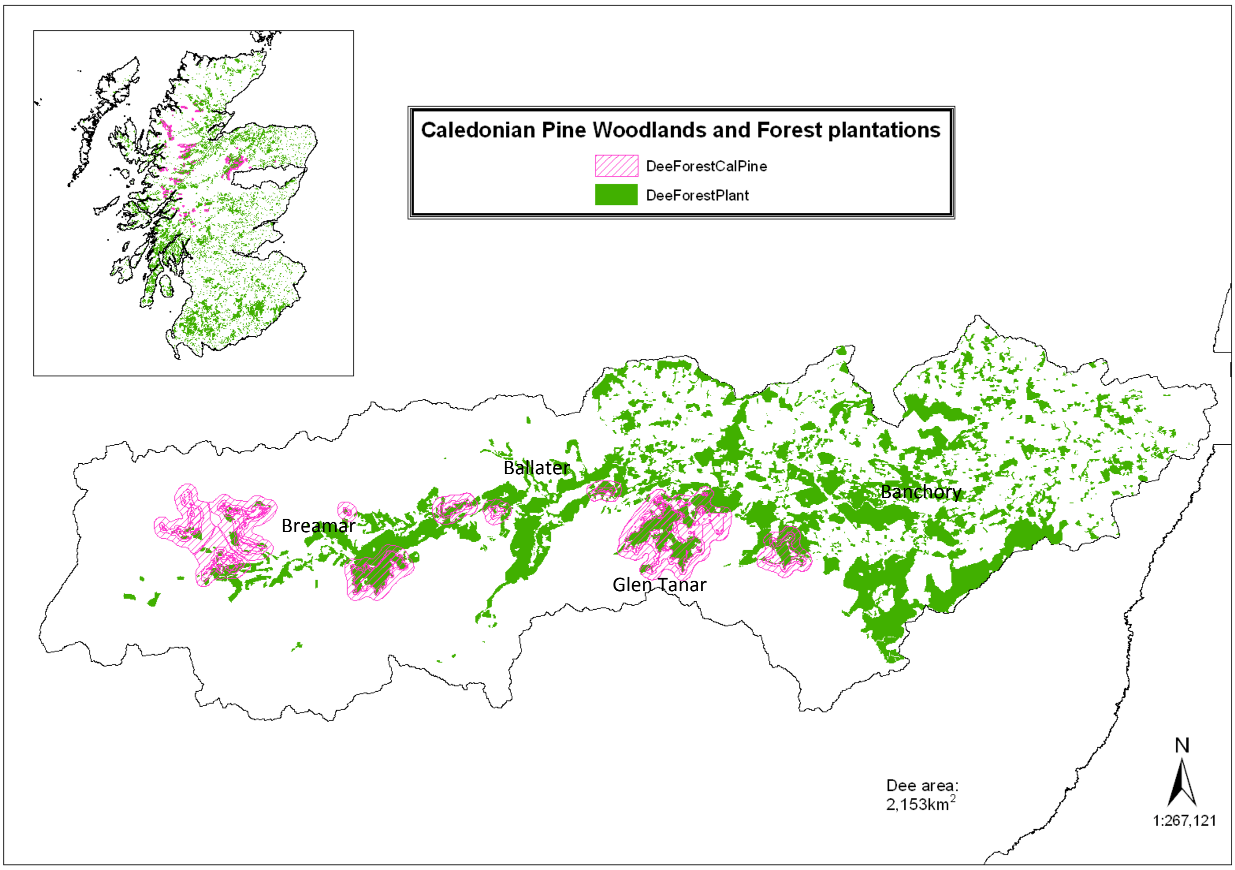

Figure 2.4 Dee Catchment showing semi-natural Caledonian woodlands and forest plantations (conifers). Source: Author’s map using James Hutton database.

Forest clearance legacy led to the decrease or extinction of species and soil erosion. Capercaillie (*Tetrao urogallus*) was extinct in the late 18^{th} century and reintroduced in the 1840's. Osprey (*Pandion haliaetus*) population fell during the Victorian period and finally was extinct in 1916 in the Deeside and Scotland. Natural re-colonization happened in the 1950's and since then it has slowly recovered. These species have also been reintroduced through Scottish Natural Heritage (SNH) and the Royal Society for the Protection of Birds (RSPB) programs.

2.1.2 Designation areas & Conservation issues.

In Europe protection of habitats and species has been carried out in the last 25 years through the Birds Directive and the Habitats Directive. Both are the bases of what is better known as the 'Natura 2000' designation; I will present the institutional arrangements of this later in this chapter (section 2.3 Institutional Landscape). Here I shall describe which are the protected areas within the Dee catchment.

Special Areas of Conservation (SAC) and Special Protected Areas (SPA) are two designations under the European Commission Habitats Directive. Consequently they are part of the network "Natura 2000". In table 2.1, I present the existing SAC and SPA in the Dee catchment and figure 2.5. Also in Appendix A, I present a full account of the habitats and species for which these areas are designated.

The river Dee itself is classified as a "Natura 2000" area with the designation of both SAC and SPA. The atlantic salmon (*Salmo salar*), freshwater pearl mussel (*Margaritifera margaritifera*) and European otter (*Lutra lutra*) are the species protected under SAC. These designations require specific management to protect the habitats and species. Although implicit, there is a call for landscape scale management in these legal designations. By definition the waters of the catchment are connected, fish populations spread through the river and subsidiaries and their protection requires landscape scale management.

Dee Catchment Designation areas		
Specific Areas of Conservation (SAC)	**Special Protected areas (SPA)**	**SAC and SPA**
Coyles of Muick	Loch skene spa	Cairngorms National Park
Dinnet Oakwood		Ballochbuie
Morrone Birkwood		Glen Tanar
Morven and Mullachdubh		Muir of Dinnet
River Dee		Caenlochan
The Maim		
Red Moss of Netherley		
Lochnagar		

Table 2.1 Areas designated under SAC and SPA within the Dee catchment (some of which are presented in figure 2.5).

Other designated areas under international agreements are the Sites of Special Scientific Interest (SSSI), and in the study area there are 28 such sites. Wetlands designation areas in the Dee are Lock Skene and the Muir of Dinnet which are recognised under the Ramsar Convention on Wetlands (see figure 2.5).

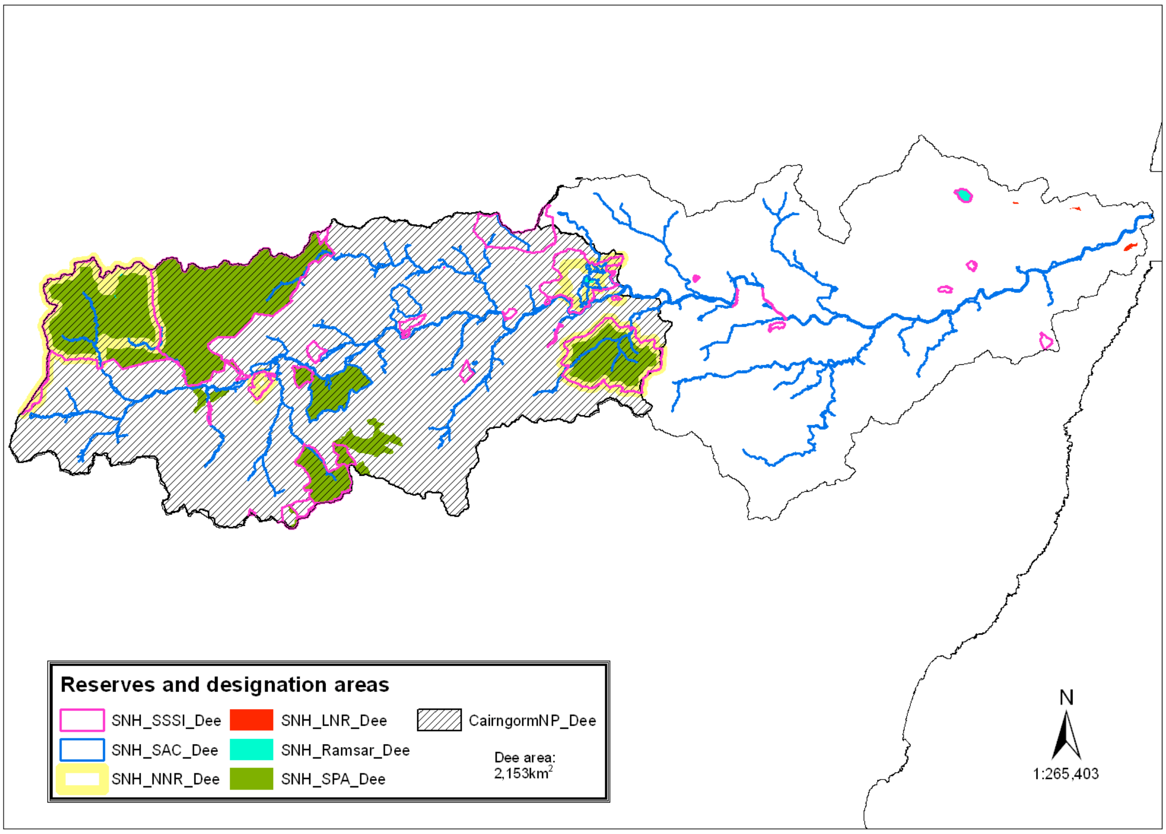

Figure 2.5 Dee Catchment showing reserves and designation areas (all existing reserves and designated areas are mentioned in table 2.1. This map shows only some of these). Source: Author's map using James Hutton database.

Recognised National Natural Reserves are as follows:

- Cairngorms (National Park)
- Morrone Birkwood
- Muir of Dinnet
- Glen Tanar
- Dinnet Oakwood

The Cairngorms National Park, which includes the upper Dee, almost half of the catchment, occupies a special place within the environmental protection policies in the area. The park, which was created in 2003, is the largest in Britain and its importance at the European level is due to its wildlife, flora and landscape: 25% of Britain's threatened birds, animals and plants are within its area (Cooksley, 2007: 23).

Morrone Birkwood next to Braemar is a National Natural Reserve because of its downy birch (*Betula pubescens*) which is one of the finest examples in the UK and includes the largest population of juniper (*Juniperus communis*). The Muir of Dinnet is important because of the habitats for flora and fauna and the geomorphological features. Dinnet Oakwood is especially important because it contains many groves of sessile oak, rare fungi species that are dependent of the oak and charcoal. Other species include many fish, amphibians, ferns, insects, mosses, reptiles, spiders and mammals (See figure 2.5 for the location of the Reserves). Glen Tanar has some of the most important native pinewoods and special plants such as twinflower and orchid creeping ladies tresses. Other species present in Glen Tanar are Scottish crossbill, capercaillie, black grouse, goshawk, ptarmigan, merlin, golden eagle and red squirrels (Gamekeeper, personal communication).

Although the number of protected areas has increased between 1991 and 2009, especially for the number of SAC and SPA and Ramsar sites, conservation and biodiversity have not particularly improved, although they stabilised or stopped declining but some species are still threatened. For instance capercaillie (*Tetrao urogallus*) and black grouse (*Tetrao tetrix*) are still in 'red status' (Shaw et al. 2006: 296). On the other hand deer numbers, overgrazing and trampling still create problems for instance in relation to woodland natural regeneration or subalpine and alpine scrub which are damaged and almost lost (Hall, 2006: 103).

Nitrate Vulnerable Zones (NVZ) should also be mentioned. Areas under this designation are those identified to be at risk of elevated nitrate levels in the groundwater. The eastern part of the catchment is within this designation. These depart somewhat from the designations above, because they are not linked directly to species or habitat conservation. Nonetheless they have some influence on land use.

Finally, another important ecosystems service provided by the Dee Catchment is the domestic water for the whole of Aberdeen city and over half of Aberdeenshire. The catchment waters are used for light industry and agriculture, and receive discharge of effluents (Cooksley, 2007: 30). Therefore conservation and water quality is vital.

One common thread in these efforts for conservation is that all of them are isolated protection plans. It has been recognised that landscape scale coordination and collaboration are needed for conservation, as single habitat and single species protection have high chances of failure. According to landscape ecologists this is because species do not evolve in isolation but to the contrary interact with other species and colonise new habitats in order to survive and reproduce. As I have shown in this section, the present context of decline in semi-natural habitats and the resulting landscape fragmentation creates an antagonistic environment for species and their conservation to succeed. This has been recognised by social scientists and approaches have emerged to solve this problem through ideas of collective action (McFarlane, R, 1998; Goldman et al., 2007; Schenk et al., 2007; de Groot et al., 2010; Scott and Shannon, 2007).

2.1.3 Ecological networks in the Dee catchment

One proposition to overcome the landscape fragmentation created with isolated protected areas, habitats and species is to connect them through ecological networks. Fragmented landscapes represent a danger for species confined to relatively rare specific habitats or with limited dispersal abilities and/or which are unable to cross non-habitat areas, such as red squirrel or capercaillie or many understory woodland plant species.

Theoretical and empirical work in landscape ecology has shown that reducing fragmentation is often a valuable strategy to compensate for habitat loss (Jongman and Pungetti, 2004).

Despite the fact that ecological networks are not a panacea to the problem, especially regarding invasive species which can benefit from the habitat connectivity to invade an area (e.g grey squirrel competing with local red squirrel), on balance they are believed to provide a possible alternative to halt biodiversity loss (Moseley et al., 2008)

Regardless of the fragmentation of the residual semi-natural habitats, including woodlands, in the Dee catchment there is no planned implementation of ecological networks yet. However scholars have developed figures that identify the potential implementation and the benefits of forest networks for provision of biodiversity and recreation (Gimona and van der Horst, 2007, Forestry Commission Scotland, 2010). As mentioned before, the implementation of habitat networks is often difficult and very costly, especially in a context where the management of privately owned land is for commodity production and business-oriented objectives dominate land use decisions.

Land managers' views and attitudes are therefore a crucial factor. Land managers' knowledge, interests, and generally the social, economic and institutional context need to be understood for the implementation ecological networks.

Social and economic trends that influence and shape land use and consequently condition the state of biodiversity are presented in the following section, while in chapter 3 will deal with public agencies and land managers collaborative practices and land managers cooperation and attitudes to conservation in chapter 4.

2.2 THE SOCIAL & INSTITUTIONAL LANDSCAPE

Landscape-level management becomes difficult as layers of policy objectives, individuals objectives, property rights and administrative boundaries come into play.

Administrative and political boundaries divide the catchment between Aberdeenshire and Kincardineshire counties and embrace 19 parishes (Appendix B). Each administrative entity follows different objectives and they have little impact on the land management and land uses in the countryside.

The impact of designated areas generally concerns urban development and planning permits which, to a certain degree, incorporate some elements of landscape scale management, mainly for beauty (e.g. forbidding building new houses in landscapes that are considered of interest). Recently in Scotland the planning system has been used as a tool for the implementation of ecological networks (e.g. in the Lothians and Fife green network partnership, which started in 2008). [16] However it is not clear if this could be effective in the Dee area, as such experiences are still too recent to draw conclusions about their effectiveness.

[16] Source: Lothians and Fife Green Network Partnership (n.d.)

2.2.1 Population.

Within the Dee Catchment there is one major urban concentration of 260 000 inhabitants living in Aberdeen (Scotland's Population, 2007), and four minor urban centres in Banchory, Aboyne, Ballater and Braemar (table 3.2 presents inhabitants by urban centres). The rest of the area is with dispersed settlement. The population practically vanishes further inland nearing the river's spring in the western uplands. Downhill, population growth has provoked pressure on the land, enlarged the size of settlements and increased the demand for housing and related services in the east of the catchment.

Agricultural land extends from Aberdeen city to Aboyne. In this area the numbers of smallholdings are higher than in the west. Going farther to the west the land use and the settlement pattern changes. Large estates own the land and population diminishes as mentioned. The west of the catchment is part of the highlands, which have experienced different periods of population decline, the last one occurring during the 1990's

Population (by settlement)	
Main settlement	
Aberdeen	260 000
Ballater	1260
Dinnet	90
Aboyne	1950
Banchory	6050
Milltimber	5930
Cults	4350

Table 2.2 Population by settlement in the Dee catchment. Source: ONS, 2009.

2.2.2 Shaping nature (the construction of the environment): Land ownership and Land tenure.

Two aspects of the institutional framework should be mentioned as part of setting the context of land managers' decisions: land rights and environmental law. These two aspects play a crucial role in the provision of biodiversity, implementation of ecological networks and are important because they refer to the socially constructed set of norms and rules that frame the human-nature relationship. They are the institutionalised worldview of natural resources management and they establish the foundations for negotiation and set the bases for what is and what is not possible to achieve.

In Scotland, landownership is a property system which, under Scots law, ensures that every square inch of land, inland water together with the surrounding coastal waters and seabed, from the ground down to the centre of the earth and up to the sky above is legally owned by somebody (Wightman, 1996; Callander, 1987). Regarding property rights, the legal basis of Scots law was in the feudal tenure, which was valid until 2004. It "[added] a 'vertical' dimension to property rights whereby more than one person can enjoy property rights over the same area of land" (Wightman, 1996: 5). In Scotland during the feudal system land was owned by three groups of people, each with different type of rights within the same area of land, the Crown, the 'Superiority' and the 'vassals'. The greater royal rights (*regalia majora*), which cannot be sold, include rights over the sea, the foreshore between high and low water mark, and tidal stretches of rivers. The lesser royal rights (*regalia minora*) include salmon fishing and precious metals. These "can be sold or otherwise disposed of" (Wightman, 1996: 6). The Crown also owns land which is now neither a property of the monarch nor of the parliament but is administered by the Crown Estate Commissioners (Crown Estate Act 1961).[17]

The second level of rights used to be held by the 'Superiority' (the superiors to the vassals) which "typically retained mineral rights and could impose any number of burdens on land which they [had in] *feu*. These most commonly [were] rights of preemption or rights to control or share in the value of certain developments (for example house building) " (Wightman, 1996: 6).

The last level of rights was that possessed by the 'vassals'. As Wightman clarifies: "Below the vassals are the tenants whose occupancy and rights are derived from the vassals and today are usually governed by legislation" (ibid.).

With some exceptions, Scotland was dominated by feudal tenure until 2004 when the feudal land rights system was abolished. Because of the recent date of this change, there are still many current examples of vertical superpositions of rights (for instance between rights to the use of the forest and shooting rights). Apart from the recent abolition of the feudal system and the Crofters Act in 1886, there was no substantial land reform before in Scotland. Nonetheless even before the land reform of 2004, feudalism itself had become much less significant whereas common law, case law and statute have been of growing importance in defining the modern interpretation of the Scots property law.

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[17] 'Crown property' is part of the hereditary possessions of the sovereigns 'in right of the Crown' but "is managed by the Crown Estate Commissioners who have the duty to maintain and enhance the value of the Crown Estate. The Commissioners are appointed by and report to the Sovereign and to Parliament" (Wightman 1996, p.6). .

The Dee Catchment reflects the most common forms of currently existing land tenure in Scotland. These are: estates, tenancies, small landownership, and commonties. Within the catchment, 61% of the land is owned, 31% is rented and 8% is seasonally rented (Agricultural Census, 2000). There is a concentration of small holdings (from 50 up to 1000 ha.) in the eastern part comparing with the west of the area where most of the land is owned by estates (from 1000 ha up to 50 000 ha.) In Figure 2.6, I present the property boundaries and in the Appendix C I present the list of holdings within the Catchment by ownership and size according to Wightman (1996).

Figure 2.6 Property boundaries in the study area, according to Wightman, 1996.

Commonties are one form of Common Good Land, or burgh commons. Legally they are the undivided and uninhabited common property of neighbouring landowners over which extensive rights of common use persisted (Commonweal, n.d.). They range from less than 1 ha. to thousands of hectares and a lot of them were divided amongst neighbouring landowners during the 17th century. Today, there are three widely known commonties in Scotland. These are: Forest of Birse, in the study area; North Hill of Alyth in Perthshire and Gifford Common in East Lothian.

Although it is said that legally there are another 87 existing commonties in Scotland most of these are unidentified and unknown (Callander, 2003). Commonties are different from the crofting system of the Highlands and Islands. Crofters are agricultural tenants with statutory rights within the estates who hold individual crofts on an annual tenancy from a landowner as well as an area of common grazing (Wightman, 1996).

Estates tenure in the study area varies in size, but in the western part of the catchment are some of the biggest extensions of land under single ownership. For instance there are some estates that cover up to 50 000 has. extending to more than one administrative boundary and a number of them are within the Cairngorms National Park. Some of these estates have been owned by the same family since the 15th century or earlier. They normally deal with a number of holdings under tenure, fishing, stalking and shooting.

Most Estates are interested in shooting activities and this has in some cases caused controversies about the potential benefit or damage of habitat management (including control of birds of prey and other predators) and regarding the population density of red deer which, if too high, can lead to overgrazing thus destroying red grouse (*Lagopus lagopus*) habitat. Gamekeepers are in charge of wildlife management and their number per estate varies depending on the size of the shooting business. In this area it ranges from 1 to 15 gamekeepers. Tenants usually concentrate on farming activities.

In Scotland the relationship between landlords and tenants is regulated through the Agricultural Holdings (Scotland) Act. The different Acts have been amended several times since the 19th century, but the bases of their modern version are the 1991 and 2003 Acts. The currently most common types of tenancy are the 'secure 1991 Act tenancy' (representing 79.6% of the total tenancies in 2008)[18]; and '1991 Act Ltd. Partnership' (representing 10.3% in 2008)[19]; grazing or mowing lease for not more 365 days'; 'Short Limited Duration Tenancy –SLDT- of no more than 5 years (representing 6.2% of the total tenancies in 2008)[20]; 'Limited Duration Tenancy -LDT- for a minimum of 15 years (representing 2.8% in 2008)[21]. Tenancies under the 'secure 1991 Act tenancy' can be inherited. In the area there are tenants that have been under the same tenancy for 6 generations. As I shall present, land rights both limit and enable in various ways what decisions land managers can take and the cooperation patterns between them (see chapter 4).

There has been very little written in the literature about relationship between estates and tenants (Maye et al., 2009) but nothing has been written about this in relation to conservation practices. I discuss cooperation between these two groups in chapter 4.

Given the low influence that the State has over landownership and tenure patterns and land use in Scotland, rural areas are mostly under the decision making of land managers. The results of this research shows what Wightman (1996: 15) mentioned about the factors influencing land use: 1) owner motivations: from private enjoyment to profit maximisation; 2) process of landownership changes; and 3) land use incentives and development.

[18] Source SG (n.d.): The Scottish Government, Agricultural Tenancy Statistics at http://www.scotland.gov.uk/Topics/Statistics/Browse/Agriculture-Fisheries/tenancy0507 (accessed on the 19/04/2012)
[19] Ibid.
[20] Ibid.
[21] Ibid.

Incentives however, do have an important influence on land use and development. According to Wightman (1996: 15), the CAP has incited the development of 'corporate investors', landowners who are not interested in farming as such but in the profit and capital gains that can be made with the land independently of the farming activities.

2.2.3 From the tractor to the gun: Local economy

Scottish Agriculture has accounted for 1.3%, 0.8% and 0.9% of the GVA for the years 2005, 2007 and 2009 respectively (Scottish Agriculture 2006, 2009 and 2010). Although agriculture, forestry and fishing represent less than 1% of employment in Scotland (SG, 2009b: 7), 18% of the population lives in rural areas and rural areas represent 94% of the land (SG, 2011b: 8). As these figures show agricultural production is not crucial in the national economy, neither is forestry nor fishing, although these activities are very important in the local economy of the Dee. Agriculture is however key to Scotland's food and drinks sector.

The most important sector in Scotland's economy is services, including tourism, also very important and linked to other activities in the study area. In 2011, tourism was at the front of the economic performance despite the economic crisis. Important for the tourism sector in Scotland is the beauty of landscapes and outdoor activities.

In the catchment there are no heavy industries and the river is not navigable. The catchment is especially popular for tourism because of its royal history and it is known as the 'Royal Deeside'. Besides angling and salmon fishing, the local economy relies on water recreation activities in the river, lochs and sea, such as canoeing, kayaking, rowing, water skiing, sailing and windsurfing.

In the study area salmon fishing is estimated to create an income of between 5 and 6 millions of pounds/year. According to the report on the 'Economic Impact of Game and Coarse Angling in Scotland', 920 Full Time Equivalent (FTE) jobs are directly dependent on angling activities in the North East Scotland and the activity contributes to the annual income of households by £11.5m GVA (SE 2004). In Scotland large estates are mostly on poor soils and the opportunities for diversification are limited to a mix of sporting, forestry and hill-farming enterprise. The case of large estates in the upland of the Dee catchment is not an exception. Estate owners rely on fishing and shooting activities, despite the annual capital investment required to provide well managed sporting shooting[22]. These economic activities are of benefit to the area not only for those who directly provide the service or product but also for others providing activities such as accommodation, restaurants and related services. This multiplier effect economically benefits the estate, the pluriactive farming household being and other local businesses.

Sport and recreation activities are increasingly important for the whole of local economy (Slee et al., 2009), but in the East of the catchment, closer to Aberdeen, the land use is mainly agricultural, whereas in 88.6% of the total area, land capability is low for agricultural purposes. The land use are 20% crops and improved grass; 58% Uplands 16% woodland.

In the East of the catchment Aberdeen's influence as an international city and Europe's main hub for the oil and gas industry has direct impact on demand for outdoors sports and land prices.

[22] Shooting activities have been estimated at £47m of direct adds to GVA and a total of £240 of impact to GVA (direct, indirect and induced expenditure) according to Scottish Government (2009).

2.2.4 Conserving nature (the protection of the environment): Economic Incentives and Environmental Law.

The economic activities in the area are partly dependent on the land and its natural environment. However most of these activities may be to some degree in conflict or harmony with biodiversity conservation and contribute to its deterioration or enhancement. Environmental law is critical to balance different interests and protect the environment. Economic incentives are vital to compensate land managers for biodiversity enhancement. European Union (EU) Environmental law and the EU Common Agricultural Policy (CAP) are directly related to land uses, how the environment is shaped and have an impact on conservation practices and biodiversity through the designated areas and CAP subsidies. These represent important economic support and legislative documents for Scotland’s countryside.

It is at the European Union level where a number of legislation and subsidies are designed and objectives set. Member states in turn implement these legislations and decide on how the subsidies will be applied depending on their particular circumstances and depending on EU and national economic funding. This is the case of the EU Agri-enviromental Schemes, Water Framework Directive (WFD) and designated areas. In the Dee valley, designated areas include the Dee as Specific Area of Conservation (SAC) under the EU Habitat Directive. As presented in 2.1.2 all the existing categories of designations are represented in the valley. Furthermore the economic incentives are necessary for the economic viability of the agricultural sector and they are important for the forestry sector. To illustrate how the institutional framework works, in the rest of this part I present how the Forest public policy works in Scotland and how it could influence land managers decision making.

i) Forestry sector and institutional framework.

Traditionally forests have only been managed and developed by landowners, their woodland staff, nurserymen and timber merchants (Edlin, 1963). However this changed with the creation of the Forestry Commission (FC) in 1919. The role of FC has been to manage public forests as well as giving skilled advice on management to land managers and economic incentives for tree planting.

Until 1999, forestry policies formulation and objectives were decided for the whole of the UK by the UK parliament and through the Forestry Commission. With the political process of devolution in 1999, Forestry Commission Great Britain was subdivided in three parts and transferred responsibility to Scottish, Wales and England (Forestry Commission, 2002). The creation of Rural Affairs Departments in each country (Scotland and Wales) and the publication of the Forest Strategies were the most important changes in the domestic forestry policy (Forestry Commission, 2002). Forestry Commission - Great Britain still exists as a national public body that coordinates activities across the board <u>when</u> Scotland, England and Wales agree to collaborate. However 'Forestry Commission Scotland' reports separately to the Scottish Minister (this is also the case for Wales and England). Figure 2.7 presents the institutional framework with the roles and responsibilities for forest policies in Scotland after devolution. This figure shows that Forestry Commission is an over-arching public body at the national UK level. At the Scottish level the Forestry Commission Scotland (FCS) is responsible of designing, promoting, implementing and reporting back to Scottish Ministers (Forestry Commission, 2002).

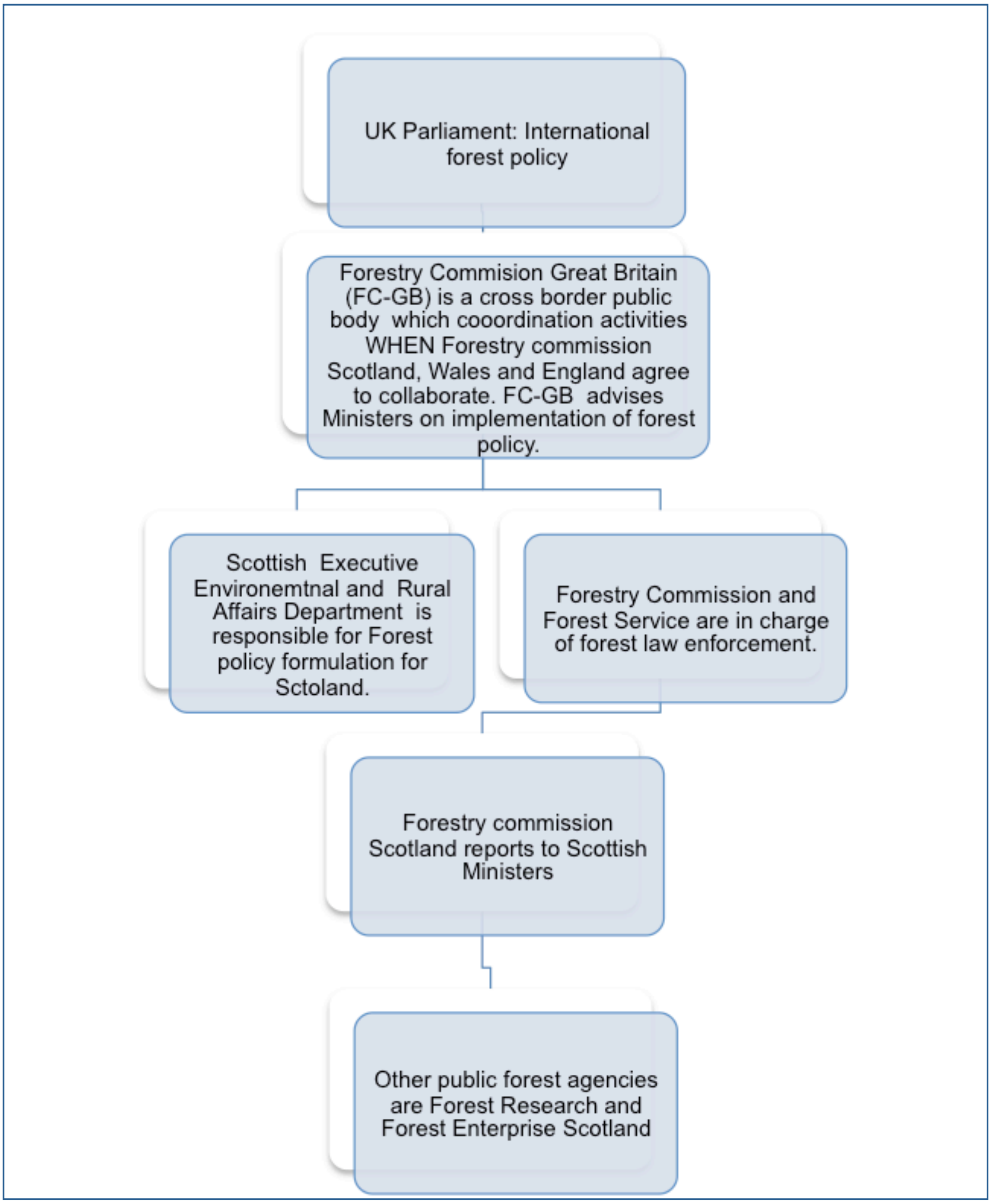


Figure 2.7 Forestry Institutional Framework for Scotland after devolution

As mentioned one of the most important changes within forest policy was the publication of the Scottish Forestry Strategy in 2000 and 2006 (SE, 2006). With this strategy the Executive set out the aims and vision of what is desired for the whole of Scotland:

Increased forest cover from 17% to 25%; creation of multifunctional forests from which people can benefit (SE, 2006). Some of the forest functions recognised in this strategy document are timber, climate change mitigation, sustainable development, integration with other land uses and biodiversity, amongst other services. The strategy is embedded in the web of Scottish policies, regulations and national objectives such as the *Rural Scotland: A national Approach*, 2000; *Improving Health in Scotland- the Change*, 2003; *Scotland's Biodiversity –it's in your hands*, 2004; *A partnership for a better Scotland: partnership Agreement*, 2003; *Smart successful Scotland* 2004 and many other documents.

The strategy is a comprehensive document explaining in detail why and what is important for forests in Scotland however the implementation plan (published in 2007) clarifies how and who should implement it and how different documents interlink with each other. Reviews and evaluations of the strategy achievements are planned every five years. At national level are the strategic plans that set objectives, aims and requirements from the forestry sector. Of all these, only two documents are statutory instruments: the Planning Circular 1/2009 and 1/2011; and the Climate Change Act, 2009.

The first Land Use Strategy was approved by the Scottish parliament and published in 2011 in response to the Climate Change Act 2009 (SE, 2011). The most important point of the Land Use Strategy regarding forests is the clarification of the objective to reach a 25% increase in forest by 2050 (although mainly as a response to climate change rather than as a direct concern for biodiversity).

Also at the national level, the National Planning Framework 2 (NPF2) sets objectives and aims for Scotland's different sectors taking into account scale and spatial configuration (SG, 2009a). NPF2 gives guidance when planning permissions are requested or in the preparation of development plans by local authorities. The most important points regarding forestry are that NPF2 can designate national developments, for example the ecological networks in Clyde Valley Green Network; or when ecological networks implementation are considered as national infrastructure projects and therefore developed through the planning system rather than economic incentives (SG, 2009a).

All these national strategies, plans, objectives and challenges set in the different documents are linked to and in tune with each other.

The implementation however is at regional and local levels. At the regional level there are a number of documents that guide the implementation phase such as the National Inventory of Woodlands and Trees (Forestry Commission, 1997), which identifies where trees are and should be protected. Also 'The right tree in the right place' guides planners and other governmental agencies in the spatial aspects of forest expansion (Forestry Commission, 2010).

All these documents are very useful in setting national objectives and guiding on the achievements, however the implementation relies only on voluntary economic incentives showed at the local and farm level. Besides the two statutory documents already mentioned above, the preferred tools to achieve national objectives are voluntary economic incentives, which in part come from CAP and/or national budgets. Therefore the achievement of national objectives relies mainly on land managers' willingness to apply for voluntary schemes and depending on what they want to do in their own land.

The Scottish Rural Development Program –Rural Priorities and Land Management Contracts are the channel through which economic incentives are given to land managers for forestry and agri-environmental schemes. Forest schemes used to be given by Forestry Commission and Scottish Natural Heritage, however all of them are now closed to new entrants as shown in figure 2.8 (although some of the payments are still being made to former participants). Rural Priorities and National Forest Land Scheme are the only economic incentives available to land managers for forest plantation.

Figure 2.8 Succession of Forestry Schemes in Scotland since 1990's.

2.3 THE SCOTTISH RURAL DEVELOPMENT PROGRAM –RURAL PRIORITIES, CAP AND FORESTRY SCHEMES.

In Scotland, the UK, and more generally in the EU, environmental public goods are provided using top-down environmental regulations and bottom–up voluntary economic incentives such as prescribed agri-environmental schemes (AES) and other funds for conservation projects (e.g. LEADER). EU member states aim at achieving their commitments to various international agreements to enhance biodiversity and halt biodiversity loss through Pillar II, Axis II subsidies of the Common Agricultural Policy (CAP) in addition to other funds. [23]

Although CAP is the most important economic incentive for agricultural production in Scotland today, economic support for food production has had a long history (e.g. see the 'deficiency payment' for cereals in the 1930's, Warren et al. 2008). The EU Common Agricultural Policy (CAP) is a land management policy and decision-making instrument at the international European level but has had a primary role in shaping the environment through subsidies to agricultural production at the local level. The creation of the European Community's CAP in the 1950's had as a primary objective to maintain strategic self-sufficiency in food supplies. For decades CAP economic incentives aimed at food production with little attention to the environmental impact that the production systems caused. However in part for this reason CAP has been reformed in 2003 to decouple funding from agricultural production (Pillar I) re-orienting them towards environmental measures, animal welfare, food safety and rural development (Pillar II).

[23] For the case of Scotland there are a number of international agreements, such as Convention on Biological Diversity (through the EU habitat and birds directives), Rio summit 1992, Global strategy for plant conservation 2002 to mention some.

Depending on the implementation by member states, this reform could have more or less impact on environmental policy and environmental improvements (Gay et al. 2005). As part of these changes farmers have to comply with the Good Agricultural and Environmental Conditions (GAEC) and Statutory Management Requirements in order to receive direct support under Pillar I (Single Farm Payments, -SFP-), which are the most important in farming production.

Habitat connectivity and reduction of habitat fragmentation are explicitly part of the Scottish Government's biodiversity objectives (SG, 2004b). The effectiveness of this tool, however, has been questioned in the light of biodiversity loss and farmers' attitudes towards more conservation and environmentally friendly actions, as I will present in further chapters.

One of the main problems is the mismatch between payments at the holding scale and the landscape scale needed to achieve the biodiversity objectives. Most of the AES in Europe are applied at the holding scale. Some exceptions to this approach are the Meadow Birds Agreements in the Netherlands (Verhulst et al., 2007) and Hedgerows Planting scheme in Denmark (Kristensen, 2001; Busck et al, 2007). The Netherland case is special because they have a long history and experience in farming organisation and farmers' participation in co-operatives. Since 1994 'agri-environment collectives' have become a very important channel for AES implementation. The objective of the collectives is to increase ecological knowledge and encourage members to implement the schemes where they are more effective (Verhulst et al., 2007). For the Meadow Birds Agreements the collectives are crucial because they encourage members to participate and the scheme application is for a minimum of 100 ha. Payments are a combination of action-based (delayed mowing) and outcome-based (number of clutches farmers have on their land). This suggests that payments are a combination of income forgone, additional costs and payment by clutches (Schwarz et al., 2008).

The Hedgerows in Denmark is another special case. It started in the 1800's and has continued since then (Kristensen, 2001; Busck et al., 2007). Prevention of soil erosion was the objective at the beginning, but now in addition to that the objectives are also to increase biotopes and ecological networks in agricultural lands.

There are other cases within AES that could have an impact at the landscape scale; such is the case of the Rural Priorities of the Scottish Rural Development Program (SRDP), which gives an option for joint applications. However, the applications may or may not be for adjacent holdings, therefore, the landscape scale potential may be lost. Another case is the Higher Level Stewardship in UK, which requires the entry of three farms with specific management practices for each to guarantee the conservation advantages. Further examples are the cases of common land in England and the Top-Tier AES in Wales.

Although tackling habitat fragmentation through ecological networks is one of the biodiversity objectives, there is no mechanism in place to achieve this objective. There is no coordination or payments that compensate for both income forgone and the costs of trust that cooperation implies, or the costs of risks of defection due to cross property management that the scheme involves.

Most EU AES are action-based payments and the calculations are based on income forgone and additional costs. As mentioned earlier, this method does not allow for the differences in costs and opportunity costs across farms, letting low cost farms enter into the scheme, rather than the parcels needed for the habitat connectivity or farms that can offer higher additional biodiversity benefits (Schwarz et al., 2008). However, AES payments are the easiest pragmatic payment method that avoids the uncertainties of measuring environmental outcomes or complexity of landscape scale management.

There is but little autonomy in the choices for payment design. The grounds for this are the changes in the CAP and the agreements with the World Trade Organization (WTO). As a result of the negotiations with the WTO, CAP was reformed in 2003 and significantly changed environmental standards and payment subsidies. Cross-compliance was introduced, which is a minimum environmental standard condition for farmers to fulfil in order to receive EU subsidies. In addition, direct payments to support traditional markets and products were considerably changed to subsidies that are identified as non-trade distorting i.e. in tune with the Green Box compliant schemes.[24]

CAP reform has been taking place since 2003 and every year there are cuts from Pillar I and more incentives are available in Pillar II. Despite these efforts the allocation of economic incentives is still mostly related to agricultural production. The SFP represents 50% of the farming income in Scotland (SG, 2011a).

In this regard the study area follows the national trend where in 2009, 81% of the subsidies were directly related to agricultural production, Pillar I (in the study area these figure was 82%); and only 18.90% corresponded to rural development Pillar II (in the study area these represented 17.76%) as figure 2.9 shows. Within Pillar II the Less Favourable Areas scheme is very important for Scotland and for the Dee catchment.

[24] 'Green Box' is the terminology used in WTO to identify subsidies that are permitted under the agricultural agreements. Other subsidies are part of the amber box which are forbidden subsidies and the blue box for subsidies that are tied to programmes that cap production.

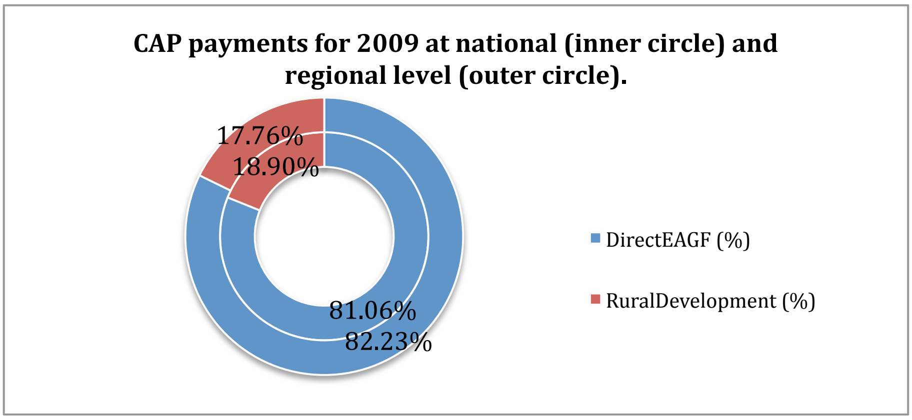


Figure 2.9 CAP payments by type of payment at national and regional level.

The implementation of CAP-Pillar II subsidies is carried out through the Scottish Rural Development Programme (SRDP). For Scotland the objective of the SRDP 2007-2013, is to increase competitiveness in **agriculture and forestry**, improve the environment and the countryside and '*enhance the quality of life in rural areas'*. The emphasis in Scotland is 'rural areas' as opposite to only 'agricultural areas'. Consequently the schemes are open to land managers, communities and any other groups of stakeholders who aim to enhance the quality of life in rural areas. In the study area this is of benefit to land managers, trusts and partnerships of land managers and public agencies that have applied for the schemes. The SRDP certainly represents an opportunity for landscape scale management.

The SRDP has concentrated older schemes and proposed new ones, the most relevant SRDP programme for the context of this research is the Rural Develop Contracts for Rural Priorities.

In Scotland the Rural Development Contracts were introduced in 2007, these are a competitive scheme, and they help to link support under Pillar I (Single Farm Payment and other direct schemes) with Pillar II support (Tiers II and III of the SRDP) under CAP.

This scheme aims to deliver 5 outcomes of the SRDP, which are:

a) business viability and competitiveness; b) water quality; c) adaptations to mitigate climate change; d) biodiversity and landscapes; and e) thriving rural communities.

The scheme is implemented in Scotland (11 regions) and has specific priorities for each region. It creates synergies between different policy documents, national strategies and other national commitments. Table 2.3 shows SRDP – Rural Priorities and how they achieve the 5 objectives of the SRDP for the region in which the study area is included.

Grampian region	
Business Viability and Competitiveness Priorities	Improving business practices (production, distribution, etc.) including options relating specifically to New Entrants and Organics.
Biodiversity Priorities	Halting the loss of biodiversity and reversal of previous losses through management, conservation and enhancement. Protection of rare/endangered species, reducing threat from non-native/invasive species, achieving 'favourable condition' on SSSIs and increase in area of connected natural habitats are all encouraged.
Landscape Priorities	Enhancements of the rural landscape which have a positive impact on people's environment. The importance of Scotland's woods and forests is also highlighted.
Built & Cultural Heritage Priorities.	Conservation and enhancement of the historic environment by increasing vernacular rural buildings and sites of archaeological or historic interest that we protect, enhance and manage.
Water and Soils Priorities	Improvement of habitats/water quality through various means. Reduction of diffuse pollution, flood protection, protection against risk of erosion and actions within Nitrate Vulnerable Zones, Bathing Water Catchments, shellfish growing areas and Drinking Water Protected Areas are all identified.
Adaptations to Mitigate Climate Change Priorities	Reduce emissions of greenhouse gasses, improving efficiency of practices and better management of current climate change actions.
Public Access Priorities	Public access provision with a particular emphasis on creation, improvement and promotion through various means.
Diversification of Rural Enterprise Priorities	Improvement of rural enterprise through diversification. Innovation, Strengthened links between primary producers and other sectors, improved environmental performance, career development opportunities and maximisation of tourism are all highlighted.
Thriving Rural Communities Priorities	Empowering and encouraging rural communities to take a positive role in addressing the issues which affect them. Support for community led initiatives, improvement of skills, knowledge and capacity as well as access to sustainable rural buildings are all highlighted.

Table 2.3 Rural Development Contracts-Rural Priorities for the Grampian region, 2010.

Another change in the SRDP is the inclusion of the Forestry Scheme. All new applications have to be done through Rural Development Contracts - Rural Priorities and Land Management Options schemes. All plans have to be approved by Forestry Commission and in some cases by SNH.

Public and private afforestation has not been of great success; in more than eighty years of planting the forest covers only 17% of Scotland (Cramb, 1998: 41). Native species cover less than 2% of land surface (less than 20% of the forest cover). Commercial forest plantation was based on exotic species, single-species blocks that destroyed habitats especially in upland grazing areas and peatlands (Cramb, 1998: 41). However changes in practices and new rules for planting are in place since the beginning of the 1990's.
The relative failure in forestry and the lack of success in increasing forest cover is explained in part because it relies mainly on voluntary economic incentives.

Contrasting with forestry policy where a voluntary economic incentives approach has been taken, I present very briefly how the scenario changes if environmental measures are enforced by law taking as an example the Water Framework Directive and how it works in the Dee Valley.

2.3.1 The case of the Water Framework Directive (WFD)

The Water Framework Directive (WFD) is an initiative at the EU level which was adopted in Scotland in 2003. It stipulates that all member states have the obligation to meet 'good ecological status' for water bodies by 2015 and to prevent deterioration. On behalf of Scottish Ministers, the Scottish Environmental Protection Agency (SEPA) is the public agency in charge of introducing regulatory controls over activities in order to protect and improve Scotland's water environment (Cooksley, 2007). SEPA is in charge as well of carrying out the assessments of water bodies in order to evaluate the achievement of the obligations under the WFD.

In Scotland the implementation of WFD at the local level is carried out through river basin planning. In the case of the Dee there is the Dee Catchment Management Plan, which identified actions and specific management practices for the catchment. A partnership was set up to implement the plan, the Dee Catchment Partnership, with more than 15 institutions and public agencies participating. Their influence in the land uses is restricted to what land managers are willing to do. SEPA has direct impact because they are in charge of the implementation of the law. They can therefore fine land managers if they contaminate or do not follow the law (although this is limited by the resources of the agency for monitoring and evaluating land uses on a regular basis). The partnership has to persuade land managers to carry out specific management work, which may or may not be effective. The Dee Catchment Partnership uses external funding or CAP money (AES) whenever possible to compensate land managers (farmers and others) to carry out specific works. As I shall present in other chapters, the plan works very well on paper but not so much in practice (chapter 3 and 4).

2.3 CONCLUSION

In this chapter I have presented the biophysical, social and institutional landscape of the Dee Valley. It showed that each of these landscapes have 'boundaries' that either constrain or present opportunities to land managers. Decision-making by land managers is embedded in the interactions of these different landscapes. I present in the next chapters how these changing landscapes influence land managers' decision-making but at the same time how land managers shape biophysical, social and institutional landscapes.

Chapter 3

Missing Links: Assessing the Potential of Adaptive Co-management for Ecological Networks Implementation in the Dee Valley, North East Scotland

3.0 Introduction

As discussed in chapter 1, habitat loss represents a threat to wildlife due to both loss of habitat area and fragmentation of these areas. In the UK, the biodiversity for the eight identified habitat groups (both aquatic and terrestrial) is reduced or degraded, and 30% of these habitat areas are in decline (UK NEA, 2011). It is likely that this loss and fragmentation of habitat area will become an increasing problem as the effects of climate change will create a need for species to move across the landscape in the attempt to track their climatic niche (Gimona et al., 2012).

As discussed in chapter 1, during the last 60 years most countries have protected biodiversity in designated areas at international, national, regional and local scales. However, natural scientists, and more recently policy advisers, have highlighted the need to connect these designated areas and, more generally, to link viable patches in the landscape in order to increase resilience and cope with the afore-mentioned pressures.

It has been recognised that the protection of isolated designated areas does not guarantee biodiversity protection (Adams, Lawton et al., 2010; Biodiversity Action Plans UK; Government Office for Science, 2010). Influential reports, such as the Land Use Futures study (Government Office for Science, 2010) and the Lawton Review (2010), noted that management of the wider landscape is needed as land use changes outside protected areas could compromise management within the areas. Therefore, the implementation of landscape-scale ecological networks has been advocated in addition to new forms of governance (Land Use Futures, 2010, Lawton et al., 2010).

Adaptive Collaborative Management (ACM)

The principles of Adaptive Management (AM) are appropriate to establishing an environmental management paradigm capable of accepting the uncertainty and complexity of natural resource management (e.g. Schreiber et al., 2004). AM adopts a system perspective which encourages managers to treat knowledge as provisional and tentative and to constantly learn from evaluation of their activities.

AM has also been proposed as a conceptual model for the design and implementation of ecological networks; studies have indicated that AM can be useful in assessing the potential effect of networks and network design (e.g. Rowland and Wisdom, 2008). However, to date the use of AM appears mainly limited to creating maps and developing policy guidance. Land managers ultimately control the delivery of public goods deriving from land use, and without their help policy objectives are likely to be missed.

AM, however, does not specifically address the process of collaboration amongst the stakeholders involved. Yet collaboration is a crucial attribute in the management of socio-ecosystems (e.g. Plummer and Armitage, 2007), including the implementation of ecological networks (Simenova, 2009).

This deficiency in AM is resolved by the Adaptive Collaborative Management Framework (Adaptive Co-management or ACM); this framework fuses adaptive management and collective management with a view to enable capacity building and encourage social and ecological resilience.

Aims, Objectives and Research Questions

I used Adaptive Co-management (ACM) as a framework in order to investigate the possibility of implementing ecological networks on land owned by multiple actors.

The ACM framework has been utilised by academics but in practical application has been limited to ‘common pool’ resources; national parks; and reserves (Colfer, 2005; Armitage et al., 2007; Olsson et al., 2004). Therefore, I do not expect ACM *per se* to be in place on embarking on the study area and for the subject of forestry networks. However, I have chosen ACM as a framework because of its application in studying processes of natural resource management at multiple scales with multiple groups of stakeholders.

The aim of this chapter is to **establish whether the preconditions for collaborative action are present in my study area. This chapter will also examine the potential for collaborative action to promote the implementation of ecological networks.**

The objectives of this chapter are: **(i) to draw parallels between existing practices in the Dee Catchment and the case of ecological networks (which need to be implemented by multiple land managers); (ii) to highlight institutions and activities that might predispose land managers to undertake collaborative endeavours at the landscape scale; and (iii) to highlight gaps and areas where the comparison is not applicable and clearly breaks down.**

In this chapter I focus on the potential for development of collaborative processes through ACM, among land managers and public agencies for the implementation of ecological networks in a private ownership regime in North East Scotland. My analysis is based on my fieldwork, the interviews I carried out with representatives of public agencies, researchers and land managers, and on the existing literature about the study area. When referring to specific land managers I will generally stipulate whether they are estate owners (or factors[25]), smallholding owners or tenants; these distinctions will be further addressed in the following chapter as they play a role in understanding attitudes to conservation and in establishing whether there is a propensity to cooperate amongst land managers. The differences in attitudes to conservation were found to be distributed across three clusters of land managers; as these differences were essentially related to land tenure, I identified the three clusters of land managers accordingly.

As noted in chapter 1, I defined land managers as people with access to land who are in a position to take decisions and carry them out; in other words, people who make decisions on land use which can have an impact on the environment.

[25] Factor or land factor specialises in Estate Management.

From a social science perspective, I answer the research question, **what are the opportunities and barriers influencing the development of ACM for the implementation of ecological networks?**

In this section of the thesis, I first study collaboration and partnerships and investigate the extent to which ACM is in place; secondly, I question whether ACM processes could be used as channels for the implementation of ecological networks.

3.1 ACM Components

To answer my research question I assess three key components of ACM (Armitage et al., 2007, 2008a and 2008b; Berkes and Folke, 1998; Berkes 2008): 1) local ecological knowledge; 2) sharing power; 3) evaluation (to assess adaptation).

3.1.1 Local Knowledge and Scientific Ecological Knowledge

Ecological knowledge across multiple scales is vital to effectively building and managing ecological networks; as such, the question of whether the actors involved possess this knowledge is of obvious importance.

Knowledge is institutionalised, practiced and embedded in the social, cultural, economic and political context (Roth, 2004). Local and traditional ecological knowledge are contested terms; in this research the term 'traditional ecological knowledge' is understood as the cultural continuity transmitted in the form of social attitudes, beliefs, principles and conventions of behaviour, and practices derived from historical experience (Berkes, 2008).

This knowledge evolves and adapts over time in response to the relations of living beings with one another and with their environment. What makes this knowledge useful is not its antiquity but rather the way it is acquired and used (Battiste 2005). Berkes (2008) observes that local and traditional knowledge refers to an 'ecological understanding built, not by experts, but by people who live and use the resources of a place'. In other words, local knowledge is produced through observation of the local environment and may include both practical and scientific knowledge (Olsson and Folke, 2001).

In this research, the notion of ecological knowledge is identified with Berkes's concept of 'knowledge of the land' (Berkes 2008); this refers not only to the physical space but to the living environment. Berkes (2008) follows the idea of Aldo Leopold's (1945) 'Land Ethics', where 'knowledge of the land' refers to land as an ecosystem which includes both the land itself and the processes happening there. Similarly, Kalland talks about 'paradigmatic knowledge': knowledge of the living environment gained through observation, but interpreted through people's worldview (Kalland 2000).

To evaluate knowledge in these terms, Berkes (2008: 17-18) proposed different levels of study: 1) individual (one person) and individual knowledge of species of animals and plants, soils etc; 2) the use of this knowledge in management practices (the management of systems implies the use of knowledge through practices, techniques and tools); 3) practices that are embedded in social institutions, rules-in-use, norms and codes of social relationships (e.g. fishers, hunters, agriculturalists, etc.); 4) worldview, which shapes environmental perception and gives meaning to observations of the environment (how empirical knowledge is acquired and how it is shaped by values and culture).

A degree of shared ecological knowledge is necessary to manage habitats and develop ecological networks. Ecological systems are affected by decisions and resulting actions. These decisions can be taken at different scales, which affect ecological systems differently. The decisions made by land managers are in part constrained by policies, laws and access to subsidies. Therefore, in this work, local ecological knowledge is also about the ecological systems and the regulatory policies and other documents that affect ecological systems.

In section 3.3.1, I present the results of the interviews with reference to the four levels of knowledge identified by Berkes (2008: 17-18). I do not compare local and scientific knowledge, but rather argue that these can complement each other when both scientists and traditional knowledge holders are open to understanding each other in collaborative processes and power sharing.

3.1.2 Sharing Power

Collaboration would be needed, at least among neighbours, to manage an ecological network adaptively. For example, the land managers involved would need to agree on the spatial configuration, any land use change, management timing and regime in order to benefit species using the networks.

A central idea behind collaboration is the sharing of rights and responsibilities by the government and civil society (Plummer and FitzGibbon, 2004). This idea is important since the management of natural resources is becoming more a question of negotiation and agreement amongst stakeholders than a matter of appropriate expertise (Brunner et al., 2005). This would imply that land managers, public agencies, researchers and other actors interested or affected by the management of natural resources, agree on management practices. However, this is difficult to achieve due to property rights; ultimately, land managers have the right to do whatever they choose with their land.

Management that enables cross-linkages, both horizontal and vertical, builds capacity and aims at institutional resilience. It calls for decentralisation and the sharing of power through alternative governance approaches. Armitage et al. (2007) observed that there is a need to develop decision-making processes that result in partnerships and empower communities and local resource users. Wiber et al. (2009), found that empowerment through collaborative learning, political engagement, and dealing with power difference constitute the key elements in developing effective community-based fisheries management.

I analysed the sharing of power by investigating existing arrangements where partnerships and other collaborative initiatives were in place. This analysis offers insight into decision-making processes and the empowerment of local resource users. It is important to distinguish between collaborative initiatives and Adaptive Collaborative Management (ACM). In this study, ACM is said to exist only when processes of local ecological knowledge, sharing power and evaluation are in place.

3.1.3 Evaluation Processes (learning-adapting cycles)

Berkes and Folke (1998) mentioned that a key principle of Adaptive Co-management is 'learning'. Learning is the process whereby agents can improve their management practices and policies as they respond to the feedback from ecosystems. Policies and management strategies are considered experiments where trial and error permit the development of practices that are adaptive and open to improvement.

This learning process assumes constant knowledge acquisition through knowledge flow: knowledge and practices should be shared and transmitted through social networks and institutional frameworks. In this process, the role of public agencies is crucial in allowing information flows to link local-level land managers and other stakeholders on the ground, with high-level national and international institutional policies and law. Figure 3.1 presents the cycle of learning-adapting processes at an individual level; figure 3.2 presents the same cycle at a collective level. Constant acquisition of knowledge and evaluation of practice allows community-based management systems to cope with change and uncertainty and create resilient communities (Gadgil, et al., 1993; Berkes and Folke, 1998; Smit and Wandel, 2006).

In this research, I assessed whether interviewees had a process of evaluation in place as an indicator for the existence of feedback loops of learning practices and evaluation-adaptation.

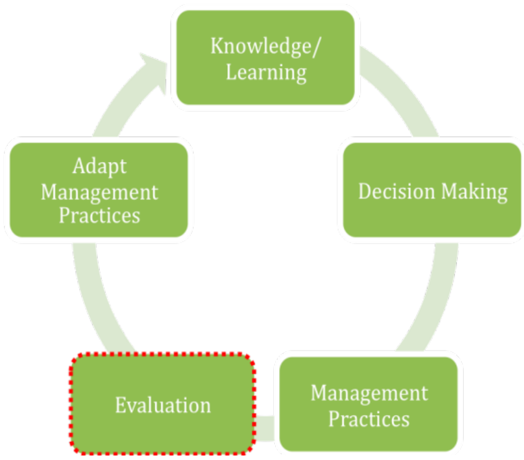
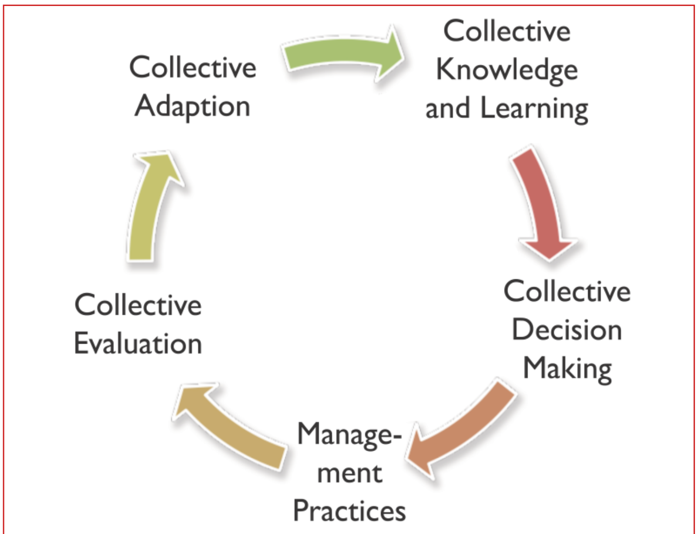


Figure 3.1 Feedback loops of ‘adaptive management’ at individual scale. Source: Based on own field data.

These three components (local ecological knowledge; sharing power; evaluation processes) are essential to the functioning of adaptive co-management cycles. The creation and reproduction of these cycles both depends and builds on the resilience of a socio-ecological system.



The figure shows ACM processes where agents are involved in cycles of collective learning-management-evaluation-adapotion-learning. ACM assumes that each agent has in place processes of adaptive management with similar cycles.

Figure 3.2 Feedback loops of 'adaptive collaborative management'. Source: Based on own field data.

Ecosystem Resilience is the degree of disturbance that can be absorbed before a system alters its structure by changing the processes that control behaviour (Gunderson and Holling, 2002). Alder (2000) notes that social resilience refers to the capacity of human communities to endure external shocks to their social infrastructure in relation to environmental, social, economic and political disturbance (Alder, 2000). Bakers et al. (2003), identify three central features of resilience: 1) the ability of a system to absorb or buffer disturbances and still maintain its core attributes; 2) the ability of a system to self-organise; and 3) the capacity for learning and adaptation to the context of change.

Based on these ideas, I used the model of adaptive management proposed by Rowland and Wisdom (2008), for the design and implementation of the ecological networks. I adapted the model to be appropriate for ACM. I therefore integrated the 'collaborative' dimension of ACM to use the ACM model as a benchmark for existing cases of collaboration for ecological networks in the study area. Ideally, a process of ecological networks design and implementation should use this model as guidance for practice. Figure 3.3 shows the differences between AM and ACM.

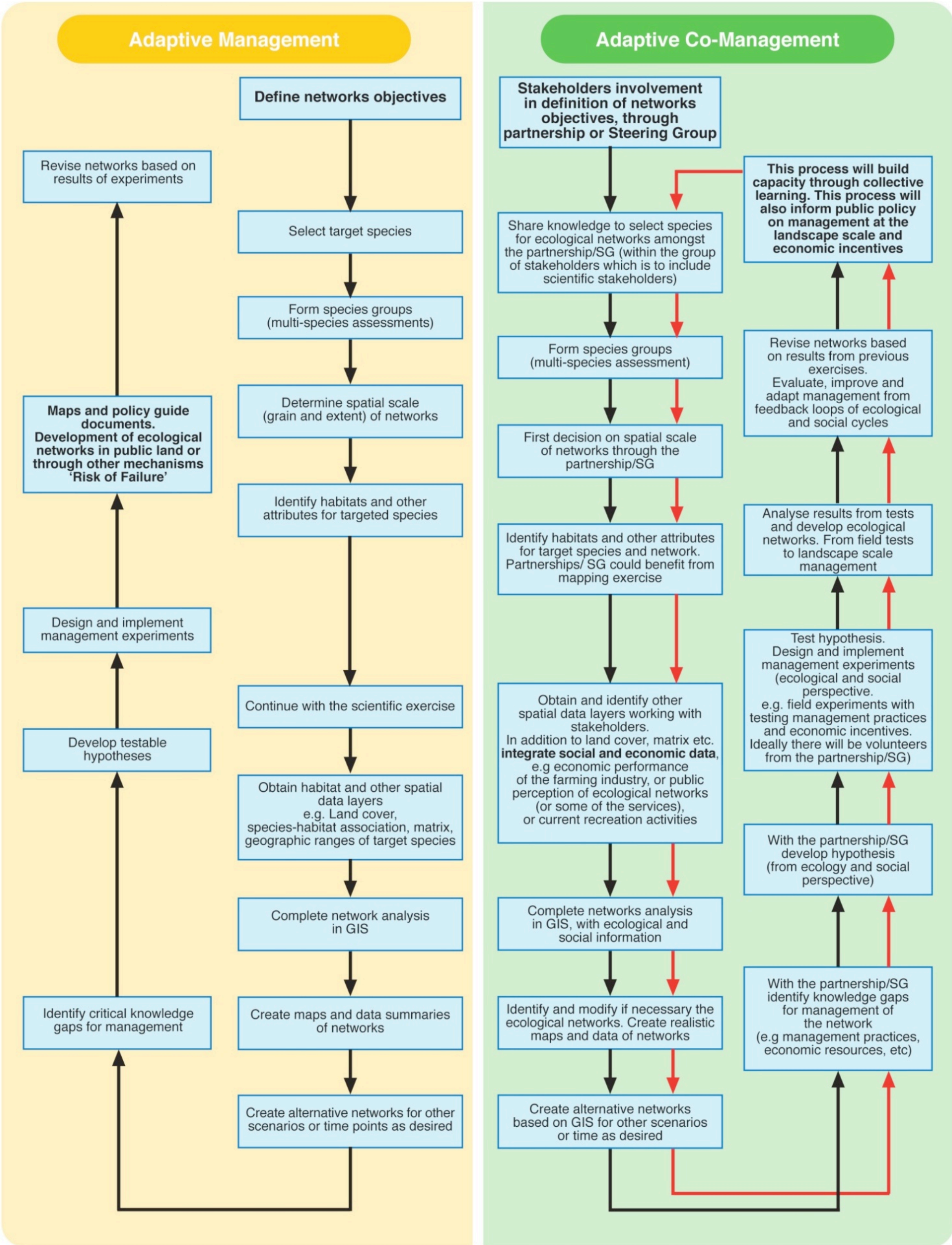


Figure 3.3 AC and ACM for implementation of ecological networks (adapted from Rowland and Wisdom, 2008).

3.2 METHODS

I conducted face-to-face, semi-structured interviews. I interviewed a number of public agencies and officers from non-governmental organisations involved in the Dee valley, working on natural resource management. Overall, I report results of a total of 42 face-to-face, semi-structured interviews with land managers, public agencies, non-governmental organisations, researchers and one local authority (see list of interviewees below and Appendix E).

I recruited public agencies and non-governmental organisations by first identifying all of those involved in natural resources management in the case study area. I found both their telephone and email details and made initial contact by email. I then called them to make an appointment if they were identified as willing to participate in this research.

Table 3.1 List of interviews.

Informant identification number	Type of informant	Agency or institution name. Tenancy type	Holding size (ha. approx)	Multi-functional Land uses
1	Public agency	Cairngorms National Park Authority (CNPA)		
2	Public agency	Scottish Environment Protection Agency (SEPA)		
3	Land manager	Tenant	50	Arable land and grassland Mixed farm system.
4	Land manager	Tenant	50	Arable land and grassland Mixed farm system.
5	Land manager	Smallholding owner and tenant	120	Arable land and grassland. Mixed farm system.
6	Land manager	Tenant	70	Arable land and grassland. Mixed farm system and other sport livestock production.
7	Pubic agency	Scottish Environment		

		Protection Agency (SEPA)		
8	Land manager	Smallholding owner	350	Arable land and grassland. Mixed farm system. Other: Shop.
9	Land manager	Tenant	50	Arable land and grassland Mixed farm system.
10	Public agency	Forestry Commission Scotland (FCS)		
11	Land manager	Estate	3500	Arable land and grazing are *in hand*. There are a number of tenants. Farming is mixed. Housing for letting, woodlands, shooting and fishing are managed by the estate.
12	Charity	Royal Society of Protection of Birds (RSPB)		
13	Land manager	Smallholding owner and tenant	200	Arable land and grassland. Mixed farm system.
14	Land manager	Small holding owner	130	Arable land and grassland. Mixed farm system. Woods for bird hunting. Other: shop.
15	Land manager	Tenant	130	Arable land and grassland Mixed farm system.
16	Land manager	Tenant	90	Arable land and grassland Mixed farm system.
17	Land manager	Estate	3300	Agricultural land and grazing are leased to a number of tenants. Farming is mixed. Housing and woodlands are managed by the estate.
18	Land manager	Estate	3000	Arable land and grazing are *in hand*. There are a number of tenants. Farming is mixed. Housing for letting, woodlands, shooting and fishing are managed by the estate.
19	Land manager	Small holding owner	250	Let land for crops and livestock. Recreation and environmental activities.
20	Land manager	Tenant	200	Arable land and grassland Mixed farm system.
21	Land manager	Smallholding owner and tenant	400	Arable land and grassland. Mixed farm system.
22	Land manager	Tenant	250	Arable land and grassland Mixed farm system.
23	Land manager	Tenant	100	Arable land and grassland. Mixed farm system.
24	Land manager	Smallholding owner	-	N/A

25	Land manager	Smallholding owner	150	Arable land and grassland. Mixed farm system. Other: Shop.
26	Land manager	Tenant	300	Arable land and grassland Mixed farm system.
27	Local Authority	Chester Ecological Networks		
28	Public agency	Scottish Natural Heritage		
29	Researcher-Scientist	Wageningen University		
30	Researcher-Scientist	University of Cambridge		
31	Land manager	Tenant	130	Arable land and grassland Mixed farm system.
32	Land manager (Trust-community organisation)	Commonties		
33	Land manager	Smallholding owner	100	Arable land and grassland. Mixed farm system.
34	Land manager	Estate	50000	Arable land and grazing are tenanted. Farming is mixed. Housing for letting, woodlands, shooting and fishing, skiing and other recreation activities are managed by the estate
35	Land manager	Estate	3500	Tenanted all arable land
36	Land manager	Estate	2500	Arable land and grazing are *in hand.* There are a number of tenants. Farming is Mixed. Housing for letting, woodlands, shooting and fishing are managed by the estate.
37	Land manager	Estate	20000	*In hand* arable land and grazing. There are a number of tenants. Mixed farming, woodland, housing shooting and fishing are managed by the estate.
38	Public agency	Scottish Government Rural Payments Inspections Directorate (SGRPID)		
39	Land manager	Smallholding owner and tenant	400	Arable land and grassland. Mixed farm system.
40	Public agency	Scottish Natural Heritage (SNH)		
41	Land manager	Estate	15000	Arable land and grazing are tenanted. Farming is mixed. Forest, shooting, fishing, recreation, housing are managed by the estate.
42	Public agency	Local Biodiversity Action Plans Officer		

A combination of methods was used to recruit interviewees within the Dee Catchment. First the business Yellow Pages were taken as a starting point to identify and send letters asking for participation on a voluntary basis. I searched under ‘farmers’ and ‘land agent’ because there was no other category under which I could search; there was no category for ‘land managers or estates’; even in the case of ‘land agent’ there were very few listings. However, the resulting list could be confused with a ‘convenience sample’ or a ‘sample of volunteers’ (Rachad, 2004) since not all the individuals selected through sampling answered the letter of invitation. Moreover, not all land managers are in the Yellow Pages and, as Burton and Wilson (1999) point out, the less commercial ones are excluded from that source. Therefore, I contacted people by attending different public events across the catchment and taking the contacts from their websites (some estates have their own website). Furthermore, from the initial contacts onwards, a snowballing methodology was used to include further land managers. However, very few land managers gave names of other land managers and in other cases the person named did not want to participate. Therefore, snowballing had a limited impact: only four new contacts were made and only in one case were they neighbours.

Although the number of interviewees represents a significant proportion of the study area’s land managers, the objective was not necessarily to attain a statistically representative sample. Indeed, this part of my research was really meant to produce predominantly qualitative data about land managers’ practices and views, as described in this and the following chapter. However, so as to avoid any bias due to the recruitment methods, I took caution to have a geographic distribution of land managers representing the different parts of Deeside and of different types of land managers.

Interviews were one hour long on average and were split into sections (see schedule of the semi-structured interviews in Appendix D). Each of these sections covered different aspects of the three components of ACM. The local knowledge section refers to respondents' knowledge of conservation, environment and practices, awareness of designated areas and BAPs, knowledge about species and habitats, and law and policy objectives at different scales .

In terms of landscape-scale management, the main question addressed is whether participants see their management within the wider context of the Dee catchment. The section on power sharing (collaboration and partnerships with other land managers and/or public agencies, existing cases of collaboration). Finally, section on the evaluation I asked if interviewees had an evaluation process in place by which they reflected, evaluated and adapted their practices for their own business or organisation. I also asked respondents if this process was in place in cases where they participated in partnerships or collaborative management.

There were other questions addressed in the interviews which are not included in this chapter: these are explained in chapter 4 where the information is analysed in detail.

In accordance with the choice of taking a qualitative approach to land managers' practices and views, my investigation was carried out in the form of 'field research' (Beaud and Weber 2003) and I used semi-structured interviews as a method for its openness enabling interviewees to express their views more freely (Becker 1998). Therefore, although the nature and time constraints of this research did not allow for proper ethnographic participant observation (i.e. spending several weeks or even months living on or near a farm or an estate and following people in their daily activities), my engagement with land managers was certainly inspired by my previous experiences of ethnographic fieldwork. I believe this was crucial in terms of my position as a researcher in the relation to the interviewees. All interviews were conducted at the interviewee's place of work.

As Bourdieu (1993) underlines in his seminal essay on the necessary methodological reflexivity to be applied by the researcher in social sciences, the methods one uses are never neutral and any situation of investigation in social science is still a social relationship. This is why I decided not to proceed by telephone interviews, although this would have been a more cost-effective method both in time and in fieldwork expenses. Indeed, I am convinced this would have produced far less useful and reliable answers. As Bourdieu suggests (1993: 3), even with the best of intentions the social scientist cannot avoid the fact that his interaction with the people in his study is automatically charged with some form of symbolic violence or another. As such, it is essential that the researcher is aware of how this might affect her investigation and that she takes measures to minimise possible undesirable effects on the quality of the information obtained.

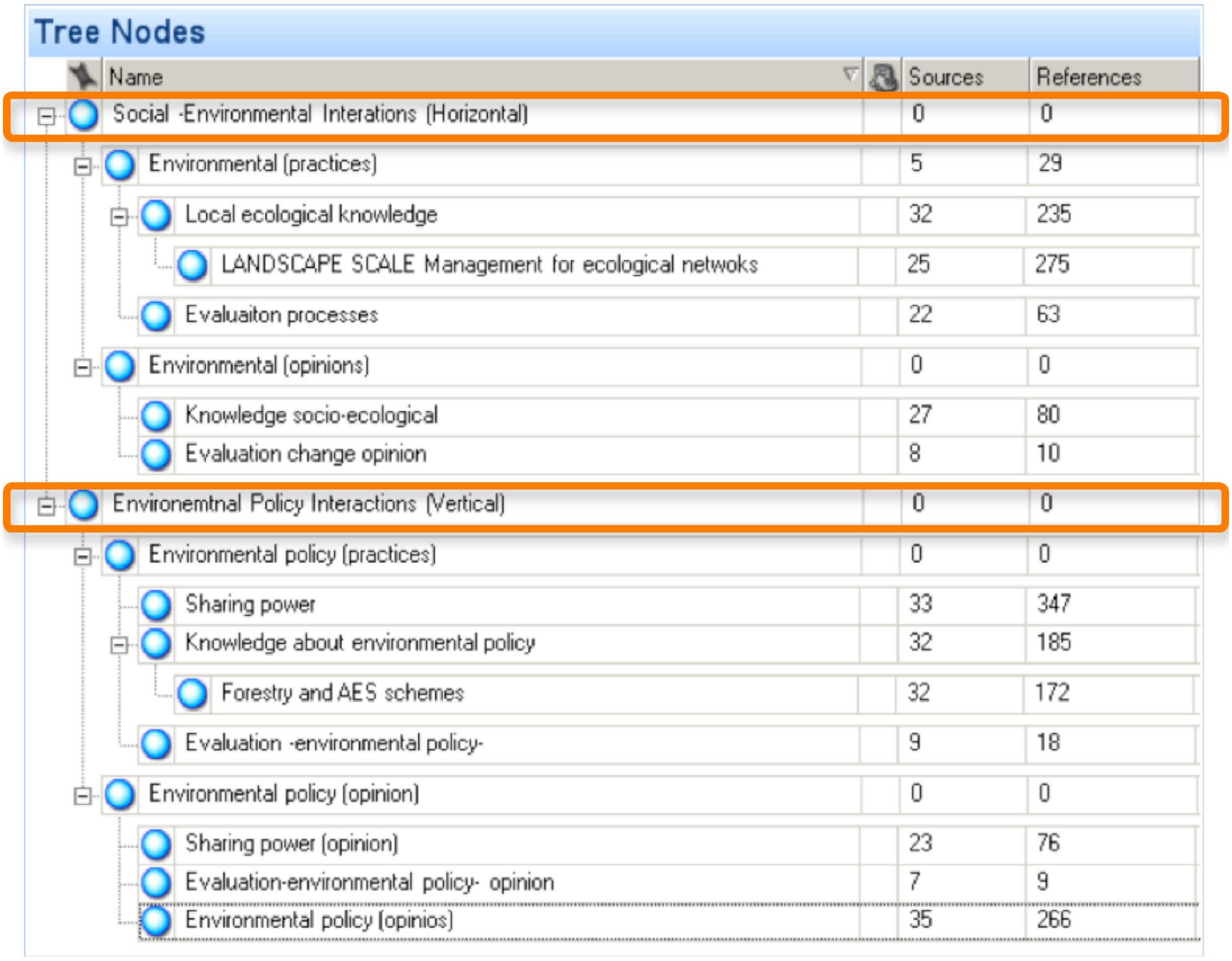
In comparison to a face to face conversation, the rather anonymous phone call from someone working for a research institute can be a situation quite prone to symbolic violence, especially with those land managers less used to interaction with the academic world (for example, those with small farms or tenant farmers). It can also induce an intimidating perception of remoteness, creating an image of the scientists in their offices who have some kind of claim of superior knowledge regarding what should happen in the countryside. Conversely, this can be looked down upon by some land managers who might be more confident in dealing with civil servants and researchers. These managers may be more vocal about agricultural and environmental policies and may, depending on their social position, even have influence on policy makers. Moreover, they may feel, and actually often are, more knowledgeable regarding government's processes of policy making. I clearly felt this was sometimes the case with estate owners or managers.

Proceeding by field visits allowed me to minimise some of this distance by meeting with interviewees literally 'on their ground'. In several cases, I met with land managers on more than one occasion, either through repeat visits at their home, or by meeting them first at a public meeting and then again at their property or at another meeting. This allowed me to build a rapport with interviewees, to 'break the ice' or even to gain their trust.

In a sense, the fact that I am actually a foreigner also worked to establish a more neutral position towards different types of interviewees: to start with, I have a foreign accent, so cannot be situated within Scottish (British) class relationships which are so characteristically identified by the way one speaks. This made those land managers who spoke Scots/Doric English more understanding and patient with my difficulties to understand them and with my requests for them to repeat their statements. I believe my outsider status and experience also reduced observer bias and made it easier for me to suspend any judgment on what interviewees were telling me.

As mentioned earlier, all interviews were conducted at the interviewee's place of work and, whenever possible, part of the interview with land managers was carried out whilst walking through the fields of the holding. This was important methodologically, as it allowed for the production of a discourse situated in context, which presents several advantages. Discussing land managers' interactions with the land while walking through their fields or woods is itself a situation of interaction with the land (see Jones et al., 2008; Carpiano, 2009); as such, it allows ad hoc commentaries and connections between different decisions and activities carried out by the land manager to be raised.

All the information from the interviews was recorded, transcribed and analysed with QRS Nvivo 8 software. Coding was applied to all interviews, allowing me to establish a systematic inventory of answers expressed. I created four 'parent nodes' with three 'child nodes'. Figure 3.4 presents how nodes were created and organised.


Tree Nodes

Name	Sources	References
Social -Environmental Interations (Horizontal)	0	0
Environmental (practices)	5	29
Local ecological knowledge	32	235
LANDSCAPE SCALE Management for ecological netwoks	25	275
Evaluaiton processes	22	63
Environmental (opinions)	0	0
Knowledge socio-ecological	27	80
Evaluation change opinion	8	10
Environemtnal Policy Interactions (Vertical)	0	0
Environmental policy (practices)	0	0
Sharing power	33	347
Knowledge about environmental policy	32	185
Forestry and AES schemes	32	172
Evaluation -environmental policy-	9	18
Environmental policy (opinion)	0	0
Sharing power (opinion)	23	76
Evaluation-environmental policy- opinion	7	9
Environmental policy (opinios)	35	266

Figure 3.4 Shows tree nodes created to analyse the interview data. There are two 'parent nodes' (highlighted in orange): the first contains data regarding social-environmental interactions (horizontal across the landscape); the second contains data regarding policies and other statutory documents in relation to environmental management (vertical across international, national and regional scales). All others are 'child nodes' organised by knowledge, evaluation and sharing power. I differentiated between opinions and practices because often interviewees have views about how things should work or how they used to work, but have other management practices in place (at the time of the interviews).

I present the results of the analysis in the following section. I use numbers to identify interviewees and the type of respondent, for instance ‘public agency [1]’ or ‘estate [23]’ etc.

In the following chapter, where the expression of more personalised views was important for the analysis, I have used personal pseudonyms to safeguard the anonymity of participants while still conveying some sense of the personality of the interviewees. The list of interviewees with their identifying numbers can be found on page 94 and Appendices E. As I noted above, for land managers I distinguish between estates, owners of smallholdings and tenants as a result of the specific analysis of land managers’ attitudes to conservation and propensity to cooperate (see chapter 4).

3.3 RESULTS

I present the results of the interviews for the three components of ACM: local ecological knowledge, sharing power and evaluation.

3.3.1 Local Knowledge and Practices

According to the four levels I presented above based on Berkes’ definition of ecological knowledge (section 3.1.1), the results showed that all interviewed land managers tended to relate ecological knowledge to their empirical knowledge about the production system they managed. In other words, ecological knowledge was considered as relevant to them mainly in as far as it was subordinated to the economic soundness (profitability) of their business. This is important as agricultural activities often compete with land allocation for ecological networks. There is, therefore, a competition between the economic objectives of their business and non-economic value products such as public good biodiversity. In chapter 4 I analyse some of the variations between land managers' views, with a specific focus on conservation.

The extent of land managers' knowledge about ecological processes, such as soil erosion or diffuse pollution, is very variable. As a public agency representative noted [40], '[some land managers] are unaware that they can do anything better, some are either unaware or aware but simply don't care, and there are some who care and are willing to but can't afford to in the present climate'.

Various other respondents confirmed this. Some of them were aware of the damage the farming system or forestry practices caused to the environment, but they did not have any motivation to change their practices. Knowledge, interest and willingness are at the centre of the decision-making of land managers. Empirical knowledge, what respondents do in their everyday practice, is institutionalised through norms and codes of practice. The results suggested that institutionalised organisations, such as the National Farmers Union, work as platforms where knowledge is exchanged and norms and codes of human-nature relationships are partly laid down (not homogeneous across the whole organisation but across areas or groups within the NFU).

Norms and rules are also institutionalised through land managers' self-identification with a certain group. For instance, the results showed that those who identified themselves as 'agriculturalists' or 'farmers' felt that they were taking care of the environment by the practices they undertake [smallholding owners -tenant 21 and tenant 26]. They gave examples such as 'keep[ing] the ground clear of weeds' or 'tidy[ing]', and they were generally not interested in forestry (see also chapter 4).

Self-identification and participation with certain groups allows knowledge exchange and, to a certain degree, extends common knowledge. Such sharing of ecological knowledge often takes place through informal interactions. As an owner of a small holding commented:

‘Most of the information I get is from people, the two or three people that I know, on the beats on the day. One of them in particular I know is on the Dee committees and when we are fishing obviously lunch time is the time to catch up and he’s been telling me quite a bit about keeping cattle back from the burns, cleaning the burns, removing all the obstructions. I’ve not read anything about it. But I just get the information from two or three of these people’.

This common knowledge amongst groups sometimes leads to similar objectives and practices being established; e.g. in the case of estates management of habitats for red grouse (*Lagopus lagopus*), and to a lesser extent for capercaillie (*Teatro urogallus*). For tick (*Ixodes scapularis*) control, land managers learned from different sources but the actions of their neighbours played a very relevant role in their decisions [estates 18, 36]. In other cases I found that for management of deer and the waters of the Dee (for fishing), land managers participate in formal partnerships (i.e. Dee District Salmon Fishery Board); in these formal partnerships, knowledge is exchanged and transferred and common objectives and practices are agreed.

However, I did not find any group of land managers that identified themselves as ‘environmentalists’ or ‘environmentally friendly producers’, while individuals would identify themselves in terms such as ‘I am a farmer’ or ‘I am an estate owner’. There were cases where land managers mentioned they were interested in the environment, but these managers did not identify themselves primarily by this interest. The implementation of ecological networks did not appear as a priority to them. This suggests that land managers have to be persuaded to implement these networks. Moreover, more knowledge exchange is needed regarding the status of aspects of ecological networks as an added value to the business, rather than as a purely environmental service. In cases where environmental management practices are enforced by law, land managers are obliged to deliver and this changes their knowledge and understanding of environmental management. Only in a few cases was this change led by personal decision [smallholding owners 8, 19 and estate 17] or a combination of both personal decision and legal obligation, as one respondent observed:

'We get paid to deliver processes and public benefits rather than traditional land uses. [We] used to […] produce dead things – dead wood and dead animals. Now [we] produce experiences. Another service we provide is biodiversity [through] two national nature reserves SSSI, several tourist sites, also its got [sic] a range of species that are concomitant with that, from raptors such as eagle, osprey, harrier and so on and so forth to fresh water pearl mussel, salmon and so forth'. [estate 41]

Interest and values are a strong motivation for acquiring new knowledge. My results show that biodiversity *per se* did not have any significant economic value for respondents, and only in one case was it explicitly expressed as having 'spiritual value' [estate 17]. Along the same lines, semi-natural woodlands were interesting only for a limited number of land managers who managed these areas for shooting and recreation (in which case the habitats are a by-product). Land cover under semi-natural woodlands represents a small extension compared with forestry plantations; this indicates land managers' interest in forest plantations. These results are important as forest plantations have very limited ecological benefits but do have value for carbon sequestration. This creates trade-offs and competing policy objectives: multifunctional ecological networks could create synergies between these. As mentioned, knowledge within ACM is about both ecological systems and the policies and statutory documents that affect these systems. The results of this study showed a lack of knowledge by land managers about land use decision-making at different scales from international and national law to regional and local policy objectives. Respondents were aware of the general objectives of the public agencies they worked with, yet little was known about their national objectives. For instance, the majority of land managers among the interviewees did not know about the Biodiversity Action Plans (BAP), even though these plans were first published in 1994 as part of the UK's commitments in the Convention on Biological Diversity (CDB).

Conversely, some public agencies had scarce contact with different types of land managers and little knowledge about their interests, objectives and local knowledge. However, some agencies recognised the need for integrating scientific and local ecological knowledge in their decision-making process [SEPA, 2]: '[land managers] will have any intimate details, knowledge of that, which is vital to the process. You have, yes, they have knowledge that we need and we have to engage them somehow'.

It is important to note that this recognition of farmers' knowledge does not mean that knowledge integration is taking place. Regarding scientific knowledge, the respondents [SEPA, 2] commented that the problem is how this knowledge is used and prioritised.

Knowledge exchange is fragmented across-scales (horizontal and vertical). I identified a few cases where respondents [estates 41, 34, 17 and Trust-community 32] have knowledge exchange programs in place. For instance [estate 41]: '[works with between 100 and 150 different groups this year, people who do knowledge transfer. So there might be volunteers doing hands on conservation work but they will be getting some ecological briefing as well as part of that. So the groups we work with are from pre-school playgroups to academics postgraduates'.

This example shows that some land managers are well aware of the ecological knowledge they have through their land management practices and are willing to share it. This same example also reminds us that the boundary between local and scientific knowledge can actually be more blurred than one might initially assume, especially given the fact that larger estates often hire biologists among their rangers. Some land managers clearly see themselves as producers of knowledge which is useful for the public in general, other practitioners and even scientists, as a ranger of the above estate [41] highlights:

'So other expertise we provide, I'm just in the middle of organizing a seminar just now for wildlife managers to come to [the estate] so we can explain what we are doing and so on and so forth. So we provide a focus for knowledge transfer, KT, so people think about an estate as just providing stuff, things that go out on the back of a truck, whether its venison or a load of logs and that's obvious and of course we do do these things. But actually what's as important and certainly what's more critical to the way we manage the place are the less tangible aspects that we provide benefits and activities which we take part in'.

According to one academic respondent [researcher 29], communication between scientists and policy makers is not always easy: *'policy makers don't have the time. They always have their other obligations and are not interested in what the science is saying so the policy interface needs a lot of thinking how to do this [sic]. I had to learn to talk to politicians as well. That took me several years. You have to learn to communicate with each other. And they are different worlds'* [researcher 29]. In considering the potential implementation of ecological networks through ACM, the results suggest that common knowledge about ecological networks across the valley will increase land managers' interest and willingness to participate.

Land managers need more information about the benefits and disadvantages of ecological networks. In addition, it is necessary to coordinate and integrate existing local and scientific knowledge across-scales.

3.3.2 Sharing Power and Evaluation

The idea of collaborative management, or 'co-management', explicitly refers to the sharing of responsibilities and power in the management of natural resources. In the study area there are many examples of collaborative management at a small scale. For instance, it is common for neighbouring estates to work together for vermin control and burning of heather (for red grouse habitat). It is also common for an estate owner or manager to come to agreements with their tenants when specific land management practices require coordination throughout the estate; this is the case for riparian woodland corridors, as described by this estate manager [estate 41]:

'We have to prepare a forest plan for [the estate] and it should be on our website and some of the suggestions that were made for how we develop our forestry, would mean that we would have to negotiate with tenant farmers because it would mean that we would have to negotiate things like riparian planting and obviously that would have an impact on them – on their watering rights and obviously there is good grazing next to the streams. I think we decided at that point that it was probably more appropriate that the tenant farmers apply for the funding to do the work rather than we take all and away from them and then we applied for that. I think that was the decision that was made then. That way we still get the rent, but then they get an income as well'.

It is worth noting here that such coordination of land use may lead to collaboration and shared work between the estate and its tenants; this is because such practices may be required in order to apply for subsidies from agri-environmental schemes. In some cases, this can require the estate and its tenants to share both the work and the benefits of agri-environmental schemes by submitting a joint application for funding. This is something that has been encouraged by the Dee District Salmon Fishery Board for the development of riparian woodland, as the owner of another estate testifies:

'Yes, well at the moment we are doing a joint project through the Dee district board for further improvement on the river Feugh in the catchment area so it's going to be a joint application with four farmers, by doing further fencing off of areas that are burns or streams going into the river Feugh, trying to exclude livestock from certain areas. Yes, there's been a fair bit of work on that'.

Sharing power and knowledge are widespread characteristics of common resource management found in successful cases of ACM. In the study area there was only one case of common resource management that echoed these ideas: the forest of Birse, which is common land (see section 2.2.2 for a presentation on this). Birse Community Trust (BCT) is in charge of the management of the forest, and for them common knowledge is vital for the functioning and existence of the organisation:

'[…] you always have to deal with knowledge security. BCT is responsive to the knowledge, skills and interests within the community, but also has to have an idea and approach to how you maintain and continue that as the community changes. That's where you have…because of its approach of not having an employee or a manager, the knowledge is spread between a lot of different people in the community and the community's knowledge base is therefore more secure because of that […]'.

As already indicated in chapter 2, in the case of the Birse Community Trust, sharing of power and knowledge does not happen only within the community, but also between the community trust and neighbouring estates as a result of shared rights on the same forest. No other organisation in the study area was close to BCT in terms of common knowledge and practices. However, for some public agencies knowledge exchange and transfer is part of their *modus operandi*, as is the case of Scottish Natural Heritage. This public organisation is in charge of managing the wild habitat and landscapes in Scotland. Their work includes implementing environmental law and many other conservation issues, such as raising awareness. Consequently, they work with all types of stakeholders and end users (as figure 3.5 illustrates).

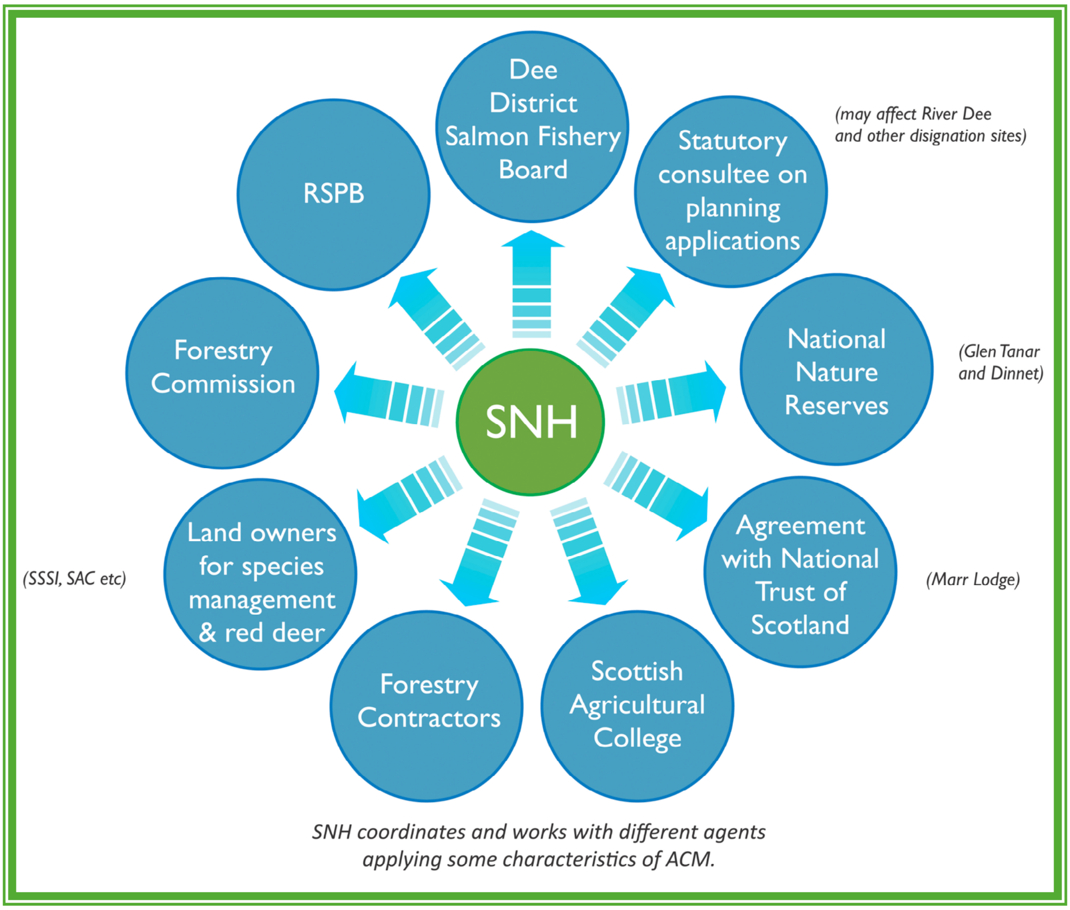


Figure 3.5 Scottish Natural Heritage and existing knowledge exchange and transfer with other institutions and land managers. Source: Based on own field data.

In my data, SNH was the only case identified where a public agency was coordinating and creating partnerships with land managers (including estates, smallholding owners and tenants). These partnerships represent cases of sharing power when they are implemented on the ground, and demonstrate collaboration with a range of stakeholders in the decision-making process.

Taking into account the three components of ACM, I found only three examples of Adaptive Collaborative Management: the Birse Community Trust, the Deer Management Group and the Dee District Salmon Fishery Board. These three cases operate across the landscape (horizontal) with the participation of public agencies (vertical). There are many other collaborative practices where sharing of power exists in the catchment, but these are at the smallest scales as mentioned above (generally two/three partners).

Based on the three characteristics of a) trust, b) power, and c) interest, I identified existing cases of collaboration as **symmetric** and **asymmetric** according to the balance or imbalance of shared power. I labelled cases as symmetric collaboration when there was a balanced sharing of power: in other words, when all participant parts in the collaboration defined objectives and agreed management practices and processes for evaluation of results (see figure 3.6).

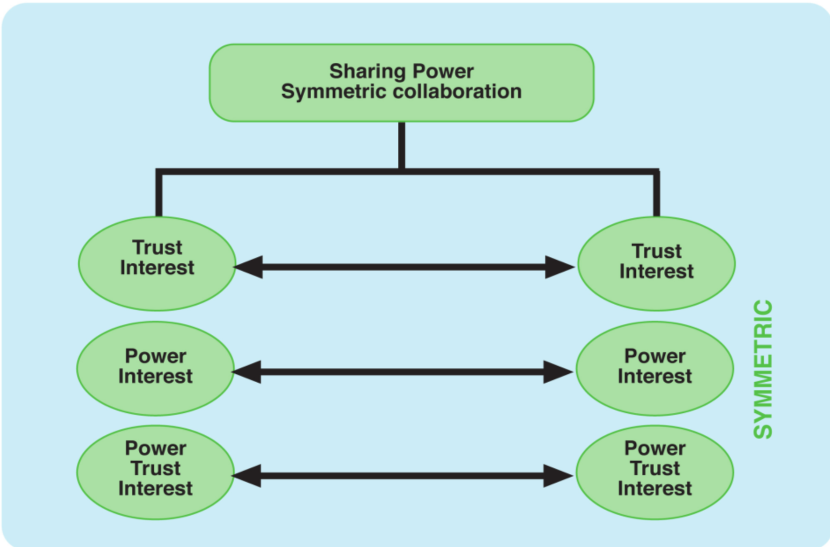


Figure 3.6 Shows symmetric collaboration where power is balanced. Based on balance of different combinations of trust, interest and power. Source: Based on own field data.

I applied the label **asymmetric** when there was no sharing power but rather a hierarchical (top-down) power relationship. Figure 3.7 presents the types of collaboration.

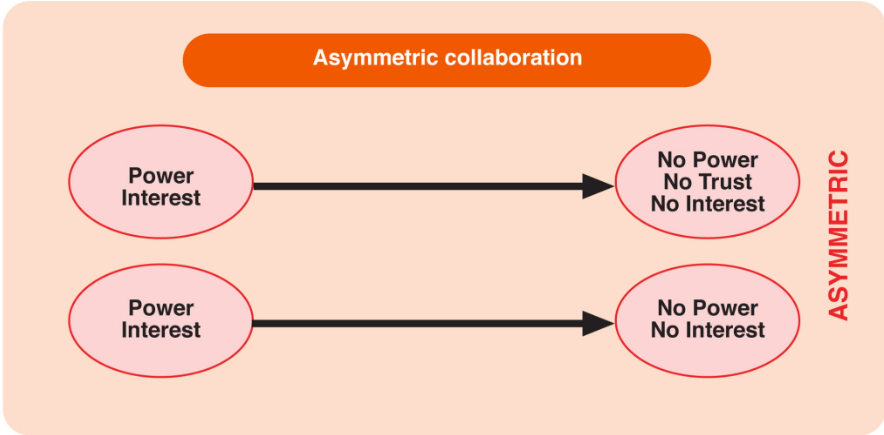


Figure 3.7 Shows asymmetric collaboration where power is imbalanced. Based on imbalance of different combinations of trust, interest and power. Source: Based on own field data.

The results show examples of **symmetric** collaboration for estates that tend to work with other estates (see figure 3.8, which indicates this with arrows in both directions): for instance, for management of shooting (deer and red grouse), fishing (salmon), and forest management (fire). These are cases of symmetric cooperation because participants' self-interest and empowerment leads them to trust others that are in the same position. In these cases there is power sharing, with agreements on common objectives and common management practices and agreed evaluation processes (management of the river Dee waters and numbers of salmon are monitored every year). Participants in these collaborations help to decide on whether to repeat the same pattern of collaboration or to change it, which suggests that they have an evaluation process in place. The same relationship was found amongst tenant farmers who tended to work more with other tenant farmers.

I found that symmetric collaboration happened in different degrees: from occasionally helping each other to having common objectives and long-term collaboration.

As one respondent noted [tenant 26]:

‘there’s not enough people working on the land now and everybody has got enough of their own to do. You help your neighbour if there is a problem and the same as someone would come and help me if we were needing help but just being neighbourly you give one another a hand’.

Similarly, another interviewee [tenant 23] remarked,

‘oh aye, if I was asked to help my neighbour get rid of water I’d have no objections to that. You’ve got, well there is so few people on the land now, you really have to see your neighbour and help them out’.

Other interviewees had more formal collaboration arrangements, for instance for harvest time (sharing machinery and exchanging labour with neighbours) or buying barley and other cereals from one farmer in exchange for livestock work; these collaborations will be presented in detail in chapter 4.

Smallholding owners in the study area were, in general, the more independent group, although there were some exceptions as figure 3.8 shows. Sharing power between estates and tenants is rare (see chapter 4 for the analysis on cooperation). I found two cases where collaboration was symmetric, five cases where there was no relation at all, and ten cases where the relation was asymmetric. Not surprisingly, I found that asymmetric power relations were very often established between estates and tenants; in such cases the asymmetric power relationship is not purely vertical (i.e. the estate dictating to tenants) as tenants also have some power backed up by tenancy legislation. As interviewees mentioned [tenant 15]:

‘[…] you just pay the money every year and he can’t put me out, unless I’m a untidy farmer or do everything….there’s rules and regulations that you do when you are farming so if I broke all the rules in the lease then he would have the powers to put me out through a long legal fight’.

Yet, overall, tenants have very limited possibilities to exert pressure over estate owners, as is illustrated in the words of another respondent [smallholding owner and tenant 39]:

'[…] when we had the problem with our water supply we could say the estate was more concerned with the quality of water in the burn than they were about the quality of water that we were drinking. That's generally the case. They would rather plant hedges than fix our roof when we were living in a damp mouldy house […]'.

Along the same lines, for some estates tenants are part of history: '[…] the agricultural ground we have six small tenant farms […]. All of them are far too small – I would suggest that its history' [estate 35]. This illustrates the normative judgments expressed by estates regarding tenancy regulation in general; many estates considered the long leases a limitation to their own land use decisions and business opportunities because of the land being tied up for years, or even for generations.

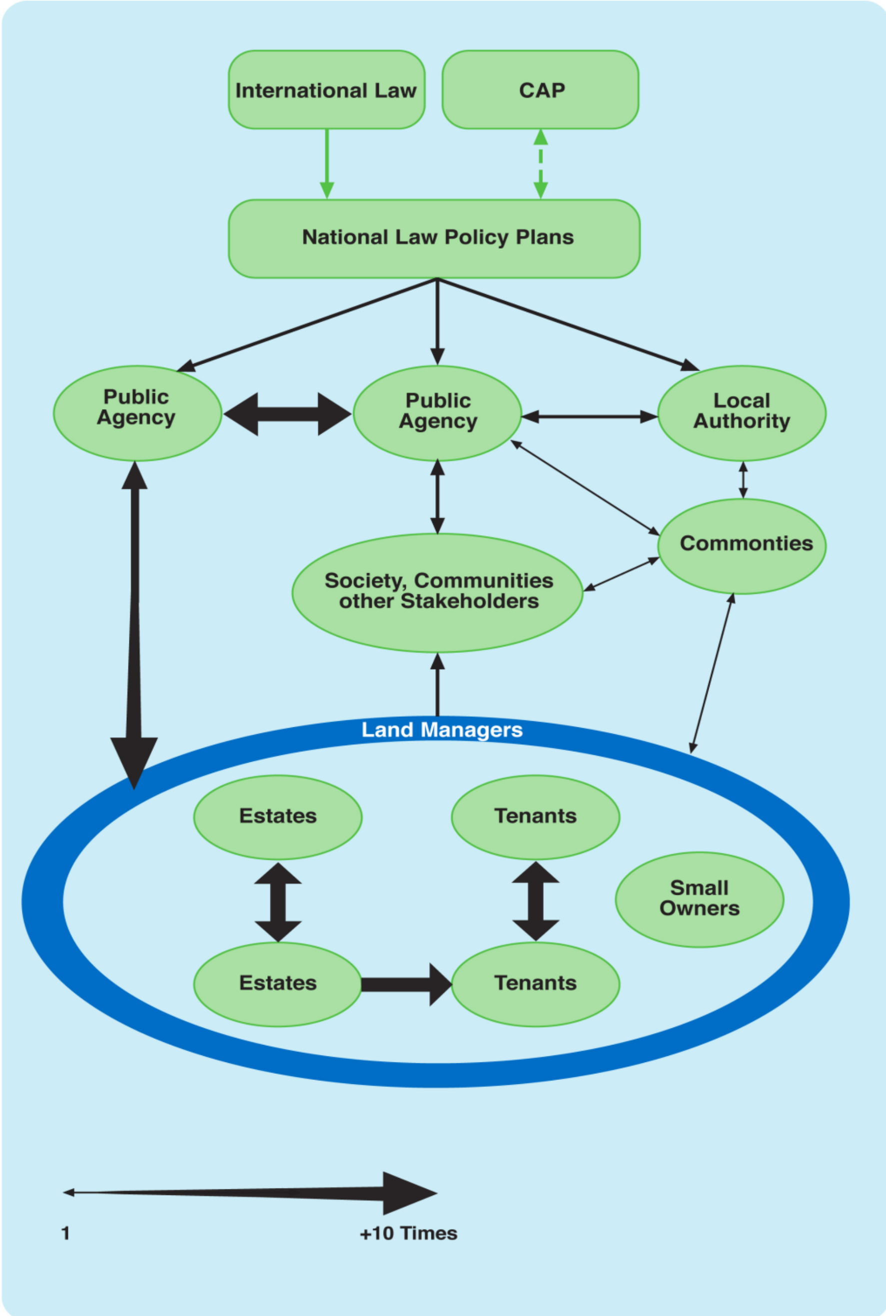


Figure 3.8 Recurrent symmetric and asymmetric relationships between and amongst groups of interviewees. The diagram presents the results of the analysis of the interviews. It shows the links of the symmetric or asymmetric collaboration between groups (indicated by arrows in one or two directions). Based on chapter 4, where I will present three distinct groups of estates, tenants and small owners, here I also present these groups as one sole group of land managers (blue circle). The width of the arrow indicates the number of times the same relation was found (if the same type of relationship was found '> 10 times' the arrows are thicker). There are some areas in which no arrows are drawn which denotes an absence of links. The most obvious relations are the work collaboration from estate to estate, tenants to tenants, and public agencies to public agencies. The links between public agencies and land managers, and especially with estates, are robust as well. Public agencies also work with local authorities and other stakeholders. Work between estates and tenants is, in most cases, asymmetric, with estates often asking for work from tenants (therefore, the arrow is one way). Small owners are in general a more independent group of people, although they work with public agencies and other institutions. Links between land managers and other stakeholders are very often one-way only. The only group that works on a more symmetric basis, in the sense of exchanging information and setting up common management objectives, working with different land managers, public agencies and other institutions, are the 'commonties' (of which there is only one case in the study area).

I did not find any case where tenants asked estates to collaborate with them, suggesting a lack of shared power. However, there were cases where estates asked tenants to carry out specific work, asked permission to carry out work on their land, or were exchanging land with tenants to carry out specific management. I identified these cases as asymmetric collaboration with unbalanced power relations. There was one case where, as a condition of the lease of land, tenants had to carry out specific conservation work. Talking about water protection through fencing of river margins, one respondent [tenant 20] noted,

'Part of it was that the landlord was on a renewal of the tenancy. It's a limited tenancy duration and it was up for renewal and this was things that the landlord was asking us to do. But it wasn't a problem as it was grant aid and there is something in it'.

For others it was only a matter of allowing the estate to do work on their tenanted land [tenant 26]: 'I don't know which scheme. They are doing everything. I've nothing to do with it. I just give them permission to do it'.

The factor of one estate keen on conservation [estate 17] mentioned that

'[…] all the limited duration tenancies have requirements to undertake environmental improvements […]. And we haven't been putting pressure on the remainder, but we will be working with the remainder to make sure they fulfil their obligations under their tenancy agreements'.

For other farmers (tenants and smallholding owners), when asked whether they were collaborating with estates, their answer was a consistent 'no absolutely not' [smallholding owner 33]. By contrast, when asked whether they were in collaboration with other farmers their response was, '[o]h yes, [with] other farmers hugely' [tenant 6].

Regarding the collaboration of public agencies with land managers, the results suggest that these were similarly based on a) trust, b) power, and c) interest. I identified three forms of collaboration with agencies (all three understood from the point of view of land managers): a) **Intentional** when land managers approach public agencies to work together or through voluntary membership, asking advice, consultancy work etc.; b) **Compulsory** when implementation of environmental law is the basis of the cooperation; c) **Coerced** when public agencies have to persuade land managers to participate in specific projects, raising awareness, and so on. I considered all these relations as asymmetric since trust, power and interest are not shared between parties. Figure 3.9 presents these types of collaboration.

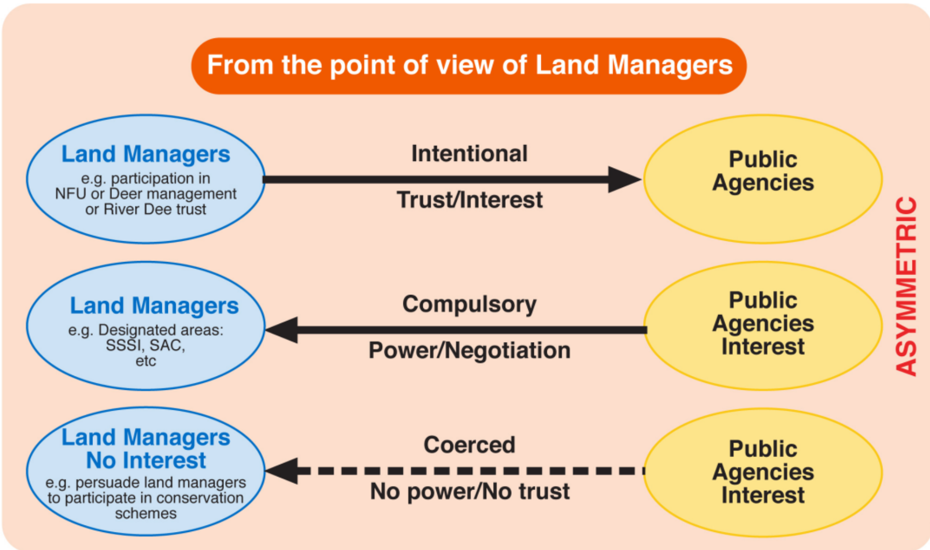


Figure 3.9 Intentional, compulsory and coerced collaboration. Source: Based on own field data.

The National Farmers Union (NFU) is an example of **intentional** collaboration, where land managers approach the NFU and participate on a voluntary basis. As some participants mentioned regarding their membership with the NFUs [smallholding owner 25], ‘oh well they definitely keep you in touch with things in business ways and the legal side, they really help you greatly on that […] if you’ve kind of made a mistake maybe, you don’t mean to make a mistake filling up a form or something, they help you out there. Then of course I do all my insurance through NFU so they are definitely excellent. A lot of information at their meetings [sic]’. The Dee District Salmon Fishery Board is another example of intentional collaboration that echoes the ACM process. This is a regulatory body that aims at protecting and enhancing salmon stocks in the Dee and other rivers. However, land managers' participation is 'voluntary', as they mentioned, because they have direct interest and see the economic benefit of the scheme. When asked about their participation, land managers commented [estate 34], '[o]n the fishing side we have a voluntary catch and release program. We could kill fish but we decided not to. The season starts and finishes and we have to abide by that'.

Other forms of **intentional** collaboration are found when estates, other land managers and public agencies create partnerships. The nature and scale of the estates make symmetric and asymmetric collaborations essential for effective management:

'[…] the fishing and the deer are the two important ones where everybody works closely together. Because the fish move up and down and the deer move around. So the deer – you've got the Deer Management Groups and the board which are the two main mechanisms for communicating and working jointly together […] working with the landowners and the government agencies and the fishery board […]'.

Compulsory collaboration (e.g. designated areas, such as SAC or SSSI) is a top-down process where the management has to be agreed between public agencies and land managers. In this respect, interviewees noted that [estate 34]

'[…] you have to make certain that you are complying with the designations. Sometimes it is an opportunity and sometimes it is a challenge. Sometimes, […] it [is] the government or the Scottish Natural Heritage says this is what should happen. Then we have to agree with what they say and we have to do what we are told so that can happen […] we are very much controlled […] we have to do what we are told by the government. On a designated site – if it is not designated it doesn't matter so much'.

However, top-down environmental law is shaped at the national or international scale and, as representatives of public agencies commented, '[i]n Scotland our laws don't allow us to under implement things in any shape or form so if the EU say that pigs will have a certain area to lie in then that's exactly what we will do [sic]' [SGRPID 38].

Coerced collaboration is found when, for instance, public agencies' objectives imply persuasion of the land mangers. In these cases, persuading land managers can become challenging for both parties. According to the findings, land managers do not trust public agencies, either because they do not want to or because they are unable to. Representatives of public agencies mentioned that [FCS 10]

'[t]here's a mix of estates and some are quite private about their business and others are more public. Especially the private, the kind of approach is more face to face, maybe a site visit. We just might have a telephone conversation or at an event. Relatively informal because it is a persuasive job rather than telling them to do anything because they will just tell us to get lost, in the nicest possible way. So it's all about building a working relationship and it's quite informal'.

Other public agencies noted that establishing communication and understanding between parties is difficult [SEPA 2, SEPA 7]. Land managers and public agencies highlighted the need for trusting each other; for instance, one land manager suggested that public agencies 'have got some interesting ideas which I wouldn't implement [for instance] wide margins round the fields. That was [a public agency] idea and they couched it in terms of all good farmers do this and I thought uh-uh, I've never heard of this idea before and I thought of all the farmers that I knew that didn't do that'. [tenant 6]

In other cases, respondents have a negative opinion based on their experience with public agencies, as the following comment illustrates [tenant 6]:

‘[t]he way the department word all their letters about subsidies via threats of thousands of pounds worth of fines and jail terms if we don’t – if we don’t do everything correctly to the letter. It’s alright for them to make mistakes, but we don’t make mistakes. We are just trying to cheat. And it really was very alienating. Because the subsidies were so essential to our survival, it was very intimidating. We got used to it after a while […] I think I don’t read them any more. The rules change all the time. So I’ve just given up completely trying to keep track of it all. I’m told when I need to know something’.

Despite the number of land managers that reported similar feelings, most of them were found to work with public agencies or non-governmental organisations in one way or another.

However, the work of public agencies also involves communities and other stakeholders. My study produced limited data which suggested that land managers collaborate with communities and other stakeholders in further ways; while my information is insufficient to report on this here, it is worth noting that the data suggests that these were not strong links. The results show that land managers provided services to communities through estates’ community woodlands, path access, recreation activities or, as some respondents mentioned, ‘designation areas which are a way to provide biodiversity services to society’. In this respect, one respondent [estate 41] recalled, ‘[w]e get around 40,000 visitors a year to this place for informal recreation, spiritual enjoyment and […] organise seminars for wildlife managers […] so we can explain what we are doing’.

This indicates that land managers provide services and exchange information rather than collaborate with communities and society. This characteristic is represented in figure 3.8 by the thin arrow in one direction. Public agencies share power, but they collaborate for landscape scale management only when the organisation has this as an objective. As respondents mentioned [CNPA 1], ‘[...] each organisation has got its own particular priorities and I think there's a big issue in a lot of organisations in terms of the resources that they can input into a consultation from as supposed to on their own particular objectives'.

Respondents identified that limited resources, large objectives and large areas to manage make collaboration necessary: '[…]away from the formal planning side, is actually trying to persuade people to do things for us in a way or do things that will compliment both our objects and their objectives as well' [CNPA 1]. However, it is people, personalities, which make collaboration happen. In the words of one respondent, '[i]t's not the plan that makes it easy, it's the group […] the useful thing is having a group that brings everyone together, which gives you a forum to kind of work with' [FCS 10].

Commonties are a special case in the study area. Sharing power occurs to a certain extent in the Forest of Birse, through the Birse Community Trust (BCT). Inhabitants of the parish of Birse participate in the decision-making process, but they also have to agree with three other estates because they are the owners of the salmon and shooting rights. According to respondents, sharing knowledge and responsibilities amongst those who participate in the management of the land is a common practice.

BCT also works with public agencies and stakeholders. These characteristics of sharing power allow them to manage other woodlands and be involved in a number of other projects over the parish level. BCT has established a symmetric relationship with other estates. It is an interesting case because there is little trust between BCT and the estates (due to a long process over the shared rights); however, they have a similar level of empowerment and interests that allow them to negotiate and agree on common management practices. As one of the interviewees mentioned [estate 36], '[t]he arrangement is they run a native pine wood scheme and that's an area that we have shooting rights over so we basically do is deer management for them and they pay us. And we do it in cooperation with them but it's basically done for the benefit of the community […] and then there is general rights that everyone has over the whole of it. Basically [the other estate] shoots over part of it, we shoot over part of it, his tenants graze part of it, we graze part of it and commonty in Scots law is something where rights are held in common use'.

In the words of another land manager [estate 37],

'The forest of Birse has got a complicated arrangement of rights with different understandings and interpretations of what they are […]. But we have a management agreement in relation to a set area […] we have regular dialogue with the parties to agree on management operations […] the management agreement has a forestry plan and its an approved plan with the forestry commission and the Scottish forestry grant scheme so we know what's happening within that plan and if that involves the felling of trees or whatever then that's something we've all agreed and approved'.

The same empowerment between the parties helps to balance each party's interest with the common interest and facilitates agreement in the management. BCT identified the advantages they perceived from managing the woodlands [Trust community organisation 32]: '[…] it was about estates […]. Now the estates consult the community. [Apart from the salmon and the shooting rights], all the other rights of use for the whole area are now held by the community – forestry rights, grazing rights, rights to put bees up there, rights to pull heather, rights to do everything'. BCT power sharing structures make natural resources management possible at the landscape scale and at the parish level; these structures also facilitate working with public agencies, non-governmental organisations and researchers when needed. For instance, regarding conservation practices [Trust –community organisation 32], '[w]e look at different habitats and species and run projects across the whole parish and we take a lead in organising the Deer Management Group and we are well known […] for capercaillie conservation and other things […]'. Furthermore, they commented, '[…] we have lots of red squirrels with the pine woods and the grey squirrels are just across the river […] so they get shot but what we are doing is to put a leaflet into the 260 households and we've coordinated the estates so that if a grey squirrel appears we can produce lots of fire power and because of the cohesion of the community, putting the leaflet in allows us total feedback' [Trust –community organisation 32].

Along the same lines, BCT works in partnership with public agencies and local authorities. For instance, regarding a path network plan for the Dee Valley they 'have a particular partnership with Aberdeenshire council […]. Why not? We know the people and in consulting the people locally, we don't go and put silly lines on the map that gets everybody upset and we can deal with the estates and everything'. BCT know their relevance as an institution for the delivery of public goods and management of natural resources at the scale of the parish. This is also recognised by public agencies, although negotiations can be difficult at times. A BCT representative mentioned, 'the forestry commission have always been a main partner of ours […] we have given them great value for money because we are seen as one of the leading community forestry initiatives in Scotland […]. We've had up and down relationships with SNH […]'.

The history of BCT is an interesting case and further investigation is needed to highlight processes of community empowerment, negotiation and practices for natural resource management at the scale of the parish. Evaluation and adaptation are processes resulting from feedback loops within resources management. According to the ACM framework, these feedback loops should happen for both natural and social systems; consequently, they should occur across-scales and along horizontal and vertical power relations. This presupposes common knowledge and power sharing.

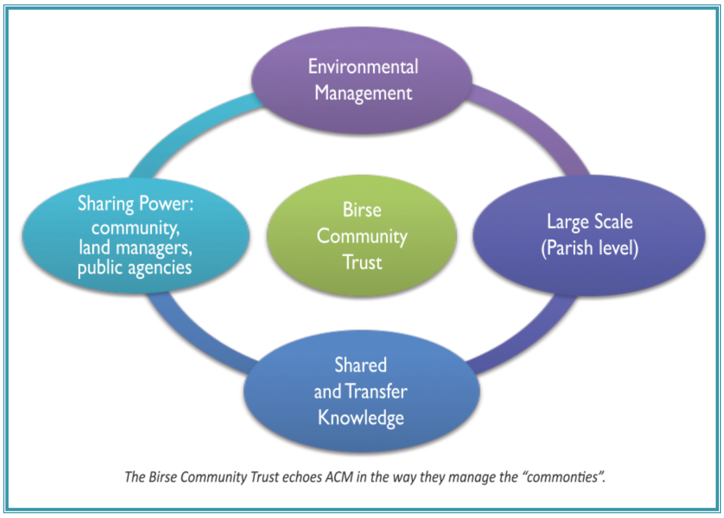


Figure 3.10 The case of BCT and how they work for the management of forestry (and other services) at the parish level. Source: Based on own field data.

As mentioned, I found none of these operating across the entire valley. However, I did find cases where common knowledge, interest, power sharing and evaluation processes were in place on a smaller scale. Some of the larger estates have moved away from the traditional estate model, focused on forestry and shooting, towards a more diversified model which includes tourism, leisure activities and the provision of (sometimes subsidised) public amenities; as such, they are also involved in public engagement activities. This implies a form of evaluation of the estate's activities through public consultation. This is only possible when the estate can count with a substantial management team, as this ranger responsible for public engagement highlights [estate 41]:

'Your other question was about how you integrate the different land uses. I referred earlier to the management team and we meet on a monthly basis and go over what our plans are on the short term and medium term plans and discuss any issues that have come up. In addition to that we all prepare longer term strategic plans which obviously go round the houses, i.e. go round our colleagues firstly, but are usually open to public consultation as well. Certainly the woodland one, the core paths plan and all sorts of things and they have all been out to consultation. So that way we try to identify up front what the issues would be and decide to try and plan these issues and to try to minimise them, what's that called? Mitigation, we try to do that. But also the fact that we have an in house management team means that if there are issues that come up, we can play around them. That's adaptation to borrow the climate change jargon'.

Three cases in particular had systematic evaluation processes as part of their resources management (horizontal and vertical): Deer management, Dee Salmon Fishery Board and Birse Community Trust (see figure 3.10). The three cases are different and there is a need for further research on these ACM processes to assess whether these structures could represent the channels for ecological networks implementation.

The findings showed that, in most cases, for land managers the evaluation process is a reflection based on the financial performance of the business. Take Andrew, a smallholding owner who came from an oil and gas background and bought a farm which he is managing with a partner. When asked about whether they had a process of evaluation or self-assessment in place he answered,

'No, just me and S. [business partner], we sit down and over our coffee or lunch we just chat about what we are doing, where we are going and at the end of the year we sit down with the accounts and we look through them and just look at them and say we spent too much on equipment, we spent too much on this. Yeah, we got some money for the cattle, but there is no big evaluation'.

Despite Andrew's unusual background, his answer is very similar to that of many other more traditional land managers, whether smallholding owners, tenants or estate owners or managers.

Land managers adjust management practices based on the economics of the business and solve environmental problems as they emerge. However, more research is needed to investigate evaluation and adaptation to environmental change and to assess evaluation processes when environmental problems emerge.

3.4 DISCUSSION

In this research we have considered the implementation of ecological networks as a tool to deliver biodiversity. However, the implementation of ecological networks calls for collaboration and cooperation across horizontal and vertical scales, with different types of stakeholders. In this chapter, I aimed at investigating whether ecological networks could be implemented through coordination and collaboration amongst stakeholders.

To achieve my aim I used the Adaptive Co-management (ACM) framework because it refers to landscape-scale natural resources management. In particular, I utilised three components of ACM: local knowledge, sharing power and evaluation.

There were two points to highlight on knowledge from this research and in relation to parallels with ACM, gaps between existing practice in the catchment and the ACM model and cases where the parallel breaks down:

1) The common trend for the majority of respondents is that ecological knowledge is primarily for commodity production. This differs from other societies where a broader base of local ecological knowledge has facilitated the implementation of ACM; that is, where local ecological knowledge is closely related to cultural aspects (see the 'Key cultural species' idea, Garibaldi and Turner, 2004) or common knowledge is shared across common-pool resource users (Nadasdy, 2003; Norberg and Cumming, 2008). My results showed only three cases where knowledge was

acquired and shared in a systematic way: one case of common-pool resources (Forest of Birse), one case of a charity (National Trust of Scotland), and the case of public land. In all other cases, I found that ecological knowledge is shared and transmitted and new knowledge is acquired chiefly if it will improve the economics of the business. Therefore, new knowledge on the benefit of EN should be introduced from the perspective of the business; for instance, landscape scale field margins for bumble bees to promote pollination, or riparian woodlands along the river to keep water at low temperatures for salmon (given climate change and increases in water temperatures).

2) Provision of ACM is not secure in the long run, but rather depends on each individual land manager's willingness to provide it as property rights are held individually and land managers can decide what they want to do with their land.

In the study area, individuals are free to pursue their own objectives on their land. I did not expect to find common knowledge across the whole catchment, since individuals have different interests and resources to manage. However, I found common knowledge about management practices that explicitly or implicitly involved scales beyond the single holdings. Examples were for deer management, salmon fishing, crops and/or forestry management. People share practice-centred knowledge within a group, and these groups do not necessarily share knowledge with other groups. This creates fragmented ecological and biodiversity knowledge rather than common knowledge across the entire valley. I argue that this does not represent a barrier for the development of ACM, but rather presents a challenge to move from individual to common conservation knowledge, to more shared knowledge.

Authors have repeatedly stressed the importance of common learning in the ACM process (Schultz et al., 2011; Armitage et al., 2011; Leys and Vanclay, 2011). I found initiatives in place that echoed ACM in their practices of common learning. Some of these examples were for capercaillie management and included the seminars given by Birse Community Trust to a range of land managers and other stakeholders. In these cases, knowledge sharing involves combining local and scientific knowledge as well as knowledge about regulations and policies.

Birse Community Trust is a form of common-pool resource and the learning process happens within the parish-community, but also occurs beyond the local community. Other examples exist where land managers share knowledge with other stakeholders. I argue that some of these processes parallel ACM; therefore, these cases could be used as platforms to share knowledge and initiate a common learning process explicitly for conservation and ecological networks implementation.

Processes of common learning could act as a powerful tool to improve asymmetric collaboration between land managers and public agencies, and could in due course result in relations of trust. I believe that knowledge exchange, both of local and scientific knowledge, is especially important to build trust horizontally (i.e. across holdings and land manager types) and vertically (i.e. across scales, public agencies, policymakers). There is a need for a better understanding of the socially and politically complex context of natural resource management in developing countries (Wilshusen *et al.*, 2002), but also in developed countries. Existing institutions and power relations do not allow the flow of communication amongst different stakeholders and especially between public agencies and land managers. In any case, more research is needed to address this issue for the case study presented here.

Sharing power parallels were found in three cases and in many other collaborative practices that echoed the ACM process. However, in many other cases I found asymmetric collaborations, power relations, distrust and divergent interests in the same place. The latter represent a difficult barrier for utilising ACM for the implementation of ecological networks. Time and human resources are required to develop ecological networks. This will be costly in the short run, but in the long run the idea is to build capacity amongst public agencies and land managers to allow for sustained practices of landscape scale collaboration.

My results showed that in the Dee catchment, power relations are deeply rooted; this is partly due to the old Scottish system of property rights, which until 2004 was based on feudal structures. To dissolve this through Adaptive Co-management could take significant time and resources. Both of these are scarce for land managers and public agencies. In addition, to overcome asymmetric relationships and create power sharing requires a deeper understanding of social, cultural and historic issues. Adaptive Co-management cannot guarantee the dissolution of these relations in the short run. Furthermore, this confirms the need for some degree of sharing power and sharing responsibility to enable co-management (Berkes, 2007).

My results showed a number of cross-boundary collaborative initiatives, but I argue that these are only collaborative initiatives, rather than co-management practices.

Collaborative initiatives have been highlighted as a promising approach for the management of resources such as biodiversity (e.g. Goldman et al, 2010). They can be an alternative to top-down approaches and may be more effective in delivering objectives through negotiation, coordination of multiple public agencies and consensus of rules amongst a range of stakeholders (Sabatier et al., 2005). I argue that existing collaborative initiatives and cases that resonate with ACM should be taken as a starting point from which to expand ACM to the whole study area for ecological networks implementation.

Although I did not find ACM cases which would operate across the whole catchment, I argue that existing collaborative practices could be the starting point; however, more research is needed on existing agreements of collaboration in the study area. My research showed numerous cases of collaboration between land managers. Collaboration in this research is about negotiation, synergies of interest, power and trust. I argue that to implement ecological networks these collaborative cases have to be used as channels to develop a long term process of building capacity for conservation at the landscape scale.

The Birse Community Trust, the Deer Management Group and the Dee District Salmon Fishery Board, are the three examples found in this study that parallel ACM; however, further research is needed to assess their potential to be expanded or used as a channel for management of other resources such as biodiversity *per se* or implementation of ecological networks (in a multifunctional sense). In addition, further investigation is needed on the transaction costs involved in using ACM frameworks for landscape conservation and ecological networks implementation.

Finally, collaboration and coordination by third parties is needed in order to connect existing initiatives. Coordination of land managers by public agencies could be achieved, especially in cases where a relationship of trust already exists between them. Coordination can also be achieved between public agencies, for instance through steering groups of public agencies and NGOs.

Therefore, ACM alone and at first will not be sufficient for implementing ecological networks. As I show in the next chapter, there is a need to overcome different interests and attitudes to conservation amongst land managers, build trust between public agencies and land managers as I showed in this chapter and design adequate economic incentives as I show in chapter 5.

3.5 Conclusion

To conclude this chapter, I highlight five points regarding barriers and supports for the implementation of ACM for ecological networks in the Dee catchment.

1) Regarding Local Knowledge: the results showed that in the study area local knowledge responds to financial motives and little is known about ecological networks (benefits for the business and for the environment). Therefore, if ACM is to be implemented there is a need for 'common knowledge' about ecological systems. Along the same lines, I found a lack of information flows regarding policies and other national objectives on land uses and environmental management. Reinforcement and/or creation of information flows is needed to create common knowledge horizontally (across different stakeholders) and vertically (across policies and individual interests). In this sense, it is more likely that public agencies take the role to coordinate and create the information cycles across-scales, although this represents a cost.

2) Regarding Sharing Power: I presented the results regarding sharing power and highlighted different types of relationships established between stakeholders. I

identified i) trust, ii) power, and iii) interest, as bases for symmetric and asymmetric relations. The results suggested that power relations represent a difficult barrier to overcome, because these are rooted in a pre-existing context of social relationships marked by Scottish rural history. More research is needed to better understand these relations, especially in cases of cooperation amongst land managers. However, my results showed that cooperation and collaboration is sometimes taking place at a local level; these cases could be used as a starting point for further environmental management above the holding scale. In chapter 5, I will analyse the results of testing an economic incentive that aims at stimulating cooperation across holdings as an alternative to a purely ACM approach.

3) Regarding Evaluation: the results showed that land managers' evaluation processes are mainly based on financial reasons, rather than on environmental management. More research is needed to study processes of evaluation when land managers face environmental changes. This is because, according to my results, land managers take action on a daily basis (to deal with problems, e.g. a high tick population or dry weather) regarding environmental management, rather than using systematic and planned actions. In most cases land managers keep the same management practices year after year, and base these on commodity production with business turn-over as the main evaluation criterion. In order to implement ecological corridors through ACM, it will be necessary to stimulate processes where land managers are more actively involved in environmental cycles of learning-evaluating-adapting management (perhaps in the way Lawrence, 2006 and 2007 suggests).

4) Regarding existing cases of collaboration and ACM parallels: in the results I presented existing cases of collaboration and cases that echoed ACM. Assessed in line with the three components mentioned above, ACM parallels suggest that processes of ACM are happening for specific management practices; therefore, if the adequate resources were allocated, ACM could be extended to the majority of the catchment. The common trends in these cases were: asymmetric power relations were overcome; synergies of interests were created or identified; trust was in place; common knowledge was acquired; evaluation was part of the process and, therefore, learning cycles were possible. Ecological networks could be implemented through a process similar to one of the three examples presented here if these conditions were developed. I also presented a number of collaborative cases where the characteristics are present in a greater or lesser degree and are combined in different ways. Although further research is needed regarding the varieties of arrangements among land managers and between land managers and public agencies, my results show that these cases can facilitate the understanding of sharing power and local knowledge,; therefore, they can be used as starting points from which to develop ACM processes.

5) Finally, the information presented here suggests that public agencies would be paramount in initiating the development of ACM processes for ecological networks. This is because these agents possess knowledge about policies and other national objectives to be achieved: they could be the 'bridge' between top-down and bottom-up interests. It is also in the interest of public agencies to build capacity and networks with land managers and other stakeholders as they often have to execute policies, which change frequently. To create and consolidate networks is essential to mobilise the social capital needed for national land use objectives.

CHAPTER 4

LAND MANAGERS' ATTITUDES TO CONSERVATION, AES PARTICIPATION AND EXISTING CASES OF COOPERATION

4.0 INTRODUCTION

In this chapter I present the analysis and results from my interviews with land managers with a particular focus on their attitudes and views about conservation, existing cases of cooperation, AES participation and landscape scale approaches. As I mentioned in the previous chapter, chapter 3 and the present chapter are complementary and should be read as parallel analyses rather than one as a sequence of the other. While in chapter 3 I presented the analysis from all interviewees (public agencies, land managers, researchers etc.), here I take the analysis further by focusing only on the interviews with land managers. As individuals, land managers play an important role in the provision of public goods; therefore, I wanted to ascertain their attitudes and views regarding landscape scale management so as to identify the conditions which prompted their cooperation.

As discussed in chapters 1 and 2, most developed economies use a number of instruments to obtain land managers' participation in the provision of public goods and services from agro-ecosystems. The principal tools used to achieve such participation are environmental law, environmental planning and voluntary agreements, including economic incentives in the form of Agri Environmental Schemes (AES) and Forestry Schemes (FS). In the EU, AES have long been the preferred policy tools. However, many empirical studies have questioned the effectiveness and efficiency of existing AES in delivering ecosystem services and biodiversity conservation (Stoate et al., 2009; Vickery et al., 2002, 2004).

One of the key reasons for this poor performance lies in the spatial pattern of AES uptake at the multiple farm scale (Hodge, 2001; Gimona and van der Horst, 2007; MacFarlane, 1998). Most existing incentive schemes in Europe (and also the US, see Goldman et al., 2007) operate at the holding/farm scale, whilst the effective protection of biodiversity and delivery of most 'non provisioning' ecosystem services (see Millennium Assessment, 2005) requires coordinated land management action at watershed, ecosystem or landscape scales (e.g. Gottfried et al., 1996; Parkhurst et al., 2002; Michael, 2003; Franks and McGloin, 2007;). This would require a radical redesign of AES to persuade neighbouring farms into cooperation and collaborative action. Central to this is to investigate what are land managers' attitudes to conservation, cooperation practices and AES participation.

Voluntary schemes aimed at the provision of public goods, such as landscape scale AES, are unlikely to work without positive attitudes from land managers, their willingness to participate in AES, and their willingness to cooperate with each other for the provision of these non market-value services. Land managers' attitudes towards conservation have been among the preferred subjects treated by the literature on AES (Wilson, 1996; Wilson and Hart, 2000; Fish et al., 2003). Farm structure, transaction costs, knowledge transfer, information asymmetry and tacit knowledge are identified as amongst the important factors in the study of the uptake of AES (Hanley et al., 2012). An important part of these studies resulted in proposing patterns of participation, using typologies of participants and non participants, 'passive' and 'active adopters' and other forms of classification based on farmers' behaviour or attitudes (Morris and Potter, 1995; Wilson, 1996 and 1997; Lobley and Potter, 1998; Wilson and Hart, 2000; Fish et al., 2003; Andersen et al., 2007; Wauter et al., 2010). However, only a few of these studies have highlighted, as part of broader results, how patterns of land managers' attitudes influence landscape scale management (Davies et al., 2004; Siebert et al., 2006) – especially looking at land managers beyond farmers. Moreover, there is a lack of literature on the attitudes of different types of land managers and how they interact at specific scales; this information is vital to addressing how provision of ecosystem services by heterogeneous groups of land managers could be achieved.

As other authors have suggested, landscape scale connectivity should be included in AES's 'outcome effects' (environmental impact, as mentioned by Wilson and Hart, 2000).

In the AES literature, little attention has been paid to cooperation and collaboration practices, perhaps because there are but few examples of existing cases. The literature has tended to focus on, a) drivers and barriers to collective action for environmental services (Burton et al., 2006; Davies et al., 2004); b) using new institutional economics (NIE), which refer to how institutions can shape behaviour and influence the decision-making of economic actors (Smits et al., 2008). Also, there is extensive literature on the Dutch cooperatives and collaborative initiatives as examples to follow elsewhere (Franks, 2010; Smits et al., 2008; Verhulst et al., 2007), with some cases focusing on ecological networks implementation (Jongman and Bogers, 2008).

In this study, a landscape level approach (see chapter 1 for discussion of this) is taken in the analysis of land managers' attitudes regarding conservation and AES participation to investigate if, and under what conditions, cooperation is in place, and to analyse the opportunities this offers for the delivery of ecosystem services.

4.1 CONCEPTS AND DEFINITIONS

This chapter uses different concepts that deserve definition and clarification. I use the concept of 'land managers' as distinct from that of 'farmers' (although farmers are included in this category). It is used *as a generic term* to refer to people who manage the land (independently of the economic activity or type of tenure); the only condition to be identified in this category was being in a position to make land use decisions and carry out those decisions. I worked with a heterogeneous group of respondents including: a) people who have only diversified activities (e.g. commonties, charities); b) people who have diversified activities with agriculture as only one element of their management practices (e.g. estates, farmers); c) farmers (e.g only farming activities); d) people who did not identify themselves as 'farmers' even when farming represents the main economic activity. It is important to make these distinctions, and to include land managers who are not farmers or who do not identify themselves as such despite carrying out some farming activities. In order to develop ecological corridors it is necessary to include the properties of all types of land managers.

This chapter focuses on land managers' attitudes to conservation, participation on AES and existing cooperation cases. Regarding the study of 'attitudes', there are many theories used in psychology, most notably the Theory of Planned Behaviour (Ajzen, 1991) which has been applied in the AES literature (e.g. Wauter et al., 2010; Edwards-Jones, 2006;

Beedell and Rehman, 2000). However, I decided to use a definition capable of explaining attitudes in my study area without going into a whole body of specialised theory (partly due to time constraints). Therefore, in this study I understood ‘attitudes’ as theorised in Siebert et al. (2006: 326): (a) attitudes are dispositions that relate to behaviour; (b) attitudes are organised systematically, that is to say, people relate their views on one topic (e.g. the environment) to their views on other topics (e.g. family responsibilities, agricultural production) in a consistent way; (c) people share attitudes and thereby mutually confirm group affiliation. The examination of attitudes offers insight into land managers’ decision making as it reveals how their behaviour relates to their dispositions to conservation and cooperation. The results and discussion of this chapter address whether there is a direct relation between attitudes to conservation and AES participation (sections 4.3 and 4.4). Some researchers have found positive changes in attitudes to conservation through AES participation (Fish et al., 2003; Bager and Proost, 1997), while others found a negative impact or no change (Lowe et al., 1999; Herzon and Mikk, 2007; Schenk et al., 2007; Schmitzberger et al., 2005).

From a sociological point of view, attitudes depend on actors’ social positioning in a web of relationships and on their social capital. For instance, cooperation is facilitated where social capital is strong (Pretty and Smith, 2004; Pretty, 2003; Davies et al., 2004). It is generally agreed that trust, reciprocity and exchanges, common rules, norms and sanctions, connectedness, networks and groups are some of the elements of ‘social capital’ that enable and reinforce social structures (Burton et al., 2006; Davies et al., 2004). This refers to Bourdieu’s idea of social capital, which is defined as the totality of the present and potential resources that are linked with a group membership and social networks (Bourdieu, 1980: 2). The quantity of social capital that an actor possesses depends on the size of the network of connections that he can effectively mobilise (economic, cultural and symbolic) (Bourdieu 1980: 2). The quality of the social and cultural capital is produced by the totality of the relations between actors, rather than the quality of the group. It refers to how actors get involved in a social network, and how they use it and develop relations to improve their social position in different fields.

For the use of the notion of ‘cultural capital’ I took inspiration from Burton et al., (2008). Although their work was only with farmers in conventional farms, it offers an excellent study on cultural capital in relation to attitudes and participation in Agri-environmental Schemes. As they observe, represented cultural capital is the ‘prestige’ performed in everyday life and expressed through the farmers’ farming skills. A ‘good farmer’ is one who masters a process of self-improvement where repeated practice aims at improving ‘the mechanical, motoric and managerial skills required to effectively manage farmland’ (Burton et al., 2008: 20). The farming community share the same ‘perceptions and appreciations’ and the performance of the skills are recognised by the community. The generation and embodiment of cultural capital becomes the motor of the farmer’s behaviour. In this context, any other activity that does not transmit farmers’ social or cultural capital will encounter some resistance within the agricultural community as it requires a change in perceptions and behaviour. The same idea applies for other types of land managers.

I used these concepts and definitions to guide the analysis and present the results of this chapter.

4.2 METHODS

The methods used here are the same as those presented in chapter 3. The difference is that here I present the results from 27 interviews with land managers (8 estate, 14 tenants and tenants who are also smallholding owners, 5 with smallholding owners, see Figure 4.1.) rather than the complete corpus of 42 semi-structured interviews. As already noted, the semi-structured interviews were one hour long on average and were split into different sections. In addition to the sections presented in chapter 3, there were further questions asked including, different aspects of land managers' personal history (how they became land managers) and business issues (such as history of the holding and the woodlands, main changes over time, land uses, land tenure, holdings size, business plans, incomes from land uses, etc.); their experiences with subsidy schemes (participation and views of different schemes, i.e. Single Farm Payment SFP and AES, pros and cons of SFP and AES); conservation issues (what does conservation mean to them, local knowledge about conservation practices, awareness of designation areas and BAPs, knowledge about species and habitats); landscape scale management (if and how they see their management within the catchment); cooperation with other land managers and/or public agencies (existing cases of cooperation with other land managers and/or public agencies). In figure 4.2 I present a flowchart describing the steps I followed for the analysis of the semi-structured interviews for this section. Coding and queries were applied to the 27 interviews, allowing a systematic inventory of views expressed by land managers (see Figure 4.2).

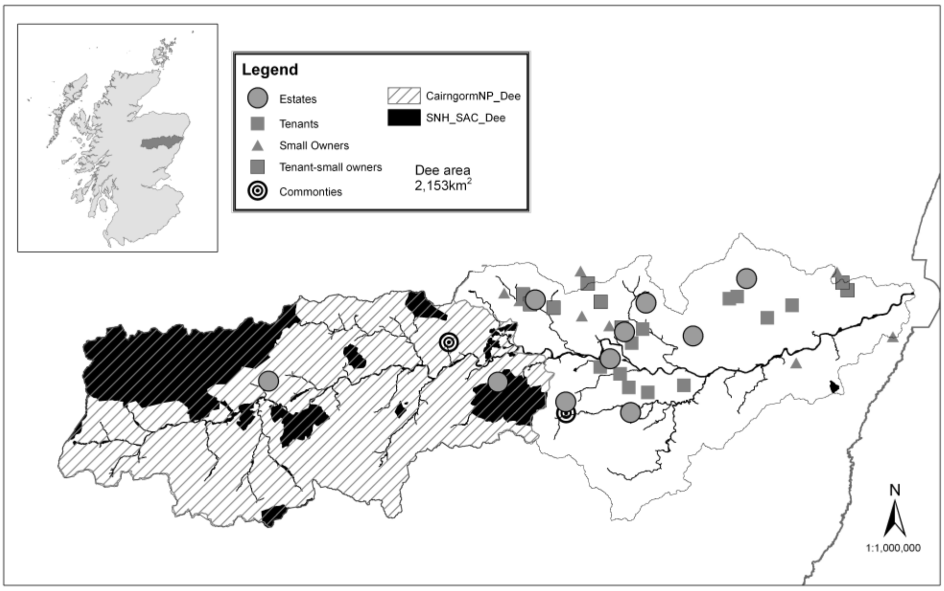


Figure 4.1 Map of the Dee Catchment, showing designation areas and location of the interviews included in the study by type of tenancy. Source: own field data.

I regrouped the 'attitudes' on conservation according to similarities using text analysis methodology. In particular, I distinguished between conservation seen as an end product (as a separate set of practices needed to allow and maintain habitat and species reproduction) *versus* conservation seen as a secondary result of existing, current management practices. I also established a more generic distinction between those land managers 'interested in conservation' *versus* those 'not interested at all' (as they stated themselves). I then looked for consistent attributes of land managers to explain the differences regarding views on conservation and propensity to cooperate. Based on the results, I formed cluster of land managers' answers and analysed practices of cooperation.

Figure 4.2 Methods used to collect and analyse data.

4.3 Results

In this section, I present the results of the interviews using clusters of land managers' answers. The clusters were identified as a result of the analysis of interviews on attitudes to conservation and propensity to cooperate. **This clustering revealed that the opinions expressed are mainly correlated to land tenure type. I therefore distinguish between a) managers of estates (factors or owners), b) tenants, and c) owners of smallholdings, to present these different views and attitudes.** It should be noted that the category of 'tenants' includes those who also own some land (or 'tenant-small owners' in the following pages) as long as the area in freehold is inferior to the area tenanted.

The analysis is presented in relation to the following three themes: a) attitudes to conservation and AES participation; b) the landscape scale approach, that is whether they see the need for landscape management and designation areas; and c) cooperation (existing cases of cooperation among land managers). [26] Appendix E presents a table with the characteristics of each informant (land tenure, property extension and type of production, attitudes to conservation and AES participation).

4.3.1 Estate owners

The nature of estate business clearly illustrates the notion of *multifunctionality* with diversified activities well beyond agriculture (in the study area estates range from 1500 ha. to 50 000 ha.). All the estates hold shooting and fishing rights. Activities and services delivered by estates are, generally speaking, game shooting, deer stalking and red grouse shooting, angling, recreation (hill walking, mountain biking), forestry, farming, tourism (hotels, cottages, restaurants, farm shops, and other services related to the sport activities) and residential property developments or property for letting (residential, commercial and land).

a) Estate owners' attitudes to conservation and AES participation

In most cases, the estate managers' knowledge and interest in conservation corresponds to their concern with shooting and fishing. For instance, for Stewart[27] conservation work is seen as a consequence of their management rather than an aim in itself:

> ' […] well, this is the point; we don't say we do this for conservation reasons but the management of the river bank ties in the management of the fishing […] and there is an awful lot of other things that benefit the management of the fishing. I put quite a bit of effort into riparian management because yes, that's part of our general ethos but also it's a benefit to the fishing […]. Oh yes. 25% of our forestry is regarded as conservation or amenity and yes, we do, but the interface between what's commercial, what's environmental and what's amenity is difficult to define'.

[26] We refer to cooperation as the action or process of working together towards the same end; as well as assistance, especially by complying readily with requests. Oxford Dictionary of English 2ed. 2003.
[27] All names have been changed to ensure anonymity.

What representatives of estates mentioned about having no intentions of paying for conservation *per se* confirmed this view. For them, conservation should go hand in hand with the economics and interest of the business in order to succeed. As Matthew put it, ‘Everything is a balance between commercial, conservation, economics, people, you know, all sorts. But obviously the conservation of the wildlife is an important consideration along with all the other things. But everything has to be paid for’.

All the estate owners questioned will apply to AES for work they are already doing or planning to do, or will slightly adapt their management if there are AES that fit their interests.

Land managers follow the management that is most convenient for the business. Private interests lead to practices that result in positive or negative externalities (externalities are unintentional side effects, see chapter 5) i.e. conservation (or not), as a by-product. This is illustrated by the example of deer shooting for sport as ‘conservation through hunting’ (MacMillan and Leitch, 2008) in the case of habitats which have deteriorated because of increasing numbers of red deer (*Cervus elephus*). Another example is the conservation and management of heather moorlands, which is carried out for shooting species such as red grouse (*Lagopus Lagopus*). Specific management and conservation of the habitat for red grouse (such as moor burning) create ecological processes that are beneficial for this game species (Ratcliffe and Thompson, 1988), but which may be detrimental to other bird species (Thirgood et al., 2000). In many of these examples there is a conflict between estates’ private interests and management practices that have an impact on the public domain and public interest (MacMillan and Leitch, 2008). Perhaps the most striking example of this is the conflict between the conservation of wild raptors and habitat management for game shooting species (Thirgood et al., 2000; Thompson et al., 2009; Redpath and Thirgood, 2009).

b) Landscape scale approach and designation areas

The idea of 'landscape scale' management in the Dee catchment was obvious for the owners or factors of the eight estates. The extent of the estates and their involvement in different economic and social activities facilitates this view: the combination of their activities relies on different services delivered by the ecosystem. Most of the interviewees are involved in landscape scale organisations such as fishery boards, woodland associations or deer management groups, where coordination of activities between estates is imperative. Although none of these organisations are focused on biodiversity *per se*, the activities are of benefit to the conservation (as by-product) of at least some of the species listed in the Biodiversity Action Plans (BAP). Conservation management is the final objective in only a few cases (management for capercaillie, *Tetrao urogallus,* for instance).

Regarding designated areas, estate management and decisions are sometimes constrained when national or international conservation interests come into play (i.e. for SSSI, SAC, etc.). In addition to what I presented in chapter 2 (section 2.3), it is important to note that land managers' practices within the designated areas are framed by a specific plan. For instance, Paul has a number of designated areas within his property and he has changed his views about how to manage this land over time:

'[…] we have to manage our interests according to those designations. It means close cooperation with Scottish Natural Heritage […] to make sure our management activities are not prejudicial. Examples are […] erosion of riverbanks and what impact that may have on our salmon fishing interest and we've got to think about fresh pearl mussels and to a lesser extent otters and Atlantic salmon. We are doing some green engineering solutions […], which is a trial where we planted some willow. That's a consequence of ultimately the river

Dee becoming a way of conservation. I'm not sure that's the only reason but it's changed our thinking and how we do things […]'

The framework of practices imposed by designations is often easier to follow if it corresponds to the estate owners' economic interests. For instance, in the example just quoted, Paul's estate draws a substantial income from salmon fishing. As the river Dee itself is designated a SAC and the estate has fishing interests in salmon, the rules to follow for water quality and habitat conservation are of benefit to all (and are perceived as such).

c) Existing cases of cooperation

Cooperation amongst estates is common, although in the first instance they may not recognise it and state that they work independently. Given the shape and size of some of the estates, their participation in cross boundary management is essential for some important resources; without this participation landscape scale conservation would be very difficult, and in some cases impossible, to achieve. Cases of cooperation in the Dee catchment are often for riparian woodlands. One of the most significant plans of this type is the Upper Dee Riparian Woodland Project, which consists of a riparian corridor between the National Trust of Scotland's estate (Mar Lodge) and two neighbouring estates. The three estates cooperate and, as noted earlier, Scottish Natural Heritage (SNH), Cairngorms National Park Authority (CNPA) and Forestry Commission Scotland (FCS) coordinate the project. In this specific case, the cooperation and coordination has a direct benefit to all participants and is indirectly reinforced through statutory documents. In this case the objective is to protect the waters of the Dee, including water quality and temperature, to restore streams and riverbanks, and to restore the population of salmon (source: interviews and River Dee annual report 2009).

Estate owners are not the only people to manage the land, and even within their property significant areas are actually leased to tenants; therefore, both parties are constrained to a certain extent. Estate owners have limited control over these areas, and the land management for landscape scale habitat conservation also depends on choices made by tenants.

4.3.2 Tenants

Tenants represent the other end of the spectrum compared with estate owners' interests and views. In the case of tenancies, property rights are restricted to the exploitation of land and there is very little interest in shooting or sport fishing activities. In Scotland, land productivity is poor and tenants' choices of food and fibre production are limited. Holding extensions are in the range of 40 ha. to 300 ha. There were only five cases (out of fourteen) where tenants also owned some land (reaching 400 ha. in total). Most of the tenants manage a mixed farming system of cattle and/or sheep, with crops (barley, wheat, rape seed and oats).

a) Tenants' attitudes to conservation and AES participation

Farm size was one of the first issues mentioned by tenants in relation to conservation and AES. In almost all cases, when asked about conservation the informants' answers were about AES (in some cases respondents explicitly asked if the question referred to AES). Out of 14 tenants and tenants smallholding owners, 8 expressed negative opinions or did not see the need for conservation practices and AES and 3 expressed no interest in conservation practices. A further 3 expressed positive views to conservation but with some reservations.

In addition, for some respondents there was no need for conservation practices *per se* as they looked at conservation as a consequence of their management practices (as a by-product). Russell lets and owns part of the farm and for him conservation comes with food production, as he mentioned:

'I haven't a huge interest in conservation. I think the best way for the countryside to look after itself is well farmed land, well managed land, so I haven't a huge interest in conservation. I don't like to see paths being left just for conservation and not used for anything. I prefer they were used for farming production as long as it helps the environment. I don't want farming to hinder conservation but they've got to go together. I don't like seeing paths or land being just left to help wildlife if it's not producing anything'.

Trevor expressed similarly critical views about public spending on conservation through AES, and offered a particularly articulate discourse conveying an even more negative judgement of conversation policies. Trevor differentiated these from conservation as a practice, which for him was inherent to farming. Certainly, the fact that he is the local NFU representative explains his views to some extent, and accounts for the fact that he is so vocal in expressing them; this position also accounts for the fact that he clearly identifies himself first and foremost as a farmer and food producer. His farming operation covers 900 acres (360ha), half as his own holding and the other half on rented land for grazing. He keeps 150 breeding cows (not counting their calves), 600 breeding sheep, and also produces some barley and some silage.

Given Trevor's role in the NFU (and therefore his influence among the farming community), and the fact that his attitudes are representative of those land managers who self-identify primarily as farmers (which is actually more often the case for tenants), a larger quote from our conversation on conservation policies seems justified here:

‘Conservation is great but they need to get into their heads that conservation has been practiced by agriculturalists for hundreds of years. If it wasn’t for farmers you wouldn’t have the biodiversity in the landscape that you have got right now. But government and government agencies have latched onto the idea of conservation which is fine, but I think, in the part of the world we live in, you can see for yourself, its pretty well looked after as it is. There are bits less well looked after. I think the nearer you get to the city boundaries the worse it is. There’s waste lying about and everything else. Look out here, you know, we’ve got a nice view to see and things are pretty tidy more or less. Conservation is great but they are going to have to draw the line somewhere. They can’t go on and on spending public funds on conservation. There is going to have to come a time when the conservation area has come to its limit, where they have to refocus on producing food, you know, the world population is multiplying […] and there’s a finite amount of land available. You know, land is actually decreasing. […] So that means that the production of food is going to have to move out. […] And the way the currency is now, the economy worldwide, we can’t afford to import it. We have the people right now with the skills to grow it, but if things don’t stabilise and get better, not or get better but have to get better, you will loose that skill base and instead of being concerned just to protect the birdies, you will have to bring into the conservation areas to feed the people. So I think there is a very fine line to be drawn somewhere. I’m not against conservation at all, but they are going to have to see the bigger picture. And really see where you are going to get all this food for all these people. So that’s where I am but I know conservation has done a lot of good things […]. So you’ll see a whole different picture of agriculture. Instead of agriculture being supported by these things, agriculture will stand on its own two feet with a market that’s actually following it. It’s going to be difficult for these guys that have gone down the conservation route, got used to this amount of money coming in and maybe dropped some of their stock so they could do this and get money from a different source, it’s not an easier but a different source’.

Interestingly, Trevor’s main point is that agricultural producers should be allowed to stand on their own feet, and that spending public money to force them to apply conservation measures on their land is not the way forward; instead, he suggests that food production and conservation need to be managed jointly by ensuring an economically viable agriculture.

Margaret and Roland (wife and husband), were, in their own way, more explicit regarding their views on conservation:

‘Well, we have heard of this con… [conservation] whatever you call it, but we’ve nothing to dee [to do] with that, hiv wi [have we]? it doesna [doesn’t] affect us, does it? Not here. Its oor [our] friend along the road that has all this wild flowers. He’s into that, nae [not] us. But its nae oor [not our] farm so we canna dee [cannot do] it, like. Disna [it does not] bother us, does it? […] I've just never thought about it. He's taken in a good bit money off that, our neighbour'.

Negative views about conservation are widespread among tenants but they are not necessarily *causing* non participation in AES. For instance, Russell has tried to apply to AES, despite his reservations on conservation, but he has not been successful (he did not qualify for the competitive scheme he applied to). It is perhaps the failure of this application that reinforces his negative views on conservation. In some cases, interviewees openly expressed that, in their position, 'getting the money' of the AES was the only reason for applying. This is not surprising since, as mentioned, the farming industry in Scotland relies heavily on CAP subsidies. Keith, for instance, noted,

'It's not something that I'm really into. But I see the point of it and I'm happy to participate in something that helps it. Unfortunately that's where the money comes from. It's the same ones all the times – the grass margins, unharvested areas and mowing grassland for birds. We only do it to get the money. Not only, no it's nice to see the wildlife that comes along. I wouldn't say there has been a tremendous increase but we did see some […] but I can't say that's down to the scheme or not'.

Similarly, Donald suggested, 'the people that's in the rural stewardship scheme they've no interest in wildlife. They are in it for pennies [money]'. He thinks that since "they are gifted with land and should be producing the food". This expresses a certain moral judgement which is anchored in tenant farmers' cultural habitus and self-image as agricultural producers.

b) Landscape scale approach and designation areas

For the majority of estate owners questioned, the landscape scale and conservation practices seem to be more obvious because of the *multifunctionality* inherent to the estate business; however, they are remote notions to most of the 14 tenants who were interviewed. When dealing with smaller holdings, the possibilities for landscape scale management and the choice of services and goods to be produced is more limited. As such, it is less likely that tenants will be interested in landscape scale management or even conservation practices. Limited access to land and restricted property rights contribute to shape tenants' views regarding landscape scale and conservation.

Allan is the second generation of a farming family, and his son has taken over the farm which is let from two estates. His comments on conservation illustrate the concern about the extent of land available:

'My wee bit of ground – I need it for farming. Now I suppose if I got another 80 – 100 acres of rough ground I could say, well, maybe I'll make a pond there because it's nae deing ony good onyhow [it's not doing any good anyhow]. But for me to make a pond in the middle of my ground, I'd never thought of that'.

When it comes to collaboration with other land managers for designated areas, none of the informants in this group seemed to be aware of the local designation areas, the BAPs or other statutory or guidance documents for environmental protection. If these findings were confirmed more widely it would indicate a failure of existing policies to reach those who are ultimately to implement them.

c) Existing cases of cooperation

Cooperation between tenant farmers was found to happen frequently on an informal basis (in addition to the cooperation that can be organised through participation in organisations such as the National Farming Union, NFU). According to my evidence, farmers most frequently lend each other tools and machinery and, to a lesser extent, labour. In the study area, farmers will help each other for the silage period in November. For instance, Macvean, a tenant-small owner shares the machinery and exchanges labour with two of his neighbours for every silage period: 'You need a few labourers and tractors at that so we pull our labour from three farms. My two neighbours. There's one with a mower and

I've got a chopper and we provide each other with labour and we do each others silage […], we call it a square, where we sit down and work out the costs due to each other and balance [sic]'.

These practices of labour exchange and sharing of costs could be considered a form of continuation of the labour exchange for 'corn stack' or 'corn ricks' practiced in Scotland. In the 18th and 19th centuries it was common that groups of farmers got together for threshing corn (also for 'hay making'). This was a labour-intensive task for a minimum of 12 people, which was then reduced to 9 people in the late 19th century with the introduction of steam threshing machines in most of Britain's rural agricultural businesses (Higgs, 1964). In Deeside, corn ricks were still practiced in the 1960s (as was noted by an informant based on a photograph he had taken then).

Another example is that of Russell and Duncan. They have an 'established' cooperation, whereby Russell buys the barley from Duncan to feed his animals, and in return Duncan helps him to move his 300 sheep to another area in the Dee for winter. There are many more examples along the same lines.

Cooperation for conservation or other public goods is also starting to happen among tenants. Neil and his neighbour started a footpath that crosses the two farms; as he commented, 'if I had just done a footpath on my own it was going to lead to nowhere. So this way we could join it up and it made a circular route. And it made more sense'. After four years another neighbour joined the group, creating a bigger footpath. The Upper Deeside Access Trust has helped as a coordinating body and an umbrella for cross-boundary cooperation for footpath networks in the study area.

Similarly to estate owners or factors, tenants see conservation as a by-product of their management practices rather than as a specific objective. Despite these views, and the differences in land tenure and property rights, tenants and tenants smallholding owners were willing to cooperate with other land managers when certain conditions were in place, such as having the right person to talk to and an appropriate economic incentive.

4.3.2 Smallholding owners

Smallholding owners are in the middle of the spectrum of opinions, between estate owners and tenants. Smallholding owners are mostly farmers but they demonstrated different attitudes to land than other groups. Often they have had other experiences in their professional careers, for instance some had worked in the oil and gas industry before becoming farmers. However, not all of these cases can be called 'hobby farmers' (Holloway, 2001) because their main income actually comes from farming or from the land they manage (although they do rely on contractors or employees with the expertise to carry out some of the management they want).

This difference is important and often underestimated in the literature on the subject. For instance, an interviewee mentioned that he had to change from a mixed (breeding cattle) farming system to mostly crops, renting grassland and fattening cattle because of the loss of the employee with the necessary expertise. Several times respondents mentioned the need for labour and expressed problems in finding it. In most cases, smallholding owners farm out of choice, because they like it.

The land extensions held by smallholding owners in the study area vary between 80 ha and 400 ha. All of them own the shooting and fishing rights and they often have an interest in outdoor activities (sport or other).

a) Smallholdings owners' attitudes to conservation and AES participation

Hendry belongs to the second generation of farmers in his family. Before he became a farmer he was a land agent. Since he inherited, he has extended the farm with a farm amalgamation scheme. He is interested in conservation. This can be observed from the appearance of his holding which presents freshly planted hedges and patches of woodland with different species of trees of varying ages. For Hendry his farm is like 'a big garden' as he mentioned when talking about conservation, landscape and woodlands: '[…] [it] is all amenity. It is all for conservation and environment really; and beauty'. Along the same lines, for James, 'nature and the environment enhance the looks of the place too'.

Since all smallholding owners interviewed had an interest in conservation or outdoor activities, they were also better informed about conservation issues. All interviewees showed knowledge of their land and thought of it as unique. James talked about the flora he has in his land:

'we have wild orchids growing up in that bit of ground […] the orchids here are lovely flowers […] unless you go looking for them, you don't see them, you know […]. And the ones we have up there are quite rare […]. I go up and see if I can find new ones you see. […]. So a lot of people wouldn't recognise, they wouldn't even bother. They wouldn't know what they were and they wouldn't worry anyway. They just think it's a wild flower and never think anything of it'.

However, views about AES are not homogeneous within this group. Four out of the five smallholding owners were willing to apply and be paid for the work they are doing for conservation. Hendry is one of the most interested in the schemes and justified his motivation in the following words:

'I think [it is] just a love of trying to improve the environment. […] I think it's a super thing to do. Also we get the fencing. The fencing was paid for. The money is very good […] hedges are very important for the environment; for the countryside. It's an excellent investment from the point of view of the Scottish office and the common market. It's always going to be there – hedges are going to be everlasting'.

Despite applying to the schemes, some of these respondents still expressed scepticism. For example, Arran, who was in the oil industry before he bought his farm. He and his son manage and own the farm and an outdoors equipment shop. He expressed the following views about conservation and the schemes:

'Like a lot of the schemes I think what I've seen of it you have to do a lot of paperwork and you had to self assess it and to me that is not a good thing. I think the environment has to be protected. I think there's far better ways of protecting the environment than just putting it down on a piece of paper. I'm not greatly enthused by the thing'.

Arran has some AES for wild birdseed; he was interested in the scheme for its conservation aspect. As he mentioned, the money was one of his reasons for joining the scheme but essentially they were going to do participate anyway. In contrast, for forestry he prefers to pay for the work and plant trees rather than spend almost the same quantity of money in the application process.

As an illustration of this self-reliant thinking, other smallholding owners also preferred to pay themselves for the conservation related work they were doing rather than to go through all the paperwork of a funding application.

Their views on conservation reflect their interest in outdoor sport activities, including their shooting and fishing rights. Informants mentioned several times that they have enhanced the habitats and conservation for species for shooting, which they mainly used for personal entertainment rather than solely for business. Take Hendry, mentioned earlier, whose sons come up from London to enjoy a bit of sport at the family farm. For him this is one of the main motivations to do conservation work on his land:

'Well we always shoot really. I have two sons and they both shoot but it's not run commercially. I haven't got a commercial let. The objective is to improve it [the habitat] for shooting really, for birds; whether it's for pheasants or hares, but there is a lot of wildlife here. A lot of game; tremendous amount of partridge, hares, a lot of yellow hammer, a lot of finches, a lot of just general lovely birds'.

At the same time, besides the shooting or fishing-driven interest in conservation among owners of smallholdings, changes in the landscape due to conservation works on their land are often seen as increasing the value and the aesthetics of the property.

b) Landscape scale approach and designation areas

The idea of landscape scale management for conservation was obvious to owners of smallholdings and they even insisted on the need for it, especially those who have an interest in fishing as a sport. In fact, for some, this was the main concrete experience they had of the broader landscape scale, for instance Eileen (who took over the farm from her father): 'I'm only aware of the catchment area in terms of the lack of fish in the burns that there's been and the fact that there are now only the odd fish to be seen quite far out. There used to be fish all the way up. I'll show you before you go'.

As with the estates, the fact that wildlife moves across boundaries makes the idea of landscape scale management particularly meaningful for those owners of small holdings who have interests in hunting and fishing. This is the case for Hendry:

‘I think it would probably be excellent. I mean what I’m doing here is putting in all those hedgerows and lovely bits of wood and it draws, it’s a magnet, for game birds apart from anything else. So a lot of these shooting interests like the [neighbouring] estate, those people who are coming and shooting down their pheasants and birds and then they wonder why they disappear. And then they wander down my hedgerow and we shoot them here and then they wonder why. Its common sense that, if you plant more. These properties, maybe they put in a game crop or they feed a lot, but birds will naturally go somewhere where the habitat is good. It’s like a human being, you go where it’s nice to live. A bird is the same. It wants somewhere nice to live so naturally they will converge. It’s like bees to a honey pot. So I think I’m quite happy for people to improve [habitat]. I think it’s a good idea. I hope many people will put in new hedgerows’. (Hendry)

Linked to these interests in cross-boundary conservation is the fact that all respondents in this group were aware of the designation areas in their vicinity such as SSSI, SAC and others. In terms of the Biodiversity Action Plan, respondents in this group knew at least some of the species and habitats covered and were also aware of some local organisations involved in land management coordination in the catchment, such as the Dee Fishery or Deer Management Group.

c) Existing cases of cooperation

Compared to tenants, smallholding owners are more independent in their decision-making. In fact, they can also be more independent compared to estates since they have both access to land resources and the property rights of the land they manage.

Regarding cooperation, smallholding owners reported that land managers ‘are terrible people for not working with one another. I have no problem with that [accepting it]’

(Arran). Compared to the two previous groups, smallholding owners seem to be more independent and individualistic. That is not to say that they consider their holdings as ‘islands’, but they tend to work exclusively alone or rely more on employees and contractors rather than exchange help with their neighbours as the other two groups of land manages do more often.

For some smallholding owners, there is a certain pride associated with finding out by themselves through trial and evaluation, in order to improve their management through a learning process (through ‘experimenting’). The pride they feel over managing and improving their own piece of land plays a role in their attitudes (as they have a different identification with the land than estate owners or tenants have). Although they do ask advice and share knowledge with other land managers, they often referred to their experience as a process of self-learning. Only one interviewee mentioned asking neighbours for help in cases of emergency (such as the tractor breaking down).

4.4 Discussion

I discuss my findings in the light of existing literature, drawing particular attention to the drivers and barriers for the delivery of ecosystem services as revealed by my research.

The clustering of land mangers’ answers, based on land tenure, into tenants, estates and smallholding owners was carried out as a result of the analysis of the interviews: these were not identified as categories prior to the analysis. This post-clustering helped to explain existing cooperation cases, where land managers cooperate more within their group (tenants with tenants, estates with estates, small holding owners were the only more independent group) than across groups (with a few exceptions).

Land tenure has been mentioned as one of the factors affecting AES participation; for instance, Wilson and Hart (2000), in their study across different countries of the EU and Switzerland, found that farmers with more than 50% of land as freehold property were likely to uptake AES than those with less than 50% (Wilson and Hart, 2000, p. 2175). There are many other studies that mention 'tenure' as one of the farm-structure factors for participation in AES (e.g. Brouwer and Lowe, 1998; Brouwer and van Berkum, 1997; Buller et al., 2000; Morris and Potter, 1995); however, there is no study on AES participation focused specifically on land tenure.

Within the AES literature, Wilson and Hart (2001) studied whether AES could affect farmers' attitudes to conservation and found that it did have an impact in some cases. Although I did not test how AES participation would change land managers' attitudes, I found that conservation *per se* was mainly practiced by smallholding owners who saw this as increasing the value of the property, with one estate seeing the benefit to the environment and to their own land as worth pursuing in itself.

The other two groups saw conservation as a result of their management, as an inherent by-product; therefore, for them there was no need for management practices aimed solely at conservation. Authors have studied how farmers' attitudes to conservation affect AES participation and non-participation (e.g. Wilson, 1996; Morris and Potter, 1995). I was, however, more interested in how these attitudes affect environmental management and what the drivers and barriers were for delivering ecosystem services. Consequently, I have presented how land managers' decisions on commodity and/or services produced can affect biodiversity conservation: management for shooting *versus* farming (the main impact is on the type of species conserved).

For the case of estates, their management activities to serve fishing and hunting interests may, in part, have a negative effect on other/wider conservation efforts; similarly, other activities co-deliver certain types of wider benefits for landscape biodiversity. These trade-offs and synergies have been studied both in England (Oldfield et al., 2003) and Scotland (Thirgood et al., 2000; MacMillan and Leitch, 2008; Thompson et al., 2009; Redpath and Thirgood, 2009). On the other hand, farming practices can create benefits for biodiversity conservation through the creation of habitats for some species, such as Corn Bunting (*Emberiza calandra*), Reed Bunting (*Emberiza schoeniclus*), and Tree Sparrow (*Passer montanus*). However, these effects are marginal compared with the losses, as the decline in farmland birds over recent decades shows (Hails, 2002; Boatman et al., 2007; Butler et al., 2007). In addition to this, and as things stand now, ecosystem services that need landscape management (Bailay et al., 2002), such as carbon sequestration and protection from soil erosion, are under-delivered in farmland (Donald and Evans, 2006; Govaerts et al., 2009). There is a need for tools to deliver these at the landscape scale, such as the Dee catchment, to increase the sustainability of agricultural activities.

Since I used ecological networks to frame my research on landscape scale management, and these ecological networks were mainly based on forest habitats (Gimona and van der Horst, 2007), I asked land managers specifically about forestry schemes.

Some respondents reported reservations in applying for forestry schemes; these tenants were uncertain of whether they were allowed to apply for such schemes. This can partly be explained by two facts. The first is associated with the Single Farm Payment (SFP), established in 2005. When the SFP was introduced, one of the conditions to receive these Payment Entitlements was that ‘the land must be used for arable land [or] permanent pasture […]’; the conditions explicitly stated that areas for non agricultural use, permanent crops, forest, fruit, vegetables, table potatoes were excluded (Scottish Executive). In the hypothetical case of people wanting to afforest they would lose their entitlements. The second fact is related to Agricultural Law. Until 2003, tenants did not have rights over the trees; all planted trees were the property of the landlords, regardless of who planted them. As a result, tenant participation in forestry schemes was very limited (Appleton and Crabtree, 1991).

Although the legal framework has changed for SFP and Agricultural Law, it seems that not all tenants are aware of, or interested in, the new opportunities. Authors have studied land managers' attitudes to woodland plantation and the results show similar findings. The degree of lack of interest varies amongst land managers (as does its appraisal in different studies), but the most common reasons for lack of interest were identified as follows:, low level of financial incentives; lack of knowledge about planting schemes; uncertainty on financial returns (Sandys, 1994; Bishop, 1992; Watkins et al., 1996).

As with my own findings, a few studies identified land tenure as a restriction to woodland planting (the Marsoton Vale farm survey and Scambler, 1989). Bishop (1992), mentioned that woodland schemes should therefore be seen as an 'innovation', and suggested more time was needed for land managers to be willing to take up schemes and/or increase woodland areas. However, I argue that my results show that many of these motivations for not planting remain the same, including the size of the farm and even, for some informants, the view that it would be 'morally' wrong if they converted their agricultural land into woodland (as Watkins et al., 1996 also observed). Therefore, for me it is rather a question of identifying the conditions that allow for some 'innovations' to be adopted and others rejected.

Moreover, my results suggest that the Agricultural Holding (Scotland) Act 2003 (*S42 Tenant's right to timber*) allows tenants to plant trees under agreements between the tenant and the landlord, and between landlords who are willing to apply to AES for land that is tenanted. There are an enormous number of formal and informal agreements between landowners and tenants. There is a lack of research on the spectrum of these agreements, especially for environmental management and conservation practices. Therefore, for me it was important to study existing cases of cooperation amongst land managers.

Propensity to cooperate varies between the three groups and although all of them cooperate in one way or in another, the level of commitment is different. Cooperation appears to be more common within than across each of the groups and occurs to a lesser extent between different groups. Smallholding owners were the most independent land managers.

When estates and tenants cooperate, their relationship is often asymmetric (using the classification of chapter 3), in the sense that the terms of the cooperation are set by the estate. Examples include the application to specific AES to improve water quality in the river Dee; in this case the estates make it a condition when they lease the land under Short Duration Tenancy.

When given the example of the implementation of ecological corridors, respondents from all three groups of land managers often mentioned the need for coordination of practices by a third party. It was interesting that, of the three groups, only estate factors or owners could see their role as coordinators; this was particularly the case for those who already had a plan for their estate, for footpaths or field margins for instance. In other cases, the coordinating person is the consultant who is in charge of helping tenants through the application for AES (when the estate has a plan for these schemes). This offers a valuable example where bottom-up processes are taking place, and suggests the need for more channels to stimulate such processes.

Policies to deliver conservation *per se* address market failure in relation to the delivery of public goods to society by land managers. It is not surprising that most land managers think they should be reimbursed for their explicit activities to deliver these public goods.

4.5 CONCLUSION

Land managers are different with regards to their objectives and views and these differences could represent a barrier; however, existing cases of cooperation and propensity to cooperate offer opportunities for the provision of ecosystem services.

The potential for the delivery of ecosystem services via existing AES is limited. These operate at the holding scale rather than at the landscape scale and only achieve limited additionality. The complicated nature of the application process represents a capacity barrier to those land managers who are restricted in terms of time or other means (computers, money to pay consultants).

Despite these barriers, there are opportunities to engage each of the three groups of land managers in the delivery of ecosystem services through AES support. If AES were delivered at the landscape scale, according to my results, smallholding owners who have an interest in conservation *per se* appear as a promising potential target group: they could be seen as 'core social actors'. Moreover, their land parcels could be the most easily achievable 'starting points' from which to develop conservation practices at the landscape scale.

Ecosystem services at the landscape scale call for coordination and, as land managers have mentioned, there is a need for coordination to actually be made to happen (see also results from chapter 3). They mentioned the need for a third party to act as a coordinator in implementing collaboration rather than them taking the initiative.

Delivery of ecosystem services implies cooperation between land managers of different (land tenure) groups. In this regard, the results showed that land managers have a propensity to cooperate. Existing cases of cooperation show that each group of land managers have strong social and cultural capital within their groups but very little across groups.

Finally, the majority of land managers could benefit from information about landscape scale issues and ecosystem services, in order to achieve the delivery of ecosystem services though AES at the landscape scale. It is necessary to involve land managers in the early stages of policy, allowing them to actively participate in the design for delivery. In order to achieve maximum policy effectiveness, it is imperative that those who can supply ecosystem services are part of the development process. This will make the development of 'socio-ecological systems' possible – by which I mean systems that ensure land managers' adaptive capacity to changes in ecosystems.

The greater role of land managers in the policy process could be embedded in local community initiatives to deliver the necessary degree of cohesion and coordination for environmental outcomes of AES. For example, Eggers et al. (2008), highlight the possibility of an agri-environmental forum or an environmental cooperative as part of Local Action Groups (LAGs); this could be funded through mechanisms such as LEADER, under the EU Rural Development Regulation, or other partnership arrangements. However, they also acknowledge some of the practical capacity difficulties - a point echoed by more general literature on community initiatives and the need to develop human and social capital (e.g. Quirk, 2007).

While a number of studies have highlighted the importance of addressing issues of governance and information provision to promote cooperative rather than individualistic behaviour (Pascual and Perrings, 2007; Goldman et al., 2007), the question of coordination is underexplored in the literature and merits further research.

CHAPTER 5

'EVERYTHING HAS TO BE PAID FOR' RESULTS FROM AN EXPERIMENT TO TEST '1-2-1 COORDINATION BONUS'

5.0 INTRODUCTION

As discussed in chapter 1 regarding the 'Payments for Environmental Services' framework, in the UK conservation biodiversity at farm and holding scale takes place, in most cases, as a direct consequence of payments or as a by-product of existing activities (Kleijn and Sutherland, 2003). In other words, these conservation benefits are external benefits. External benefits are often seen as public goods, especially if this involves large-scale benefits (FAO, 2007). Property rights could exclude people from benefiting from certain aspects of biodiversity, or biodiversity management could reduce the possible benefit by others (e.g. the case of fishing rights). However, biodiversity can be considered a public good, as my definition in the introductory chapter explained. Public goods are often under-provided by markets, therefore they are known as 'market failure'.

There are a number of mechanisms to correct this: top-down approaches such as environmental law or public policy, or bottom-up economic incentives and other market-based instruments (Brauer et al., 2006). Having focused the previous chapters on other mechanisms, such as top-down, bottom-up coordination and existing cases of cooperation, this chapter will present the results of testing a bottom-up voluntary ‘coordination bonus’ incentive to stimulate cooperation. I found it useful to call the incentive a ‘one-to-one coordination bonus’ (or ‘1-2-1’), since it reflects the design of the experiment which rewards players when they coordinate their actions on a one-to-one basis with neighbouring parcels. The methods section explains the experiment in depth.

Cooperative and non-cooperative behaviour in economics and environmental economics has been studied through behavioural economics and game theory (Ostrom, 1990; 1998; Camerer, 2003; Zizzo and Tan, 2007; Bayer et al., 2009; Banerjee et al., n.d.; Parkhurst et al., 2002; Parkhurst and Shogren, 2007). In addition to mathematical models, behavioural economics in relation to public goods have been well addressed by experimental economists since the 1970s (Smith, 1991; Ostrom, 1994; Cherry et al., 2008). Experimental methods have been proved to be a useful tool to inform public policy (Friedman and Sunder, 1994; Ferraro, 2005). They have been used to test different aspects of theory (see for instance the large volume of literature on experimental research in public goods). Amongst other applications, laboratory experimental methods have been used to investigate patterns of behaviour, to study how people coordinate actions, and to test economic incentives for conservation, biodiversity and emissions trading (Segerson, 1988; Vossler et al., 2002; Cason and Plott, 1996; Zelmer, 2003; Warziniack et al., 2007; Parkhurst et al., 2002).

The discussion in relation to these subjects is vibrant and has become more important in the light of ecosystem services delivery at the landscape scale, climate change (and therefore carbon sequestration) and the use of market-based instruments (see for instance

TEEB, 2010). Inspired by game theory and the literature on agglomeration 'bonuses', I present the results of a lab experiment played with land managers that aimed at testing a '1-2-1 coordination bonus' incentive that aimed to stimulate cooperation across adjacent parcels for the implementation of ecological networks.

The chapter answers the following research question: **'How efficient will an economic incentive be in encouraging cooperation between adjacent holdings in order to influence changes in land use patterns for conservation practices (the implementation of ecological networks)?'**

I follow two research aims:

1. To assess factors which stimulate or constrain cooperation practices to deliver environmental services.
2. To evaluate what the appropriate economic incentives are for stimulating cooperation at the landscape scale.

This chapter will 1) present the literature on PES that have landscape scale applications, 2) present and discuss the results of the experiments that tested a '1-2-1 coordination bonus' incentive to stimulate cooperation, 3) analyse the results in the light of behavioural game theory, 4) highlight how the results suggest opportunities for public policy, and 5) reflect on the method and consider the opportunities it offers for future research.

There is a lack of data and experience regarding the performance of economic incentives to stimulate cooperation across adjacent habitats. As a result of this lack of data in Europe, and the very few cases around the world (see for instance Oregon's Conservation

Reserve Enhancement Program, see Oregon Department of Agriculture, 2005), the use of experimental economics is particularly relevant. Experimental methods offer an opportunity to collect new data, test theories and policy tools and report back on their scope (Friedman and Sunder, 1994).

This research addresses three central problems that most research in experimental economics tends to overlook (Cherry et al., 2008): a) One recurring critique (Cherry et al., 2008) to the use of this method is that the lab experiments are carried out 'context-free', which sometimes makes the results irrelevant for real-life situations and of little interest to environmental policy. In contrast, the results of the experiments I carried out come from a specific context, informed by the qualitative data explored in previous chapters; b) the '1-2-1 coordination bonus' incentive was specifically designed to test landscape scale conservation and cooperation rather than generic 'public goods'; c) our pool of participants were land managers: those who own and manage the land where the desired corridors were mapped by landscape ecologists (Kling, 2008).

The chapter is organised into six sections. The first section presents the literature review on public goods, externalities and Payment for Environmental Services (PES), with particular focus on existing cases of PES that address landscape scale management. The second section presents behavioural game theory and related experimental methods. The third section describes the methods I used (experimental design and procedures), with the results recorded in section four. Sections five and six constitute the discussion and conclusion respectively.

5.1 LITERATURE REVIEW

5.1.1 Public Goods

Classic authors had already recognised the need of state intervention for goods that are not profitable, and which the market is therefore unable to provide. Adam Smith (1723-1790) identified three roles for the state in the provision of public goods: 1) to administer justice; 2) the national defence; 3) other enterprises of public interest that could never be profitable if undertaken privately. Along the same lines, many other authors assigned a role to the state in different degrees for the provision of public goods (e.g. John Stuart Mill and Jules Dupuit). However, it is Paul Samuelson who is best known for establishing the foundations and characteristics of public goods (see 1954 and 1955).

Samuelson (1954 and 1955) explicitly identified two types of goods: private consumption goods and collective or public consumption goods. Private and collective goods are fundamentally different. For the former, the amount of consumption by one person reduces the availability for a second person and so on. The assumption behind collective goods is that consumption by one person does not subtract from any other individual's consumption of that good (Samuelson, 1954). Samuelson used the polarised model of two extreme public and private goods and addressed only one characteristic of public goods: non-excludability. However, the literature on public goods recognised *pure public goods* and *impure public goods*; both with characteristics of non-excludable and non-rivalry.

Pure public goods are characterised as non-excludable and non-rivalry. A classic example of a *pure* public good is national defence or clean air because it is non-excludable and non-rivalry.

Non-excludable refers to the consumption of a good by one person that does not exclude another person from consuming exactly the same amount. In other words, there is no zero-sum effect whereby the more one persons consumes the less there is left for others. Consequently, it is not possible to price the good and charge people for their consumption. In economic theory, common good resources such as fish-stocks are considered non-excludable, but this is based on the assumption that stocks can constantly be renewed which, of course, is not the case.

Non-rivalry refers to the consumption of the good by one person, which does not reduce the possibility of others consuming or enjoying it simultaneously independently of the any quantification of the consumption (as is the case of watching a movie in the cinema for instance, or admiring a landscape). In other words there is no competition for use of the good.

That biodiversity should be considered a *pure* public good is a contested idea. It can be argued that biodiversity excludes people in some places, as access to resources is delimited by property rights (for instance, bird watching on private land). Furthermore, it can be suggested that biodiversity creates excludability between present and future generations, because the amount of biodiversity available to future generations depends on how we consume and manage it today. In other words, biodiversity can be seen as an excludable and rivalry good.

However, if we accept the following definition of biodiversity, then we can consider it a *pure* public good: 'the variability among living organisms from all sources including, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems' (CBD, 1992). With this definition, provision of biodiversity at the landscape scale does not exclude people from benefiting from it at the local or global scale. Neither does the benefit taken by one person create competition with others to take the same benefits. These two characteristics of non-exclusion and non-rivalry make biodiversity a *pure* public good. From the standpoint of social optimal biodiversity, as with other public goods, is under-provided (Hodge and Reader, 2007). This common problem of under provision of public goods is known for being a 'market failure'.

All other possible combinations across the spectrum of private-public goods characteristics are identified as *impure* public goods. The rationale of most types of *impure* public goods is that the units consumed by one person will affect positively or negatively the units consumed by another person. In other words, changes in welfare for each unit consumed equals the difference between the values attached to the resource by person 1 and the costs incurred by person 2 because the resource is crowded (Randall, 1983; Olson, 1971; Buchanan, 1965). Some of these *impure* public goods are called 'open access resources', 'club goods' and 'common-pool resources'.

Landscape scale biodiversity management highlights an old common problem when correcting market failure for provision of public goods: free-riding and social dilemmas. These occur when 'individuals in interdependent situations face choices on which the maximisation of short-term self-interest yields outcomes leaving all participants worse off than feasible alternatives' (Ostrom, 1998:1).

In public goods dilemmas, all people who would benefit from the provision of public goods find it costly to contribute and would prefer others to pay for the good. In principle, because biodiversity is non-excludable and creates no rivalry between individuals, there is a risk that every person will try to free-ride in the hope that others will pay for the provision of the service (although this can be arguable at the local scale where, for instance, property rights exclude people from enjoying the view of scenery or species). If everyone follows this behaviour then biodiversity is underprovided or not provided at all, despite the fact that every person would be better off if they contributed to the provision. This is illustrated by ecological networks. If a group of people are paid for the implementation of ecological networks but only a small number of them are willing to participate, and there are others within the ecological network who do not want to put in their share of the effort or work, then there is a problem of free-riding. The behaviour of those who do not participate affects the welfare of those who do, and society in general, because biodiversity is not achieved. At the same time, people unwilling to participate in the network are free-riding the benefits created by those participating. This social dilemma is created because there is a need for cooperative behaviour amongst those who own or manage the land where the ecological network is planned.

5.1.2 Externalities

Public goods and externalities are a market failure and recurrently lead to inefficient allocation of resources. For the purposes of this research, externalities are understood as external economies: 'external economy (diseconomy) is an event which confers an appreciable benefit (or inflict[s] an appreciable damage) on some person or persons who were not fully consenting parties in reaching the decision or decisions which led directly or indirectly to the event in question' (Meade 1973, in Cornes and Sandler, 1986: 29). This definition refers to the lack of appropriate institutions (markets) to allocate resources. There is a lack of information on the actual outcome of these external economies and, therefore, there is a problem with no use or inappropriate use of institutions (Cornes and Sandler, 1986: 29-47).

This definition leaves aside the question of the 'intentionality' of producing these side-effects or externalities. It is, however, important to note that when these are intentionally produced there may be an opportunity cost attached. External economies and diseconomies are often underpaid services or impose a cost on other parties, creating a Pareto suboptimal allocation.

Different institutions are needed in this context to 'internalise these externalities', that is, to control pollution and compensate for the cost of producing social benefits. Crucial to this is the type of institution. There are two main views: those who advocate governmental intervention following Cecil Pigou (1920), and those who criticise it, inspired by Ronald Coase's (1960) school of thought. Existing economic incentives for conservation are based on both views and use a combination of both schools of thought. In the following section, I present existing economic incentives for conservation with regard to landscape scale.

5.1.3 Economic incentives

Economic incentives are payments to land managers who voluntarily commit to participate in conservation practices or who receive a payment for conservation outcomes (OECD, 2008). In environmental economics, researchers dealing with spatial economics have focused on spatial interconnections and, more recently, on adjacent cross-boundary management (Vokoun et al., 2010; Koskela and Ollikainen, 2001; Swallow and Wear, 1993; Parkhurst and Shogren, 2007). Some of the obvious issues related to spatial problems are diffuse pollution (non-point source pollution), for which Segerson (1988) and other authors (Vossler et al., 2002; Segerson and Wu, 2006 amongst others) have proposed ambient-based mechanisms (tax/subsidy, fixed penalty and tax/subsidy combined with fixed penalty used depending on ambient pollution levels).

Cross-boundary management has also been studied, and in recent years the 'agglomeration bonus' literature has grown (Smith and Shogren, 2001 and 2002; Parkhurst et al., 2002; Parkhurst and Shogren, 2007; Banerjee et al., 2009). Despite the growing literature on spatial matters, there are but few existing examples of economic incentives (as I present in the following sections).

I will now present incentives that are designed or have an effect on landscape scale and that pay for positive externalities rather than impose penalties for negative externalities (for example, taxes for pollution). I present the principle of Payment for Environmental Services or PES (others call this Payments for Ecosystem Services or PES)[28] and, within this, the modalities of Payment by Result (PBR) and Agri-Environmental Schemes (AES).

[28] The difference between these terms is that 'ecosystem' here refers to the four services identified by the Millennium Ecosystem Assessment (2005) of provisioning (e.g. food and fibre), regulating (e.g. water regulation), cultural (e.g. aesthetic values) and supporting (e.g. soil formation). In contrast, environmental services are identified as the ecosystem providing services (e.g. forest, coral reef). It is also used to denote 'emission-reduction technologies' or 'environmental impact assessments' (McAfee and Shapiro, 2010).

i) Payment for Environmental Services (PES)

PES are defined as the '*voluntary* transaction in which a *well-defined* environmental service (ES), or a form of land use likely to secure that service, is bought by at least one ES *buyer* from a minimum of one ES *provider*, if and only if the provider continues to supply that service (*conditionality*)' (Wunder, 2005, see Chapter 1).

Although none of the PES are specifically orientated to achieve landscape-scale management, some of them are de facto being implemented at scales larger than the holding because the payment is made to communities rather than individuals. Such is the case of the 'PES-like scheme'[29] for carbon-sequestration paid by the Dutch Face the Future Foundation for reforestation in Ecuador and different parts of Africa,[30] or the Scolel Te project in Mexico (Tipper, 2002). Other examples are the Mexican payments made to community land holdings - called '*ejidos*'[31] (Muñoz-Piña et al., 2008; Brechin et al., 2002), and the Costa-Rican, Colombian and Nicaraguayan projects on regional integrated silvopastoral Ecosystems Management (Pagiola et al., 2007). Other PES-like examples are the watershed-scale payments, see for instance: Asquith & Wunder (2008); Southgate & Wunder (in press); and also the 'watershed markets' initiative.[32]

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[29] There are many examples of public policy on conservation in the world that use the PES approach, but most of them are 'PES-like schemes' that do not fulfil exactly the definition presented above (Wunder, 2007; Engel et al., 2008; Munoz-Piña et al., 2008; Barton et al., 2008; Kalacskaa et al., 2008; Lipper et al., 2009).

[30] http://www.face-thefuture.com/projects/community-reforestation-projects, (accessed on 25/Nov/2011).

[31] *Ejidos* are a type of common property rights. The PES-like payments are made to the *Ejido* in which a committee makes the decision on how to spend the money for the whole area under the scheme.

[32] See the website at: http://www.watershedmarkets.org/casestudies/Colombia_Fuquene_E.html.

ii) Payment by Result (PBR)

Payment-by-result (PBR) schemes are an approach to target PES towards outcome-based payments which are adjusted according to the quantities and qualities of the environmental outcome (Schwarz et al., 2008). PBR can be made in money or in kind to individuals or groups (Albers and Ferraro, 2006).

PBR stimulates farmers to be more proactive by using their ecological knowledge to provide the environmental outcome. It is more cost-efficient because it could attract high cost farms, rather than low cost farms where AES represent a significant income (Schwarz et al., 2008; Matzdorf and Lorenz, 2010; Groth, 2009). One of the problems with this method is the high uncertainty because environmental outcomes are difficult to measure (Schwarz et al., 2008; Hanley et al., 2012).

There are few existing practices of PBR around the world and most of those in place occur at the holding scale (Mishra et al., 2003; Flintan, 2002; Ferraro and Gjertsen, 2009; Pagiola et al., 2007; Morton et al., 2006), although some authors, such as Casey and Boody (2007), discuss issues of indicators at the national, regional and farm scale (Schwarz et al., 2008 also discuss landscape scale needs).

Exceptions of PBR at larger scale are: Auction for Landscape Recovery in Australia which encourages joint applications across adjacent holdings (Reeson et al, 2011); and Conservation Performance Payments in Sweden for wolves and Iynx conservation (Zabel and Holm-Müller, 2008). In the latter case, payments are made to Sami individuals or village administrators and the decision about how to pay is made collectively or by an elected committee (Zabel and Holm-Müller, 2008).

iii) Agri-environmental Schemes (AES)

AES are a ‘PES-like scheme’ (OECD, 2010). They are ‘action-based’ schemes that pay farmers who follow a prescribed set of action and management practices and are independent of the outcome of those actions.

Chapter 2 presented the rationale behind AES. Therefore, here I refer only to the few exceptions of AES that are at a scale larger than the holding, notably the Meadow Birds Agreements in the Netherlands (Verhulst et al., 2007) and the Hedgerows Planting scheme in Denmark (Kristensen, 2001; Busck et al., 2007).

As I noted in chapter 2, since 1994 in the Netherlands ‘agri-environment collectives’ have become an important channel for AES implementation (Verhulst et al., 2007). The Hedgerows Planting scheme requires application for a surface of 100 ha. per application and the collectives are crucial for application.

The Hedgerows scheme began in Denmark in the 1800s and has continued to the present day (Kristensen, 2001; Busck et al., 2007). The scheme aims to prevent soil erosion and to increase biotopes and ecological networks on agricultural lands. According to Schwarz et al. (2008), individuals as well as collectives can apply for the schemes and in 2005, 78% of applicants were collectives.

Other AES which have characteristics for the landscape scale are, Rural priorities in Scotland (see chapter 2); the Higher Level Stewardship in the UK, which requires the entry of three farms; common land in England; the Top-Tier AES in Wales (Mills et al., 2006).

iv) Existing 'Bonus' schemes

The key exception regarding landscape scale schemes is Oregon's Conservation Reserve Enhancement Program. The payment is made by a partnership created between the State of Oregon and the US Department of Agriculture Farm Service Agency. This action-based scheme for riparian areas offers, in addition to the standard costs calculation, a 'bonus' when land managers enrol 'over 50% of the streambank in a 5-mile segment of a stream into the scheme' (Oregon Department of Agriculture, 2005: 4).

Apart from this exception, all other existing schemes present limitations regarding landscape scale conservation payments. Questions about how to create cooperative behaviour between land managers at low transaction costs are very much of interest, not only for biodiversity but also in the light of ecosystem services delivery and climate change. The 'agglomeration bonus' literature proposes to pay land managers a 'bonus' for contiguous management practices, similar to that found in Oregon's program (mentioned above). I develop the discussion on the possibilities of an 'agglomeration bonus' in the following sections. This is based on my prospective experimental data as, to the best of my knowledge, there is no other scheme similar to the Oregon case existing in practice.

I address cooperation from an economic perspective. In economics, cooperation amongst individuals has been studied through behavioural game theory: I discuss this in the next section.

5.2 Behavioural Game Theory with experimental methods

The first rare, sporadic applications of experimental methods in economics started in the 1940s and continued to the 1960s (Chamberlin, 1948; Hoggatt, 1959; Siegel and Fouraker, 1961; Smith 1962). Major developments in this method took place during the 1970s and 1980s, when experimentalists started to test market institutions and provide evidence for economic theory. Vernon Smith (1976), Bohm (1972), Scherr and Babb (1975), have used lab and field experimental studies to provide evidence to solve the free rider problem in public goods, as well as to test incentive-compatible mechanisms for the provision of public goods proposed by Thompson (1965) and Clarke (1971), amongst others. Classic subjects tested in these studies are the Pigouvian taxes and Coasean bargaining; these are used to provide evidence on how to solve problems of externalities, to test new incentives and market institutions, and other social dilemmas such as common-pool resources (Smith, 1991; Ostrom et al., 1994; Ostrom et al., 1992).[33]

I do not aim to present an exhaustive account of the extensive literature on experimental environmental economics, but rather to present the general ideas underlying my own design and to discuss this within the 'agglomeration bonus' literature that was my model (Albers et al., 2008; Smith and Shogren, 2001, 2002; Parkhurst et al., 2002; Parkhurst and Shogren, 2007; Grout, 2009; Michael, 2003; Banerjee et al., 2009). Work in experimental economics very often addresses pragmatic environmental problems. This is the case for this research; as such, it was important to carry out the research with land managers playing the games and to contrast this information with the qualitative information presented in previous chapters. Therefore, I used descriptive statistics, decision trees and utilised the

[33] See also the experimental work on emission trading programs and international GHG (for instance: Mestelman, 1998; Bohm and Carlen, 1999; Soberg, 2000; Cason, 2003).

ideas of game theory to design the experiments. I did not use any mathematical modelling to describe the experiments. Precisely because this is the first exercise of this type within the agglomeration literature, it presents limitations and strengths which I highlight in the conclusion.

5.2.1 Behavioural Game theory

Game theory is a mathematical tool used to describe and analyse situations of conflict, cooperation and coordination (Gächter, 2004: 486).[34]

On the other hand, games [not game theory] 'are a taxonomy of strategic situations' (Camerer, 2003: 3).

Furthermore, behavioural game theory is a branch of behavioural economics and searches for empirical information about how humans behave in strategic situations: in other words it studies what players actually do in games (Gächter , 2004; Camerer, 2003: 3).

Games and experiments are a rich methodology applicable to thousands of different phenomena. Here I only discuss experiments that use game theory on non-cooperation (that require coordination) and cooperation games with multiple equilibria. Non-cooperation games are when players cannot 'collude'; therefore, they cannot bind agreements and they have to take decisions independently. In cooperation games, players can make agreements with each other to coordinate their preferences through 'cheap talk'. Within the experimental

[34] In rational player models, as the name suggests, it is common to assume that players are rational, that they understand the strategic situation, and will always maximise their preferences given their rational beliefs about the behaviour of other players (Gächter, 2004). Carmerer notes, 'Analytical game theory is based on a highly mathematical derivation of what players with different cognitive capabilities are likely to do in games' (Carmerer, 2003, p. 3). It is based in introspection and guesses rather than careful observation of how people actually play the game (Camerer, 2003, p.3).

literature ‘cheap talk’ refers to when players can make (costless) announcements and talk with others (they may or may not respect their agreements).

Classic examples of non-cooperation games are, ‘battle of the sexes’, ‘market entry games’ and ‘payoff-asymmetric order-statistic games’, amongst many others. In all these examples a degree of coordination is needed in order to increase returns to players. The battle of the sexes is a game with asymmetric equilibria, where a couple will benefit from coordinating their choices (different preferences) to see a movie/show (Gibbons, 1992). In market entry games, coordination is needed because entrants’ returns decline with the number of entrants and is negative if the capacity of the market is exceeded (Sundali et al., 1995; Duffy and Hopkins, 2005).

In order to put this type of non-cooperation game with need of coordination into context, I present an example. Consider a farmer’s decision about extending his farmland or business. Imagine that farmer ‘A’ will normally expand, improve or change his business once every 10 years, and that he is in a position to do this, but his decision will depend on what the neighbouring farmer will do. The neighbouring farmer ‘B’ will retire soon and sell his land which represents a unique opportunity for farmer ‘A’. However, farmer ‘B’ may retire this year or in two or three more years. Farmer ‘A’ has to decide whether to keep the business as it is and wait for the neighbour to retire, or to improve and change other parts of the business and forget about the possibility of extending his farm land.

Payoff-asymmetric order-statistic games were my inspiration in designing and running the experiment I present in this research. A classic example of this type of game is the ‘Wolf’s Dilemma’ or the ‘Stag hunt’ (Rydval and Ortmann, 2005; Camerer, 2003). These games follow the same idea presented above. Players have two choices: they may hunt rabbits or stag. If they choose to hunt rabbit they earn '1'. If they choose to hunt stag they earn '2'; however, as the player cannot hunt stag alone, they earn '0' if the other player does not choose to hunt stag (Camerer, 2003: 375). Similarly, in the game I present here players earn a '1-2-1 coordination bonus' if they cooperate in adjacent holdings and earn less if they do not cooperate. The objective is that players coordinate their preferences and create the ecological corridor by aggregating adjacent holdings. This coordination is achieved through the '1-2-1 coordination bonus', which gives extra earning when two players chose the same and only the same choice for two neighbouring parcels.

The '1-2-1 coordination bonus' game I tested is a coordination game which considers a social dilemma and treats public goods in a similar way to the prisoner's dilemma. In public-goods social dilemmas, 'individuals in mutually dependent situations face choices in which the maximisation of short-term self-interest yields outcomes which leave every individual worse off than if they all cooperate or coordinate their actions' (Ostrom, 1998: 1). Social dilemmas are about trusting others. There are many examples of social dilemmas ranging from daily experiences to strategic international relations (Sandler, 1992), collective action (Olson, 1965), and many other examples (Smith, 1991; Ostrom, 1997). Biodiversity, as suggested previously, is an underprovided public good. The provision represents a social dilemma since people will be better off if everyone cooperates in the provision, but individuals prefer not to pay the associated costs.

Following the similarity of the games described above and the requirements for the implementation of ecological networks, I used the 'agglomeration bonus' literature to design my own experimental game. The 'agglomeration bonus' literature refers concretely to landscape scale provision of biodiversity, or how to solve problems of fragmented landscapes (Albers et al., 2008; Smith and Shogren, 2001, 2002; Parkhurst et al., 2002; Parkhurst and Shogren, 2007; Grout, 2009; Michael, 2003; Banerjee et al., 2009; Shogren et al., 2003).

Several authors (Smith and Shogren, 2001 and 2002; Parkhurst et al., 2002; Parkhurst and Shogren, 2007) have designed non-cooperative games with students as players, testing the effectiveness of an agglomeration 'bonus' for equilibrium behaviour in simultaneous move games. In their experimental session they presented players with a set of strategy combinations from which they were able to choose. The idea is that players received an agglomeration 'bonus' when contiguous neighbouring parcels were managed to create habitat connectivity. Parkhurst et al. (2002), found that voluntary mechanisms with no agglomeration 'bonus' created fragmented landscapes. With the agglomeration 'bonus', players found the first-best outcome, creating the habitat reserve. Many players preferred the lower risk option without coordination and created fragmented landscapes. When cheap talk (costless action) was introduced players chose the first-best habitat reserve (Parkhurst et al., 2002; Warziniack et al., 2007).

Albers et al. (2008) developed a spatially explicit game model to investigate land conservation patterns that arise under private and public agents. The authors argue that although socially-preferred low levels of fragmentation happen when all agents want agglomerated conservation, problems with coordination can still produce fragmented landscapes. They also found that very small 'bonuses' for conserving parcels next to conserved land also improved the conservation outcome in the model; however, this was not tested in an experiment (Albers et al., 2008).

5.3 Methods (Experimental design and procedures)

My experiments were based on a classic coordination game and aimed at testing an economic incentive, which I shall call ‘one-to-one (or 1-2-1) coordination bonus’, that stimulates cooperation for landscape configuration (ecological networks). I called the incentive ‘1-2-1 coordination bonus’ because the ‘bonus’ is given to players when they coordinate their actions from one neighbouring parcel to another, and therefore the coordination between land managers is on a ‘one-to-one’ basis (‘1-2-1’). That is when one player chooses to have the same choice in one of his parcels as his neighbour’s parcel. There were two types of ‘1-2-1 coordination bonus’ incentives: Agri-environmental Schemes (AES) + ‘bonus’ and Environmental Services (ES) + ‘bonus’. As in the real world, in the experiments AES schemes rewarded land managers for environmentally sensitive land management (for example, field margins). Consequently, land managers continue with commodity production in addition to these schemes. ES rewarded land managers for conversion of the entire parcel into the production of environmental services (for example, conversion into forestry or restoration of pond habitat).

The experiments were run with land managers and, therefore, they played their real life role in a scenario situation. By inviting land managers to the experimental sessions, the aim was to achieve results which were a closer reflection of land managers’ real-life decisions: land managers played as if it was their business. With the experiments I tried to reproduce the real-life set of choices of economic incentives, business and conservation preferences. I let players (land managers) take decisions and balance these choices as they wished.

In the games there were different Nash equilibriums and players coordinated their actions by choosing the '1-2-1 coordination bonus'. The game was based on the standard model of non-cooperative games, therefore, contribution to the network by one player costs '$c < 1$'. The contribution by one player to the ecological network gives K, and contributions by two players gives $K + u$ and allows the creation of ecological networks. No contributing players gives '$1 - e$' of the ecological network. In this game a Nash equilibrium is:

$K + u - c > K(1 - e)$ only if u and e are large enough.

Cooperation gives the Nash equilibrium as presented in figure 5.1 (adapted from Camerer, 2003: 377).

	(AES or ES) 'bonus'	**NO 'bonus'**
(AES or ES) 'bonus'	$K + u - c, K + u - c$	$K - c, K(1 - e)$
NO 'bonus'	$K(1 - e), K - c$	0, 0

Figure 5.1 Payoff with synergy and exclusion adapted from Camerer (2003: 377).

This type of game is also known as 'strategic complementarities', in which the marginal productivity of one player's strategy choice rises with the level of another's strategy choice. An individual player benefits and the marginal productivity increases (earning more points) if another player coordinates with their actions, that is if another player's strategy choice is the same.

A social optimum in these experiments was assumed to be reached when the networks were produced. In other words, this was achieved when the '1-2-1 coordination bonus' coordinated land managers' private choices and stimulated land managers to uptake the '1-2-1 coordination bonus'. The ideal spatial configuration was identified as a combination of AES + 'bonus' and ES + 'bonus' and, therefore, the social optimum was reached when land managers chose to cooperate for both AES and ES. However, it was not desirable to have all parcels under ES and, in fact, it would not be possible for all the parcels to be under AES because of budget constraints.

The experimental design and the experimental sessions were conceived so as to answer the research question defined earlier: **How efficient will an economic incentive be in encouraging cooperation between adjacent holdings in order to influence changes in land use patterns for conservation practices (the implementation of ecological networks)?**

The experiments follow the standard procedural aspects of the methods of experimental economics. The general structure of the experiments was as follows: there were 3 experimental sessions with 6 different players each. These were held on different dates. All players received instructions and an introduction to the experiments. The instructions were both spoken and written. Each player received an envelope with instructions, pen, paper, calculators, sheets to register their choices and count their points for each round, post-its of different colours corresponding to land-use choices and four 'parcels', two high quality land (in yellow) and two low quality land (in brown). Each experimental session consisted of 12 rounds (see figure 5.2). The first 3 rounds were the control rounds; then the '1-2-1 coordination bonus' was introduced but players were not allowed to talk from rounds 4 to 8. From rounds 9 to 12, players were allowed to collude and coordinate their choices (cheap talk). In each round, players were asked to allocate each of their parcels against one of the choices. All experiments were run with low technology (pen and paper), which allowed me to move around the study area to hold the separate sessions and have more different land managers participating.

The 3 experimental sessions were each conducted with a different group of land managers as subjects (all participants manage land in the study area). First a letter of invitation was sent to 30 land managers with whom I had previously carried out an interview (see previous chapters). I asked them if they were willing to participate in the experimental sessions and offered them different options of dates, times and locations to carry out the experiments. I gave the participants limited information about the experiments to avoid influencing them before the experimental sessions. After two weeks I called the 30 land managers and started to form groups of 6 players. 15 land managers and 3 students (one per session) participated in 3 experimental sessions. I had to ask 3 students to play the experiment (one in each session) because a land manager cancelled immediately before the session and the design of the game required 6 players.

Before I carried out the games with land managers, I also carried out three *practice trials* with students and staff of The James Hutton Institute.

All participants in the experimental session were paid according to their decisions. Players were told at the beginning of the experiment that the number of points they earned during the sessions would be exchanged for money. At the end of each session I added the total number of money points and exchanged every 100 money points for £10. In addition, conservation points were calculated and the person with the most conservation points won a natural history book at the end of each experimental session. I paid all participants travel expenses of £24 and offered them refreshments.

Each experimental session lasted 3 hours with 20 minutes taken up with the introduction, presentation of the experiment and instructions. Each session consisted of a total of 12 rounds of 3 minutes. Two experimental sessions with land managers were conducted at the Victory Community Hall in Aboyne, and one session with land managers was conducted at the James Hutton Institute (see figure 5.2 below).

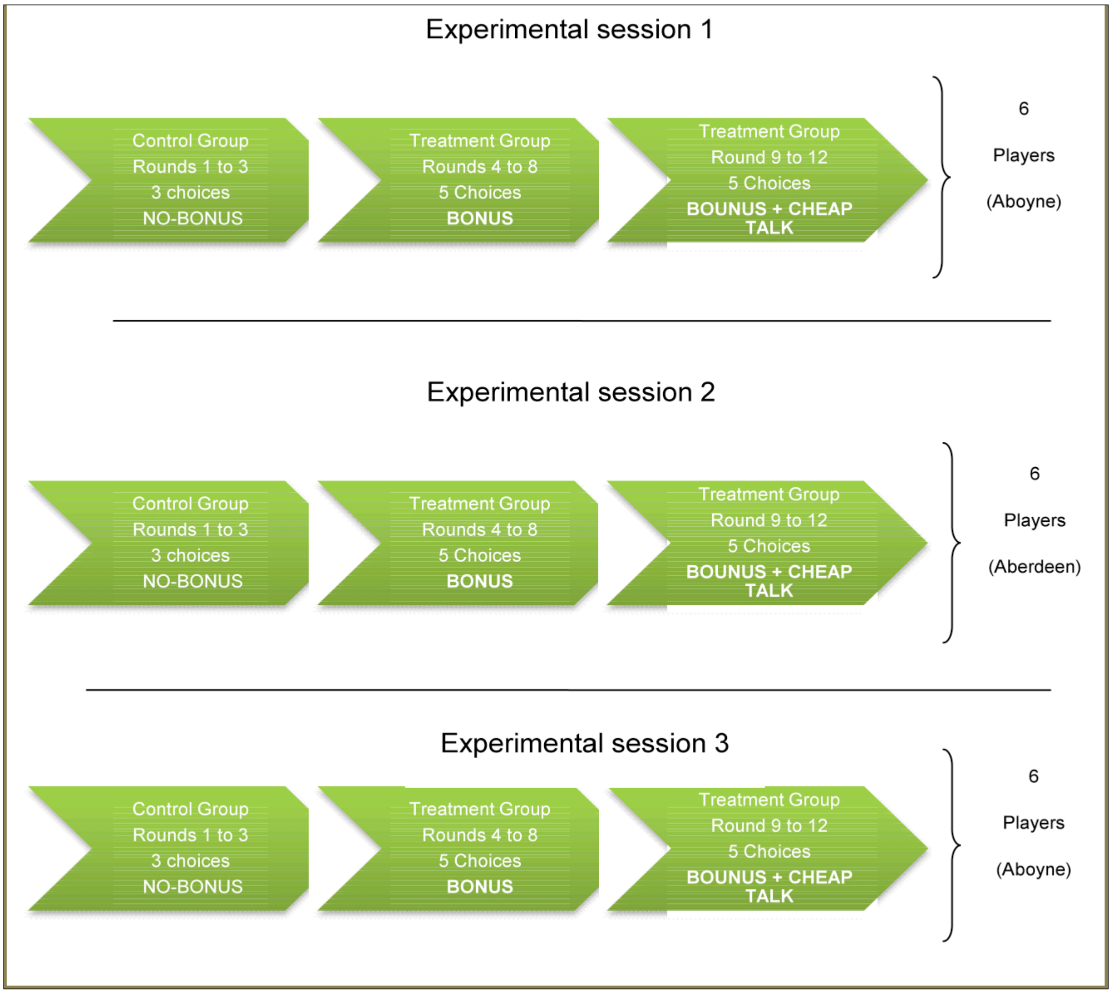


Figure 5.2 Experimental sessions showing rounds, number of players and location.

Control rounds (1 to 3). For the control rounds the 'landscape' was represented through a grid of 24 'parcels' of irregular sizes (each parcel had a different number of adjacent parcels but each player had the same total number of adjacent parcels and the same chances for cooperating). These 24 parcels were subdivided into sets of four parcels, with each set allowing owners an equal chance to cooperate with the owners of neighbouring parcels. Each player was randomly allocated a set of four parcels.

The four parcels allocated could be in one block of adjacent parcels or distributed in different subsets across the grid/landscape. This reflected the reality on the ground in Deeside, where the operations of any given land manager could be carried out on holdings (either in direct ownership or as tenanted land) which were grouped in a single area or scattered across different areas.

All participants were allocated two high quality parcels of land (HQP) and two low quality parcels of land (LQP) for production of food or fibres. They all had access to the same payoffs, which were based on 'earning' points (see table 5.1). In order to allow the experimental session to indicate what players' (land managers) preferences were, I decided to give players the chance to earn 'money points' and/or 'conservation points'. As such, I did not constrain their answers to maximising only money if this was not their preference (thus avoiding biasing the results).

After each round, land managers counted the total of their earned payoff points. However, since the games simulated running a 'business' (participants played their real life role, that is land managers running a business) players had to show a certain 'economic' performance, which I established at earning '≥ 30' money points in each round. A Player needed to reach '≥ 30' to continue in business. When players had '< 30' they were declared bankrupt and the round was annulled. However, players were allowed to continue to play the following rounds. In other words, the round was cancelled for them in terms of gaining points, but the results of these rounds were included in the data produced for analysis. At the end of the game, I aggregated the number of points players earned in each round, but did not take into account the rounds with less than 30 points. In this sense the game does not reflect a real-time progression as there is no path-dependency from one round to another.

In table 5.1, I present the payoff that players received. The numbers were calculated as a proportion of what land managers would have earned by producing only commodity on high quality land. In other words, I assumed '1' as the total maximum number of money points for one choice (i.e. commodity production in HQP) and proportions of this for all other choices, therefore:

If HQP = 1 then LQP = 0.6	for commodity production
and HQP = 0.8 and LQP = 0.7	for AES
and HQP/LQP = 0.5	for ES

I assumed that players maximised their short-term self-interest and, therefore, would not contribute and pay the cost of providing biodiversity services when they chose commodity production only. Players willing to maximise their returns, and who did not have any interest in the provision of public goods, would choose commodity production in HQP. Players who were conservation-oriented would choose ES in either high or low quality parcels, because it implied complete conversion of the parcel (for instance, into forest or into a pond) for biodiversity services. Based on this information, in this game players received more points by applying for AES in LQP than by choosing commodity production, as table 5.1 shows.

Players earned conservation points according to their choices and level of commitment to biodiversity delivery. Therefore, when players chose commodity they did not earn conservation points; however, with ES players earned the maximum number of conservation points (3 points). With AES players earned 1 conservation point. I assumed that conservation services were the same in high quality and low quality land, as table 1 shows.

	Commodity		**AES**		**Environmental service**	
	Money Points	Conservation Points	Money Points	Conservation Points	Money Points	Conservation Points
Land Quality High	10	0	8	1	5	3
Land Quality Low	6	0	7	1	5	3

Table 5.1: Payoff for control rounds (1 to 3).

Treatment rounds (4 to 8) had the same number of parcels and the same payoffs (a grid of 24 parcels of irregular sizes), so players continued with the same resources. These rounds differed from the control rounds in the introduction of the '1-2-1 coordination bonus' for AES and PES options.

It is important to note that between rounds players could see the aggregate results of their choices, thus allowing them to compare their outcomes between rounds. As such, although there was no real-time progression with a path-dependency from one round to another, an adaptive learning process was allowed to take place throughout the game (choices from the previous round could condition players' choices in subsequent rounds).

	Commodity		Factor B [bonus]		Environmental service [bonus]	
	Money Points	Conservation Points	Money Points	Conservation Points	Money Points	Conservation Points
Land Quality High	10	-	8 [12]	1 [3]	5 [10]	3 [5]
Land Quality Low	6	-	7 [9]	1 [3]	5 [8]	3 [5]

Table 5.2 Payoffs for treatment rounds (4 to 12)

In table 5.2, I present the treatment rounds (4 to 12). In these rounds players had the same options as the control rounds, plus 2 additional options. The new options gave players the option to earn extra points when they chose '1-2-1 coordination bonus' and other players chose the same in two adjacent parcels: AES + 'bonus' or ES + 'bonus'. For instance, if two players (X and Y) with adjacent parcels chose AES + 'bonus', 'player X' in high quality land and 'player Y' in low quality land, then they both earned the 'bonus' according to land quality: 'player X' gets 12 money points and 3 conservation points and 'player Y' gets 9 money points with 3 conservation points. However, if one of the players defects their utilities are altered accordingly. If, for example, player Y defects then the points earned are as follows: 'player X' earns 8 money points and 1 conservation point (rather than the 10 money points he could earn by choosing commodity, or 12 money points by coordinating choices with another player); 'player Y' earns 5 money points and 3 conservation points (rather than 6 by choosing commodity or 9 by coordinating choices).

In rounds 4 to 8, players were not allowed to talk to each other and they made simultaneous decisions. Therefore, players had to decide if they were ready to cooperate by choosing the '1-2-1 coordination bonus' incentive without knowing about their neighbour's choices.

In rational decision-making the assumption is that players will maximise their expected utilities (money points). In this game, allocating commodity, commodity for HQP and AES, AES for LQP were the *dominance* solutions because players were better off by choosing commodity and AES regardless of what other players chose. It is also payoff-dominant and is the secure highest minimum set of values that a player can have. In other words, this represents the set of strategies that maximises the smaller earning that can be made with full trust and confidence from a player.

The equilibrium AES + 'bonus', AES + 'bonus' is Pareto dominant because it is better than any other choice (ES + 'bonus', ES + 'bonus' or commodity, commodity) and is the best choice for all players (in terms of money points). However, this choice requires trust in others, and although cooperation pays it is risky. In this *assurance game* players will only choose '1-2-1 coordination bonus' if there is a high probability that others will choose the same (ES + 'bonus', ES + 'bonus' or AES + 'bonus', AES + 'bonus'). Strategic uncertainty arises from the conflict between the players' common motives: players want to coordinate (on '1-2-1 bonus', '1-2-1 bonus') but also want to avoid the risk of getting a lower return (8 or 5 rather than 10 or 12 points) if the other player does not choose to cooperate (see figure 5.3). Choosing AES + 'bonus', AES + 'bonus' or ES + 'bonus', ES + 'bonus' is a 'risk-dominant' strategy.

		Other player A’s parcel 1 (high quality)		
		AES + ‘bonus’	ES + ‘bonus’	Commodity
Player’s B’s parcel 1 (high quality)	AES + ‘bonus’	$\underline{12}$, $\underline{12}$	8, 5	8, 10
	ES + ‘bonus’	5, 8	$\underline{10}$, $\underline{10}$	5, 10
	Commodity	10, 8	10, 5	$\underline{10}$, $\underline{10}$

Figure 5.3 Normal-form game. The matrix shows the return for land managers for high quality parcels for the ‘bonus’ and commodity production and Nash equilibriums (underlined).

In figure 5.3, players can allocate ‘bonus’,‘bonus’, which is a pure-strategy Nash equilibrium. The choice commodity,commodity is also a pure-strategy Nash equilibrium. In Nash equilibriums players do not benefit from changing their strategies if other players do not change their own strategies. As the table shows, the best strategy for players is to coordinate their choices.

Finally, in treatment rounds 4 to 8, once players had allocated their parcels, I revealed the choices made by all other players. Players were then able to see what their neighbours had chosen and count the number of points they earned.

Treatment rounds with cheap talk (*9 to 12*). After round 8, I allowed players to collude and bind agreements (through ‘cheap talk’ which is a costless action). I revealed information about all parcel ‘owners’. Players found out who their neighbours were and agreed if, and with whom, they wanted to cooperate, and for which parcels. In addition, I restricted their choices by asking players to have at least one parcel under commodity.

5.3.1 DATA

Players registered their choices on a sheet designed for the experiment: this was included in the envelope of materials I gave to participants at the beginning of the experimental session. Players used the same sheet to note the sum of their points per round. I entered all the information in an Excel spreadsheet in CSV (Comma delimited) format, which allowed me to use the files with 'R' software. I entered the following variables: experimental session, round number, test game (control, 'bonus' and 'bonus' with cheap talk), player number, type of tenure of the player (in real life), land capability (land quality), parcel number, parcel choice and money and conservation points (this information for each of the four parcels) and total number of money and conservation points earned (in Appendix F I present an extract of this information). With this information I carried out descriptive statistics and decision trees using classification and Regression Trees (CART) (Breiman et al., 1984).

Exp.S	RoundN	ID	ChoiceP	ChoicePrev	NPComm	NPAGRI	NPES	NPAB	NPEB	LandC
1	8	1	D	D	0	0	0	4	2	L
1	8	2	D	D	1	0	0	3	0	L
1	8	3	A	A	0	0	0	5	0	H
1	8	4	D	D	1	0	0	3	0	L
1	8	5	D	D	1	0	0	2	0	H
1	8	6	D	D	0	0	0	3	0	L
1	8	7	D	D	0	0	0	5	0	H
1	8	8	D	D	0	0	0	3	0	H
1	8	9	D	D	0	0	0	3	0	H
1	8	10	D	E	0	0	0	3	0	L
1	8	11	D	D	0	0	0	3	0	L
1	8	12	D	D	0	0	0	4	1	L
1	8	13	D	B	0	0	0	3	0	L
1	8	14	C	D	0	0	0	1	3	L
1	8	15	D	D	0	0	0	4	0	H
1	8	16	E	E	0	0	1	1	1	H
1	8	17	E	E	0	0	1	2	2	L
1	8	18	E	E	0	0	1	3	1	L
1	8	19	D	D	0	0	0	3	0	H
1	8	20	D	D	0	0	0	3	2	H

Figure 5.4 Extract of data entered from the experimental sessions for decision trees.

The descriptive statistics allowed me to see what players' choices were and what the consequences of these choices were at the landscape scale. In other words, they indicated how efficient the '1-2-1 coordination bonus' was to encourage cooperation and allowed me to see the patterns created at the landscape scale. This information enabled me to answer my research question, indicated above. For the decision trees I used 'land capability' and 'type of tenure' as predictors and 'test game' as a dependent variable.

I also wanted to understand players' behaviour and establish what the patterns of cooperation were. I therefore carried out decision trees using Classification and Regression Trees (CART) (Breiman et al., 1984). For this component of the analysis I entered the following variables: experimental session, round number, parcel number, present and previous choice of the player in question, and the previous choice of all neighbouring parcels (how many parcels under the different choices) and land quality, as figure 6 shows. Previous choices by neighbouring parcels were used as predictors, while 'present choices' were used as the dependent variable.

5.4. RESULTS

This section comprises three aspects: 1) the results of the landscape patterns given the '1-2-1 coordination bonus' from a landscape ecology stand point; 2) how land managers behave as individuals and as a group from a behavioural game theory standpoint; 3) the consequences of the '1-2-1 coordination bonus' for public policy.

5.4.1. '1-2-1 coordination bonus' and landscape patterns (landscape ecology perspective)

The results showed that landscape scale patterns changed depending on rounds. Control rounds showed more parcels under commodity production. However, it was interesting to see that in all control rounds there were some parcels under AES and ES in the 3 experimental sessions.

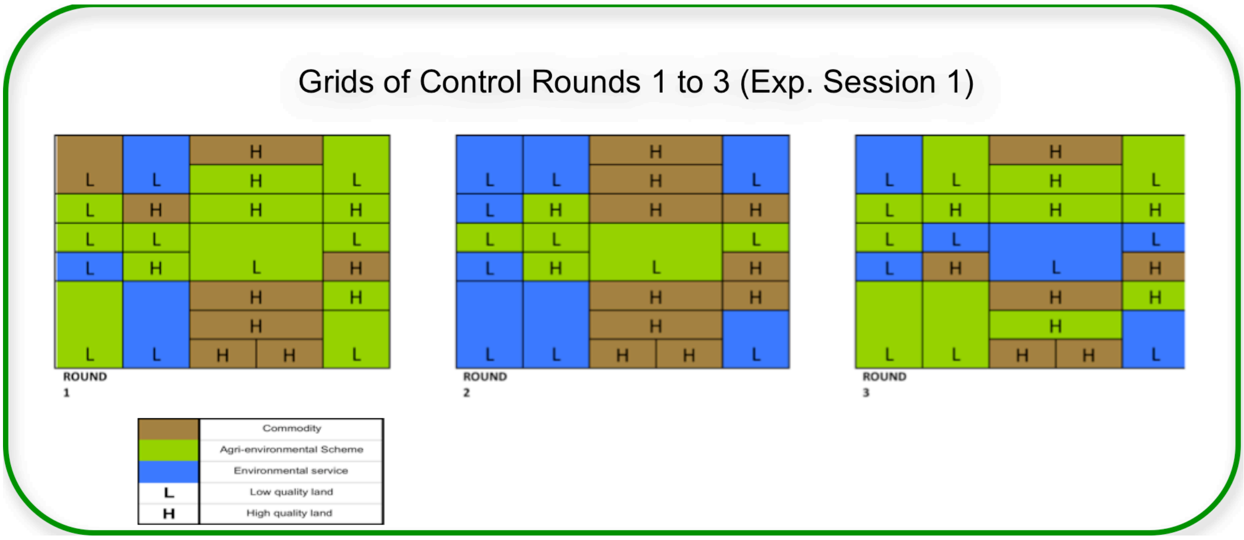


Figure 5.5 Grids of control rounds in experimental Session 1. It shows the choices made by players in the first three rounds (Control rounds: no 'bonus' or cheap talk).

In figures 5.5 to 5.7, I present the 24 parcel grid resulting from the experimental sessions with players' choices and land capability. The choices are differentiated by colours: brown for commodity, green for AES and blue for ES. The land capability is differentiated by letters: 'H' for high quality and 'L' for low quality.

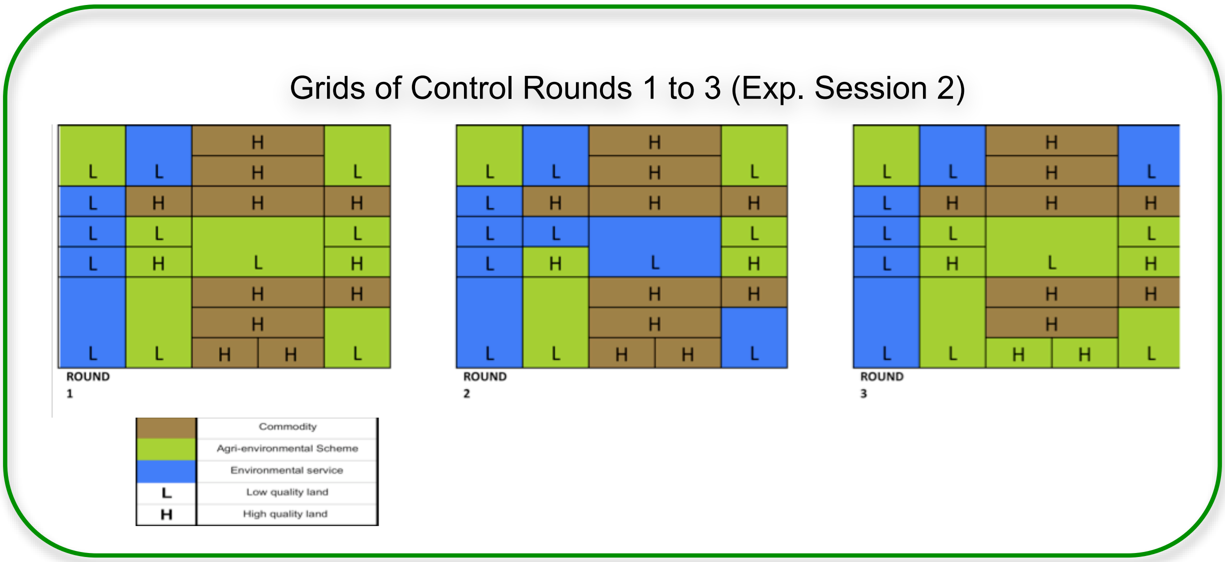


Figure 5.6 Grids of control rounds in experimental session 2. It shows the choices made by players in the first three rounds (Control rounds: no ‘bonus’ or cheap talk).

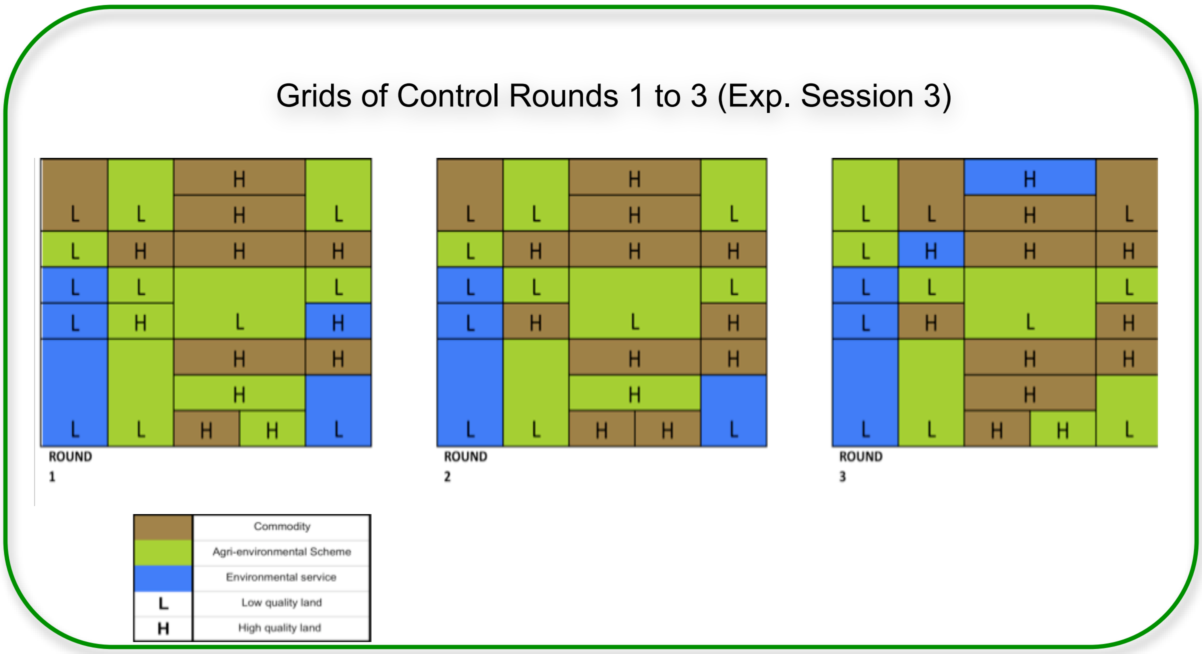


Figure 5.7 Grids of control rounds in experimental session 3. It shows the choices made by players in the first 3 rounds (Control rounds: no ‘bonus’ or cheap talk).

As the figures show, a large proportion of the high quality land was allocated to commodity production and low quality land was allocated to agri-environmental schemes or environmental services. As we can see in the figures, players in experimental sessions 1 (Fig. 5.5) and 3 (Fig. 5.7) changed their choices in each round, except for some of the high quality land, which was constantly allocated to commodity production. In experimental session 2 (Fig. 5.6), players did not alter their choices greatly.

The results show that land managers allocate low quality land to AES. Therefore, rather than a coherent spatial allocation of incentives to achieve biodiversity at the landscape scale, it is an allocation based on land quality (although low and high quality land are both equally valuable from an ecological point of view). In these conditions landscapes are fragmented.

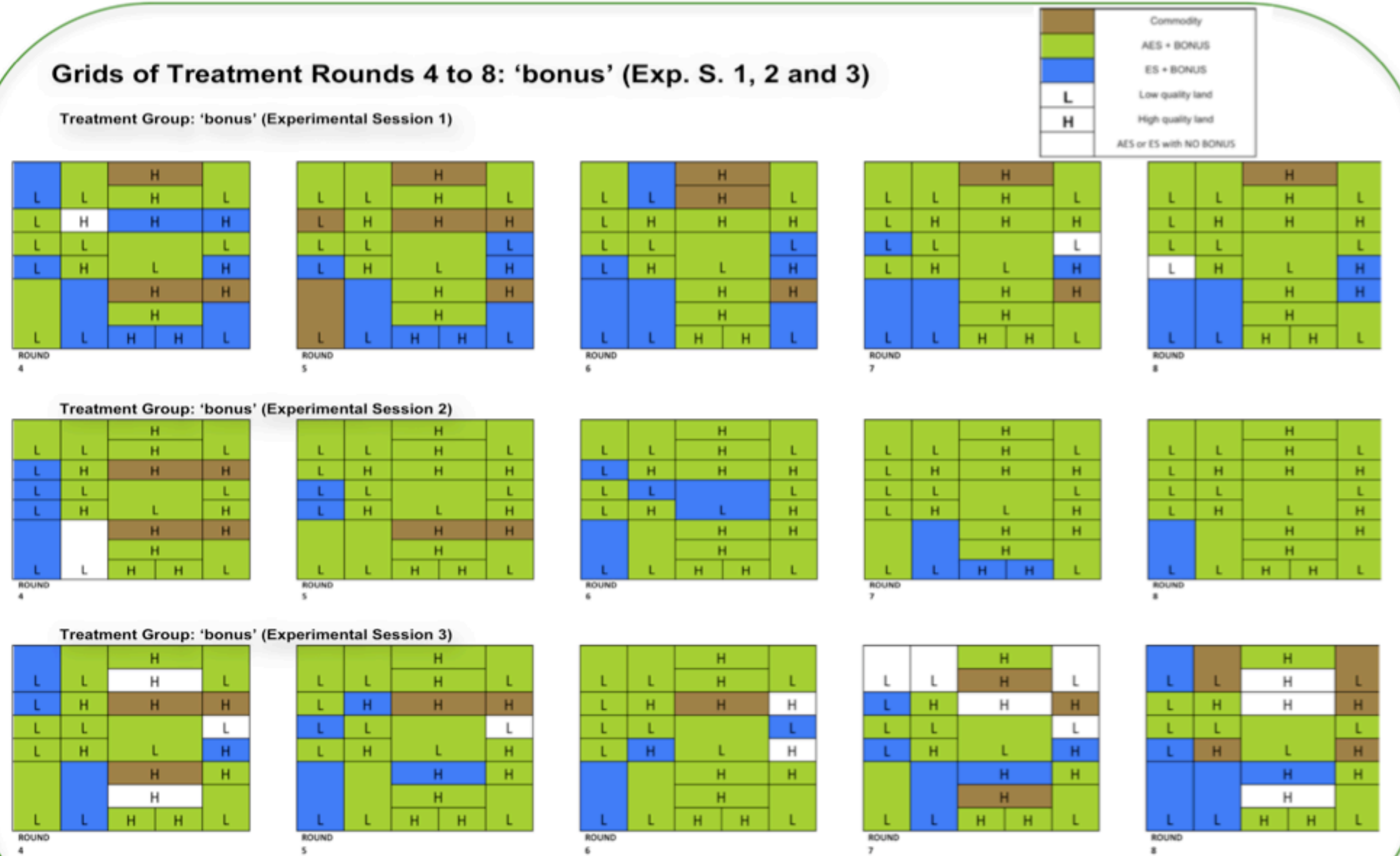


Figure 5.8 Grids of treatment rounds 4 to 8 in experimental session 1, 2 and 3. It shows the choices made by players and land capability ('bonus', no cheap talk).

This fragmentation is exacerbated if land managers change their choices in each round and keep high quality land for commodity and low quality for whatever choice is more convenient (here AES or ES). It is, however, important to mention that players, here land managers (and 3 students), applied for AES or ES. In control rounds players made their decisions individually and information was kept private (i.e. no players were informed about other players' choices).

In rounds 4 to 8, I introduced the '1-2-1 coordination bonus'. Comparing these treatment rounds with the previous control rounds, most players gradually switched to AES + bonus regardless of land capability. In figure 5.8, I present players' choices and land capabilty. Choices are in colours as follows: brown for commodity, green for AES + 'bonus' and blue for ES + 'bonus'. Land capability is identified by letters: 'H' for high quality and 'L' for low quality. In sessions 1 and 2 players gradually changed their allocation of land into green, which designates AES + 'bonus' for both low and high quality land. This is due to other players' choices and the associated payoffs. The brown areas denote parcels allocated to commodity production. Experimental session 3 demonstrated no clear pattern.

As we can see in figure 5.8, no network is formed, rather AES + 'bonus' (green parcels) dominate the landscape. Parcels in white represent AES or ES without 'bonus'. As figures 5.8 and 5.9 show, in experimental session 3 there is no clear pattern: the results of the experiments are very variable and therefore no clear pattern can be derived.

This landscape, dominated by AES + 'bonus', could potentially be beneficial for the environment, for example by creating field margins or hedgerows across the landscape, which would benefit some (small) species such as bumble bees for pollination.

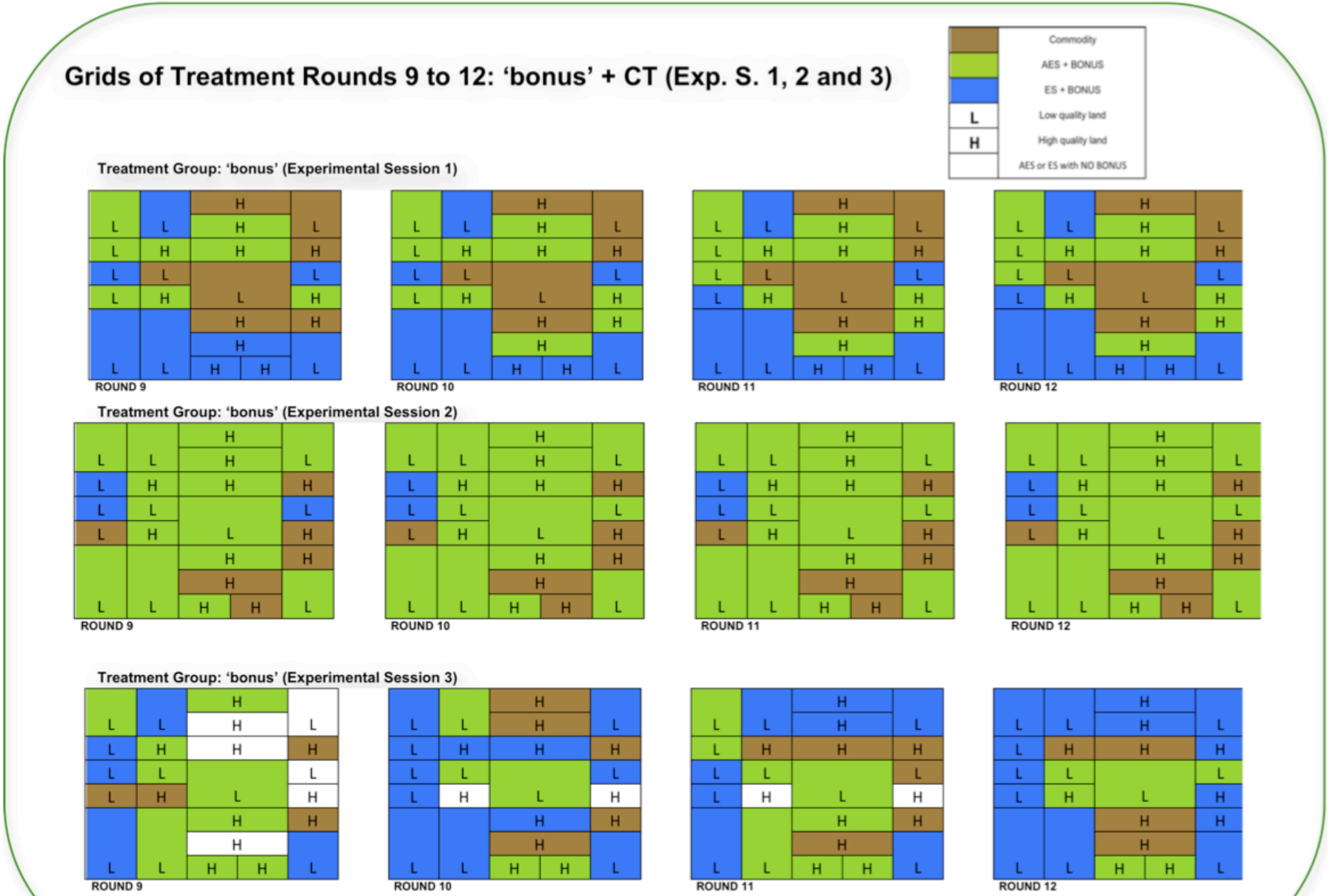


Figure 5.9 Grids of treatment rounds 9 to 12 in experimental session 1, 2 and 3. It shows the choices made by players and land capability ('bonus' with cheap talk)

However, these areas do not offer enough robustness for bigger species (such as, say, capercaillie) as no ecological network is formed. Moreover, it is necessary to investigate whether doing this in the real world leads land mangers to intensify other parts of the parcel to compensate for the loss from the areas under the scheme (green 'parcels' are under AES and therefore commodity is still part of the production. Blue parcels are for services production only). The ideal ecological network, in this context, would be ES + 'bonus' (blue) creating the network and embedded in the AES + 'bonus' (green) scheme that dominated the landscape. In other words, we would ideally have commodity production framed in networks of hedgerows for small species and parcels under forest or other substantial habitat networks for bigger species.

This pattern was clear in experimental session 2 (rounds 6 and 7) and apparent but less visible in experimental session 1. It was interesting to see that in experimental sessions 1 and 3 ES + 'bonus' (blue) was always present, while in session 2 these parcels almost vanished. This is perhaps because the most profitable choice was AES + 'bonus', suggesting players in this session were more 'rational' regarding their choices.

In rounds 9 to 12, when players were allowed to collude and forced to retain at least one parcel under commodity production, the landscape pattern changed again with more parcels under ES + 'bonus' (blue). This is because cheap talk was introduced. 'Cheap talk' is a costless action – in other words players could follow deception strategies – but it appears to have enhanced cooperation between players by coordinating their choices. This was particularly the case for sessions 1 and 3. Only in experimental session 2 was there no change; this group was more profit-oriented and the green parcels represented a higher financial return. In experimental session 2 players followed the same strategies as they had in rounds 4 to 8.

5.4.2. How land managers behave as individuals and as a group (behavioural economics perspective)

The ways in which players, in this case land managers, made decisions and followed strategies is relevant to the understanding of landscape scale patterns and to the policy implications of the '1-2-1 coordination bonus' tested in the experiments.

As noted earlier, all players were offered the same payoffs, therefore, they had equal chances of maximising their money or conservation points. Following the assumption of rationality, a player will maximise their expected utilities. Rationality in this experiment is reached by the allocation of parcels to a set of choices. I present below the allocation of a set of parcels, assuming rational behaviour, when: a) a player aims at maximising their utilities expressed in money points; b) a player aims at maximising their utilities expressed in conservation points.

Allocation of parcels in control rounds (dominance solutions):

- **Money points maximisation**. High quality land to commodity and low quality parcels to AES. Total: 34 money points and 2 conservation points.
- **Conservation points maximisation**. High quality land to commodity production and low quality land to ES. Total: 30 money points and 6 conservation points.

Allocation of parcels in treatment rounds 4 to 8 (with '1-2-1 coordination bonus', assuming there is coordination of choices of players. Pareto dominant):

➢ **Money points maximisation**. All parcels into AES + 'bonus'. Total: 42 money points and 12 conservation points.

➢ **Conservation points maximisation**. All parcels into ES + 'bonus'. Total: 36 money points and 20 conservation points.

Allocation of parcels for treatment rounds 9 to 12 (with '1-2-1 coordination bonus', cheap talk and at least one parcel under commodity, assuming there is coordination of choices of all players. Pareto dominant):

➢ **Money points maximisation**. 3 parcels into AES + 'bonus' and 1 into commodity. Total: 40 money points and 9 conservation points.

➢ **Conservation points maximisation**. 3 parcels into ES + 'bonus' and 1 into commodity. Total: 36 money points and 15 conservation points.

The results show that players' actions were close to 'rational behaviour' only in session 2.

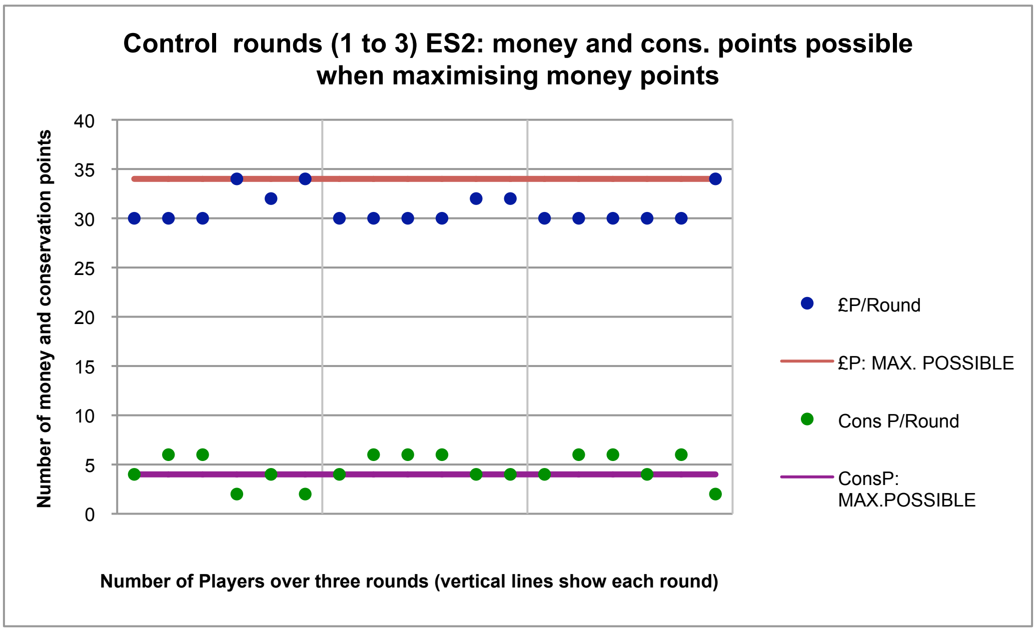


Figure 5.10 Control rounds (1 to 3) of experimental session 2. Choices made by each player for money points (blue) and conservation (green). Each circle represents the total sum of money and conservation points that players had, and the choices they made for each parcel, for each round. The vertical grey lines denote the rounds (3 rounds). The red line marks the maximisation of utilities in money points, and the purple line represents the minimum conservation points that a player earned when they **maximised utilities expressed in money points**. The vertical axis shows the points. The horizontal axis shows the 6 players per round. For instance, player 1 in round 1 earned 30 money points with 4 conservation points; player 2 in round 2 earned 30 money points with 6 conservation points; and player 6 in round 3 demonstrated 'rational behaviour' earning 34 money points (the maximum) and 2 conservation points (the same as player 4 in round 1).

In the control rounds players' choices were made individually, their choices were kept private and there was no strategic interaction. Therefore, the utilities were entirely the result of their individual choices: if they wanted to maximise utilities (money or conservation) they could do so. As figure 5.10 shows, there were only two players who maximised their money points' utilities (as indicated on the red line). In other rounds, 2 players in one round and 3 players in another round decided to maximise their conservation points demonstrating 'rational behaviour' and gaining 30 money points and 6 conservation points (as figure 13 shows). Graph 5.10 shows the general tendency in the 3 experimental sessions, where a few players 'behave rationally' by maximising their money or conservation utilities. I present these results in Appendix G for the control groups. In all sessions, a player was bankrupt on only one occasion (< 30 money points).

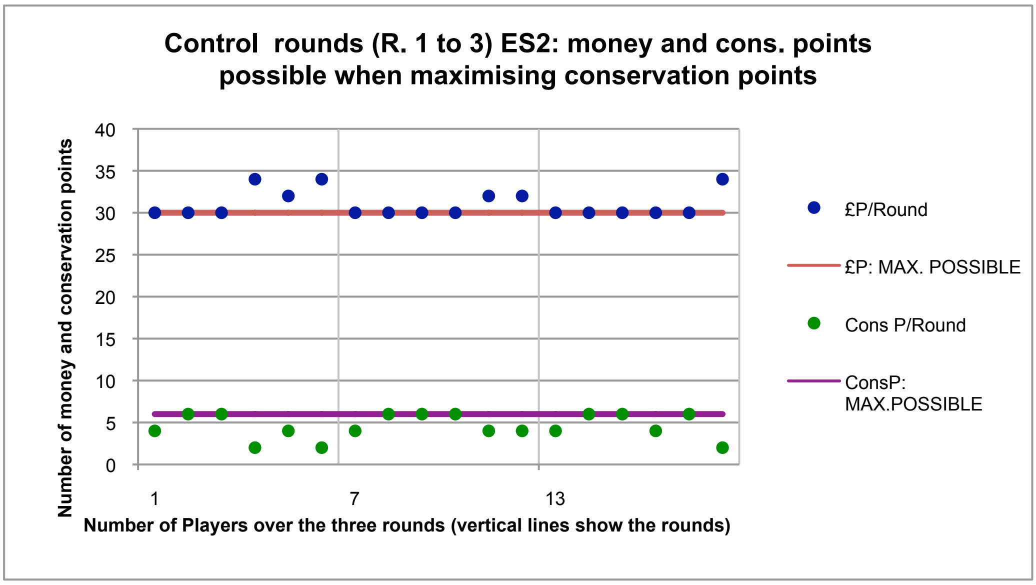


Figure 5.11 Control rounds (1 to 3) of experimental session 2. Choices made by each player for money points (blue) and conservation (green). Each circle represents the total sum of money and conservation points that players had and the choices they made for each parcel, for each round. The vertical grey lines denote the rounds (3 rounds). The red line shows the minimum number of money points that players earned when they tried to **maximise conservation points**. The purple line represents the maximum number of conservation points that a player earned. The vertical axis shows the points. The horizontal axis shows the 6 players per round. For instance, player 3 in round 1 earned 30 money points with 6 conservation points (the rational behaviour for maximisation of utilities expressed in conservation points); player 5 in round 2 earned 33 money points with 4 conservation points.

Figure 5.11 shows that 2 players in one round and 3 players in the other two rounds maximised their conservation points (green circles on the purple line); they achieved 30 money points which allowed them to 'stay in business' and followed a 'rational behaviour' of maximising their conservation utilities.

In rounds 4 to 8, the 'bonus' was introduced. In these rounds of strategic interaction, players had the opportunity to coordinate their choices and increase their productivity when their strategy choice was the same as another player's strategy choice. The dominance solution in these rounds was AES + 'bonus' if other players coordinated their choices. However, players would have secured the highest minimum set of values by choosing commodity and AES without the '1-2-1 coordination bonus'.

The results show that for the case of maximising their money utilities, 4 players in experimental session 2 showed rational behaviour and reached their dominance solution from rounds 4 and 5 to 8 (figure 5.12). In experimental session 1, 2 players reached this point in round 8. In session 3, 2 players in rounds 1 and 3 maximised their money utilities (Appendix H).

The results showed that no single player tried to coordinate their choices to maximise their conservation points, as figure 5.12 indicates and Appendix H shows for sessions 1 and 3.

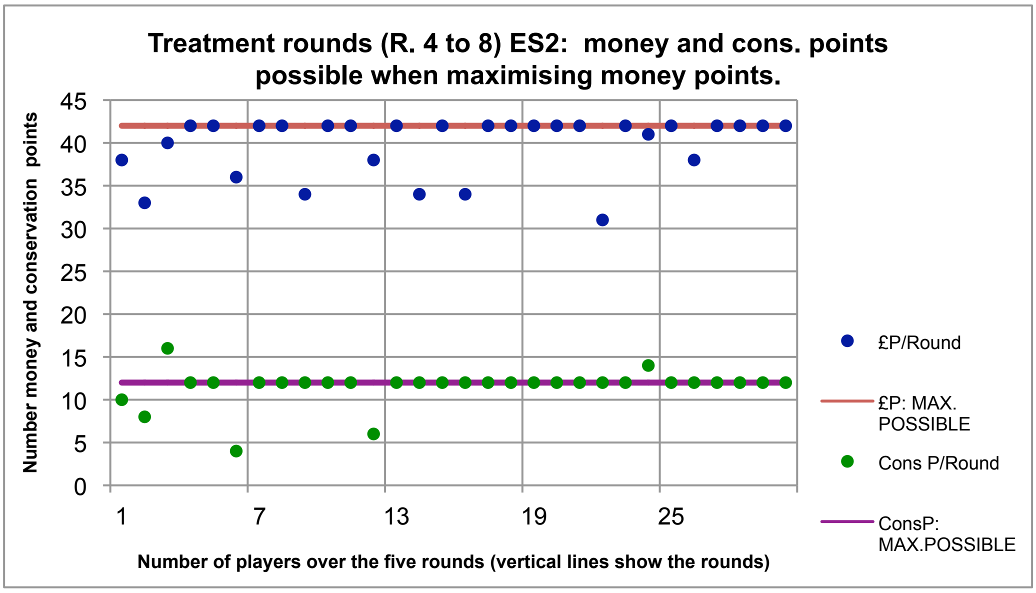


Figure 5.12 Treatment rounds 4 to 8 of experimental session 2. Choices made by each player for money points (blue) and conservation (green). Each circle represents the total sum of money and conservation points that players had and the choices they made for each parcel, for each round. The vertical grey lines denote the rounds (5 rounds). The red line marks the minimum number of money points that players earned when they tried to **maximise money points**. The purple line represents the maximum number of conservation points that a player earned. The vertical axis shows the points. The horizontal axis shows the 6 players per round. For instance, player 2 in round 1 earned 33 money points with 8 conservation points (the rational behaviour for maximisation of utilities expressed in money points); player 3 in round 1 earned 40 money points with 16 conservation points.

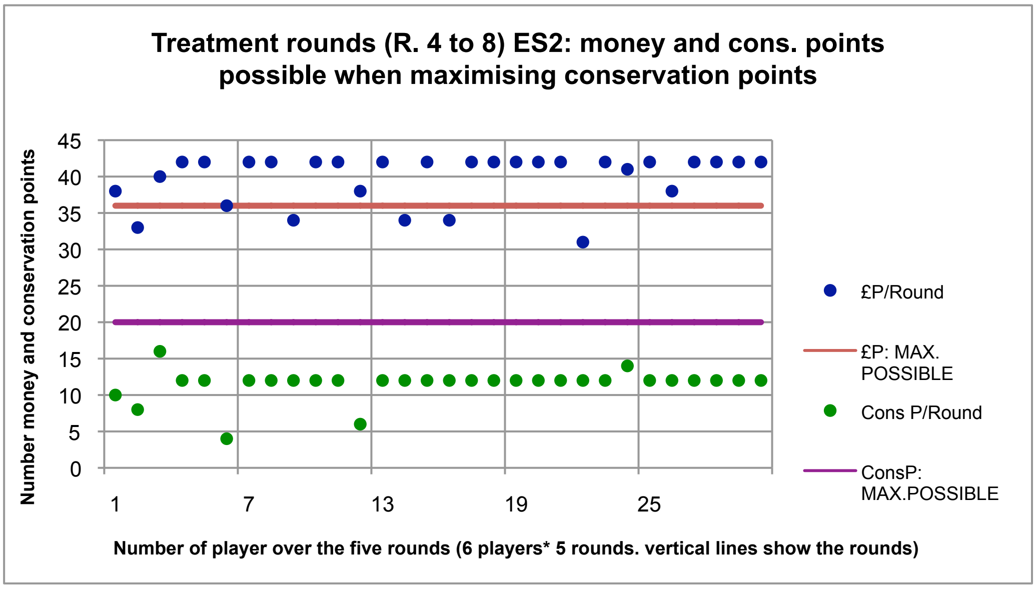


Figure 5.13 Treatment rounds 4 to 8 of experimental session 2. Choices made by each player for money points (blue) and conservation (green). Each circle represents the total sum of money and conservation points that players had and the choices they made for each parcel, for each round. The vertical grey lines denote the rounds (5 rounds). The red line marks the minimum number of money points that players earned when they tried to **maximise conservation points**. The purple line represents the maximum number of conservation points that a player earned. The vertical axis shows the points. The horizontal axis shows the 6 players per round. For instance, player 2 in round 1 earned 33 money points with 8 conservation points (the rational behaviour for maximisation of utilities expressed in money points); player 3 in round 1 earned 40 money points with 16 conservation points.

Figures 5.12 and 5.13 clearly show that most players in session 2 showed rational behaviour where they maximised their money points. These results contrast with other sessions where players did not coordinate their strategic choices and some preferred to secure their earnings and/or diversify their choices. Figure 5.14 and Appendix H show the results of experimental session 1.

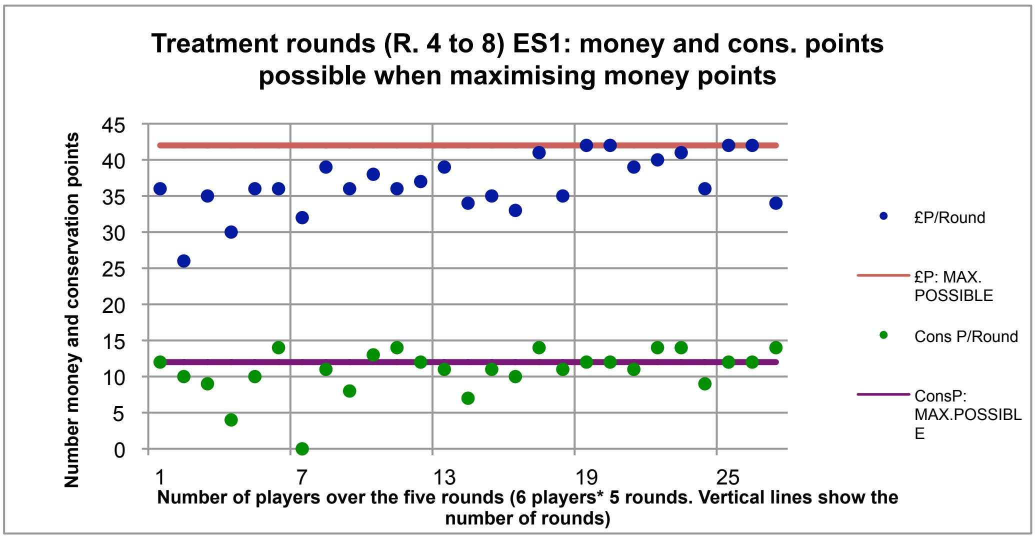


Figure 5.14 Treatment rounds 4 to 8 of experimental session 1. Choices made by each player for money points (blue) and conservation (green). Each circle represents the total sum of money and conservation points that players had and the choices they made for each parcel, for each round. The vertical grey lines denote the rounds (5 rounds). The red line marks the minimum number of money points that players earned when they tried to **maximise money points**. The purple line represents the maximum number of conservation points that a player earned. The vertical axis shows the points. The horizontal axis shows the 6 players per round. For instance, player 1 in round 1 earned 36 money points with 12 conservation points.

The outcome of the experimental sessions showed that no single round demonstrated Pareto dominance, despite the fact that a number of players behaved rationally (especially in session 2).

For all 3 sessions, in rounds 4 to 8 only 7 players out of 18 progressively reached their dominance solution and maximised their utilities in money points. Some of them reached this point in round 4, others in round 7, but all of them gradually found the maximisation point and once there maintained same strategy over the remaining rounds. These results suggest that those players were willing to coordinate their strategies with their neighbours (and actively looked to do so) and, consequently, were willing to risk a loss if their neighbours did not want to cooperate.

These players trusted other players and took more risks. Other players did not maximise utilities and did not demonstrate a ‘rational behaviour’ of maximisation, they did not trust others or were not willing to take risks. However, since their earnings depended on other players’ strategic choices, in some cases even if they wanted to maximise their earnings it was not possible as they were affected by their neighbours. In Appendix J, I present the figures showing individual choices for the 18 players.

In the last 4 rounds (9 to 12) of the experimental session players were allowed to collude, but their choices were constrained as at least one parcel had to be allocated to commodity production. Players decided whether or not to cooperate, and identified which neighbours they wanted to cooperate with.

The results are very different from one experimental session to another. However, again in experimental session 2, players behaved more ‘rationally’ than in the other sessions. This session clearly showed a strategy of maximisation (money points). It was interesting to observe that, when players were able to collude, once they had reached an agreement they kept the same strategy for the rest of the rounds (as figure 5.15 shows). This result suggests that once ‘uncertainty’ is removed and players are able to trust others, cooperation becomes easier. This is confirmed by the results I presented in previous chapters where I considered collaboration practices. Land managers tend towards cooperation if they have a common interest. In this case, the interest in common would be to earn the '1-2-1 coordination bonus' (in money and/or conservation points).

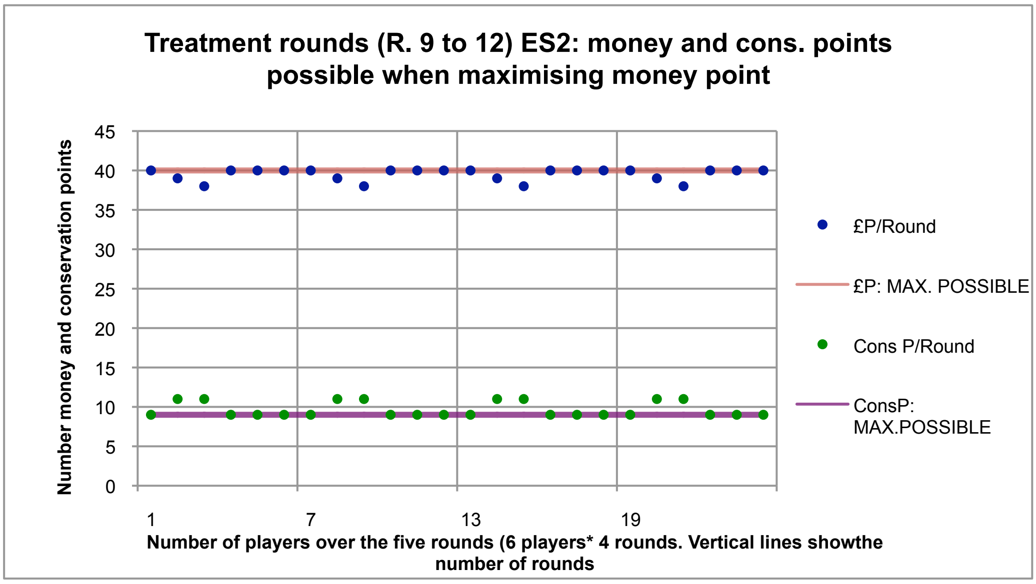


Figure 5.15 Treatment rounds 9 to 12 of experimental session 2. Choices made by each player for money points (blue) and conservation (green). Each circle represents the total sum of money and conservation points that players had and the choices they made for each parcel, for each round. The vertical grey lines denote the rounds (5 rounds). The red line marks the minimum number of money points that players earned when they tried to **maximise money points**. The purple line represents the maximum number of conservation points that a player earned. The vertical axis shows the points. The horizontal axis shows the 6 players per round. For instance, players 4, 5 and 6 in round 1 earned 40 money points with 9 conservation points (maximisation of utilities in money points) and they kept the same strategic choices over the remaining 4 rounds.

In sessions 1 and 3, players changed their strategies in each round, suggesting that they chose to cooperate with different neighbours in each round or decided to change the allocation of their parcels every time. In sessions 1 and 3, players were closer to maximising their conservation utilities. I present the figures in Appendix I.

I analysed the data to interpret what individuals chose to do and how they allocated their parcels. As noted earlier, some players took more risks than others and some players behaved rationally by maximising their utilities in money points or, more rarely, in conservation points. I also analysed the results of the behaviour of the group and considered how players influenced other players' choices. I ran decision-trees (see section 5.3.1), for rounds 4 to 8.

The results show two meaningful groups of players: a) **self-reliant** and b) **other-dependent.** The **self-reliant** group were those who chose AES or ES + 'bonus' predicting that others would do the same (assurance game) and, therefore, aimed at maximising their utilities. These players trusted their neighbours by choosing a 'risk-dominant' strategy of AES or ES + 'bonus'. They could have chosen instead to secure the highest minimum set of values that a player can achieve.

The **other-dependent** group, were those players who made their decisions based on what others had chosen. According to the results, other-dependent players will change their decision if, and only if, there are more than 2.5 neighbours that have chosen differently from them (i.e. when other players choose AES + 'bonus', then they will adopt the same strategy as their neighbours). I present the results in figure 5.16.

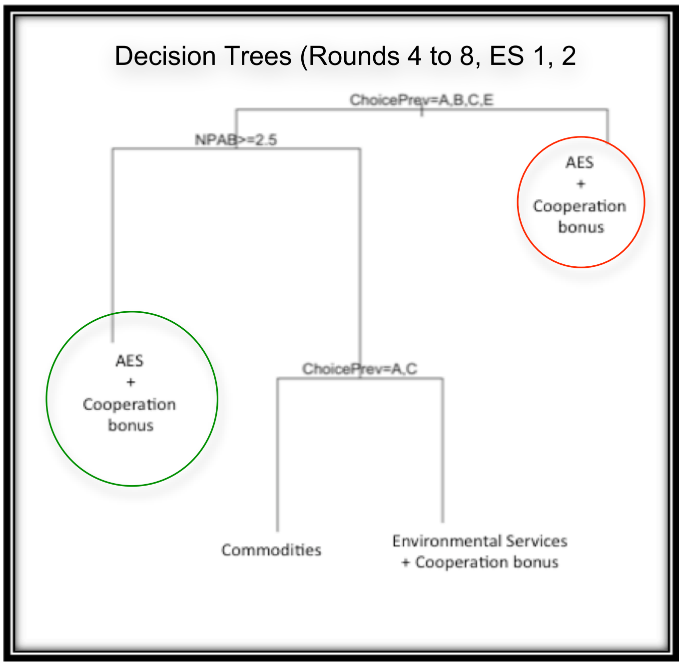


Figure 5.16 Decision tree for rounds 4 to 8 for all experimental sessions. Looking at the decision tree, the self-reliant group includes those players who chose AES + 'bonus' (red circle, to the right as we see the figure); all other players are at the left of the figure. Within this subgroup, players that are more other-dependent are the subgroup at the left of the figure (green circle) and all other players are at the right. The last subgroup on the right shows all those players who have chosen option '*A*' (commodity production) from the beginning: these players would not change their choices, regardless of what other players have chosen. Behaving along similar lines are those who have chosen option '*E'* (environmental services + 'bonus') from the beginning and will not change their choice no matter what others chose.

5.4.3. The '1-2-1 coordination bonus' and its consequences for public policy

The results show interesting information that could inform public policy on decisions about conservation and improve existing economic incentives. Information about players' choices and their consequences for policy are presented below.

In order to establish what players' choices were, I ran a decision tree for decision-making at individual levels, taking into account the following variables (as indicated in section 5.3.1): type of game, land tenure and land quality as predictors; players and their choices as the dependent variable. I present the decision tree in figure 5.17 for all players in rounds 1 to 8 (control and treatment groups with '1-2-1 coordination bonus').

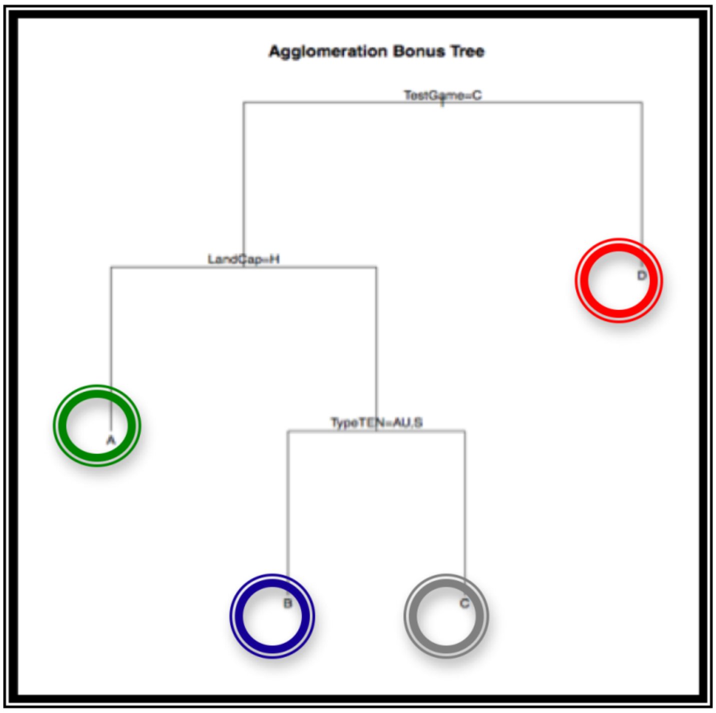


Figure 5.17 Decision-tree for all rounds for the 3 experimental sessions. The figure shows that a group of players chose *'D'* AES-'bonus' scheme (red circle). A subgroup based their decisions on the land quality of their parcels: high quality land was allocated to *'A'* commodity production (green circle). For all other players, and for all other land qualities, players changed their decisions based on the type of tenancy they had: owners of small properties tended to choose AES without the 'bonus' (blue circle) and all other players chose ES without the 'bonus' (grey circle).

The decision trees showed that a group of players chose *'D',* the AES + 'bonus' scheme, as the scheme offered a good reward. Players from another subgroup were found to base their decisions on the land quality of their parcels: in the majority of cases, the high quality land was allocated to *'A'* which represented commodity production. Finally, for all other players, and for all other land qualities, players changed their decisions depending on the type of tenancy they had: in the majority of cases, owners of smallholdings chose AES without the 'bonus' and all other players chose ES without the '1-2-1 coordination bonus'.

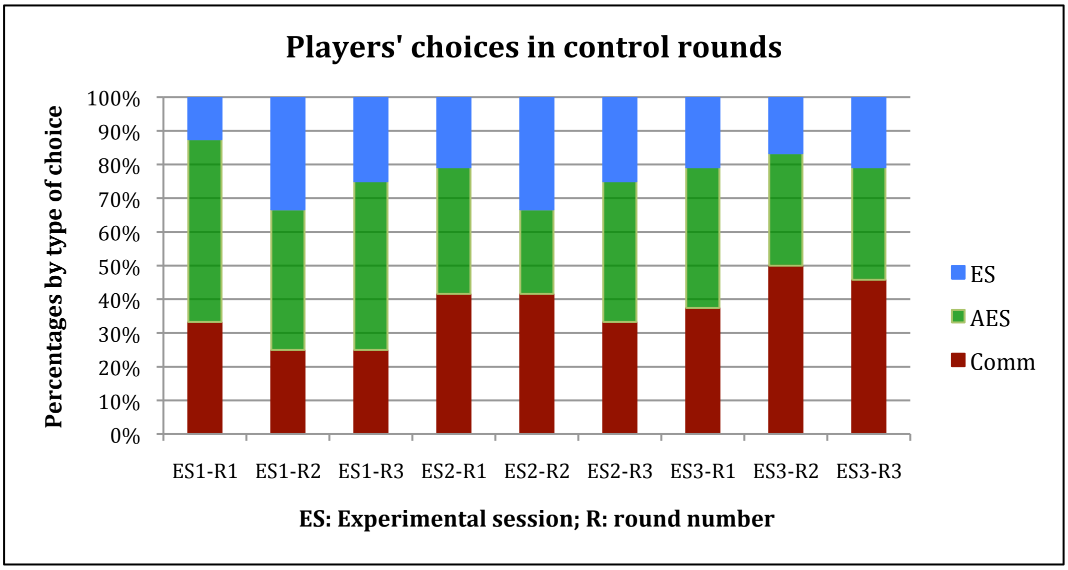


Figure 5.18 Allocation of parcels by experimental session. The vertical axis shows the experimental session (ES1 starting at the bottom of axes) and the rounds (R1) for control rounds in sessions 1 to 3 (e.g. ES1-R1 reads: Experimental Session 1 – Round 1; ES2-R2: Experimental Session 2- Round 2, etc.). The horizontal axis shows the percentages of land allocated to each of the three choices players had in control rounds. Red indicates parcels allocated to commodity, green shows parcels allocated to AES and blue indicates parcels allocated to ES.

When examining how players allocated their parcels, the results show that in all experimental sessions and all rounds players chose all options available to them: commodity, AES and ES, with or without the '1-2-1 coordination bonus' scheme. In the control groups (rounds 1 to 3), only five high quality parcels were allocated to areas other than commodity production. Almost all low quality land parcels were allocated to AES or ES. In experimental session 1, parcels allocated to commodity production represented between 25% and 35% of the total allocation of parcels to all choices; in experimental session 2, 35% and 42% of the total allocation was to commodity production; and in session 3, between 38% and 50% of the total allocation of parcels was to commodity production, as figure 5.18 shows.

Allocation of parcels to commodity production changed dramatically when the '1-2-1 coordination bonus' was introduced. As figure 5.19 shows, players allocated high quality and low quality parcels to AES or ES + 'bonus', reducing the commodity production in some cases to 0% of the total allocations or to 25% in other cases. This suggests that if there was a '1-2-1 coordination bonus' incentive, land managers would be willing to change their production practices by taking up the scheme AES or ES + 'bonus'.

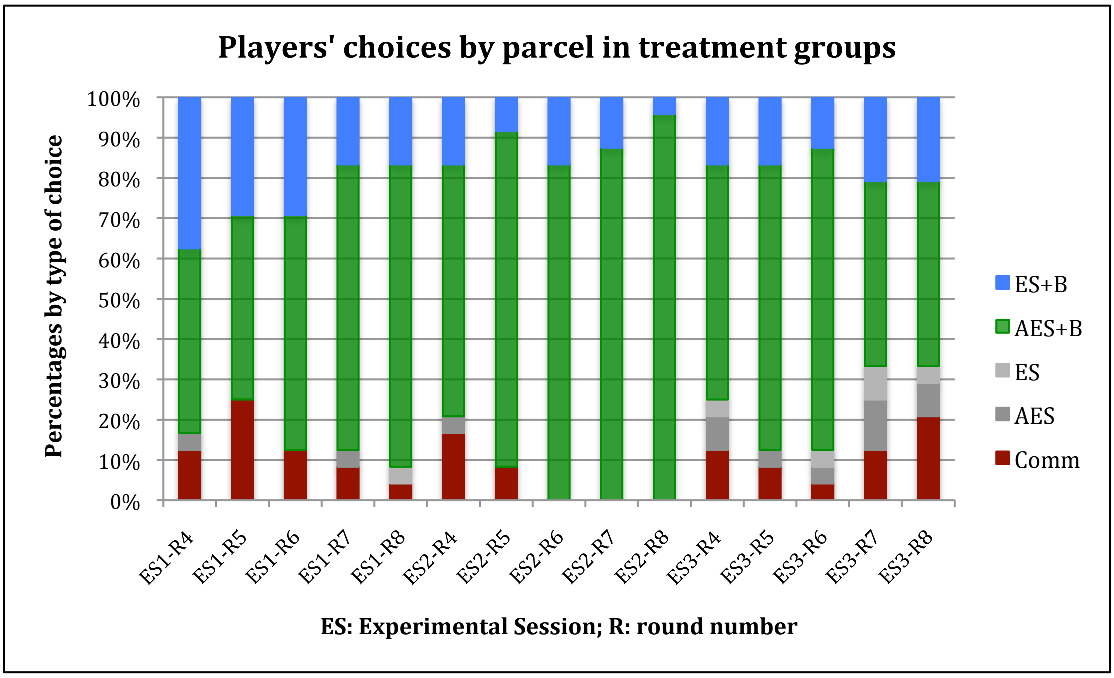


Figure 5.19 Allocation of parcels by experimental session. The vertical axis shows the experimental session (ES1) and the rounds (R4) for treatment rounds 4 to 8. The horizontal axis shows the percentages of land allocated to each of the five options players were given. Red indicates parcels allocated to commodity, green shows parcels allocated to AES + 'bonus' and blue indicates parcels allocated to ES + 'bonus'; grey shows parcels allocated to AES or ES without the 'bonus'. For instance, in experimental session 2 (ES2) rounds 6 and 7 (R6 and R7), players allocated 93% and 95% of the parcels to AES + 'bonus', 13% and 5% to ES + 'bonus' and 0% to commodity. It is important to note that AES + 'bonus' allows commodity production.

More generally, the figures presented in this section suggest that public policy and AES could potentially be targeted towards low quality parcels of land in a coherent manner in order to achieve ecological networks development. Alternatively, this could be achieved by an AES scheme, which pays land managers the usual payment (costs of implementation, restore or convert habitats) plus a cooperation '1-2-1 coordination bonus'. In both cases, AES would have to be targeted.

5.5 Discussion

This chapter has drawn attention to a number of points that were raised by addressing the research question (to test an economic incentive for cooperation) and related research aims. These points relate to 1) behavioural game theory, 2) cooperation through a '1-2-1 coordination bonus' for landscape scale management, 3) challenges in the design of a '1-2-1 coordination bonus', 4) opportunities for public policy and 5) the method design used in this research. I discuss these below.

5.5.1 Behavioural Game Theory

When the '1-2-1 coordination bonus' was introduced, land managers played a Pareto-dominant strategy, particularly in experimental session 2. According to the literature, these players were more rational than others who did not play the 'bonus' in the first instance. In session 2 it was clear that players maximised their money utility by choosing the 'bonus' scheme. This tendency is confirmed by looking at the results presented where no player tried to maximise their conservation utilities *per se*. This corresponds to what Wightman (1996:15) was referring to when he used the phrase 'corporate investors' to describe landowners who are interested in the profit and capital gains that can be made through financial support, rather than being interested in the purpose of the support (for instance farming, forest AES or other).

Players reached an agreement faster when 'cheap talk' was introduced (although this is a costless action), but even in these rounds an ecological network was not achieved. This suggests that once 'uncertainty' is removed and players are able to trust others by talking, cooperation becomes easier. However, I argue that targeting or coordination by third parties is still needed depending on the type of ecological networks to be implemented (I will come back to this point in the general discussion in chapter 6). Again, this differs from what other researchers have found (Parkhurst et al., 2002) as they questioned the coordination reached when cheap talk was allowed. By contrast, Ostrom et al., (1994) found that face-to-face communication helps to solve the problem of the tragedy of the commons. I found that face-to-face communication reduced the time players needed to reach an agreement, making cooperation easier. Furthermore, because players had different neighbours they had more chances of reaching an agreement with whomever they wanted (as is likely to happen in the real world).

5.5.2 Cooperation through '1-2-1 coordination bonus' for landscape scale management

The '1-2-1 coordination bonus' has potential for achieving landscape scale management. I found that players were influenced by the actions of other players, as may be the case in the real world. The results showed that there were two groups of players: those who were 'self-reliant' and those who were 'other-dependent'. In other words, I could observe two different types of behaviour: players who chose the '1-2-1 coordination bonus' in the first instance; and players who waited to see what the strategies of others were before making a decision. If more than 2 neighbours chose the '1-2-1 coordination bonus' then other-dependent players did the same.

Regarding the spatial configuration, Parkhurst et al., (2002) and Parkhurst and Shogren (2007) found that the ecological network would be achieved through the ‘agglomeration bonus’. However, the authors designed their experiment in such a way that the network was created when players had an accumulative ‘bonus’; that is, players earned higher utilities if they had more neighbours with whom to coordinate their choices. The proposals with the greatest number of contiguous parcels were more profitable if reserved for conservation, regardless of land quality. In contrast to these authors, in the experiment presented here the ‘1-2-1 coordination bonus’ was fixed to one neighbour only. In addition, the only condition was that both neighbours had to have ES + ‘bonus’ or AES + ‘bonus’, regardless of land quality. My results showed that land managers first allocated parcels of low quality land to AES and ES and then, with the implementation of the ‘bonus’, allocated both high and low quality land to these. Allocation of low quality land to AES is known in the literature (Hodge and Reader, 2007); this is because AES’s payments represent a better opportunity cost (Schwarz et al., 2008; Hanley et al., 2012).

The results of the experimental sessions and the land use patterns presented here suggested that although land managers are participating in AES and ES, the implementation of ecological networks calls for coordination by agencies or for other forms of governance. If, and only if, the ‘bonus’ is targeted to a specific area, it could be sufficient to create a targeted spatial configuration. This is because the results showed that the ‘1-2-1 coordination bonus’ is able to stimulate cooperation between different neighbours, or to change their behaviour when their neighbours cooperate.

5.5.3 Challenges in the design of '1-2-1 coordination bonus'

Many 'PES-like' schemes recognised the need for landscape scale but none of them addressed this explicitly. AES are action-based payments (including the action of 'doing nothing') and the calculations are based on income forgone and additional costs.

There a number of issues that have to be addressed before AES payments can compensate for the costs of cooperation:

1. Payments at the regional or community level can be challenging, given that collective action potentially creates social traps and prisoners' dilemma. In contrast, individual payments solve this problem by clearly identifying individual actors and actions (Schwarz et al., 2008).

2. The 'Green Box' criteria of the World Trade Organisation (WTO)[35] established the modalities for calculating payments. This represents an important restriction for the design of the schemes and their ability to deliver environmental services (Blandford, 2001; Brunner and Huyton, 2009; OECD, 2001). These payments are based on income forgone or costs incurred, additional costs and up to 20% for transaction costs. Since payments are limited to income forgone there are various barriers:

    a) Income forgone is normally calculated at the holding or farm scale, per hectare and based on opportunity costs (Schwarz et al., 2008; Hanley et al., 2012). AES payments are calculated on the basis of standard cost approaches,

[35] As a result of negotiations with the WTO, (amongst other drivers) CAP was reformed in 2003 and significantly changed environmental standards and payment subsidies. Cross-compliance was introduced, which is a minimum environmental standard condition for farmers to fulfil in order to receive EU subsidies. In addition, direct payments to support traditional markets and products were considerably changed to subsidies that are identified as non-trade distorting i.e. in tune with the Green Box compliant schemes. 'Green Box' is the terminology used in WTO to identify subsidies that are permitted under the agricultural agreements. Other subsidies are part of the 'Amber Box' which are forbidden subsidies and the 'Blue Box' for subsidies that are tied to programmes that cap production.

using 'typical' or average figures for costs incurred and income forgone, and do not allow for the differences in costs and opportunity costs across farms (Schwarz et al., 2008). The most common method to upscale the payment is aggregation (as is the case of Sweden and PES in the *ejidos*). However, there is a mismatch between the farm scale and the landscape scale needed to provide biodiversity. This creates a barrier for the appropriate design of a '1-2-1 coordination bonus' for two reasons: firstly, because of standard approaches in the calculation, low cost farms enter into the scheme, rather than the parcels needed for habitat connectivity or farms that can offer higher additional biodiversity benefits (Schwarz et al., 2008; Hanley et al., 2012). Therefore, payments do not always reflect the real costs of delivering biodiversity at the landscape scale. Secondly, because other costs, such as cooperation costs, cannot be justified or taken into account at all.

b) Value of the services. Environmental services are valued differently and if their value is higher than 'income forgone' the service is likely not to be provided at all or to be underprovided. In this case, the payment is, again, not reflecting the value of the service. However, the 'value' of environmental and ecosystem services represents a fundamental problem, because there are no markets for most of them (values are estimates and indicatives).

c) There is no link between biodiversity and payments. Payments are not a direct consequence of environmental actions and provision.

d) Limitations on payments. ‘Bonuses’ or ‘premiums’ are not allowed (by the WTO criteria) and, therefore, compensation for costs of cooperation, the risks of defection of other farmers, or the costs of trust, cannot be included in the economic incentives payment, thus limiting the possibilities of landscape scale delivery.

According to some authors (Ferraro, 2000), payments-by-result (PBR) are easier to apply at the landscape scale than other interventions, because they can be targeted and have more effects on the selected target areas, such as ecological networks. This is especially the case if there is a base payment and an additional variable payment that could include a premium when management is beyond the farm scale. However, PBR schemes must address issues of an environmental baseline of conservation benefits at the landscape scale, which could make the design more challenging (Schwarz et al., 2008).

5.5.4 Opportunities for public policy

These results are relevant to all policy makers that aim at landscape scale ecosystem services delivery. An incentive aimed at the landscape scale is needed for the delivery of ecosystem services, and the ‘1-2-1 coordination bonus’ I have tested offers a viable option.

From a public policy standpoint, this suggests that costs of coordination could potentially be reduced, but a degree of third party coordination would still be needed for two reasons. Firstly, without it a large proportion of land would be covered under AES or ES: this is an unrealistic scenario since there are budget constraints and not all land managers would be able to get the scheme. Secondly, in a hypothetical case of no budget constraints, a degree of coordination would still be needed for the creation of the desired ecological networks. Since, at present, there are no top-down nor bottom-up tools to develop landscape scale conservation management, these results showed both the potential and weaknesses of a 'bonus' incentive.

It is impossible to encompass and simplify the complexity of the real world (without making the analysis meaningless) in the experimental session and, therefore, there is a need for more research to test these methods and the '1-2-1 coordination bonus' scheme. For instance, it would be beneficial to conduct experiments which introduced dynamic payoffs where players' utilities changed with rounds to reflect changes in commodity production prices, rather than a static payoff in which players earned the same and maximised their utilities with the 'bonus' scheme. It is necessary to question whether the AES + 'bonus' could really be competitive with commodity production, and if so under what circumstances. It is important to note that budget constraints were not calculated in these experiments.

Furthermore, because my results suggested that land managers would take the 'bonus' scheme if it were available, it should be asked if, by applying to AES or ES + 'bonus', land managers intensify other parts of their land in order to compensate for the 'loss' under the schemes. In principle, the scope for intensification should be limited for holdings that receive direct payment (Single Farm Payment), and some AES, due to cross-compliance of Statutory Management Requirements and Good Agricultural and Environmental Conditions. In this sense, a 'bonus' scheme should not be a problem in terms of intensification of land uses for commodity production.

5.6 Conclusion

I have presented the results of a lab experiment with land managers. The experiment tested a '1-2-1 coordination bonus' to stimulate coordination amongst land managers for the implementation of ecological networks. The incentive was a 'bonus' paid when two neighbouring players chose the same option.

In this conclusion I would like to highlight three major points:

1. **The 'bonus'**. The '1-2-1 coordination bonus' has potential for achieving landscape scale management. However, there are barriers to the possible design of payments which need to be overcome (for instance WTO limitations). Furthermore, the 'bonus' should be targeted to specific areas or used with some type of coordination.

2. **Effects of rationality versus trust.** 'Cheap talk' (costless action) improved cooperation. Without 'cheap talk' players: a) did not want to maximise utilities; b) did not find the maximisation strategy; c) did not understand the game; d) did not trust their neighbours. When 'cheap talk' was allowed players promptly agreed with whom they wanted to cooperate.

3. **Self-reliant versus other-dependent.** I could observe two different types of behaviour: 1) players chose the '1-2-1 coordination bonus' showing their willingness to cooperate; 2) players waited to see what the strategies of other players were before making a decision: if more than 2 neighbours chose 'bonus',

‘other-dependent’ players would change their strategy and choose ‘bonus’ as well.

These results are relevant to all policy makers that aim at landscape scale ecosystem services delivery. An incentive aimed at the landscape scale is needed for the delivery of ecosystem services, and the ‘1-2-1 coordination bonus’ I have tested offers a viable option.

Chapter 6

Overall Discussion and Conclusion

Landscape scale studies are becoming ever more important in the light of policy demand for Ecosystem Services (Millennium Assessment, 2005). There is an increasing amount of research regarding landscape management in relation to environmental issues from different angles such as planning and social perspectives (respectively Groot et al., 2010 and Brown and Reed, 2012; Bryan at al., 2011; Nielsen-Pincus 2011). I suspect this trend will continue.

There is also an important volume of literature on landscape scale modelling with some authors calling for more integration of the socio-political context in modelling and landscape scale analysis (Ryan, 2011). A new field of study on organisation of farming practices at the landscape scale is also emerging, called 'landscape agronomy' (e.g Schaller et al., 2010). Landscape ecology is the most established discipline studying landscape scale dynamics (e.g. Turner et al., 2001) and has for long time highlighted the importance of management at landscape scale.

Within this body of literature, ecological networks are one of the proposed tools to deliver a number of environmental services which require a landscape scale approach, including conservation (e.g. Ellis et al., 2011; Batary et al., 2012; Dallimer et al., 2010), recreation (e.g Gimona and van der Horst, 2007) and pollination (e.g Carvalheiro et al., 2010; Devoto et al., 2012). To the best of my knowledge, the present work is one of the first studies to offer a view on landscape scale management for the implementation of ecological networks (EN) using a combination of perspectives from social sciences (qualitative interview analysis and experimental economics) while engaging with the literature in landscape and conservation ecology.

Its main contribution is to show that landscape scale management for conservation through the implementation of ecological networks in the Dee catchment:

1) depends strongly on land managers' views and attitudes which are conditioned by property rights;

2) cannot rely only on the type of collaboration promoted by the ACM approach and requires coordination by third parties (public agencies or others) and

3) would be facilitated by the introduction of an economic incentive for neighbouring land managers to cooperate for their implementation.

This research contributes to filling the gap in landscape scale studies from a social science perspective, using a combination of three approaches. Chapters 3, 4 and 5 in this thesis focused each on one of these perspectives: a) Adaptive Co-Management (ACM), b) attitudes to conservation, AES, and cooperation and c) testing economic incentives for cross-boundary cooperation.

The aim of this chapter is to bring these three subjects together, to go beyond each of the approaches mentioned and highlight the contribution this study makes to push to new boundaries the questions addressed in the existing literature on landscape scale management for conservation.

6.1 ECOLOGICAL NETWORKS (EN)

The literature on ecological networks has mainly focused on research by landscape ecologists using GIS and other methods to identify where ENs could best be implemented (e.g Gimona and van der Horst, 2007, Willis et al., 2012; Vannier et al., 2011; Gurrutxaga et al., 2010). A number of publications have also discussed how to implement ecological networks (Jongman and Pungetti, 2004; Bennett and Mulongoy, 2006; Jongman and Bogers, 2008; Barreto et al., 2010; Leibenath et al., 2010; Vimal et al., 2012). Leibenath et al. (2010), for instance, carried out an analysis of trans-boundary cooperation for EN implementation between Germany and other countries and found 34 existing projects. The authors mentioned the need for more knowledge and information exchange and transfer amongst practitioners in order to achieve coordination for ecological networks implementation. This coincides with the results of chapter 3 in this work, in which the review of existing collaborative initiatives and the analysis of the views expressed in land managers' interviews highlighted a lack of shared knowledge as a barrier to the development of Adaptive Co-Management practices for the implementation of EN in the Dee catchment.

Vimal et al. (2012) discuss a collective learning system whereby stakeholders' input should be clearly identified in the process of EN implementation; they indicate that spatial landscape planning would benefit from this process. However, Jongman and Bogers (2008) rightly call for more attention on professional planning (expertise) as part of the process, and indicate the need to move beyond simple identification of stakeholders for the sake of 'stakeholder engagement', a catch phrase which some times doesn't translate into much else than tokenism. This is interesting for me because, as I mentioned in chapter 2, in Scotland planning has little influence on rural land use; therefore, it requires extra effort and expertise from planners to develop ecological networks in this area – and conversely, in the interviews land managers have indicated that they would welcome action by public agencies as a third-party to coordinate conservation actions between neighbouring landholdings.

As discussed in chapter 1, the implementation of ecological corridors is difficult in any country. Many of the existing cases of ecological networks are at different stages of implementation and very few of them are in an advanced stage as is also the case in the UK. Lawton et al. (2010), strongly highlighted the need to include land managers in the implementation of ecological networks. This research responds to this call by contributing to the discussion on drivers and barriers to the inclusion of land managers in this process.

6.2 Landscape scale cooperation, collaboration and coordination.

The case of ecological networks implementation is analogous to other natural resource management issues for which Adaptive Co-Management (ACM) has been developed (e.g Colfer, 2005; Sabatier et al., 2005; Armitage et al., 2007; Berkes et al., 2008; Norberg and Cumming, 2008). ACM has been used in a number of cases where resources are common-pool such as natural reserves and water management (e.g Nadasdy, 2003; Norberg and Cumming, 2008; Schultz et al., 2011; Sabatier et al., 2005; Akamani and Wilson, 2011).

The ACM approach has also been used in conflict resolution on natural resource management (e.g Butler et al., 2011). Although common pool forest resources are not present in my study area (except to a limited degree in the case of the Birse Community), I chose to use ACM because it is one of the only frameworks that explicitly address natural resource management at the landscape scale. Indeed, despite the private nature of land tenure in the study area, the problem of cross-property and landscape-scale protection of biodiversity (as a public good) makes the analogy illuminating despite its limitations. This framework made it possible to simultaneously study collaboration and coordination horizontally and vertically, as I presented in chapter 3.

Other existing frameworks that I considered using for this research included actor-network theory (ANT). ANT maps relations that are both material and semiotic and has been used to understand stakeholders' micro-dynamic collaborations, for instance for rural tourism. Some authors have proposed to use ANT as a 'practical technique' for landscape studies (Allen, 2011). I also considered using the framework proposed by Hagedorn (2002) on cooperation and institutional change (cooperation and coordination for provision of public goods especially from the farming communities). Eventually, I decided to use ACM because the other approaches did not offer the integration of horizontal (across different stakeholders) and vertical (across policies and individual interests) collaboration and cooperation while also taking into account the adaptive cycles of learning-by-doing as ACM does.

For this research ACM as a concept has proved to be useful to analyse the potential of cooperation for conservation and appears to be a promising approach if developed as a skeleton for practice to be used as a process to deliver other Ecosystem Services.

Nowadays, most natural resources are delivered through stakeholders' participation and ACM offers a framework to develop this process.

In this research I have analysed three of the components that are central for the development of ACM: local knowledge, sharing power and evaluation as part of the process of learning-adapting cycles (Sabatier et al., 2005; Armitage et al., 2007; Berkes et al., 2008; Roth, 2004; Becker and Ghimire, 2003; Armitage et al., 2011; Leys and Vanclay, 2011). I used these components as benchmarks to assess the potential of ACM to be developed within a private property context. It is to be noted however that in such a context of property rights and market based agri-environmental payments, ACM contributes to the 'institutional blending' characteristic of the 'neoliberalisation' of rural land conservation arrangements as discussed by Hodge and Adams (2012).

The literature on ACM suggests that local ecological knowledge that is related to cultural aspects makes conservation easier. For instance, Garibaldi and Turner (2004) refer us to the 'cultural keystone species', which may have a material use (food, medicine etc.) but also have a sociocultural use, and therefore have an important role in social dynamics and ceremonies and are often mentioned in narratives. An example of a 'cultural keystone species' is the case of the corn (or maize) in Mexico, especially amongst indigenous groups (Lozada, 2008 and Lozada-Ellison, *in press*), or reindeer among the Sami in Finland (e.g Ingold, 1980). In the case of 'cultural keystone species', not only is an economic meaning attached to species and ecological systems, but also skills, knowledge, social-cultural interests and meanings are derived from them as they give cohesion to social and cultural communities through a specific worldview. This makes it easy to protect such species.

In contrast with these notions, in the Dee catchment my results showed that local ecological knowledge is mainly pertinent to commodity production. Although there are no 'cultural keystone species' as such in Scotland today, more research is needed on the cultural value of the following species: salmon (*Salmo salar*); red deer (*Cervus elaphus*, for cultural aspects associated to this species see Fiorini et al. (2011); red and black grouse (*Tetrao tetrix, Lagopus lagopus scotica*); and capercaillie (*Tetrao urogallus*).

The results presented in this work show that there is often a rupture between cultural-social systems and ecological systems, for example in the management of land mainly as a commodity. I therefore argue that when this is the case, the relationship with natural resources is merely utilitarian and, moreover, value is equated with monetary value. This is because it is stripped of any further cultural or ethical attributes; although such attributes do exist at the level of personal opinions and perceptions, these only have a limited impact on the social and economic structuring of society-environment relations. In this context it is always necessary to pay from the public purse for every service produced because land managers incur the costs of implementing conservation activities, hence the need for economic incentives to pay them to deliver biodiversity. This is in stark contrast with contexts were there are cultural keystone species.

A further difficult barrier to overcome is the lack of 'power sharing' across the catchment (i.e. different parties to the management of a resource being equally interested and proactive in the management, including sharing a similar degree of power in the decision making over resources). Equity of power is an important component for ACM (Kruse et al., 1998) but the literature on the subject has not yet given enough attention to power relations as such (Nadasdy, 2003; Doubleday, 2007). As I have illustrated in chapters 2, 3 and 4, there are differences in property rights and relations between different groups of land managers. The lack of power sharing is deeply rooted in Scottish history. In the study area, property rights shield land managers from the need for common decision-making because these rights are held individually and land managers can decide what they want to do with their land within the rules set by the Scottish Agricultural Law.

Cases of power sharing that echo ACM were found in some instances of management, most notably the Dee River Trust and the Birse Community Trust, (for other cases see chapter 3). In most cases, however, I found asymmetric collaborations, vertical and horizontal power relations, distrust and divergent interests in the same place. To better understand and to compensate for the gap regarding sharing power in the ACM literature (Nadasdy, 2003; Doubleday, 2007; Kruse et al., 1998), I offered a classification of the type of power relations based on interest, power balance and trust. The classification was based on information from the study area and, therefore, it is representative only of the Dee catchment but it could be used for further research. I identified a series of collaborations as being either symmetric or asymmetric – generally depending on whether land managers are from the same land tenure group (symmetric) or not (asymmetric).

This analysis leads me to argue that ACM cannot guarantee the dissolution of asymmetric power relations in the short run. In order to implement ecological networks through ACM it will be necessary to stimulate processes where land managers are more actively involved in environmental cycles of learning-evaluating-adapting management (perhaps in the way Lawrence, 2006 and 2007 suggests). The obvious consequence is that to compensate for this institutional barrier to ACM and ecological networks development, there is a need for other tools such as regulation (e.g. designated ecological network areas) and/ or economic incentives. The creation of institutions that build trust and facilitate voluntary cooperation is also necessary. Often a mixture of the three factors above might be needed: the simple availability of incentives does not seem to be sufficient to achieve public policy objectives as they are currently designed and implemented.

ACM is useful as a theoretical framework to disentangle elements of landscape scale management (horizontal and vertical; ecological and social; also policy relevance); however, as mentioned above, it has limitations in the understanding of power relations. One resolution to this problem became apparent from my interviews. The results from the analysis of these, presented in chapter 3, showed that land managers desired coordination through third parties. In this sense public agencies could play a role to 'bridge' top-down and bottom-up interests, knowledge and balance sharing power relations amongst actors. The role of public agencies is crucial to allow information flows linking local-level land managers and other stakeholders on the ground with high-level national and international institutional policies and laws. Among the cases reviewed in chapter 3 it appears the Scottish Natural Heritage (SNH) is an example of a public agency fulfilling such a role (see Chapter 3).

However in most cases mentioned in this study a limited mutual knowledge of each other's objectives resulted in a lack of trust and asymmetrical relations of collaboration between land managers and public agencies. Land managers tend to have a negative view of public agencies, especially of government institutions in relation with applications to subsidies such as agri-environmental schemes due to the threatening language and possible sanctions imposed to them when missing to comply to the letter of conditions for public funding.

However, land managers and representatives of public agencies all highlighted the need for trusting each other. To reduce the mistrust and the asymmetrical power relationships through adaptive co-management could take significant time and resources. Both of these are scarce for land managers and public agencies. Adaptive co-management cannot guarantee the dissolution of these relations in the short run.

To overcome problems of trust between public agencies and land managers, I propose that some agencies (public or private – for instance consultants already helping with AES applications as mentioned in some interviews) or local governance (as was the case of Birse Community Trust) should take the coordination role.

Processes of common learning through collaborative initiatives and partnerships could also represent a powerful tool to improve asymmetric collaboration between land managers and public agencies, and could in due course result in relations of trust.

I argue that existing collaborative initiatives and cases that resonate with ACM should be taken as a starting point from where to expand ACM to the whole study area for ecological networks implementation. Similar results have been highlighted by other authors who stress the need for partnerships for landscape management of ecosystem services (e.g Goldman et al., 2010; Groot et al., 2010; Leibenath et al., 2010; Vimal et al., 2012; Jongman and Bogers, 2008).

In the process of analysis of ACM, I decided to carry out a parallel analysis focussed on land managers' attitudes which gave me a better understanding of their preferences. The parallel analysis offered a more in-depth insight into land managers' attitudes to conservation, their uptake of AES and the existing cases of cooperation amongst land managers.

As I presented in the results of chapter 4, my findings regarding these views and attitudes were similar to what other authors have observed in terms of motivations and reservations to the uptake of AES (Bishop, 1992; Sandys, 1994; Morris and Potter, 1995; Watkins et al., 1996; Wilson 1996; Brouwer and van Berkum, 1997; Brouwer and Lowe, 1998; Buller et al., 2000; Wilson and Hart, 2001; Walford, 2002). An important difference however, was that land tenure explained, in part, land managers' attitudes to conservation, cooperation patterns and AES uptake. These results came to light perhaps because my interest was on landscape scale management so an obvious consequence was the inclusion of a more varied range of land managers and management activities, beyond the more common focus on generic farmers as is the case of many studies on AES uptake.

However, based on my results I argue that even within the AES literature (e.g Morris and Potter, 1995; Wilson and Hart, 2001) and its inherent farming community focus, farmers should now be identified as land managers in a broader sense, because farming activities are less and less the main, let alone the only, economic activity on the farms. Moreover, current AES involve a range of options some of which are completely disconnected from farming (without minimizing the value of agriculture). My results showed that even when farming plays the most important role in their business, farmers/land managers may see themselves as more than producers of food and fibres and this influences their decision-making regarding conservation. This was clearly the case of some of the owners of smallholdings interviewed.

Indeed, the clusters of answers of land managers based on land tenure showed substantial differences across the three groups of tenants, estates and smallholding owners. The results of the experimental sessions confirmed this.

This shows that the distinctions and labels applied to land managers for research (and for policy) are important as they help to uncover how different attitudes and behaviours are associated with different identities. For instance, the idea of being a 'good productivist farmer' (Burton et al., 2008), which in this study applied mainly to tenants, is reinforced within the group by the affirmation that individuals are 'not interested in conservation' per se, but apply to AES for financial reasons. In contrast, smallholding owners see land more as a place to live rather than as the means to make a living. This is similar to what other authors found (Schramek et al., 1999; Drake et al., 1999; Primdahl, 1999). Consequently, work for conservation on their land is perceived by owners of small holdings as increasing the value of the property both in terms of aesthetic value and also as a potential family asset to be inherited (with the idea that future generations might benefit more of the land management changes for conservation introduced by the current generation). In some cases owners of smallholdings will therefore even prefer to pay for the conservation work from their own pocket rather then go through all the paper work required to obtain a subsidy (AES or FS). This corroborates the findings of other authors such as Siebert et al. (2006) and Kaijonen (2006) and clearly shows that their motivation is not an immediate financial one.

Regarding existing cases of cooperation, the results showed that this was more frequent within, rather than across, each of the land tenure groups. Collaborative practices were frequent among estate managers, especially for habitat management for sporting activities, and among tenants based on mutual help for technical tasks (this perhaps is rooted in earlier forms of exchange of labour found in traditional farming practices).

These results regarding land managers' experience and views of existing cooperation practices corroborate the initial analysis in chapter 3 based on the ACM framework: one limitation to landscape scale cooperation is the prevalence of vertical power relationships and the lack of cooperation across different groups of land tenure. However, most land managers expressed willingness for cross-boundary cooperation and those involved in collaborative practices saw a need for landscape scale coordination for conservation but on the condition that appropriate incentives were in place.

Based on these results, I argue that existing collaborative practices could be used by public policy as channels to develop a long-term process of building capacity for landscape scale conservation. As other authors have noted (e.g. Sabatier et al., 2005), collaborative initiatives are an alternative to top-down approaches and are more effective in delivering objectives through negotiation, coordination and consensus amongst stakeholders.

Based on these results I hypothesised that landscape-scale conservation could be achieved through ACM-like cooperation, given the existence of appropriate incentives since the latter often appeared as a necessary condition. I therefore decided to test a 'one-to-one (1-2-1) coordination bonus' aimed at stimulating cooperation at the landscape scale. This '1-2-1 coordination bonus' is based on the 'agglomeration bonuses' literature (Smith and Shogren, 2001 and 2002; Parkhurst et al., 2002; Parkhurst and Shogren, 2007; Banerjee et al., 2009).

6.3 Experimental sessions: '1-2-1 coordination bonus' incentive to stimulate cooperation

The results of the experiments were very informative in that they somewhat mitigated the utilitarian view of managers' attitudes that was deduced from the interviews. First the results showed that without the ‘1-2-1 coordination bonus’ most players will allocate low quality land to AES and ES and high quality land to commodity production. These results are in tune with what the literature has assumed regarding the behaviour of land managers who will allocate low quality parcels to AES or ES based on an ‘economically rational’ model of behaviour (Hanley et al., 2012). If we consider these results in the context of what some authors have found on changes in land capability for Scotland due to climate variation (Brown et al., 2011), where low quality could become high quality, my results suggest that any change in land capability could cause a conversion of AES and ES land into intensive farmland.

This was not the case, however, when the ‘1-2-1 coordination bonus’ was offered to players. They were willing to allocate land parcels in both low and high quality land to AES and ES even when they did not earn the higher utilities offered with the ‘1-2-1 coordination bonus’. This suggests that the ‘1-2-1 coordination bonus’ would work if it was available to land managers. As I presented in chapter 5, land managers would uptake the scheme even when this was not their first choice. If more than 2 neighbours took the ‘1-2-1 coordination bonus’ up this was sufficient to motivate others to do the same. Therefore, it is likely that an ecological network could be implemented through a ‘1-2-1 coordination bonus’.

My findings also indicate that some types of ecological networks would be relatively easy to implement, namely those for invertebrates such as bumble bees and /or butterflies important for pollination. In this case, connected field margins (represented by AES in the experiments) at the landscape scale could be relatively easy to achieve with a bonus. The caveat is that further measures, such as avoidance of contamination through insecticides, would have to be implemented very strictly to avoid such margins becoming ecological traps, i.e. ‘killer zones’ with a counter-productive effect.

A second problem would arise if land managers changed their strategies yearly by choosing different parcels for different types of schemes, as if they were experimenting with the schemes. This is something that seemed to happen in some of the sessions of the incentive experiment. However, this might reflect more on the lack of consequences of such changes in a non path-dependant game scenario compared to a real life situation. Given the results of the interview analysis in chapters 3 and 4, I would hypothesise that this tactic of changing from one scheme to another is less likely to be applied in real life by land managers whose surface of farming operations is smaller and who are more dependant on subsidies for their total income (this is more often the case of tenants than owners of small holdings). The analysis of the players’ choices in the experimental session and their “real-life” identity confirms this. On the other end of the spectrum, managers of estates can afford to experiment and spread the risks over different parcels. In this sense, unsurprisingly, in two out of three experimental sessions it was an estate manager/owner who won the most conservation points.

A situation of inconsistency in land managers’ choices of schemes would be likely to create population disturbance and localised extinctions through loss of habitat. Many agri-environmental measures must be in place for a number of years in order to maximise the improvements in biodiversity, and this would have to be mirrored in the design of incentive schemes through minimum duration clauses.

Whether this is feasible has not been tested by the experiments in this study and could be the object of further work. Ecological networks require time to be established and, therefore, need long-term management practices. Regarding woodland plantations, other authors (Sandys, 1994; Bishop, 1992; Watkins et al., 1996) found that land managers were unwilling to take these up, in part because of the long-term commitments implied. Whether similar issues would arise regarding features that are easier to implement (such as field margins) and whether long-term contracts would be required needs further investigation through both experiments and interviews.

These results, however, are very relevant in light of the need to up-scale AES to create field margin habitat networks as has constantly been underlined in different studies (Gimona and van der Horst, 2007; Merckx et al., 2009; Dallimer et al., 2010; Gabriel et al., 2010 and Batary et al., 2012). In addition to up-scaling, this responds to the need for targeting AES.

Furthermore, such an incentive scheme could be an excellent companion for other tools such as third party coordination if, for instance, a larger ecological network is needed. The '1-2-1 coordination bonus' scheme serves to stimulate cooperation, but in order to create robust ecological networks the results showed that this should be synchronized by third parties. The '1-2-1 coordination bonus' would certainly reduce costs of coordination by public agencies but it would not create an ecological network without more targeting or a minimum of top-down coordination and persuasion, thus raising again the issue of trust between land managers and public agencies (or non-governmental organisations for that matter) already discussed above.

In any case, an inescapable restriction in the current international framework is that to implement a '1-2-1 coordination bonus' the design has to take into account the limitations imposed by the WTO criteria for such incentives (see chapter 5).

6.4 Concluding remarks: weaknesses, strength and improvements for future work

This research presents limitations and strengths regarding the methods and the approaches taken to carry out the analysis, which I partly highlighted earlier in this chapter.

The interviews were carried out with as many different types of stakeholders as possible; however, the results would have been stronger if more interviews could have been carried out to represent the area more exhaustively. Furthermore, some participants to the experiments found the fact that I used the hypothetical case of the implementation of ecological networks very abstract. A number of interviewees asked me for clarification of the idea. Nonetheless, there was a significant methodological advantage in referring to generic ecological networks rather than specific examples of landscape-scale conservation. It allowed for more 'neutral' responses than if I had used examples such as 'deer management' or 'river management', about which some respondents may have strong and possibly divergent views (for instance between estates and tenants about deer management). This would have created a distraction from the issues of cooperation for landscape-scale management at the centre of my interest.

A case is to be made as well for the combination of sociological qualitative data and experimental economics methods. The analysis of the interviews helped me acquire a good understanding of the study area and of the social dynamics at the landscape scale. This allowed me to incorporate as much of the specific context as possible into my experimental design when testing the incentive.

Because of time constraints I only ran three experimental sessions, but more sessions are needed in order to represent a larger area and carry out a systematic quantitative analysis of land managers' responses to the introduction of economic incentives for cooperation. Moreover, although I used table games as my inspiration in order to make the sessions accessible to participants, the simulation games were still abstract for players. Furthermore, the fact that they had limited time to play the game created confusion for some participants, hinting that more repeat-sessions would enhance the reliability of results. The methodology of these experiments, however, is innovative in the sense that the 'players' were mainly land managers playing their own role (incidentally, in trial runs students were proven to behave very differently in their land allocation choices, with an unrealistic pro-conservation attitude).

I was not interested in testing 'game theory' *per se,* because the majority of people in everyday life make decisions based on many factors that do not correspond to the predicted 'rational behaviour'. Therefore, for me it was important to carry out the experiments with land managers rather than students. I argue that experimenters should make the effort of running the session with the relevant stakeholders (when appropriate). The mapping exercise and short interviews carried out at the end of each experimental session were an improvement in the methodology because they have the potential for crossing qualitative and quantitative information to give more explanatory elements about players' behaviour and choices. In fact, the interviews show that some times the motivations for a choice that appears as “rational” within a game theory framework can be very different from the theoretical motivations attributed to “rational actors”.

Variations on this methodology could be applied to a range of policy makers, communities and many other stakeholders. The experiment was only a ‘pilot’ project, with a rather limited sample size (18 players). Nonetheless, it offered a valuable insight into land managers’ strategic spatial behaviour and the potential for public policy in this area. However, further experiments might be needed to make policy recommendations.

Following from this, I would say that a lesson to be taken from this methodology (of combined qualitative interview-based data and experimental economics) is that there is a need for better understanding of the social and political context of natural resource management. Authors have highlighted these needs for developing countries (Wilshusen et al., 2002; Caruso, 2011) but I argue that this understanding is also needed in developed countries. **I advocate that a combination of ACM, economic incentives and better understanding of the social and economic dynamics of an area are essential elements for public policy to be implemented more effectively. ‘Context-free’ broad national policies for land use have reduced chances of success.**

This research is one of the first studies to offer a view on landscape management for EN implementation using a combination of ACM-framework and interviews about attitudes to conservation, which reviews existing cases of cooperation and also tests the use of economic incentives. It is the first to use the methodology of experimental economics combined with qualitative and quantitative information from the field, and one of the first cases where the experiment is applied to the ‘real world’ actors who would be involved in the incentive tested (here land managers). I consider this to be very important. Indeed, while abstract policies and network designs proposed on maps are useful as guides for suggesting the general course of action required to achieve policy goals, in the present institutional framework land managers have the power to implement these policies or to ignore them: they have the last say. **Understanding the complexity of how to involve them constructively in decision-making regarding public goods and natural resources, is therefore crucial to the success of public policy.**

APPENDICES

APPENDIX A. LISTS OF HABITATS AND SPECIES THAT ARE PRIMARY REASON FOR DESIGNATED AREAS.

***River Dee* Special Area of Conservation (SAC)**		
Habitats that are a primary reason for selection of this site*	Species	Other Species/Habitats
n/a	**Freshwater pearl mussel *Margaritifera margaritifera***	n/a
	Alantic salmon *Salmo salar*	
	Otter *Lutra lutra*	

* There are other habitats listed which present a qualifying feature, but not a primary reason for selection of the site.

***Cairngorms* Special Area of Conservation (SAC)**		
Habitats that are a primary reason for selection of this site*	Species	Other Species/Habitats
Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto-Nanojuncetea	Green shield-moss Buxbaumia viridis	Otter Lutra lutra
Northern Atlantic wet heaths with Erica tetralix		
European dry heaths		
Alpine and Boreal heaths		
Juniperus communis formations on heaths or calcareous grasslands		
Siliceous alpine and boreal grasslands		
Species-rich Nardus grassland, on siliceous substrates in mountain areas (and submountain areas in continental Europe) * Priority feature		
Blanket bogs * Priority feature		
Petrifying springs with tufa formation (Cratoneurion) * Priority feature		
Alpine pioneer formations of the Caricion bicoloris-atrofuscae * Priority feature		
Siliceous scree of the montane to snow levels (Androsacetalia alpinae and Galeopsietalia ladani)		
Siliceous rocky slopes with chasmophytic vegetation		
Caledonian forest * Priority feature		
Bog woodland * Priority feature		

* There are other habitats listed which present a qualifying feature, but not a primary reason for selection of the site.

***Ballochbuie* Special Area of Conservation (SAC)**		
Habitats that are a primary reason for selection of this site*	Species	Other Species/Habitats
European dry heaths	n/a	Otter Lutra lutra
Calcareous rocky slopes with chasmophytic vegetation		
Siliceous rocky slopes with chasmophytic vegetation		
Caledonian forest * Priority feature		
Bog woodland * Priority feature		

* There are other habitats listed which present a qualifying feature, but not a primary reason for selection of the site.

***Coyles of Muick* Special Area of Conservation (SAC)**		
Habitats that are a primary reason for selection of this site*	Species	Other Species/Habitats
Calaminarian grasslands of the *Violetalia calaminariae*	n/a	n/a

* There are other habitats listed which present a qualifying feature, but not a primary reason for selection of the site.

***Dinnet Oakwood* Special Area of Conservation (SAC)**		
Habitats that are a primary reason for selection of this site*	Species	Other Species/Habitats
Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles	n/a	n/a

* There are other habitats listed which present a qualifying feature, but not a primary reason for selection of the site.

***Glen Tanar* Special Area of Conservation (SAC)**

Habitats that are a primary reason for selection of this site*	Species	Other Species/Habitats
Northern Atlantic wet heaths with *Erica tetralix*	n/a	Otter Lutra lutra
European dry heaths		
Caledonian forest * Priority feature		

* There are other habitats listed which present a qualifying feature, but not a primary reason for selection of the site.

***Morrone Birkwood* Special Area of Conservation (SAC)**		
Habitats that are a primary reason for selection of this site*	Species	Other Species/Habitats
***Juniperus communis* formations on heaths or calcareous grasslands**	n/a	**Geyer`s whorl snail *Vertigo geyeri***
Alpine pioneer formations of the *Caricion bicoloris-atrofuscae* * Priority feature		

* There are other habitats listed which present a qualifying feature, but not a primary reason for selection of the site.

***Morven and Mullachdubh* Special Area of Conservation (SAC)**		
Habitats that are a primary reason for selection of this site*	Species	Other Species/Habitats
***Juniperus communis* formations on heaths or calcareous grasslands**	n/a	

* There are other habitats listed which present a qualifying feature, but not a primary reason for selection of the site.

***Muir of Dinnet* Special Area of Conservation (SAC)**		
Habitats that are a primary reason for selection of this site*	Species	Other Species/Habitats
Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto-Nanojuncetea	n/a	Otter Lutra lutra
European dry heaths		

* There are other habitats listed which present a qualifying feature, but not a primary reason for selection of the site.

APPENDIX B. NAME AND CODE OF PARISHES IN THE DEE CATCHMENT.

Table: Parishes that are part of the Dee Catchment, by parish code, name and number of inhabitants.

Code Parish	Name Parish
1	Aberdeen
11	Peterculter
8	Newhills
7	Kinellar
12	Skene
5	Echt
44	Kincardine O’Neil
46	Lumphanan
41	Coull
45 (part of)	Logie Coldstone
42	Crathie and Breamar
43	Glen Muick Tullich and Glen Gaim
38	Aboyne and Glentanar
39	Birse
484	Strachan
482	Bachory-Ternan
483	Durris
3	Drumoak
472	Maryculter
471	Bachory-Denenick

APPENDIX C. LIST OF LANDOWNERSHIP IN THE DEE CATCHMENT.

Table: List of Landownership with holding sizes and location of holdings according to Wightman, (1996).

No.	Proprietor (Aberdeenshire)	Property	Principal Interest	Acreage	Grid Ref
1	Capitan A.A.C Farquharson's invercauld trusts*	Invercauld	Capitan A.A.C Farquharson	87500	NO1792
2	National trust Scotland	Mar Lodge and others		73582	NO0989
3	Viscount Cowdray & Trust*	Dunecht & others		65600	Nj7507
4	The Queen and Trustees of Balmoral	Balmoral & Delnadamph		50370	NO2594
5	Glen Tanar Trusts	Glen Tanar	Michael A. Bruce	29150	NO4795
6	Captain A.A.A.D.M Ramsay	Mar		25143	NO0984
7	Edward Humphrey & the Wester Coull Trust	Dinnet & Wester Coull		23800	Nj4400
10	Sir Ian Okeover-Walker Bt.	Glenmuick		13000	NO3690
12	John Howard Seton Gordon of Abergeldie	Abergeldie		10200	NO2992
15	Donald H.M. & Andrew M.L. Farquharson	Finzean		7900	NO5993
21	Nicol Brothers	Ballogie		6500	NO5795
22	The MacRobert Trust Estate	MacRobert Trust Estate		6500	Nj4905
24	Thomas Innes of Learney	Learney		5900	Nj6304
25	Monymusk land Co. & Monymusk Estate	Monymusk (Small part is within the catchment)	Sir Archibald Grant	5486	Nj6815
28	Trustees of the Cluny Estates	Cluny Estates		5000	Nj6912
30	Andrew Salvesen	Findrack & Tillyfour (part within the Dee Catchment)		4600	Nj6005
42	Cullerlie Trust	Cullerlie		3000	Nj7602
46	R.L.O. Fyffe	Corsindae		2500	Nj6808
49		Midmar		2250	Nj7005
50	William A.j. Davie,	Lumphanan		2200	Nj5703
58	Aboyne Castle Estate trustees	Aboyne	Marquis of Huntly	2000	Nj5299
59	Andrew E.H. Bradford	Kincardine		2000	Nj6000
60	Trustees of Lt.Col> Forbes	Corse		2000	Nj5407
63	C.R Ratcliffe & Family	Courtcairn & Kinnernie		1800	Nj7211
64	Craigmyle Estate Ltd.	Craigmyle		1800	Nj6301
66	Trustees of James Allan	Midbeltie		1700	Nj6200
67	Sluie Estate Trust	Sluie	R. Strang-Steel	1700	NO6296
70	James C.A. & Alexander J.A Burnett	Cathes & Leys (Part)		1500	Nj7500
73	Craigie Farm Estate	Park		1500	NO7898
81	Crannach Woodland Partnership	Crannach	Robin Callander and others	1261	Nj3899
82	Alistair J. Lilburn	Coull		1250	Nj5102
83	M. Calvert	Dessmuir & Dess		1250	Nj5700
84		Tillydrine		1250	NO6098
105		Camphill		1000	Nj5706
No.	**Proprietor (Kincardine)**	**Property**	**Principal Interest**	**Acreage**	**Grid Ref**
1	C.A. Gladstone & Gladstone 1987 Settlement	Fasque Estate	Sir William Galdstone	47700	NO6475
2	Viscount Cowdray & Trusts*	Dunecht & others (part)		11000	Nj6802
5	James C.A. & Alexander J.A. Burnett	Crathes & Leys (Part see No.70 in Aberdeenshire)		5200	NO7398
7	Mary C. Rodwell	Tilquhillie		2700	NO7193
14		Ashentilly		1700	NO8297
16	Capt Kenneth l.H. Lumsden	Banchory & Leggart		1565	Nj9102
19	ON MARKET	Shillofad Forest		1055	NO7389

APPENDIX D. INTERVIEW SCHEDULE FOR LAND MANAGERS (example of estates)

Interview guide for ……………
No…/…

SEMI-STRUCTURED INTERVIEWS
Interview guide
Fieldwork in the Dee Catchment, March and April 2009.
All interviews will be recorded (ask for permission)
This format will be filled in as a safe notes of the interview and the transcription will be annexed to this format.
In each interview I will present my project and the objectives of doing the interviews. If interviewees ask, I will give a short explanation about how I will use the information from the interviews.

Date …………………………………
Place (Name of the town/village and If possible identify the area on the map before the interview) ……………………………………………..
Name (if they want to give it)…………………………………………………
Land extension

A. General information

1. Could you explain your role within the estate?
2. Could you tell me about the land uses within the estate for *in hand* land?
3. Could you tell me about the history of the estate regarding land management?
4. Which types of tenancies are there in the estate?
5. Do you rent land from neighbouring estates or other owners?
6. What other economic activities does the estate have (e.g tourism)
7. Which of the activities represents the first income of the business?
8. Do you receive SFP?
9. Could you tell me the percentage that subsidies represent in the business?
10. What are the business plans for the next 10, 20 or 30 years?

B. conservation attitudes and knowledge

1. What is 'conservation' for you? Can you define conservation?
2. Is the management of your land contributing to conservation?
3. Is land a commodity or has it other values to you?
4. What type of woods do you have? (Type of trees?) What percentage of the land is under woods? Is it all commercial forestry?
5. Could you tell me about the history of the woodlands in the estate? Since when have the woodlands been there and what are the motives to have them, to keep them?

6. Could you tell me more about the history of the shooting?
7. (For cases where there is a town nearby such as the case of Torphins) Are there woodlands for the community that the estate has provided?
8. Have you participated in inventories, wildlife censuses e.g. bird watching or other forms of surveying? What was your motivation in participating?
9. What are the main issues about environmental protection in the Dee Catchment? Is there a need for protection?

C. Schemes

1. Does the estate participate in woodland schemes?
2. Why did the estate become involved in those schemes?
3. What are the estate's motivations for NOT becoming involved in woodland Schemes?
4. In which AES is the estate committed at the present?
5. Are they in tune with the estate's management plans?
6. Could you give and example of where you have seen changes within your land as a result of the application of one or more of those schemes?
7. (In cases where the land is under Special Areas of Conservation (SAC's), Special Protected Areas (SPA), Sites of Special Scientific Interest (SSSI)

How do you integrate (designation name) with your management plans?

8. What is the role, If any, of BAPs in your management plans?
9. What do you think about the SRDP, its Rural Priorities and LMOs?

D. Ecological networks.

1. Have you heard about ecological networks? What do you think about them?
2. Does the estate's land include corridors? Could you give an example and the results of having them?
3. Connectivity and networks (EXPLAIN) are increasingly valuable e.g. connectivity for forestry - what do you think about it? Connectivity implies management at cross-boundaries; management at landscape scale; a need for collaboration between neighbours. Are you willing to co-ordinate your management with neighbours? Have you done so in the past? Why yes? Why not? Do you think that is feasible? If there are good incentives? If there is regulation? Are you willing to work with your neighbours?
4. Are you aware that the estate's land lies within a potential forestry woodland corridor? Are you willing to collaborate with your neighbours to this respect? How do you think forestry corridors in this part of Scotland could be achieved?
5. (For land businesses in the Davan project), What is your experience of the Davan project?

E. Power sharing

1. What do you think about sharing knowledge?
2. With whom are the farming and forestry issues in the estate discussed? Could you

mention some of the agencies with which discussion is carried out? Do you have close friends with whom you discuss those issues?

3. In your opinion, what is or should be the role of scientific knowledge? In your opinion, is there sufficient scientific knowledge available on the type of management that could enhance environmental issues?
4. On environmental issues, have you experienced processes where you and other estates work together? Or experimented with new forms of management used on other estates? What are the observed results of this collaboration? Have you shared the results? if yes, how and with whom?
5. What are your motives to collaborate? (Incentives? by principle? Business or environment motivation?)
6. Have you done the same with tenants? Have you applied to 'joint applications' for AES? Have tenants asked you for it?
7. If you have experience of partnership with other estates or tenants, there could be differences or tensions. If that is the case, how do you solve differences? (reinforce the confidentiality in reporting the results) Can you give an example?

F. Evaluation

1. As part of your management, do you have an evaluation process in place? Do you self-evaluate your management? If yes how; if not, why?
2. When unforeseen environmental problems come up as a result of your actions in the estate, how do you address this? Could you give an example to illustrate the process of solving such problems?

G. Other comments

1. How do you feel about payment for environmental services? What are the barriers? And the advantages?

"SNOWBALL" Do you now someone else to whom I can do the Interview?

APPENDIX E. TABLE WITH LAND MANAGERS CHARACTERISTICS AND PSEUDONYMS.

Table shows the characteristics of land managers: type of tenancy, holding sizes, farming system, awareness about designation areas and BAPs and participation to AES and/or FS. We also present in the table what land managers said about conservation (extracts from the interviews) and how we scored them.

Pseud.	Type of tenancy	Holding size (ha. approx)	Multi-functional Land uses	Awareness about BAP,SAC, SSSI	Attitudes to 'conservation'. [and conservation practices]	AES & FS participation	Resp IN
Stewart	Estate	2500	Arable land and grazing are *in hand.* There are a number of tenants. Farming is Mixed. Housing for letting, woodlands, shooting and fishing are managed by the estate.	Yes	*" Oh yes. 25% of our forestry is regarded as conservation or amenity and yes, we do, but the interface between what's commercial, what's environmental and what's amenity is difficult to define"* *"well, (…) we don't say we do this for conservation reasons but the management of the river bank ties in the management of the fishing. I put quite a bit of effort into riparian management because yes, that's part of our general ethos but also it's a benefit to the fishing*	AES & FS	36
Douglas	Estate	3300	Agricultural land and grazing are leased to a number of tenants. Farming is mixed. Housing and woodlands are managed by the estate.	Yes for: SAC, SSSI. No for: BAPs	*"It's spiritual thing for me to some extent. It's a…I mean, I haven't read a lot but interested in deep ecology and those sorts of things so yup, it's pretty fundamental to life in a way. (…) in very simple terms, if we don't look after the world, we're just going to kill it off eventually so yes."* *"… the vision for the estate (is) trying to improve the ecological and landscape from the estate. (…) I think to have a healthy estate, to have a healthy ecology is fundamental to the way the whole system works and fundamental sustainability and in the absence of looking after, then the whole estate would suffer in the long term. (…) it's important to get a better balance between the agriculture and forestry. (...) certainly there is a desire to play our part and contribute to the ecological interest on the estate and in the area."*	No directly, because they do not have *in hand* land, but asking tenants to apply to specific AES.	17
Graig	Estate	3500	Arable land and grazing are *in hand*. There are a number of tenants. Farming is mixed. Housing for letting, woodlands, shooting and fishing are managed by the estate.	Yes	"*We've been in the business a long time doing it anyway and trying to farm and do forestry in a conservation way. We've been doing it without all the hoo-ha that goes on.* *"We do it in our own. We produce the timber, we produce the farm goods and all the rest of it and we've always done it in a way that no-one's given us any serious complaints about it"* *"We just do what we do and as environmental as we can, complying with regulations such as prohibition to have a bonfire and things like that".*	FS	11
Graig	Estate	3500	Arable land and grazing are *in hand*. There are a number of tenants. Farming is mixed. Housing for letting, woodlands, shooting and fishing are managed by the estate.	Yes	"*We've been in the business a long time doing it anyway and trying to farm and do forestry in a conservation way. We've been doing it without all the hoo-ha that goes on.* *"We do it in our own. We produce the timber, we produce the farm goods and all the rest of it and we've always done it in a way that no-one's given us any serious complaints about it"* *"We just do what we do and as environmental as we can, complying with*	FS	11

Grant	Estate	3000	Arable land and grazing are *in hand*. There are a number of tenants. Farming is mixed. Housing for letting, woodlands, shooting and fishing are managed by the estate.	Yes	" *[…] we're very pro-active in conservation really. We have always been very supporting of conservation on the estate. By doing what we are doing at the moment plus other areas*" (Within the estate there is important part of the Feugh flow that joins the Dee river at Banchory. In the last years there has been work carried out to protect the Feugh's water through excluding livestock off it by fencing the area).	FS and RSS and RDC-RP	18
Matthew	Estate	50000	Arable land and grazing are tenanted. Farming is mixed. Housing for letting, woodlands, shooting and fishing, skiing and other recreation activities are managed by the estate.	Yes	[Referring to the most important work that the estate does for conservation] *"I would say the catch and release on the river is very important and I would say getting a balance grazing regime is important, controlling the deer numbers or fencing the deer numbers and basically making certain that we understand all the designations. And we are using native species whenever possible"*	WGS, RSPB schemes	34
Paul	Estate	20000	*In hand* arable land and grazing. There are a number of tenants. Mixed farming, woodland, housing shooting and fishing are managed by the estate.	Yes	[Referring to the work that the estate does for conservation] *"…if we're managing 7000 acres (3000 ha.) of heather moor land for red grouse then I'd like to think its pretty well documented what conservation benefits come form that type of management in terms of wildlife and managing areas of semi natural woodland. Hopefully that has spin off. If we are employing gamekeepers on low ground area that are controlling foxes and crows then hopefully there is benefit (…) if we are controlling grey squirrels so predator control, I suppose it is. Predator control and habitat management that's really the answer to it in substantial effects, in sort of faming operations in environmental schemes" Unsubsidized land use –sporting upland- management delivers significant benefits, not only in conservation terms but social economic terms."*	AES & FS	37
Ian	Estate	15000	Arable land and grazing are tenanted. Farming is mixed. Forest, shooting, fishing, recreation, housing are managed by the estate.	Yes	*"Survival –conservation now is helping what does exist now to survive given the threats. That's a pity because I'm not all that comfortable with word conservation because that implies that the status quo is fine. And I know historically and technically we live in a degraded landscape with degraded habitats, degraded by biodiversity, I know that. But our detriment –it's costing us physically, spiritually, emotionally and technically. So 'conservation' does not mean a huge amount to me nowadays. It would be wonderful to see an improved developed and more diverse biodiversity".*	FS	41
Ian	Estate	15000	Arable land and grazing are tenanted. Farming is mixed. Forest, shooting, fishing, recreation, housing are	Yes	*"Survival –conservation now is helping what does exist now to survive given the threats. That's a pity because I'm not all that comfortable with word conservation because that implies that the status quo is fine. And I know historically and technically we live in a degraded landscape with degraded habitats, degraded by biodiversity, I know that. But our detriment –it's costing us physically, spiritually, emotionally and technically. So 'conservation' does not mean a huge amount to me nowadays. It would be wonderful to see an improved developed and more diverse biodiversity".*	FS	41

Margaret and Roland	Tenant	50	Arable land and grassland Mixed farm system.	No	*"it does not affect us, does it? not here."* *"I've just never thought about it"*	No	3
Allan	Tenant	50	Arable land and grassland. Mixed Farm system.	No	*"My wee bit of ground – I need it for farming"* *"I'd never thought of that"*	No	4
Richard	Tenant	50	Arable land and grassland. Mixed Farm system.	No	*"Nature looks after itself if it is it interfered with"* *"No interest in conservation"*	No	9
Neil	Tenant	130	Arable land and grassland. Mixed farm system.	Yes	*"It's not something that I am really into to. But I see the point and I am happy to participate in something that helps it"* *"Unfortunately that's where the money comes from for these schemes. But we do a little bit of conservation. We only do it for the money"*	AES.	31
Doland	Tenant	130	Arable land and grassland. Mixed Farm system.	Yes for SAC. No for BAPs	*" I'd like to think that I can produce food, whether its animals or cereal and to me, we're gifted with land and should be producing the food. The people that's in the RSS they've no interest in wildlife. They are in it for pennies. Don't get me wrong there are some people in it who are interest un wildlife and everything…"*	No	15
Russell	Tenant	250	Arable land and grassland. Mixed farm system.	No	*" I haven't a huge interest in conservation. I think the best for the countryside to look after itself is well farmed land, well managed land. I don't like to see paths being left just for conservation and not used for anything. I prefer they were used for faming production as long as it helps the environment. I don't want farming to hinder conservation but they have to go together. I don't like seeing paths or land being just left to helps wildlife if it's not production anything".*	No	22
Macvean	Tenant	200	Arable land and grassland. Mixed farm system.	Yes for SAC and SSSI. No for BAPs	*" (…) I'm quite keen to conserve the wildlife. But I don't see the land disappearing. That is the one constant. Although you think by some that was…. I have a neighbour that s a very green man and accused me of raping the soil and poising all my livestock. Farmers won't do that because that's once thing they try to look after as much as they can- specially the livestock" He's an organic farmer but says that he lives in a little cottage and never works. I've never seen him working. I couldn't live like he does. I've got people to support and rent to pay and make a living".*	Yes	20
					" (…) I'm quite keen to conserve the wildlife. But I don't see the land disappearing. That is the one constant. Although you think by some that was…. I have a neighbour that s a very green man and accused me of raping the soil and poising all my livestock. Farmers won't do that because that's once thing they try to look after as much as they can- specially the livestock" He's an organic farmer but says that he lives in a little cottage and never works. I've never seen him working. I couldn't live like he does. I've got people to support and rent to pay and make a living".		

Keith	Tenant	300	Arable land and grassland. Mixed farm system.	Yes for SAC. No for BAPs	*"I'm not totally against it. It's a good enough thing, some aspects of it". "Well the simple reason is they were taking over this modulation and I was trying to get some money back. That was why I got into that. To see if I'd get money back because they'd gone away with it in the first place so I thought I might get some back".*	LMC RDC-RP	26
Duncan	Tenant	90	Arable land and grassland. Mixed farm system.	No	*" I'm in favour of it but I've never been involved in it directly and never really been approached by anybody but like to see a bit of diversity wildlife. One of the things that we have a kit of which visiting farmers tend to comment on is hares. We are quite proud of that. I like to see the hares and we do seem to have a healthy population, which is probably one thing. There are not many rabbits, which is probably a good thing. There was a while when lots came out of the hill and they would eat everything up there [but not now]. Probably fewer ground nest and birds that when I came here, lapwings and oystercatchers and things like that, They seem to be fewer recently. I do not know why"*	LMC	16
Caitriona	Tenant-small owner	70	Arable land and grassland. Mixed farm system and other sport livestock production.	No	*"if we had been a bad farmers as everybody assumes we have always been there wouldn't be anything to conserve. Its here because we looked after it"*	No (in the past CSS)	6
Jean	Tenant-Small Owner	100	Arable land and grassland. Mixed farm system.	No	*" Is farming no natural conservation anyway?. I mean you feed the crows, you feed the craggy herons, you feed the geese which I do not like doing but you've no option when thousands of them descend on you"* *" I am not awful favour of this leaving areas around about fields…"*		23
Rachel	Tenant - Small owner	400	Arable land and grassland. Mixed farm system.	Yes for SAC, SSSI. No for BAPs	*" We got a pond for that too because it was areas that were of limited value for other uses so it was a case of we might as well be doing something from the environmental side". (…but the reason was)…probably mainly financial but also using some of the areas where it was a good reason to do"*	Yes RSS	39
Trevor	Tenant-small owner	400	Arable land and grassland. Mixed farm system.	Yes for SAC. No for BAPs	*"If it wasn't for farmers you wouldn't have the biodiversity in the landscape." But government [has] latched onto the idea of conservation which is fine, but.... Look out here, you know, we've got a nice view to see and things are pretty tidy more or less. Conservation is great but they are going to have to draw the line somewhere. They can't go on and on spending public funds on conservation. They is going to have to come a time when the conservation area has come to its limit, where they have to refocus on producing food, you know, the world population is multiplying".* *"And okay we get money back through environmental payments but it goes against my ethos that you have to have this rough bit to get the money".*	No now. He tried.	21

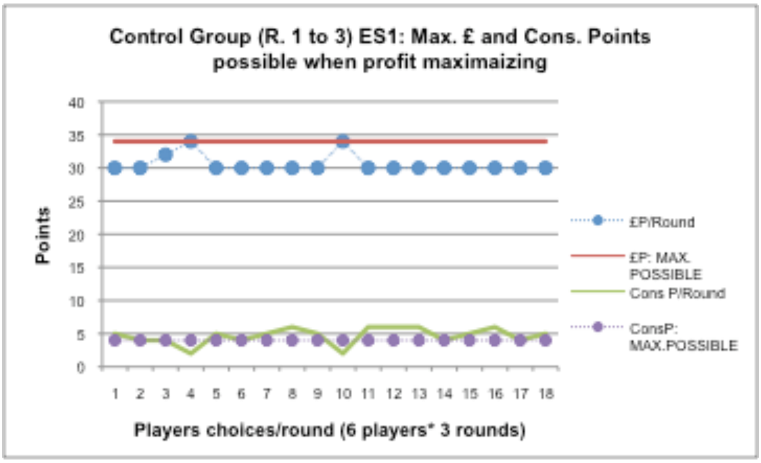
William	Small Owner	100	Arable land and grassland. Mixed Farm system.	No	*" I think there has to be a balance between conservation and food production"*	AES	33
James	Small owner	150	Arable land and grassland. Mixed farm system. Other: Shop.	Yes	*" I am very much in favour of it. I have done quite a lot in that aspect really" "We've got quite a variety of conservation here with all the ponds, trees, woods, birds, there is a lot of wildlife".* *"I am always interested in the nature and environment and it enhance the look of the place too".*	Yes RSS LMC	25
Hendry	Small owner	250	Let land for crops and livestock. Recreation and environmental activities.	Yes. No for BAPs	*"It is all amenity. Its all for conservation and environment really, and beauty". "Well I think it's all excellent in essence but I think there's so much to talk about and so much information about it but there's not enough done in practices. I think that's the problem. People are often confused and maybe there should be a model farm somewhere which everyone can go and see it".*	Yes. CSPS LMC RP	19
Arran	Small owner	350	Arable land and grassland. Mixed farm system. Other: Shop.	Yes. No for BAPs	*"But because we are interested in the scheme, Wild Birds and that, then it was….we would have been doing it anyway. So because we are doing it, we might as well claim and get the money for it." I think the environment has to be protected. I think there's far better ways of protecting the environment than just putting it down on a piece of paper. I'm not greatly enthused by the thing".*	AES. For FS he prefers to pay rather than go through the paper work.	8

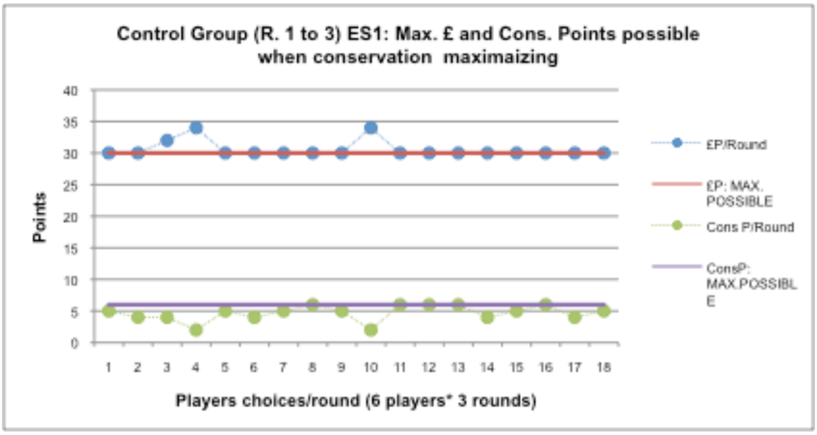
AES: Agri-environmental Schemes; **FS:** Forestry Schemes; **RSS:** Rural Stewardship Scheme; **RDC-RP:** Rural Development Contracts-Rural Priorities; **WGS:** Woodland Grants Scheme (now closed); **SFS:** Scottish Forestry Schemes (now closed); **RSPB** schemes: Royal Society for the Protection of Birds Schemes; **LMC:** Land Management Contracts (now closed); **CPS:** Countryside Premium Scheme (now closed).

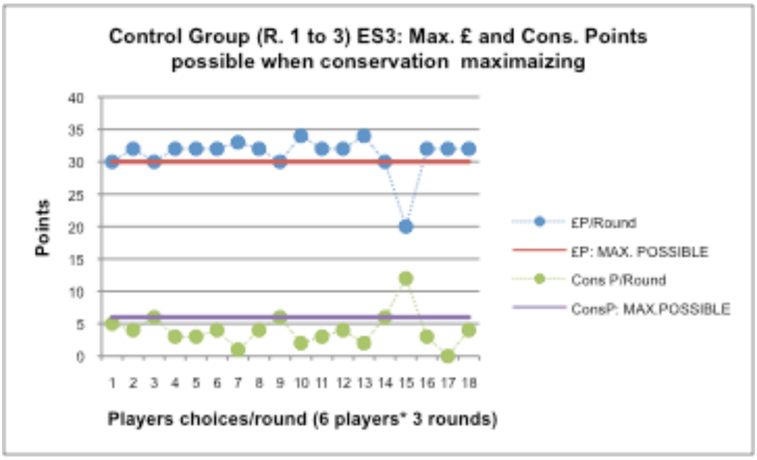
APPENDIX F. EXTRACT OF DATA ANALYSIS FROM EXPERIMENTAL SESSIONS.

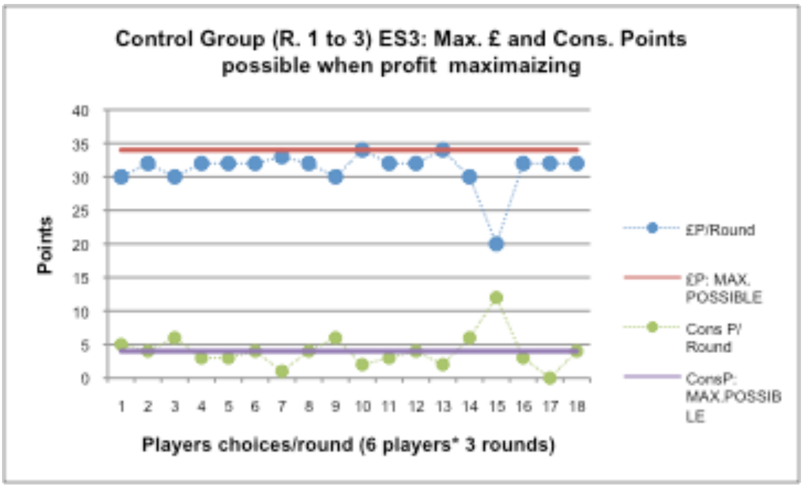
ExpSessio	RoundNur	TestGame	PlayerNur	PlayerNar	PropertyN	TypeTEN	Parcel1Nu	Land1Cap	Choice1	Points1	SppPoints	Parcel2Nu	Land2Cap	Choice2	Points2	SppPoints	Parcel3Nu	Land3Cap	Choice3	Points3	SppPoints	Parcel4Nu	Land4Cap	Choice4	Points4	SppPoints	PointsTOT	SppPoints
1	1	C				MLURI	1	L	C	5	3	13	L	B	7	1	15	H	B	8	1	16	H	A	10	0	30	5
1	2	C				MLURI	1	L	C	5	3	13	L	B	7	1	15	H	B	8	1	16	H	A	10	0	30	5
1	3	C				MLURI	1	L	C	5	3	13	L	C	5	3	15	H	A	10	0	16	H	A	10	0	30	6
1	1	C				E	17	L	B	7	1	6	L	B	7	1	9	H	B	8	1	8	H	B	8	1	30	4
1	2	C				E	17	L	C	5	3	6	L	C	5	3	9	H	A	10	0	8	H	A	10	0	30	6
1	3	C				E	17	L	B	7	1	6	L	B	7	1	9	H	B	8	1	8	H	B	8	1	30	4
1	1	C				ST	3	H	A	10	0	7	H	A	10	0	10	L	B	7	1	14	L	C	5	3	32	4
1	2	C				ST	3	H	A	10	0	7	H	B	8	1	10	L	B	7	1	14	L	C	5	3	30	5
1	3	C				ST	3	H	A	10	0	7	H	B	8	1	10	L	B	7	1	14	L	C	5	3	30	5
1	1	C				E	11	L	B	7	1	12	L	B	7	1	22	H	A	10	0	23	H	A	10	0	34	2
1	2	C				E	11	L	B	7	1	12	L	B	7	1	22	H	A	10	0	23	H	A	10	0	34	2
1	3	C				E	11	L	C	5	3	12	L	C	5	3	22	H	A	10	0	23	H	A	10	0	30	6
1	1	C				E	2	L	C	5	3	4	L	B	7	1	5	H	B	8	1	20	H	A	10	0	30	5
1	2	C				E	2	L	C	5	3	4	L	C	5	3	5	H	A	10	0	20	H	A	10	0	30	6
1	3	C				E	2	L	B	7	1	4	L	B	7	1	5	H	B	8	1	20	H	B	8	1	30	4
1	1	C				E	24	L	B	7	1	18	L	C	5	3	21	H	B	8	1	19	H	A	10	0	30	4
1	2	C				E	24	L	C	5	3	18	L	C	5	3	21	H	A	10	0	19	H	A	10	0	30	6
1	3	C				E	24	L	C	5	3	18	L	B	7	1	21	H	B	8	1	18	H	A	10	0	30	5
1	4	B				MLURI	1	L	E	8	5	13	L	D	7	1	15	H	D	7	1	16	H	E	12	3	36	12

APPENDIX G. RESULTS OF CONTROL GROUPS (ROUNDS 1 TO 3) SESSIONS 1 AND 3.

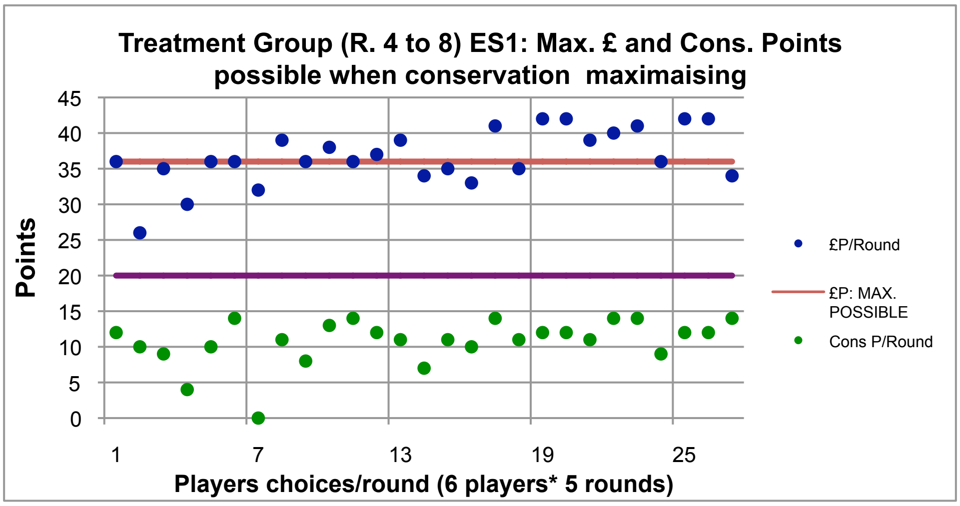


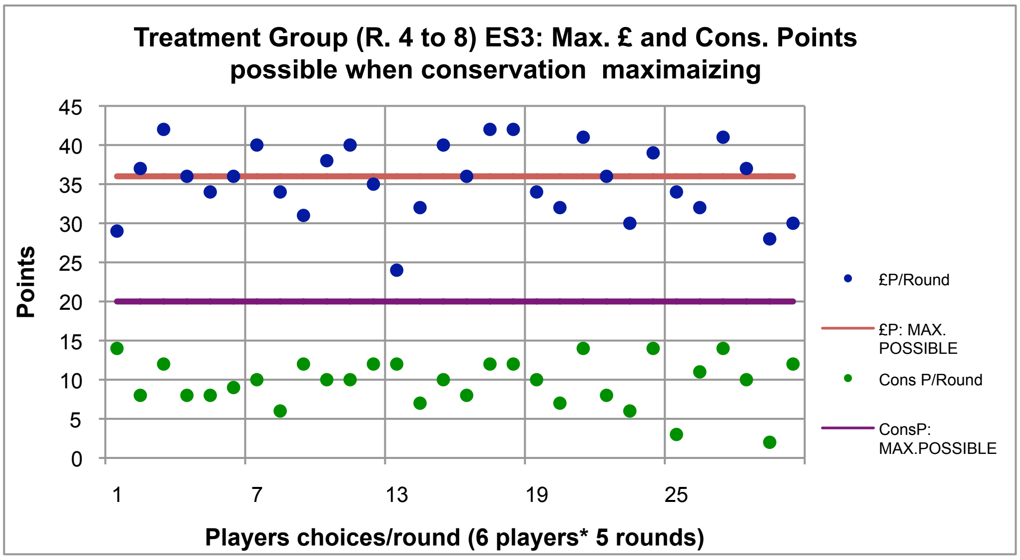


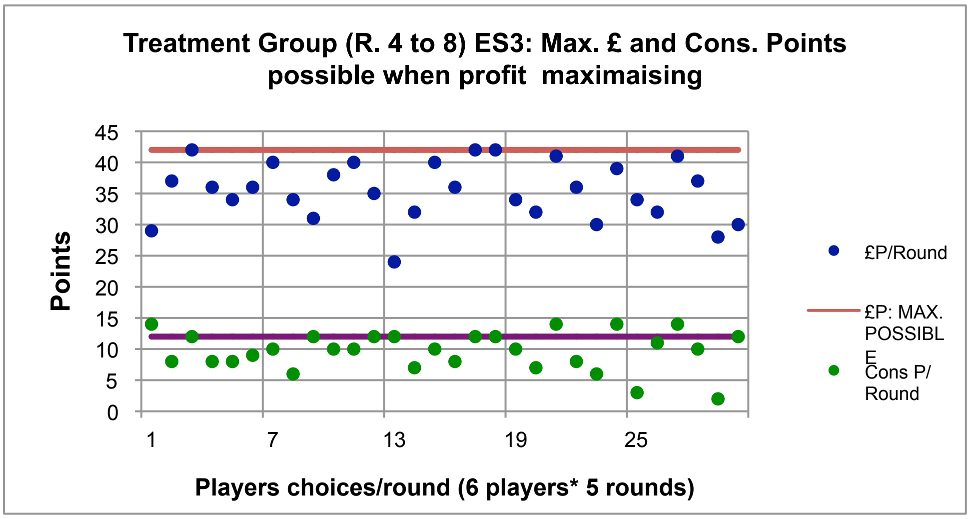




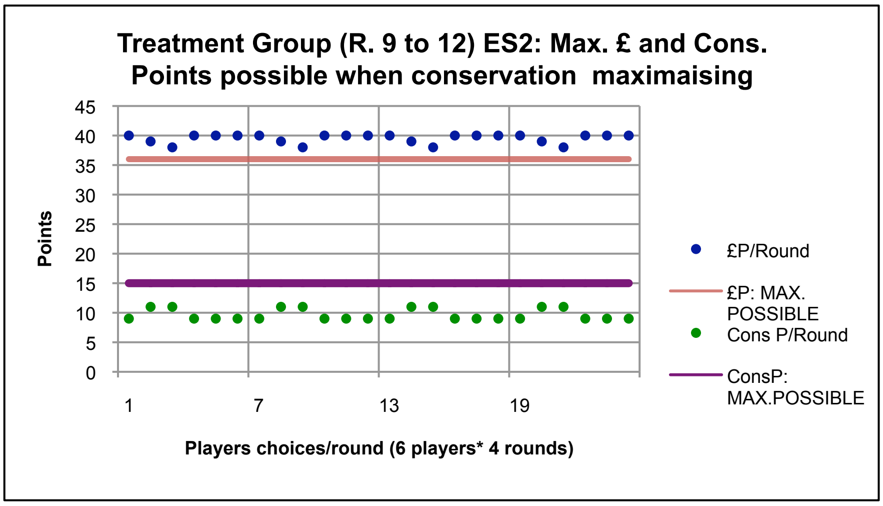
APPENDIX H. RESULTS OF TREATMENT GROUPS (ROUNDS 4 TO 8) SESSIONS 1 AND 3.

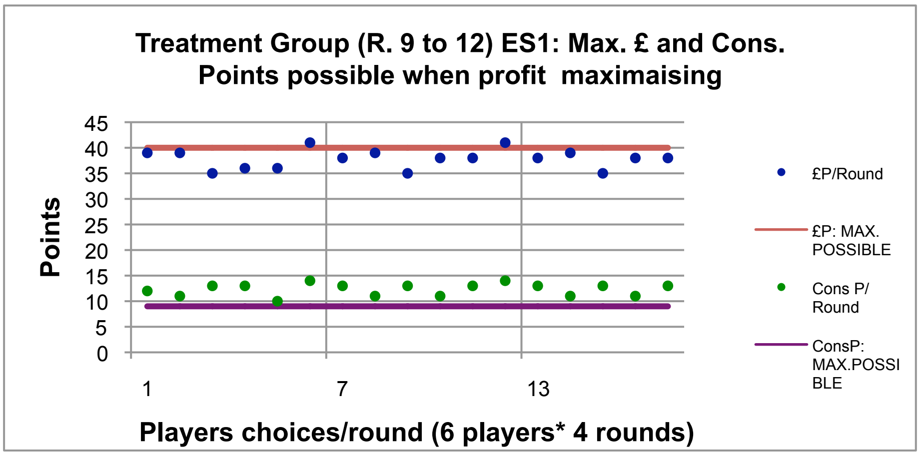


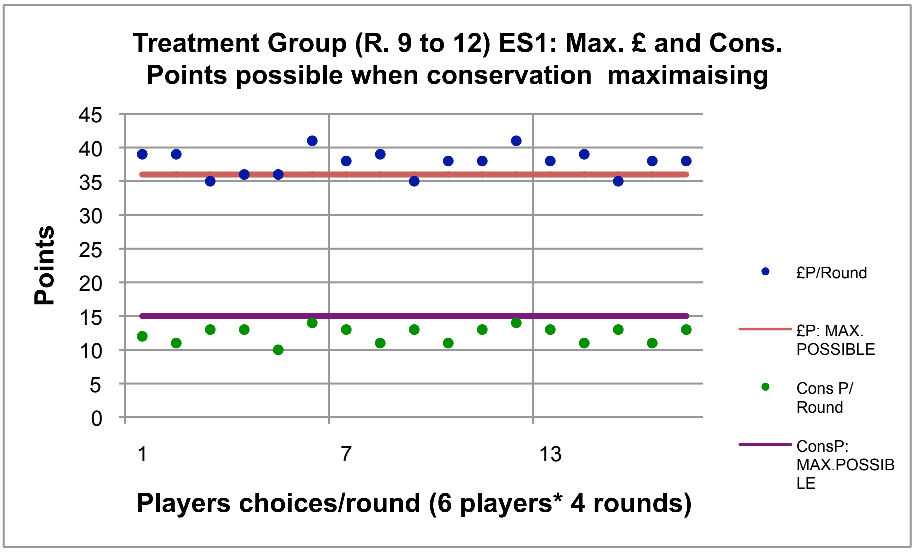


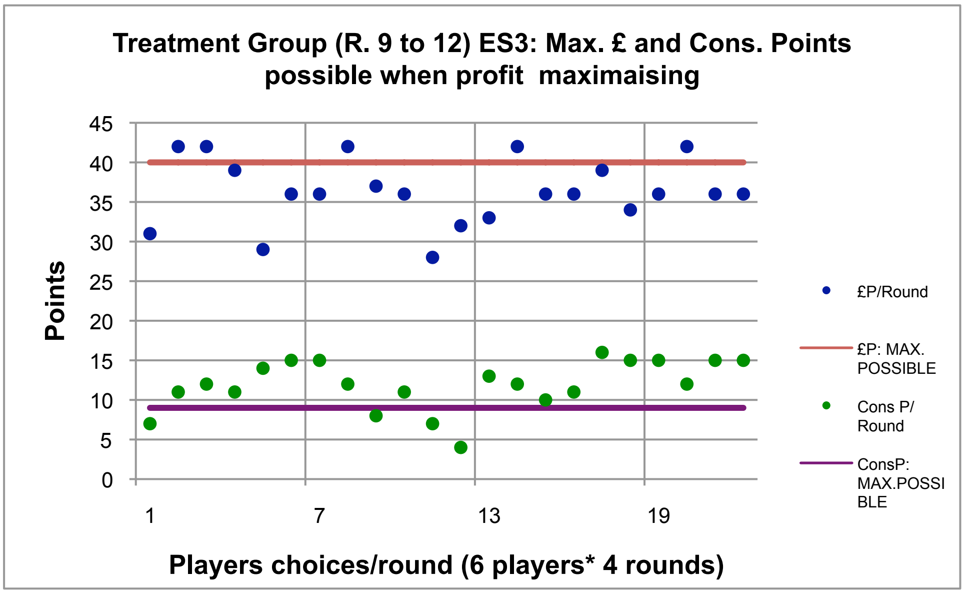


APPENDIX I. RESULTS OF TREATMENT GROUPS (ROUNDS 9 TO 12) SESSIONS 1 AND 3.

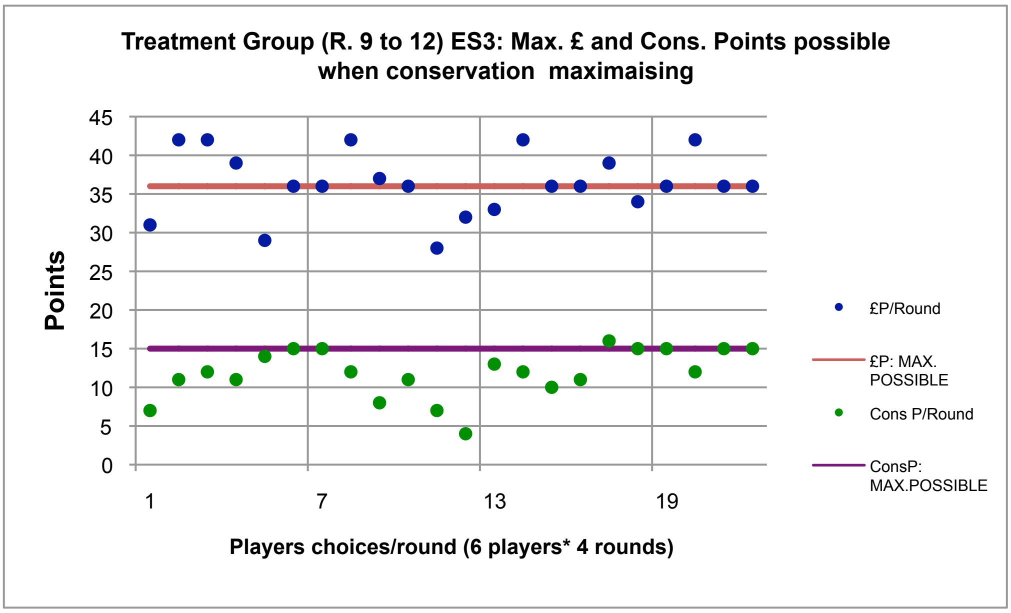








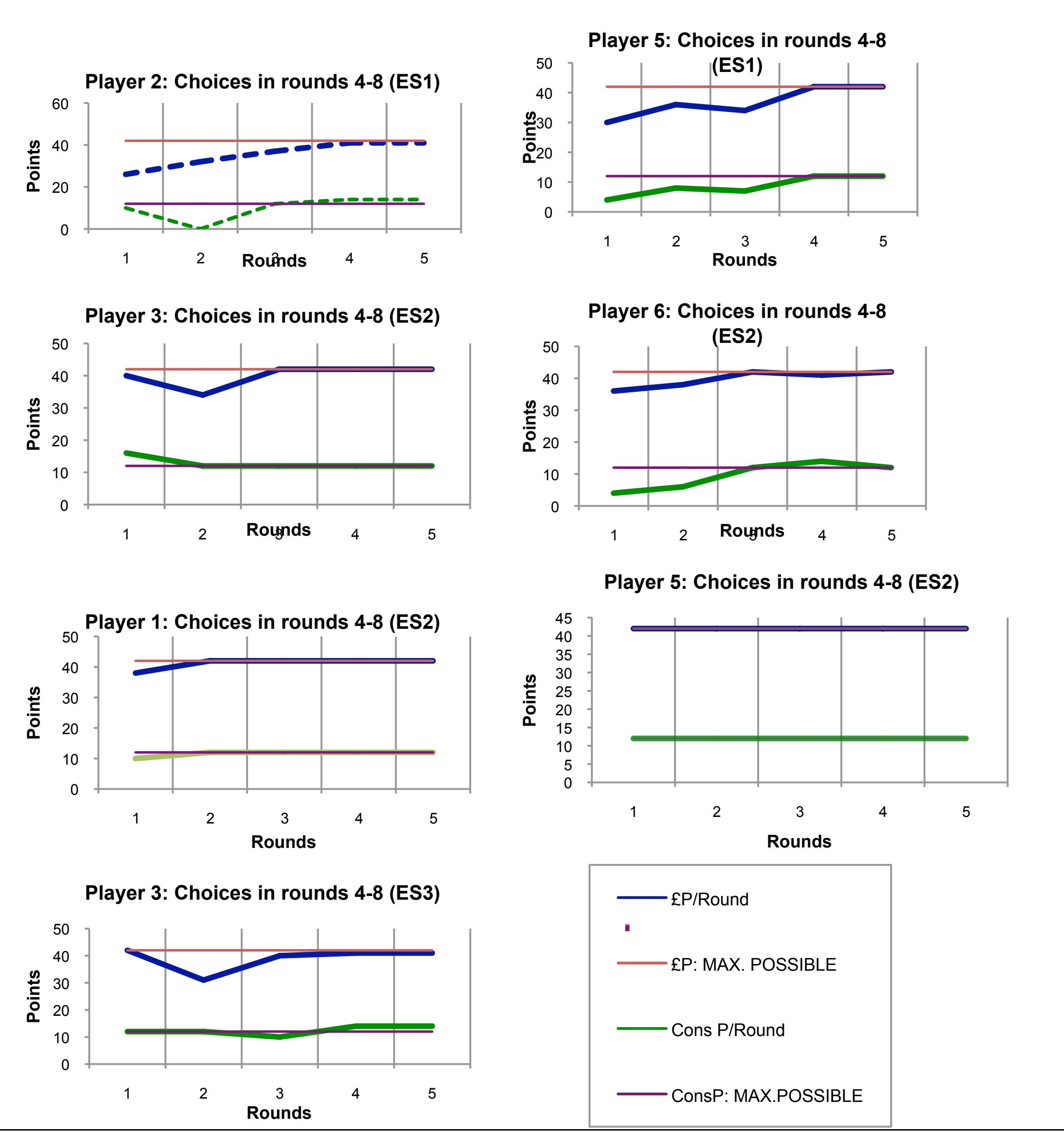
Treatment Group (R. 9 to 12) ES3: Max. £ and Cons. Points possible when profit maximaising
Points
45
40
35
30
25
20
15
10
5
0
1
7
13
19
Players choices/round (6 players* 4 rounds)
£P/Round
£P: MAX. POSSIBLE
Cons P/ Round
ConsP: MAX.POSSI BLE



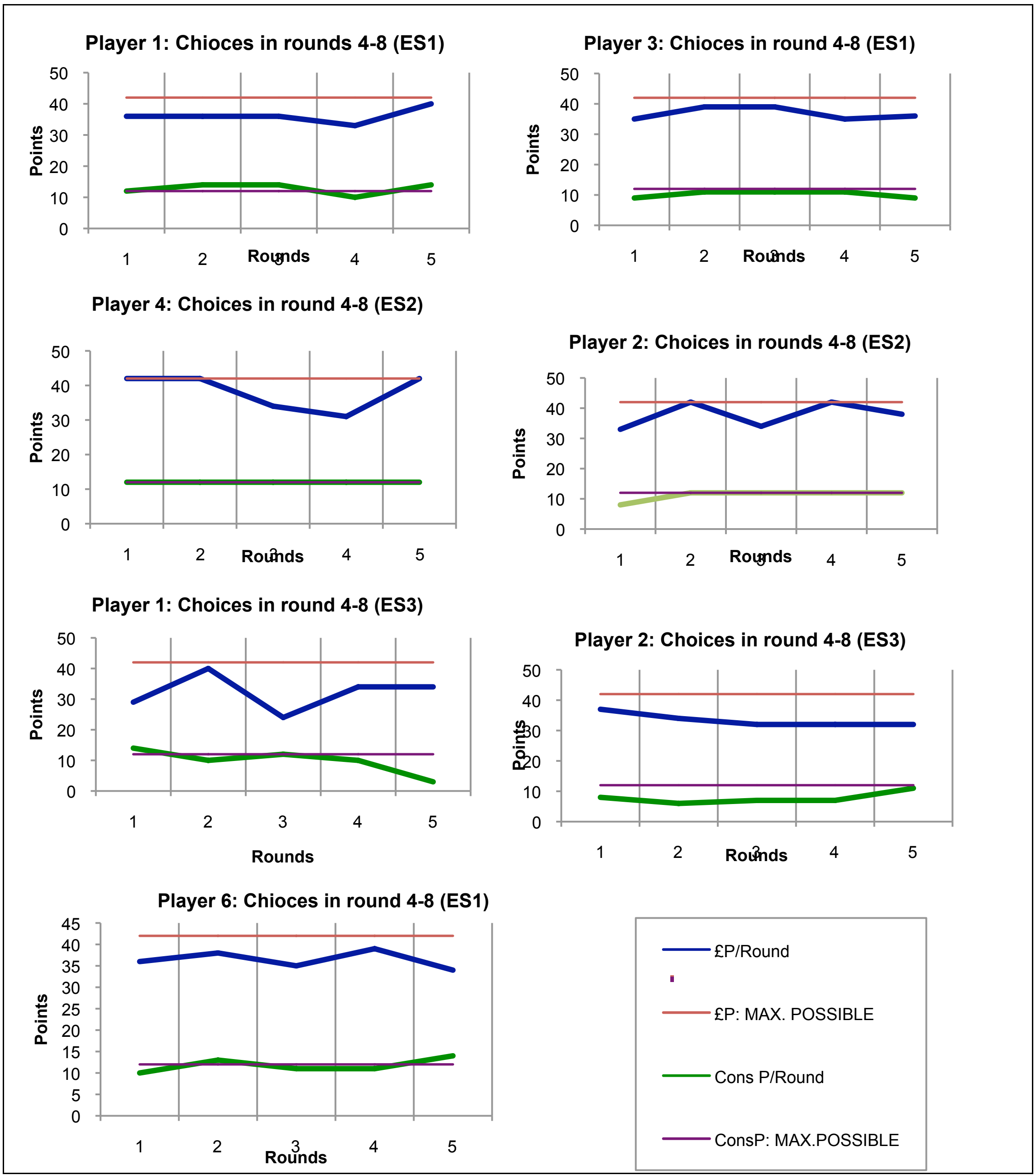
Treatment Group (R. 9 to 12) ES3: Max. £ and Cons. Points possible when conservation maximaising
Points
45
40
35
30
25
20
15
10
5
0
1
7
13
19
Players choices/round (6 players* 4 rounds)
£P/Round
£P: MAX. POSSIBLE
Cons P/Round
ConsP: MAX.POSSIBLE

APPENDIX J. INDIVIDUAL PLAYERS' STRATEGIES FOR ROUND 4 TO 8.

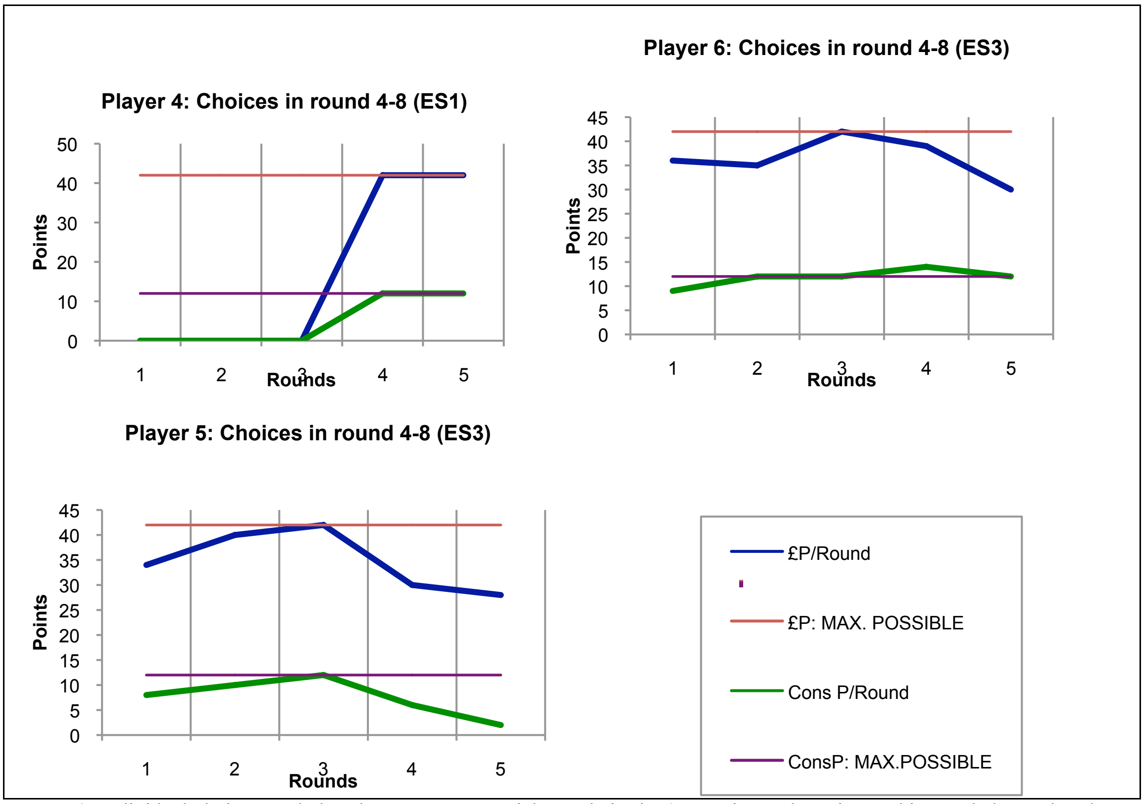
Each graphic represent one players and the strategy he or she followed in each round of the treatment groups (rounds 4 to 8). The panels enclose graphics for players of the three experimental sessions.



Panel 1. Individual choices made by players per sequential rounds in the 3 experimental sessions. Panel 1 show how many rounds players needed to find out the equilibrium point where they maximized money point. Some players took 3 or 4 rounds, others only in the last round reached this equilibrium point. Only in one case in all experimental sessions, player no. 5 (ES2), experimental session 2 in panel 1 reached this point from round one and kept the same strategy over the rest of the rounds.



Panel 2. Individual choices made by players per sequential rounds in the 3 experimental sessions. In this panel, the output of their decision depended on other players choices and therefore in some cases even if they wanted to maximize money or conservation points they would have to assume their neighbours cooperation. Coordination of strategic choices did happen in some cases and therefore players pay the price of cooperation by getting less than what they would have had with no cooperation. In Panel 2, the graphic for player 2 (ES2) shows the costs of cooperation: the neighbouring player did not choose the same option as player 2 producing a decline in player's 2 productivity 2 in ES2. The results show that in other cases players reached this equilibrium point but in consequent round they changed their strategies suggesting that players were 'experimenting' with the choices they had by trying different options. This panel shows the results of players maximized their money points and changed their allocation in subsequent rounds.



Panel 3. Individual choices made by players per sequential rounds in the 3 experimental sessions. This panel shows that there were three players who did not show a pattern suggesting that did not wanted, did not look or did not find the equilibrium point of maximization of money points. The other explanation is that they did not understand the experiment.

LIST OF REFERENCES

Adams, W. (1996) **Future Nature. A vision for conservation**. Earthscan Publications, London.

Adams, W. (2004) **Against Extinction. The Story of Conservation.** London; Stearling: Earthscan.

Agricultural Census (2000) Scottish Executive

Agricultural Holding (Scotland) Act 2003

Ahern (2004) 'Greenways in the USA: theory, trends and prospects'. In Jongman, J. and Pungetti, G. (eds.) **Ecological Networks and Greenways.** Cambridge; New York: Cambirdge University Press: 34-55.

Ajzen, I. (1991) 'The theory of planned behavior'. In **Organizational Behavior and Human Decision Processes** 50(2):179-211.

Akamani, K. and Wilson, P. I. (2011) Toward the adaptive governance of transboundary water resources. **Conservation Letters** 4 (6): 409–416.

Albers, H. and Ferraro, P. (2006) Economics of biodiversity conservation in developing countries. In Tomanan, M. and Lopez, R. (eds.) **Economic development and environmental sustainability.** New York: New policy options, Oxford University Press.

Albers, H. J. Ando, A. and Batz, M. (2008) Patterns of multi-agent land conservation: Crowding in/out, agglomeration, and policy. **Resource and Energy Economics** 30 (4): 492-508.

Albers, H. J. and Bu, M. (2009) **Economics of Habitat Fragmentation and Fragmentation Policy: A Literature Review** [online]. Available from SSRN: http://ssrn.com/abstract=1432155 [accessed 20th December 2011].

Alexander, W. (1981) **Notes and Sketches Illustrative of Northern Rural Life in the Eighteenth Century.** Finzean: Robin Callander**.**

Allen, C. (2011) On Actor-Network Theory and landscape**. Area** 43 (3): 274–280.

Andersen, E. Elbersen, B. Godeschalk, F. et al. (2007) Farm management indicators and farm typologies as a basis for assessments in a changing policy environment. **Journal of Environmental Management** 82 (3): 353-362.

Angelsen, A. (2007) Forest Cover change in Space and Time: Combining the von Thünen and Forest Transition Theory. **World Bank Policy Working Paper 4117**.

Appleton, Z. and Crabtree, B. (1991) **The Farm woodland scheme in Scotland: An economic appraisal**. Aberdeen : Scottish Agricultural College.

Antrop, M. (2001) The language of landscape ecologists and planners. A comparative content analysis of concepts used in landscape ecology**. Landscape and Urban Planning** 55: 163-173.

Argent N 2002 From pillar to post? In search of the post-productivist countryside in Australia. **Australian Geographer** 33: 97-114.

Armitage, D. Berkes, F. and Doubleday, N. (2007) **Adaptive Co-management: Collaboration, Learning and Multi-Level Governance.** Vancouver, Toronto: UBC Press.

Armitage, D. Marschke, M. and Plummer, R. (2008a) Adaptive co-management and the paradox of learning, in **Global Environmental Change** 18: 86-98.

Armitage, D., Plummer, R. and Berkes et al. (2008b) Adaptive co-management for social-ecological complexity, in **Frontiers in Ecology and the Environment** 6: 95-102.

Armitage, D., Berkes, F. and Dale, A. et al (2011) Co-management and the co-production of knowledge: Learning to adapt in Canada's Arctic. **Global Environmental Change** 21 (3): 995–1004.

Arnaboldi, M. and Spiller, N. (2011) Actor-network theory and stakeholder collaboration: The case of Cultural Districts. **Tourism Management** 32 (3): 641-654.

Arnason, A., Ellison, N., et al. (eds.) (2012) **Landscapes beyond Land. Routes, Aesthetics, Narratives**. EASA series, Berghahn books. New York, Oxford.

Asquith, N. and Wunder, S. (eds.) (2008) **Payments for Watershed Services: The Bellagio Conversations**. Santa Cruz de la Sierra: Fundación Natura Bolivia.

Bager, T. and Proost, J. (1997) Voluntary Regulation and Farmers' Environmental Behaviour in Denmark and The Netherlands. **Sociologia Ruralis** 37: 79-96.

Baines, D., Sage, R., B. and Baines, M.,M. (1994) The Implication of Red Deer Grazing to Ground Vegetation and Invertebrate Communities of Scottish Native Pinewoods. **Journal of Applied Ecology** 31: 776-783.

Baileya, S.-A., Haines-Young, R.H., and Watkins, C. (2002) Species presence in fragmented landscapes: modelling of species requirements at the national level **Biological Conservation** 108: 307–316.

Banerjee S., Shortle, J.S. and Kwasnica, A.M. (2009) **The Agglomeration Vickrey Auction for the promotion of spatially contiguous habitat management: Theoretical foundations and numerical illustrations** [online]. Available at: http://ideas.repec.org/p/ags/aaea09/49337.html [accessed 20th December 2011].

Banerjee, S. Shortle, J.S. and Kwasnica, A. (n.d) **Incentive mechanisms for spatially contiguous habitat management: The Agglomeration 'bonus' in the presence of technological externalities in deferent neighbourhoods** [online]. Available from Penn State University: http://www.bioecon.ucl.ac.uk/10th_2008/20.Banerjee.pdf [accessed 20th December 2011].

Barreto, L. Ribeiro, M.C. and Veldkamp, A. et al. (2010) Exploring effective conservation networks based on multi-scale planning unit analysis. A case study of the Balsas sub-basin, Maranhão State, Brazil. **Ecological Indicators** 10 (5): 1055-1063.

Barton, D.N., Faith, D.P. and Rusch, G.M. et al. (2008) Environmental service payments: Evaluating biodiversity conservation trade-offs and cost-efficiency in the Osa Conservation Area, Costa Rica. **Journal of Environmental Management** 90 (2): 901–911.

Batáry, P., Holzschuh, A. and Orci, K.M. et al (2012) Responses of plant, insect and spider biodiversity to local and landscapescale management intensity in cereal crops and grasslands. **Agriculture, Ecosystems and Environment** 146: 130– 136.

Battin, J. (2004) When good animals love bad habitats: Ecological traps and the conservation of animal populations. **Conservation Biology** 18(6): 1482.

Battiste, M (2005) **Indigenous Knowledge: Foundations for First Nations [online]:** http://www.win-hec.org/docs/pdfs/Journal/Marie%20Battiste%20copy.pdf
(Accessed on 15th March 2012)

Bayer, R.C., Renner, E. and Sausgruber, R. (2009) Confusion and Reinforcement Learning in Experimental Public Goods Games. **CeDEx Discussion Paper Series** No. 2009-18.

Beaud, S. and Weber, F. (2003) **Guide de l'enquête de terrain**. Paris : La Découverte.

Becker, C. D. and K. Ghimire (2003) Synergy between traditional ecological knowledge and conservation science supports forest preservation in Ecuador. **Conservation Ecology** 8(1): 1. [online] URL: http://www.consecol.org/vol8/iss1/art1/

Becker, H. (1998) **The Tricks of the Trade. How to think about your research while you're doing it.** Chicago; London : University of Chicago Press.

Beedell, J. and Rehman, T. (2000) Using social-psychology models to understand farmers' conservation behaviour. **Journal of Rural Studies** 16 (1): 117–127.

Beier, P. and Noss, R.F. 1998, Do habitat corridors provide connectivity? **Conservation biology** 12: 1241-1252.

Bennett, G. and Mulongoy, K. J. (2006) Review of Experience with Ecological Networks, Corridors and Buffer Zones. Montreal **Secretariat of the Convention on Biological Diversity. Technical Series** No. 23: 100.

Berkes, F. and Folke, C. (1998) **Linking Social and Ecological Systems. Management practices and social mechanisms for building resilience**. Cambridge University Press.

Berkes, F. (2008) **Sacred Ecology**. New York and London (2nd ed.): Routledge.

Berkes, F., Colding, J., and Folke, C. (2003) Introduction. In **Navigation social-ecological systems,** Berkes, F, Colding, J, and Folke, C (eds.) Cambridge university press: 1-30.

Berkes, F. and Kislalioglu Berkes, M. (2008) Ecological complexity, fuzzy logic and holism in indigenous knowledge. **Futures** 41: 6–12.

Berque, A. (1995). **Les raisons du paysage: de la Chine antique aux environnements de synthèse.** Paris: L'Harmattan.

Bienen, L. (2002). Informed Decisions Conservation Corridors and the Spread of Infectious Diseases. **Conservation in Practice 3** (2): 10-19.

Biodiversity Action Plans UK (2011) Joint Nature Conservation Committee/DEFRA [online] URL: http://jncc.defra.gov.uk/page-5155 (Accessed 19 April 2012)

Bishop, K.D. (1991) Community forests: implementing the concept. **The Planner** 24: 6-10.

Bishop, K.D. (1992) Britain's new forests: public dependence on private interest? In: Gilg, A.W. (eds.) **Restructuring the Countryside: Environmental Policy in Practice.** Avebury Studies Green Research.

Bjørkhaug, H. and Richards, C., A. (2004) **Sustaining agricultural in Australia and Norway: A multifunctional approach.** Paper no 8/04.

Blandford, D. (2001) Are disciplines required on domestic support?. **The Estey centre journal of international law and trade policy** 2 (1): 35-59.

Boatman, N. D., Parry, H. R. and Bishop, J.D. et al. (2007) **Impacts of Agricultural Change on Farmland Biodiversity in the UK**. Environmental Science and Technology, Biodiversity Under Threat 25: 1-32.

Bolk, M.; de Togni, G. et al. (2004) 'From models to reality: design and implementation process', in Jongman, J. and Pungetti, G. **Ecological Networks and Greenways.** Cambridge; New York: Cambirdge University Press: 12-150.

Bohm, P. (1972) Estimating the demand for public goods: an experiment. **European Economic**

Review 3: 111–30.

Bourdieu, P. (1977) **Outline of a theory of practice.** (Trans. R. Nice). Cambridge: Cambridge University Press.

Bourdieu, P. (1980) Le capital Social. **Actes de la Recherche en Science Sociales**, 31(1): 2-3.

Bourdieu, P. (1993). La situation d'enquête et ses effets, in Bourdieu (ed.) **La misère du monde**, Paris : Seuil – Extract edited by Bernard Dantier, http://classiques.uqac.ca/collection_methodologie/bourdieu_pierre/situation_enquete_effets/bourdieu_pierre_situation.doc (Accessed 15/12/2012).

Bourdieu, P. (1998) **Practical reason**. Stanford, CA: Stanford University Press.

Bourdieu, P. Passeron, J.-C. Chamboredon, J.-C, (1968) **Le Métier de sociologue**, Paris : editions Mouton.

BRAG, [Biodiversity Research Advisory Group] (2006) **Research needs analysis for the role of biodiversity in ecosystem function** (edited by Julie Robson).

Brechin, S.R., Wilshusen, P.R. and Fortwangler, C.L. et al. (2002) Beyond the Square Wheel: Toward a More Comprehensive Understanding of Biodiversity Conservation as Social and Political Process, **Society & Natural Resources: An International Journal** (15) 1: 41-64.

Brauer, I., Mussner, R., and Marsden, K. (2006) **The Use of Market Incentives to Preserve Biodiversity** [online]. URL: http://ec.europa.eu/environment/enveco/biodiversity/pdf/mbi.pdf (Accessed 15/02/2012).

Breiman, L., Friedaman, J. H., and Olshen, R. A. (1984) **Classification and Regression Trees.** Monterey, California, USA: Wadsworth, Inc.

Brinkley, K., Fisher, M., and Gray, S. (2001) Complexity, Society and Resource Management: The Complex Adaptive Systems Approach. In G. Lawrence, V. Higgins, and S. Lockie, (eds**), Environment, Society and Natural Resource Management.** Cheltenham, UK: Edward Elgar: 241 – 254.

Brouwer, F. and Lowe, P. (eds) (1998) **CAP and the Rural Environment in Transition: A Panorama of National Perspectives.** Wageningen: Wageningen Press.

Brouwer, F. and van Berkum, S. (1997) **CAP and Environment in the European Union: Analysis of the Effects of the CAP on the Environment and Assessment of Existing Environmental Conditions in Policy**. Wageningen: Wageningen Press.

Brown, I. Poggio, L. and Gimona, A. et al. (2011) Climate change, drought risk and land capability for agriculture: implications for land-use in Scotland**. Regional Environmental Change** 11: 503-518.

Brown, G. et Reed, P. (2012) Social Landscape Metrics: Measures for Understanding Place Values from Public Participation Geographic Information Systems (PPGIS). **Landscape Research** 27(1): 73-90.

Bruneau, P.M.C. (2006) Geodiversity: Soils. In: Shaw, P, and Thompson, D. (eds.) (2006) **The Nature of the Cairngorms, Diversity in a Changing Environmen**t. Edinburgh: Scottish Natural Heritage: 43-52.

Brunner, A. and Huyton, H. (2009) The Environmental Impact of European Union green box subsidies. In: Meléndez-Ortiz, R., Bellmann, C. and Hepburn, J. (eds.) **Agricultural Subsidies in the WTO Green Box. Ensuring Coherence with Sustainable Development Goals.** Cambridge: Cambridge University Press.

Brunner, R., Steelman, T., Coe-Juell, et. al. (2005) **Adaptive Governance: Integrating Science, Policy and Decision Making.** New York**:** Columbia University Press.

Brunner, R., (2006) Transboundary cooperation—a European challenge. In Terry, A., Ullrich, K., Riecken, U. (eds.) **The Green Belt of Europe: From Vision to Reality**. Gland, Switzerland and Cambridge, UK: IUCN:13–19.

Buchanan, J. M. (1965) An Economic Theory of Clubs. **Economica** 32:1-14.

Buller, H. (2000) "Regulation 2078: patterns of implementation". In Buller, H., Wilson, G. A. and Höll, A. (eds.) **Agri-environmental policy in the European Union**, Aldershot (England) and Brookfield (USA): Ashgate: 219-253.

Burton, R. and Wilson, G. (1999) The Yellow Pages as a sampling frame for farm surveys: assessing potential bias in agri-environmental research. **Journal of Rural Studies** 15: 91-102.

Burton, R., Kuczera, C. and Schwarz, G. (2008) Exploring farmers' cultural resistance to voluntary agri-environmental schemes. **Sociologia Ruralis** 48 (1):16-37.

Butler, S. J., Vickery, J. A. and Norris, K. (2007) Farmland Biodiversity and the Footprint of Agriculture. **Science** 315 (5810): 381-384.

Butler, J., Middlemas, S. and Graham, I. et al., (2011) Perceptions and costs of seal impacts on Atlantic salmon fisheries in the Moray Firth, Scotland: Implications for the adaptive co-management of seal-fishery conflict. **Marine Policy** 35 (3): 317–323.

Callander, R, F. (1987) **A pattern of Landownership in Scotland: with particular reference to Aberdeenshire.** Finzean, Scotland: Haughend Publications.

Callander, R.F. (2003) The History of Common Land in Scotland. **Commonweal of Scotland-Working Paper** No. 1 (2). Caledonian Centre for Social Development.

Camerer, C.F. (2003) **Behavioral Game Theory. Experiments in Strategic Interaction.** Princeton, Woodstock: Princeton University Press.

Carpenter, S., Walker, B., Anderies, J.M., and Abel, N. (2001) "From Metaphor to Measurement: Resilience of What to What?" **Ecosystems** 4: 765 - 781.

Carpiano, M. (2009) Come take a walk with me: The "Go-Along" interview as a novel method for studying the implications of place for health and well-being. **Health & Place** 15 (1): 263-272.

Casey, F. and Boody, G. (2007) An assessment of performance-based indicators and payments for resource conservation on agricultural lands. Conservation, Economics **White Paper** 8. Report for the Multiple Benefits of Agriculture Initiative.

Cason, T.N. and Plott, C.R. (1996) EPA's new emissions trading mechanism: a laboratory evaluation. **Journal of Environmental Economics and Management** 30(2): 133-160.

Carvalheiro, L., Seymour, C. and Veldtman, R. et al. (2010) Pollination services decline with distance from natural habitat even in biodiversity-rich areas. **Journal of Applied Ecology** 47 (4): 810–820.

Caughley, G. 1994. Directions in Conservation Biology. **Journal of Animal Ecology** 63: 215-244.

CBD(1992) **Convention of Biological Diversity**, United Nations Organization.
[online] URL: http://www.cbd.int/doc/legal/cbd-en.pdf (Accessed 18/04/2012).

Chamberlin, E. (1948) An Experimental Imperfect Market. **Journal of Political Economy** 56: 95-108.

Cherry T.L., Kroll, S. and Shogren J.F. (eds) (2008) **Environmental Economics, Experimental Methods**. London and New York: Routledge, Explorations in Environmental Economics.

Clarke, E.H. (1971) Multipart pricing of public goods. **Public Choice** 11 (1): 17-33.

Coase, R. H. (1960) The problem of social cost. **Journal of law and economics** 3 (1):1-44

Colfer, Carol J. Pierce. (2005) **The Complex Forest: Communities, Uncertainty, and Adaptive Collaborative Management.** Washington, D.C.: RFF publisher.

Commonweal (n.d.) [online] URL: http://www.scottishcommons.org/othercommons.htm (Accessed 10/08/2011).

Cooksley, S. (2007) **Dee Catchment Management Plan**. Aberdeen, The Macaulay Institute.

Cornes, R. and Sandler, T. (1986) **The theory of externalities, public goods. And club goods**. Cambridge: University Press.

Cosgrove, D. and Daniels, S. (eds) (1988) **The iconography of landscape**. Cambridge: Cambridge University Press.

Cramb, A. (1998) **Fragile Land. Scotland's Environment**. Edinburgh, Polygon

Cumming, G.S., Cumming, D.H.M. and Redman, C.,L. (2006) Scale mismatches in social-ecological systems: causes, consequences, and solutions. **Ecologia and Society** 11 (1):14.

Dallimer, M., Gaston, K. and Skinner, A. et al. (2010) Field-level bird abundances are enhanced by landscape-scale agri-environment scheme uptake. **Biology Letters** 6(5): 643–646.

Davies, B., Blackstock, K. and Brown, K. et al. (2004) **Challenges in creating local agri-environmental cooperation action amongst farmers and other stakeholders**. The Macaulay Land Use Research Institute, report for Scottish Executive Environmental and Rural Affairs Department. Aberdeen.

Dawson, D. (1994) Are Habitat Corridors Conduits for Animals and Plants in a Fragmented Landscapes? A review of the Scientific Evidence. Research report 94. Peterborough: English Nature.

Dee District Salmon Fishery Board and The River Dee Trust (2009) River Dee annual report. Aboyne: Dee District Salmon Fishery Board/The River Dee Trust.

DEFRA, Department for Environment Food and Rural Affairs, (2007) **Securing a healthy natural environment: An action plan for embedding an ecosystem approach** Published by the Department for Environment, Food and Rural Affairs, Crown Copyright.

de Groot, R.S., Alkemade, R. and Braat, L. et al (2010) Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making **Journal of Ecological Complexity** 7 (3): 260–272.

Descola, P. (2005) **Par delà nature et culture.** Gallimard, Paris.

Devoto, M., Bailey, S. and Craze, P. et al. (2012) Understanding and planning ecological restoration of plant–pollinator networks. **Ecology Letters** 15(4): 319–328.

Diamond, J., Ashmole, N. and Purves, P. (1989) The Present, Past and Future of Human-Caused Extinctions [and Discussion] **Philosophical Transactions of the Royal Society of London.** Series B, Biological Sciences, 325 (1228, Evolution and Extinction): 469-477.

Doubleday, N. (2007) Culturing Adaptive Co-Management: Finding "Keys" to Resilience in Asymmetries of Power. In: Armitage, D. Berkes, F. and Doubleday, N. **Adaptive Co-management: Collaboration, Learning and Multi-Level Governance.** Vancouver, Toronto: UBC Press: pp. 228-248.

Drake, L., Bergström, P. and Svedsäter, H. (1999) Farmers' attitude and uptake. In Huylenbroeck, G., v., Whitbay, M. (eds), **Countryside stewardship: Farmers, Policies and Markets.** Pergamon Press

Duffy, J. and Hopkins, E. (2005) Learning, information, and sorting in market entry games: theory and evidence. **Games and Economic Behavior** 51 (1):31-62.

Economic Report Scottish Agriculture. (2010) **Scottish Government Rural and Environmental Research and Analysis Directorate Rural and Environment Analytical Services.**

Edlin, H. L. (1963) Around the Forests of Deeside and the North. In Forestry Commission, **Forests of North East Scotland.** Edinburgh: HMSO:13-40.

Edwards-Jones, G. (2006) Modelling farmer decision-making: concepts, progress and challenges. **Animal Science** 82 : 783-790.

Eggers, J., Mettepenningen, E. and Beckmann, V. (2008) Assessing Local Action Groups and Auctions as Institutional Alternatives for Designing and Implementing Agri-Environmental Measures in the EU - Results from an Expert Survey. **German Journal of Agricultural Economics 7:** 325-333.

Ekelund, R. B. (Jr) and Herbert, R. F. (1997) **A History of Economic Theory and Method**. McGraw-Hill International Editions. Economic Series.

Ellis, S., Wainwright, D., and Berney, F. et al. (2011) Landscape-scale conservation in practice: lessons from northern England, UK**. Journal of Insect Conservation** 15 (1-2): 69-81.

Engel, S., Pagiola, S. and Wunder, S. (2008) Designing payments for environmental services in theory and practice: An overview of the issues. **Ecological Economics** 65: 663-674.

European Commission (EU), (2005) **Agri-environmental Measures. Overview on General Principles, type of Measures, and Application.** Unit G-4 Evaluation of Measures applied to Agriculture, Studies. Directorate General for Agriculture and Rural Development.

Evans, N., Morris, C. and Winter, M. (2002) Conceptualizing Agriculture: a critique of post-productivism as the new orthodoxy. **Progress in Human Geography** 26 (3): 313-332.

FAO (2007) **The state of food and agriculture. Paying farmers for environmental services**. Agricultural series 38.

Ferraro, P. (2000) Global habitat protection: limitations of development interventions and a role for conservation performance payments. **Conservation Biology** 15 (4): 990-1000.

Ferraro, P. (2005) Are We Getting What We Paid For? The Need for Randomized Environmental Policy Experiments in Georgia. **Water Policy Working Paper** 2005-022.

Ferraro, P.J. and Gjertsen, H. (2009) A global review of incentive payments for sea turtle conservation. **Chelonian Conservation and Biology** 8:48–56.

Fiorini S., Yearley S. and Dandy N. (2011) Wild Deer Multivalence and institutional adaptation: The 'deer management group' in Britain. **Human Organization** 70 (2):179-188.

Fischer, J. and Lindenmayer, D.B. (2007) Landscape modification and habitat fragmentation: a synthesis. **Global Ecology and Biogeography** (16): 265-280.

Fish, R., Seymour, S. and Watkins, C. (2003) Conserving English landscapes: land managers and agri-environmental policy. **Environment and Planning A** 35 (1):19–41.

Flintan, F. (2002) **Flip-flops and Turtles — Women's Participation in the Kiunga National Marine Reserve.** Kenya: ICDP.

Folke, C (2006) Resilience: The emergence of a perspective for social-ecological system analyses,

Global Environmental Change 16: 253-267.

Forestry Commission (1963) **Forests of North-East Scotland.** Forestry Commission Guide (Edited by H.L. Edlin). Edinburgh: Her Majesty's Stationery Office (HMSO).

Forestry Commission (1997) **National Inventory of Woodland and Trees, Inventory report**, Scotland – Grampian Region. Edinburgh, Forestry Commission.

Forestry Commission (2002) **Forestry Devolution Review, Interdepartmental group report, Executive summary** [online]. Available form Forestry Commission Great Britain: http://www.forestry.gov.uk/fdr (Accessed 18/03/2012).

Forestry Commission (2010) **The right tree in the right place**, **Planning for forestry and woodlands**. Edinburgh, Forestry Commission Scotland.

Franks, J. and McGloin, A. (2006) **Co-operative Management of the Agricultural Environment**. SAFRD, Rural Economy and Land Use.

Franks, J. R. and McGloin, A. (2007) Environmental co-operatives as instruments for delivering across-farm environmental and rural policy objectives: Lessons for the UK. **Journal of Rural Studies** 23 (4): 472-489.

Franks, J. (2010) Boundary organizations for sustainable land management: The example of Dutch Environmental Co-operatives. **Ecological Economics** (70)2: 283–295.

Friedman, D. and Sunder, S. (1994) **Experimental Methods. A Primer for Economists**. Cambridge, New York, Melbourne: Cambridge University Press.

Gabriel, D., Sait S. and Hogson, J. et al. (2010) Scale matters: the impact of organic farming on biodiversity at different spatial scales. **Ecology Letters** 13 (7): 858–869.

Gächter, S. (2004) "Behavioral Game Theory". In Koehler, D, Harvey, N (eds), **Blackwell handbook of judgment and decision making**. USA, UK and Australia: Blackwell Publishing.

Gadgil, M. (1998) "Traditional Resource Management Systems". In Saraswati, B (eds.) **Lifestyle and Ecology,** Indira Gandhi National Centre for the Arts and D. K. Printworld Pvt. Ltd., New Delhi.

Gallagher, R. and Carpenter, B. (1997) Human-Dominated Ecosystems, Special Issue of **Science**, New Series 277 (5325) : 445-608.

Garibaldi, A. and N. Turner. 2004. Cultural keystone species: implications for ecologicalconservation and restoration. **Ecology and Society** 9(3): 1. [online] URL: http://www.ecologyandsociety.org/vol9/iss3/art1/

Gay S.H., Osterburg B. and Baldock D. et al. (2005) **Recent evolution of the EU Common Agricultural Policy (CAP): state of play and environmental potential.** Sixth Framework Programme priority 8: Policy-Oriented Research [online]. Available from: http://www.ieep.eu/assets/224/WP6D4B_CAP.pdf (Accessed 13/03/2012).

Geyer, F. (1994) The challenge of sociocybernetics, paper presented for the symposium "Challenges to sociological Knowledge" 13th World Congress of Sociology, Bielefeld, July 18-24.

Gibbons, R. (1992) **Game Theory for Applied Economists**. Princeton University Press.

Gibon, A. and Balent, G. (2005) Landscapes on the French side of the western and central Pyrenees. In: Pinto- Correia, T., Bunce, R.G.H., Howard, D.C. (eds.) **Landscape Ecology Management of Atlantic Mountains**. APEP/IALE UK. IALE Publications.

Gibson, C., C., Ostrom, E., Ahn, T., K. (2000) The concept of scale and the human dimensions of global change: a survey. **Ecological Economics** 32(2):217-239.

Giddens, A. (1995) The construction of society, Policy press Cambridge.

Gimona, A. and Van der Horst, D. (2007) Mapping hotspots of multiple landscape functions: a case study on farmland afforestation in Scotland. **Landscape Ecology** 22 (8): 1255-1264.

Gimona, A. Poggio, L. and Brown I. et al. (2012) Woodland networks in a changing climate: Threats from land use change. **Biological Conservation (in press).**

Glasbergen, P. (editor) (1994) Managing Environmental Disputes, Network Management as an Alternative. **Series: Environment and Management** 5.

Goldewijk K. K. and Ramakutty, N. (2004) Land cover change over the last three centuries due to human activities: The availability of the new global data sets. **GeoJournal** 61:335-344.

Goldman, R., Thompson, B. and Daily, G. (2007) Institutional incentives for managing the landscape: Inducing cooperation for the production of ecosystem services. **Ecological Economics** 64 (2):333-343.

Goldman, R., Roumasset, J. and Burnett, K. et al. (2010) Landscape-scale conservation: fostering partnerships through ecosystem service approaches. In Roumasset, J., Burnett, K. and Molina Balisacan, A. (eds) **Sustainability science for watershed landscapes**, Singapore: Institute of Southeast Asian Studies: 195-218.

Goodwin, B. J. and Fahrig. L. (2002) How does landscape structure influence landscape connectivity? **Oikos** 99: 552-570.

Gottfried, R., Wear, D. and Lee, R. (1996) Institutional solutions to market failure on the landscape scale. **Ecological Economics** 18:133-140.

Government Office for Science (2010) **Land Use Futures: Making the Most of Land in the 21st Century.** London: HMSO.

Green, D., Klomp, N., Rimmington, G. and Sadedin, S. (2006), **Complexity in Landscape Ecology**, Springer, Dordrecht, Netherlands.

Groth, M., 2009. The transferability and performance of payment-by-results biodiversity conservation procurement auctions: empirical evidence from northernmost Germany. University of Lüneburg, **Working Paper Series in Economics** No. 119, February 2009 [online]. Available from: www.leuphana.de/vwl/papers

Grout (2009) Incentives for Spatially Coordinated Land Conservation: A Conditional Agglomeration Bonus Mechanism. **Western Economics Forum** 8 (2): 21-29.

Groot, J., Jellema, A. and Rossing, W. (2010) Designing a hedgerow network in a multifunctional agricultural landscape: Balancing trade-offs among ecological quality, landscape character and implementation costs. **European Journal of Agronomy** 32(1): 112–119.

Gunderson, L., H. (2003) Adaptive dancing: interactions between social resilience and ecological crises in **Navigation social-ecological systems**, Edited by Berkes, F, Colding, J, and Folke (eds), Cambridge University Press.

Gunderson, L. and Holling, C. S. (2002) Searching of a Theory of Adaptive Change. In: **Panarchy : understanding transformations in systems of humans and nature**, Washington, D.C.: Island Press.

Gurrutxaga, M., Lozano, P,J. and del Barrio, G. (2010) GIS-based approach for incorporating he connectivity of ecological networks into the regional planning. **Journal for Nature Conservation** 18 (4):318-326.

Hagedorn, K. (2002) (ed.) **Environmental Co-operation and Institutional Change**. Cheltenham, UK and Northampton, USA: Edward Elgar.

Hails, R., S. (2002) Assessing the risks associated with new agricultural practices. **Nature** 418: 685-688.

Hall, J. (2006) Forests and Woodlands. In Shaw, P, and Thompson, D. (eds.) **The Nature of the Cairngorms, Diversity in a Changing Environmen**t. UK, Scottish Natural Habitat pp. 91-108.

Hanley, N., Shogren, J, F. and White, B. et al. (2001) **Introduction to Environmental Economics**. Oxford: Oxford University Press

Hanley, N., Banerjee, S. and Lennox, G. (2012) **How should we incentivize private landowners to "produce" more biodiversity?** Stirling Economics Discussion Paper, Economics Working Papers 2012-02. Stirling: University of Stirling.

Hanski, I. (1998) Metapopulation dynamics. **Nature** 396:41-49.

Herzon, I. and Mikk, M. (2007) Farmers' perceptions of biodiversity and their willingness to enhance it through agri-environment schemes: a comparative study from Estonia and Finland. **Journal for Nature Conservation** 15 (1): 10–25.

Hess, G, R. (1996) Disease in metapopulation models: Implications for conservation. **Ecology** 77: 1617-1632.

Higgs, J. (1964) **The Land. A visual History of Modern Britain**. London, Readers Union Studio Vista

Hirsch, E. (1995) "Introduction". In Hirsch and O'Hanlon: **The Anthropology of Landscape: Perspectives on Place and Space**. Oxford: Clarendon, pp. 1-30.

Hodge, I. (2001) Beyond agri-environmental policy: towards an alternative model of rural environmental governance. **Land Use Policy** 18 (2):99–111.

Hodge, I. (2007) The governance of rural land in a liberalised world, **Journal of Agricultural Economics** 28 (3): 409-432.

Hodge and Reader (2007) **Maximising the Provision of public goods from future agri-environment schemes.** Report for the Land Use Policy Group [online]. Available from: http://www.lupg.org.uk/pdf/pubs_Maxmsng_prov_pub_gds_frm_ftr_a-e_schms%5B1%5D.pdf

Hodge I., D. and Adams W., M. (2012) Neoliberalisation, rural land trust and institutional blending. **Geoforum** 43:472-482

Hoggatt, A.C. (1959) An Experimental Business Game. **Behavioral Science** 4: 192-203.

Holling, C. S. (1973) Resilience and stability of ecological systems. **Annual Review of Ecology and Systematics** 4:1-23.

Holling, C.S. (2001) Understanding the Complexity of Economic, Ecological and Social Systems, **Ecosystems** 4 (5): 390-405.

Holloway, L. (2001) Pets and protein: placing domestic livestock on hobby-farm in England and Wales. **Journal of Rural Studies** 17(3): 293-307.

Ilbery, B. and Bowler, I. (1998) From agricultural productivism to post-productivism. In Ilbery, B. (ed) **The geography of rural change.** Pretice Hall.

Ingold, T. (1980) **Hunters, pastoralists and ranchers: reindeer economies and their transformations**. Cambridge : Cambridge University Press.

Ingold, T. (2003) (First ed. 2000) **The perception of the environment, Essays in livelihood, dwelling and skill**, Routledge, taylor & Francis Group, London and New York.

Jaffers, J (1978) **An introduction to system analysis: with ecological applications**. Edward Arnold, London.

Janssen M.A. and Ostrom E. (2006a) Resilience, vulnerability, and adaptation: A cross-cutting theme of the international human dimension programme on Global Environmental Change (Editorial) In **Global Environmental Change** 16 (3):237-239.

Janssen, M.A. and Ostrom E. (2006) Governing Social-Ecological Systems. In Tesfatsion, L. and Judd, K.L. (eds.) **Handbook of Computational Economics II: Agent-Based Computational Economics**, Elsevier Publisher: 1465-1509.

Heynen, N. and Robbins, P. (2005) The neoliberalization of nature: governance, privatization, enclosure and valuation. **Campotalism Nature Socialism** 16:1-4.

Jones, M. (1991) The elusive reality of landscape. Concepts and approaches in landscape research. **Norsk geografisk Tidsskrift.** (45): 229-244.

Jones, P., Bunce, G. and Evans, J. et al. (2008) **Exploring space and place with walking interviews.** J. Res. Practice 4 (2), Article D2. Retrieved Database [online]. Available from: http://jrp.icaap.org/index.php/jrp/article/view/150/161

Jongman, R. and Pungetti, G. (eds.) (2004) **Ecological Networks and Greenways. Concepts, Design, Implementation**. Cambridge: Cambridge Studies in Landscape Ecology.

Jongman, R. and Bogers, M. (2008) Current status of the practical implementation of ecological networks in the Netherlands. In: **KEN - Knowledge for Ecological Networks: Catalysing Stakeholder Involvement in the Practical Implementation of Ecological Networks.** Report from Alterra Institute, Wageningen UR [online]. Available from:http://ecologicalnetworks.eu/documents/publications/ke3n/NetherlandsKENWP2.pdf [Accessed 21/04/2012]

Kaijonen, M. (2006) Co-construction of agency and environmental management. The case of agri-environmental policy implementation at Finnish farms. **Journal of Rural Studies**, 22 (2):205-216**.**

Kalacskaa, M., Sanchez-Azofeifaa, G.A. and Rivarda, B. et al. (2008) Baseline assessment for environmental services payments from satellite imagery: A case study from Costa Rica and Mexico. **Journal of Environmental Management** 88: 348–359.

Kleijn D. and Sutherland W. (2003) How effective are European agri-environment schemes in conserving and promoting biodiversity? **Journal of Applied Ecology** 40 : 947–969.

Klein Goldewijk, K. (2001) Ecosystems and Human Well-being, **Millennium Ecological Assessment**, 2005.

Kling, C. (2008) "Discussion common property and public goods, in Environmental Economics, Experimental Methods". In Cherry T, L., Kroll, S., Shogren J.F. (eds.) **Environmental Economics, Experimental Methods**. London and New York: Routledge Explorations in Environmental Economics.

Koskela, E. and Ollikainen, M. (2001) Optimal private and public harvesting under spatial and temporal interdependence. **Forest Science** 47 (4): 596–607.

Kruse, J., Klein, D., Braund, S., Moorehead, L., Simeone, B., (1998) Co-Management of Natural Resources: A Comparison of Two Caribou Management Systems, **Human Organization** 57(4): 447-458.

LaFreniere G., F. (1997) Greenline parks in France: les parcs naturels régionaux. **Agriculture and Human Values** 14 (4): 337-352.

Lawrence, A. (2006). "No personal motive?" Volunteers, biodiversity and the false dichotomies of participation. **Ethics, Place and Environment** 9 (3): 279-298.

Lawrence, A. (2007) Beyond the second generations: towards adaptiveness in participatory forest management. CABI Reviews: Perspectives in Agriculture, Veterinary Science, **Nutrition and Natural Resources** 2 (28): 1-15. On line: http://www.forestry.gov.uk/pdf/Lawrence_PFM_review_2007.pdf/$FILE/Lawrence_PFM_review_2007.pdf (accesses on 20/03/2012)

Lawton, J.H., Brotherton, P.N.M., and Brown, V.K. et al. (2010) **Making Space for Nature: a review of England's wildlife sites and ecological network.** Report to DEFRA.

Leibenath, M., Blum, A. and Stutzriemer, S. (2010) Transboundary cooperation in establishing ecological networks: The case of Germany's external borders. **Landscape and Urban Planning,** 94(2):84-93.

Levins, R. (1969) Some demographic and genetic consequences of environmental heterogeneity for biological control, **Bulletin of the Entomological Society of America** 15:237–240, 1969.

Leys, A.J. and Vanclay, J.K. (2011) Social learning: A knowledge and capacity building approach for adaptive co-management of contested landscapes. **Land Use Policy** 28 (3): 574–584.

Lewin, R. (1999) **Complexity. Life at the edge of chaos,** London: Phoenix.

Lindenmayer, D and Hobbs, R (2007) Editors. **Managing and Designing Landscapes for Conservation: Moving from Perspectives to Principles**, ZSL conservation, Blackwell Publishing.

Lipper, L., Sakuyama, T. and Stringer, R. et al. (eds.) (2009) **Payment for Environmental Services in Agricultural Landscapes**. Economic Policies and Poverty Reduction in Developing Countries, FAO: Springer

Lobley, M. and Potter, C. (1998) Environmental Stewardship in UK Agriculture: A Comparison of the Environmentally Sensitive Area Programme and the Countryside Stewardship Scheme in South East England. **Geoforum** 29 (4): 413-432.

Lothians and Fife Green Network Partnership (n.d.) [online] URL: http://www.elfhnp.org.uk/ [Accessed 20/08/2011].

Lowe, P., Ward, N. and Potter, C. (1999) Attitudinal and institutional indicators for sustainable agriculture. In Brouwer, F., Crabtree B. (eds.), **Environmental indicators and agricultural policy.** Wallingford, CABI

Lozada, L. M. (2008) 'Chaleur et odeurs pour nos morts'. La cuisine cérémonielle de la Fête des Morts dans une communauté Totonaque de Puebla, Mexique. **Food and History** 6 (2) : 133-154.

Lozada, L, M. (in press) El espíritu del maíz en la comida ritual versus el maíz transgénico. Estudio entre los totonacos de la Sierra Norte de Puebla. **Anthropology of Food.**

MacDonald, (1997) (Thesis) **The effect of land use on the N and P status of the Ythan, Don and Dee Catchments in north east Scotland**. Aberdeen, University of Aberdeen.

MacFarlane, R. (1998) Implementing agri-environmental policy: A landscape ecology perspective. **Journal of Environmental Planning and Management** 41(5): 575-596.

MacMillan, D. C. and Leitch, K. (2008) Conservation with Gun: Understanding Landowner Attitudes to Deer Hunting in the Scottish Highlands. **Human Ecology** 36: 473-484.

Marion, R. (1999) **The Edge of Organization. Chaos and Complexity Theories of Formal Social Systems**, London: Sage.

Marston, S., A., Jones, J., P., Woodward, K. (2005) Human geography without scale, **Transactions of the Institute of British Geographers** 30(4) 416-432.

Matzdorf, B. and Lorenz, J. (2010) How cost-effective are result-oriented agri-environmental measures? An empirical analysis in Germany. **Land Use Policy** 27 (2), 535-544.

May, R and McLean, A (2007) **Theoretical Ecology, Principles and Application.** Oxford (Third Edition).

Maye, D., Ilbery, B. and Watts, D. (2009) Farm diversification, tenancy and CAP reform: Results from a survey of tenant farmers in England. **Journal of Rural Studies** 25 (3):333-342.

McAfee, K. and Shapiro, E. (2010) Payments for Ecosystem Services in Mexico: Nature, Neoliberalism, Social Movements, and the State. **Annals of the Association of American Geographers** 100(3): 579-599.

McCarthy, J. (2005) Rural geography: multifunctional rural geographies-reactionary or radical? Progress in **Human Geography** 29: 773.

Merckx, T., Feber, R. and Dulieu, L. et al. (2009) Effect of field margins on moths depends on species mobility: Field-based evidence for landscape-scale conservation. **Agriculture, Ecosystems & Environment**, 129 (1-3): 302–309.

Michael, J. (2003) Efficient habitat protection with diverse landowners and fragmented landscapes. **Environmental Science and Policy,** 6 (3): 243-251.

Millennium Assessment (2005) **Millennium Ecosystem Assessment and Human Well-Being: Current State and Trends** (Editors: R. Hassan, R. Scholes, N. Ash). Washington, Covelo, London: Island Press.

Mills, J., Gibbon, D. and Dwyer, J., et al. (2006) **Identification of Delivery Mechanisms for Welsh Top-Tier Agri-Environment Schemes.** University of Gloucestershire, Cheltenham.

Mishra, C., Allen, P. and McCarthy, T.O.M. et al. (2003) The role of incentive programs in conserving the snow leopard. **Conservation Biology** 17: 1512–1520.

Moilanen, A., and Nieminen, M. (2002) Simple connectivity measures in spatial ecology. **Ecology** 83

Moilanen, A. (2004) SPOMSIM: software for stochastic patch occupancy models of metapopulation dynamics. **Ecological Modelling** 179:533-550.

Morris C. and Potter C. (1995) Recruiting the new conservationists: farmers' adoption of agri-environment schemes in the UK. **Journal of Rural Studies** 11 (1): 51-63

Morton, L.W., Rodecap, J. and Brown, S. et al. (2006) **Performance-based Environmental Management: The Hewitt Creek Model**. Iowa State University, University Extension.

Moseley, D, Ray, D, and Watts, K. et al. (2008) **Forest Habitat Networks Scotland (Final Report)** Contract repost for Forestry Commission Scotland, Forestry. Commission GB and Scottish Natural Heritage.

Muñoz-Piña, C., Guevara, A. and Torres, J.M. et al., (2008) Paying for the hydrological services of Mexico's forests: Analysis, negotiations and results. **Ecological Economics** (65) 4: 725–736.

Nadasdy, P. (2007) “Adaptive Co-Management and the Gospel of resilience”. In Armitage, D. Berkes, F. and Doubleday, N. (eds.) **Adaptive Co-management: Collaboration, Learning and Multi-Level Governance.** Vancouver, Toronto: UBC Press. pp. 208-227.

Nelson, G., C. (2002) Introduction to the special issue on spatial analysis for agricultural economists. **Agricultural Economics** 27: 197-200.

Nielsen-Pincus, M. (2011) Mapping a Values Typology in Three Counties of the Interior Northwest, USA: Scale, Geographic Associations Among Values, and the Use of Intensity Weights. **Society & Natural Resources: An International Journal** 24(6): 535-552.

Norberg, J., and Cumming, G. S. (2008) Complexity theory for a sustainable future: conclusions and outlook. In: Norberg, J., and Cumming, G. S., (eds). **Complexity Theory for a Sustainable Future**, Columbia University Press: 277-293.

OECD, (2001) **Production effects of agri-environmental policy measures: reconciling trade and environmental objectives**. Paris, OECD publishing.

OECD. (2008) **Environmental Performance of Agriculture in OECD countries since 1990.** Paris, OECD publishing.

OECD. (2010) **Paying for Biodiversity Enhancing the Cost-Effectiveness of Payments for Ecosystem Services**. Paris, OECD publishing.

Oldfield, T. E. E., Smith, R. J. and Harrop, S. R. et al. (2003) Field sport and conservation in the United Kingdom, **Nature** 423: 531-533.

Olson, M. (1971) **The Logic of Collective Action Public Goods and the Theory of Groups.** Harvard Economic Studies, 124, Harvard University Press.

Olsson, P, Folke, C, and Berkes, F. (2004) Adaptive comanagement for building resilience in social-ecological systems, **Environmental Management** 34(1):75-90.

Oregon Department of Agriculture (2005) **The conservation Reserve Enhancement Program** [online]. Available from:
http://oregon.gov/ODA/NRD/docs/pdf/water/crep_brochure_4_05.pdf [Accessed on 10/-04/2012].

Olwig, K. (1996) Recovering the Substantive Nature of Landscape.
Annals of the Association of American Geographers. Vol. 86, No. 4 (Dec., 1996), pp. 630-653.

Ostrom E. (1990) **Governing the Commons: The Evolution of Institutions for Collective Action**. Cambridge, UK: Cambridge University Press.

Ostrom, E. (1998) A Behavioral Approach to the Rational Choice Theory of Collective Action: Presidential Address, American Political Science Association, 1997. **The American Political Science Review** 92 (1): 1-22.

Ostrom, E., Walker, J., and Gardner, R. (1992) Covenants With and Without a Sword: Self-Governance is Possible. **The American Political Science Review** 86 (2): 404-417.

Ostrom, E., Gardner and R. Walker J. (1994) **Rules, Games and Common Pool Resources.** Ann Arbor: University of Michigan Press.

Pagiola, S., Ramírez, E. and Gobbi, J. et al. (2007) Paying for the environmental services of silvopastoral practices in Nicaragua. **Ecological Economics** 64: 374–385.

Parkhurst, G., Shogren, J. and Bastian, C. et al. (2002) Agglomeration ‘bonus’: an incentive mechanism to reunite fragmented habitat for biodiversity conservation. **Ecological Economics** 41 (2): 305-318.

Parkhurst, G., M. and Shogren, J. (2007) Spatial incentives to coordinate contiguous habitat. **Ecological Economics** 64 (2): 344-355.

Parsram, K. and McConney, P. (2004) **Lecture Notes. Guidelines for coastal resource co-management in the Caribbean: communicating the concepts and conditions that favour success. Pro-poor Policies and Institutional Arrangements for Coastal Management in the Caribbean.** Caribbean Conservation Association.

Pascual, U. and Perrings, C. (2007) Developing incentives and economic mechanisms for in situ biodiversity conservation in agricultural landscapes. **Agriculture Ecosystems and Environment,** 121: 256–268.

Pelosi, C., Goulard, M. and Balent, G. (2010) The spatial scale mismatch between ecological processes and agricultural management: Do difficulties come from underlying theoretical frameworks?. **Agriculture Ecosystems and Environment** 139 (4): 455-462.

Phillips, A. (1999) A whole landscape approach for a holistic century. In **Policies and Priorities for Ireland's Landscape Conference Papers**, Tullamore, Co. Offaly, April 1999, http://www.heritagecouncil.ie/publications/landscape/index.htm.

Pigou, A. C. (1920) **The Economics of Welfare.** London: Macmillan

Plummer and Armitage (2007) Charting the New Territory of Adaptive Co-management: A Delphi Study in **Ecology and Society**, 12 (2):10.
[online] URL: http://www.ecologyandsociety.org/vol12/iss2/art10/

Plummer and Armitage (2007a) A resilliance-based framework for evaluating adaptive co-management: Linking ecology, economics and society in a complex world, **Ecological Economics** 61:62-74.

Plummer, R., and FitzGibbon. J. (2004a) Co-management of natural resources: a proposed framework. **Environmental Management** 33(6):876–885.

Potter, C. and Burney, J. (2002) Agfialtural multifunctionality in the WTO - legitimate non-trade concern or disguised protectionism? **Journal of Rural Studies** 18: 35-47.

Pretty, J. (2003) Social Capital and the Collective Management of Resources. **Science** 302 (5652):1912-1914.

Pretty, J. and Smith, D. (2004) Social capital in biodiversity conservation and management. **Conservation Biology** 18(3):631-638.

Primdahl, J. (1999) Agricultural landscapes as places of production and for living in owner's versus producer's decision making and the implications for planning. **Landscape and Urban Planning** 46: 143-150.

Quirk, B. (2007) **Making assets work. The Quirk Review of community management and ownership of public assets**. London, Report to Department for Communities and Local Government.

Rachad, A. (2004) **Interpreting Quantitative data with SPSS**. London, SAGE Publication.

Rakotonirina, B. and Cooke, A. (1994) Sea turtles of Madagascar – their status, exploitation and conservation. **Oryx**, 28: 51-61.

Randall, A. (1983) The Problem of Market Failure. **Natural Resources Journal** 23: 131-148.

Rappaport, R.A. (1968) **Pigs for the Ancestors**. New Haven: Yale University Press.

Ratcliffe, D. A. and Thompson, D. B. A. (1988) The British uplands: their ecological character and international significance. In: Usher, M. B., Thompson D. B. A., (eds.) **Ecological Changes in the Uplands**. Oxford, Blackwells.

Redpath, S. and Thirgood, S. (2009) Hen harriers and red grouse: moving towards consensus? **Journal of Apply Ecology** 46 (5): 961-963.

Resilience Alliance [online]. Available at: http://www.resillience.org/2448.php [accessed on the 18/09/ 2008].

Rollett, A., Haines-Young, R., and Potschin, M. et al. (2008) **Delivering environmental services through agri-environment programmes: a scoping study.** Report of the LUPG agencies and Centre for Environmental Management, University of Nottingham.

Roth, R. (2004) Spatial organization of environmental knowledge: conservation conflicts in the inhabited forest of northern Thailand. **Ecology and Society,** 9 (3): 5. [online] URL: http://www.ecologyandsociety.org/vol9/iss3/art5/

Rowland, M, M and Wisdom, M, J. (2008) Habitat networks for terrestrial wildlife: concepts and case studies. In: Millspaugh, Joshua J.; Thompson, Frank R., (eds.) **Models for planning wildlife conservation in large landscapes.** New York: Elsevier.

Ryan, R.L. (2011) The social landscape of planning: Integrating social and perceptual research with spatial planning information. **Landscape and Urban Planning** 100 (4): 361-363.

Rydval, O. and Ortmann, A. (2005) Loss avoidance as selection principle: Evidence from simple stag-hunt games. **Economics Letters** 88 (1): 101-107.

Sabatier, P, A, Focht, W, Lubell, M, et al. (2005) Collaborative Approach to Watershed Management, In Sabatier, P., Focht, W, and Lubell, M et al. (eds.) **Swimming Upstream. Collaborative Approaches to Watershed Management.** Cambridge, Massachussets and London: The MIT press. pp. 3-22.

Sala, O., Armesto, R., Berlow, J. et al. (2000) Global biodiversity scenarios for the year 2100. **Science** 287:1770-1774.

Sala, O. E., Chapin, S.F. and Armesto, J. et al. (2000) Global biodiversity scenarios for the year 2100. **Science** 287:1770-1774.

Samuleson, P., A. (1954) The Pure Theory of Public Expenditure. **The Review of Economics and Statistics** 36 (4):387-389.

Samuelson, P. A. (1955) Diagrammatic Exposition of a Theory of Public Expenditure. **The Review of Economics and Statistics** 37(4):350-356.

Sandler, Todd. (1992) **Collective Action: Theory and Applications**. Ann Arbor: University of Michigan Press

Sandys, P. (1994) The woodland grant scheme: a review from the perspective of owners and managers. **Quarterly Journal of Forestry** 8S(1): 20-26.

Scambler, A. (1989) Farmer's attitude towards forestry. **The Scottish Geographical Magazine** 105 (1): 47-49.

Schama, Simon. (1995) **Landscape and Memory**, London : HarperCollins.

Schenk, A., Hunziker, M. and Kienast F. (2007) Factors influencing the acceptance of nature conservation measures-A qualitative study in Switzerland. **Journal of Environmental Management** 83:66-79.

Scherr and Babb (1975) Pricing public goods: An experiment with two proposal pricing systems. **Public Choice** 21: 35-53.

Schaller, N., Lazrak, E.G. and Martin, P. et al. (2010) Combining farmers' decision rules and landscape stochastic regularities for landscape modelling. **Landscape Ecology** 27 (3): 433-446.

Schmitzberger, I., Wrbka, Th. and Steurer, B. et al. (2005) How farming styles influence biodiversity maintenance in Austrian agricultural landscapes. **Agriculture, Ecosystems and Environment,** 108: 274-90.

Schramek, J., Biehl, D. and Buller, H. (eds.)(1999) The **Implementation and Effectiveness of Agri-environmental Schemes Established after Regulation 2078/92**. 1. Main Report Final Consolidated Report to DG VI of the European Commission (Contract FAIR CT95 274). Brussels: DGVI (Agriculture) of the Commission of European Communities.

Schultz, L., Duit, A. and Folke, C. (2011) Participation, Adaptive Co-management, and Management Performance in the World Network of Biosphere Reserves**. World Development** 39 (4): 662–671.

Schwarz, G., Moxey, A. and McCracken, D. et al. (2008) **An analysis of the potential effectiveness of a Payment-by-Results approach to the delivery of environmental public goods and services supplied by Agri-Environment Schemes**. Report to the Land Use Policy Group, UK. Macaulay Institute, Pareto Consulting and Scottish Agricultural College.

Siegel, S. and Fouraker, L.E. (1961) **Bargaining and Group Decision-Making Experiments in Bilateral Monopoly.** New York: McGraw-Hill.

Scotland's Population (2007) The Registrar General's Annual Review 153rd Edition. London: National Statistics.

Scott, A. and Shannon, P. (2007) Local landscape designations in Scotland: Opportunity or barrier to effective landscape management? **Landscape and Urban Planning** 81: 257–269.

Scottish Agriculture 2006. The Scottish Government [online]. Available at: www.scotland.gov.uk/Publications/2007/06/08165102/1 [accessed on 20/04/12]

Scottish Agriculture 2009. The Scottish Government [online]. Available at: http://www.scotland.gov.uk/Publications/2009/06/19142408/1 [accessed on 20/04/12]

Scottish Agriculture 2010. The Scottish Government [online]. Available at: http://www.scotland.gov.uk/Publications/2011/06/09104215/1 [accessed on 20/04/12]

Scottish Executive (see SE)

Scottish Government (see SG)

SE (Scottish Executive) (2004) **The Economic Impact of Game and Coarse Angling in Scotland.** Edinburgh: The Scottish Executive.

SE (Scottish Executive) (2006) **The Scottish Forestry Strategy 2006**. Forestry Commission Scotland.

SE (Scottish Executive) (2011) **Getting the best form our Land, A Land Use Strategy for Scotland**. Edinburgh, Scottish Executive.

Sedgwick, S. (2005) **From Royal Tullich to Royal Deeside**, The Story of Ballater

Segerson, K. (1988) Uncertainty and Incentives for Nonpoint Pollution Control. **Journal of environmental economics and management**, 15: 87-98.

Segerson, K. and Wu, J. (2006) Nonpoint pollution control: Inducing first-best outcomes through the use of threats. **Journal of Environmental Economics and Management** 51: 165-184.

Selman, P. (2004) Community participation in the planning and management of cultural landscapes.

Journal of Environmental Planning and Management 47(3):365-392.

Selman, P. (2006) **Planning at the landscape scale**. London and New York, the RTPI library series, Routledge.

Selman, P. (2012) **Sustainable Landscape Planning: The Reconnection Agenda**. Oxon and New York: Routledge,

Selmi, A. and Hirtzel, V. (2007) Introduction. Parquer la nature. In **Le gouvernment de la nature**, Les Cahiers d'Anthropologie Sociale, Paris: Editions de L'Herne, pp. 9-12.

SG (Scottish Government) (2000) **Rural Scotland: A national Approach.** Edinburgh: Scottish Government.

SG (Scottish Government) (2003a) **A partnership for a better Scotland: partnership Agreement**. Edinburgh: Scottish Government.

SG (Scottish Government) (2003b) **Improving Health in Scotland- the Change**. Edinburgh: Scottish Government.

SG (Scottish Government) (2004a) **Smart successful Scotland**. Edinburgh: Scottish Government.

SG (Scottish Government) (2004b) **Scotland's Biodiversity –it's in your hands**. Edinburgh: Scottish Government.

SG (Scottish Government) (2009a) **National Planning Framework for Scotland**. Edinburgh: Scottish Government.

SG (Scottish Government) (2009b) **Economic trends in Scottish Agriculture.** Edinburgh: Scottish Government Rural and Environment Analytical Services.

SG (Scottish Government) (2011a) **Economic report on Scottish agriculture 2011 Edition**. Edinburgh, Scottish Government Rural Payments and Inspections Directorate, Rural and Environmental Service and Analytical Services.
http://www.scotland.gov.uk/Resource/Doc/359320/0121431.pdf

SG (Scottish Government) (2011b) **Rural Scotland Key Facts 2011**. Edinburgh: The Scottish Government. [online]. Available at: http://www.scotland.gov.uk/Resource/Doc/359320/0121431.pdf [accessed on 20/04/12]

SG (Scottish Government) (n.d.) **The Scottish Government, Agricultural Tenancy Statistics** [online] URL: http://www.scotland.gov.uk/Topics/Statistics/Browse/Agriculture-Fisheries/tenancy0507 [accessed on 19/04/12]

Sharov, A. (1996) **Quantitative Population Ecology** - online lectures.
http://www.ento.vt.edu/~sharov/PopEcol/popecol.html/ (accessed January, 2008)

Shaw, P., Thompson, D.B.A. and Duncan, K. et al. (2006) Birds. In Shaw, P, and Thompson, D. (eds.) **The Nature of the Cairngorms, Diversity in a Changing Environment**. UK, Scottish Natural Heritage: 293-340.

Shogren, J.F., Parkhurst, G. M. and Settle, C. (2003) Integrating economics and ecology to protect nature on private lands: models, methods, and mindsets. **Environmental Science and Policy** 6 (3): 233-242.

Siebert, R., Toogood, M. and Knierim, A. (2006) Factors Affecting European Farmers' Participation in Biodiversity Policies. **Sociologia Ruralis** 46 (4): 318-340.

Simeonova, V., E. Bos, R. Jongman, & H. Zingstra, 2009. **Implementation of ecological networks in different socio-economic contexts. Guiding principles based on experiences in Central and**

Eastern Europe. Wageningen, Alterra, Alterra-rapport 1896. 117 blz.; 20 figs.; 12 tables.; 122 refs.

Slee, B., Bergman, H. and Brown, I. et al. (2009) **Realising the Potential Contributions of Scotland's Rural Land to Delivering Sustainable Economic Growth.** Rural Land Use Study Project 2. Research Finding No. 9 Scottish Government Social Research.

Smart, R. P, Soulsby, C, and Cresser, M, S. et al. (2001) Riparian zone influence on stream water chemistry at different spatial scales: a GIS-based modelling approach, an example for the Dee, NE Scotland. **The science of the total environment**, 280: 173-193.

Smit, B. and Wandel, J. (2006) Adaptation, adaptive capacity and vulnerability, **Global Environmental Change** 16: 282-292.

Smith, V.L. (1962) An Experimental Study of Competitive Market Behavior. **Journal of Political Economy** (70) 2: 111-137.

Smith, V.L. (1976) Experimental Economics: Induced Value Theory. **American Economic Review**, (66) 2: 274-279.

Smith, V. L. (1991) **Papers in Experimental Economics**. Cambridge University Press.

Smith, R.B.W., Shogren, J.F. (2001) Protecting species on private land. In: Shogren, J., Tschirhart, J. (eds.), **Protecting Species in the United States: Biological Needs, Political Realities, Economic Choices**. Cambridge University Press, New York, pp. 326 – 342.

Smith, R.B.W., Shogren, J.F. (2002) Voluntary incentive design for endangered species protection, **Journal of Environmental Economics and Management** 43, 169 – 187.

Southgate, D. and Wunder, S. (in press). Paying for watershed services in Latin America: A review of current initiatives. **Journal of Sustainable Forestry.**

Stoate, C., Baldi, A. and Beja. et al. (2009) Ecological impact of early 21 century agricultural change in Europe, A review. **Journal of Environmental Management** 91 (1): 22 – 46.

Sundali, J. A., Rapoport, A. Seale, D. (1995) Coordination in Market entry games with symmetric players, **Organizational Behavioural and Human Decision Processes** 64 (2): 203-218.

Swallow, S., Wear, D. (1993) Spatial interactions in multiple-use forestry and substitution and wealth effects for the single stand. **Journal of Environmental Economics and Management** 25, 103–120.

TEEB (2010) **The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature: A synthesis of the approach, conclusions and recommendations of TEEB**.

Thirgood S., Redpath, S. and Newton, I. et al. (2000) Raptors and Red Grouse: Conservation and Management Solutions. **Conservation Biology** 14(1): 95-104.

Thomas, J.A., Telfer, M.G., Roy, D.B., et al. (2004) Comparative losses of British butterflies, birds, and plants and the global extinction crisis. **Science** 303: 1879-1881.

Thompson, E. (1965) A Pareto Optimal Group Decision Process. **Papers in Non- Market Decision-Making** 1: 133-40.

Thompson, P. S., Amar, A. and Hoccom, D. G. et al. (2009) Resolving the conflict between drive-grouse shooting and conservation of hen harriers. **Journal of Applied Ecology,** 46 (5): 950-954.

Tiemann, S and Siebert, R. (2009) Ecological networks implementation by participatory approaches as a response to landscape fragmentation: A review of German literature. **Outlook on Agriculture**, 38 (2): 205-212.

Tilley, C. 1994. **A Phenomenology of Landscape**. Oxford: Berg.

Tilley, C. 2008. **Body and Image: Explorations in Landscape Phenomenology 2**. Oxford: Blackwell.

Tipper, R. (2002) Helping indigenous farmers participate in the international market for carbon services: The case of Scolel Té. In: S. Pagiola, J. Bishop, and N. Landell-Mills (Editors), **Selling Forest Environmental Services**: Market-based Mechanisms for Conservation. Earthscan, London, pp.223-234.

Tizley, M. (2000) Natural Areas, the whole countryside approach and sustainable agriculture**. Land Use Policy** 17: 279

Toledo, V. M. (1985) **Ecología y Autosuficiencia Alimentaria: Hacia una opción basada en la diversidad biológica, ecológica y cultural de México**. Mexico City: Siglo XXI.

Turner, R., K., Pearce, D. and Bateman, I. (1993) **Environmental Economics, An Elementary Introduction**. Baltimore, the Johns Hopkins University Press.

Turner, M.G., Garner, R.H. and O'Neill, R. V. (2001) **Landscape Ecology in Theory and Practice: Pattern and Process**. New York: Springer.

UK National Ecosystem Assessment (2011) **The UK National Ecosystem Assessment: Synthesis of the Key Findings**. Cambridge: UNEP-WCMC.

van der Grift, E. (2005) Defragmentation in the Netherlands. A Success Story? ***GAIA*** (14) 2: 144 – 147.

van der Horst, D., and Lozada-Ellison, L. M. (2010) Conflictos entre las energías renovables y el paisaje: siete mitos y la propuesta de manejo adaptativo y colaborativo. **Nimbus** 25-26, p.231-251.

Vannier C., Vasseur, C., Hubert-Moy et al. (2011) Multiscale ecological assessment of remote sensing images, **Landscape Ecology** 26:1053–1069.

Verhulst, J, Kleijn, D, and Berendse, F. (2007) Direct and indirect effects of the most widely implemented Duch agri-environment scheme on breeding waders, **Journal of Applied Ecology** 44, 70-80.

Vickery, J., Carter, N. and Fuller, R.J. (2002) The potential value of managed cereal field margins as foraging habitats for farmland birds in the UK. **Agriculture, Ecosystems and Environment** 89:41–52.

Vickery, J., Bradbury, R. and Henderson, I. et al. (2004) The role of agri-environment schemes and farm management practices in reversing the decline of farmland birds in England. **Conservation Biology** 119:19–39.

Vimal, R, Mathevet, R and Thompson, J., D. (2012) The changing landscape of ecological networks, **Journal for Nature Conservation**, 20: 49-55.

Vokoun, M., Amacher, G., Sullivan, J., Wear, D. (2010) Examining incentives for adjacent non-industrial private forest landowners to cooperate. **Forest Policy and Economics** 12 (2): 104-110.

Vossler C. A., Poe G. L., Schulze, W., Segerson, K. (2002) An Experimental Test of Ambient-based Mechansms for Nonpoint Source Pollution Control. **Working papers Series in Environmental & Resource Economics**, Cornell: Cornell University.

Walford, N. (2002) Agricultural adjustment: adoption of and adaptation to policy reform measures by large-scale commercial farmers. **Land Use Policy** 19: 243-257.

Warren, J, Lawson, C and Belcher, K. (2008) **The Agri-environment.** Cambridge University Press.

Warziniack T, Shogren J, F, and Parkhurst, G. (2007) Creating contiguous forest habitat: An experimental examination on incentives and communication, **Journal of Forest Economics** 13, 191–207.

Watkins, C., Williams, D. and Lloyd, T. (1996) Constraints on farm woodland planting in England: a study of Nottinghamshire farmers. **Forestry** (69)2: 167-176.

Wauters, E., Bielders, C. and Poesen, J. et al. (2010) Adoption of soil conservation practices in Belgium: An examination of the theory of planned behaviour in the agri-environmental domain: **Land Use Policy** (27) 1: 86-94.

Wertz-Kanounnikoff, S. (2006) **Payments for environmental services – A solution for biodiversity conservation?** Ressources Naturelles, N° 1. Paris: Institut du développement durable et des relations internationales (IDDRI).

Wiber, M., Charles, A., Kearney J., Berkes, F. (2009) Enhancing community empowerment through participatory fisheries research, **Marine Policy** 33: 172– 179.

Wightman, A. (1996) **Who owns Scotland.** Edinburgh: Canongate

Willis K. J., Jeffers, E. S., and Tovar, C. et al. (2012) Determining the ecological value of landscapes beyond protected areas, **Biological conservation** 147 (1): 3–12.

Wilson, G. (1996) Farmer environmental attitudes and ESA participation. **Geoforum** 27 (2):115-131.

Wilson, G. (1997) Factors Influencing Farmer Participation in the Environmentally Sensitive Areas Scheme. **Journal of Environmental Management** 50: 67–93.

Wilson, G. (2001) From productivism to post-productivism…and back again? Exploring the (un)changed natural and mental landscape of European agriculture. **Transactions of the Institute of British Geographers** 26(1):77-102.

Wilson, nd Hart, K. (2000) Financial imperative or conservation concern? EU farmers' motivations for participation in voluntary agri-environmental schemes. **Environment and Planning A** 32(12): 2161–2185.

Wilson, G. and Hart, K. (2001) Farmer Participation in Agri-Environmental Schemes: Towards Conservation-Oriented Thinking**?** **Sociologia Ruralis** 41 (2): 254–274.

Wood, S. and Patrick, J. (1982) **History in the Grampian landscape**. Haughend, Finzean, Aberdeenshire: R. Callender.

Wunder, S, (2005) The Efficiency of Payments for Environmental Services in Tropical Conservation, **Conservation Biology** 21 (1):48-58.

Yliskyla-Peuralahti, J. (2003) Biodiversity – a new spatial challenge for Finnish agri-environmental policies? **Journal of Rural Studies** 19 (2): 215-231.

Zabel A, and Holm-Muller, K, (2008) Conservation Performance Payments for Carnivore Conservation in Sweden**, Conservation Biology** 22 (2):247-251.

Zelmer, J. (2003) Linear Public Goods Experiments: A Meta-Analysis, **Experimental Economics** 6: 299–310.

Zizzo D, J, and Tan, J, HW (2007) Perceived harmony, similarity and cooperation in 2 · 2 games: An experimental study, **Journal of Economic Psychology** 28: 365-386.