Cranfield University

Amy E. Rawlins

The Socio-Economic Aspects of Peatland Management: An Ecosystems Approach

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Amy Rawlins

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Professor Joe Morris

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Abstract

Peatland areas comprise half of the world's wetlands and play important ecological roles. Peatlands offer a diversity of social, economic and environmental benefits, and in so doing serve a wide range of human interests. Despite this peatlands are fast disappearing. Some uses, particularly those associated with agriculture, result in degradation of the peat stock itself.

In this context, the research aims to increase the understanding of the socio-economic dimensions of lowland peatland systems in Northern Europe. Focussing on two sites in England, namely Somerset and the Fens, it uses the ecosystem services framework to explore the flow of multiple goods and services from peatlands, while simultaneously linking these to stakeholder interests and influences.

Stakeholder and multi-criteria analysis were used in combination to identify the ecosystem services delivered in the case study areas and explain how these services were distributed amongst stakeholders. Using open stakeholder interviews, workshops and formal multi-criteria techniques (AHP and MAUT), it was possible to elucidate the factors that shape land use preferences.

Livelihood provisions, maintenance of wildlife interest and floodwater storage were found to be the most important peatland services to stakeholders. The high livelihood associated with consumptive use of peatlands, along with the high degree of private land ownership and the continued relative freedom this affords were found to be the two largest barriers to wise use of peatlands.

The findings suggest that new policy mechanisms may be required to designate property rights to secure particular ecosystem services for the public good. This might involve new institutional arrangements, possibly involving multi dimensional entitlement systems, to secure the future of peatlands. The ecosystem services framework, combined with stakeholder and multi-criteria analyses, were shown to be effective in providing an understanding of the synergies and conflicts in peatland management.

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Acronyms and Abbreviations

STAKEHOLDERS:

1^o	Primary
2^o	Secondary
3^o	Tertiary
4^o	Quaternary
R	Local Residents
F	Farmers
PE	Peat Extractors
EA	Environment Agency
EN	English Nature
RDS	Rural Development Service
EH	English Heritage
WT	Wildlife Trust
RSPB	Royal Society for the Protection of Birds
NT	National Trust
WWT	Wildfowl and Wetlands Trust
CC	County Council
DC	District Council
NFU	National Farmers Union
CLA	Countryside Landowners and Business Association
FWAG	Farming and Wildlife Advisory Group
SFL	Somerset Food Links
IDB	Internal Drainage Board
FDC	Flood Defence Committee
LAMP	Levels and Moors Partnership
WFP	Wet Fen Project
PCP	Parrett Catchment Project

LAND USE SCENARIOS:

Ex	Peat Extraction
IA	Intensive Arable

EA	Extensive Arable
IF	Intensive Forestry
W	Withies
IG	Intensive Grazing
EG	Extensive Grazing
EF	Extensive Forestry
HR	Habitat Restoration
Ab	Abandonment

OTHERS:

DPSIR	Driver, Pressure, State, Impact, Response
SA	Stakeholder Analysis
MCA	Multi-Criteria Analysis
AHP	Analytical Hierarchy Process
MAUT/MAVT	Multi-Attribute Utility/Value Theory
CBA	Cost Benefit Analysis
SWOT	Strengths, Weaknesses, Opportunities, Threats
WTP	Willingness To Pay
WTA	Willingness To Accept
ESA	Environmentally Sensitive Area
HLS	Higher Level Scheme
ELS	Entry Level Scheme
CV	Contingent Valuation
EU	European Union
UN	United Nations
UK	United Kingdom
UKCIP	United Kingdom Climate Impact Programme
CAP	Common Agricultural Policy
WMP	Wise Management of Peatlands
WWF	World Wildlife Fund
Defra	Department for Environment, Food and Rural Affairs
NGO	Non-Government Organisation
Ha	Hectare
Yr	Year

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1. Introduction

1.1 Context

Lowland peatlands in Northern Europe are a valuable and disappearing agricultural resource. Because of their high organic content and unique hydrological properties, peat soils are ideal for growing high value salad and vegetable crops as well as improved grassland suited to dairy cattle. Peatlands also provide many more benefits to people and society than agricultural production, such as hydrological regulation, archaeological preservation and nature conservation. Many of these other benefits can be in direct conflict or competition with agricultural systems but are less easy to identify and quantify. This means that peatland resource management decisions are complex, affecting multiple users and benefit streams and often dynamic relationships between peatlands and their human settlements. In order to ensure the longevity of the peat resource across Northern Europe, for the benefit of the agricultural industry as well as other stakeholders, solutions need to be found that balance stakeholder needs and wants both with each other and with the longevity of the peat resource. Furthermore, policy mechanisms need to be identified that will facilitate the implementation of these solutions. The questions that need to be asked are: What is the 'best' use for any given situation? How is this decided? And, how can it be implemented? As well as, how does the decision making process ensure stakeholder interests are balanced to maximise well-being, especially in the absence of a complete understanding of stakeholders and peatland benefits?

The problem currently faced across Northern European peatlands is not an uncommon one. In the field of natural resource management in general there is an abundance of literature relating to differing resource management issues across a multitude of locations. Most of these studies have common themes: a valuable resource being degraded through over use or mismanagement, direct consequences for human well-being and complexities involved in the identification and implementation of solutions in the light of multiple users, flows of benefit and entitlement and the lack of spatial and temporal boundaries. There are two main responses to these problems, one is a local, participative approach to resource management and the other is a broad scale and policy level integration of environmental, social and economic issues.

At the local level, common theory is that communities already have the answers. Through meaningful engagement and participation in the decision making process the stakeholders of a community will increase understanding of each other and identify, implement and take ownership of the solution. At the broad scale and policy level, common thinking is that a greater understanding of the environmental and social impacts of any potential solutions is needed (see for example Defra, 2005). Furthermore, it is thought that capturing and quantifying these impacts is necessary to integrate them satisfactorily into existing decision making tools. To secure the future of peatlands this means that a local approach would seek the knowledge and experience of stakeholders such as farmers, extractors and conservationists and a policy level approach would call for further technical research on the degradation of peat soils and implications for peatland service delivery. In general, this has led to great interest in stakeholder analysis as a tool at a local level and monetary valuations of environmental goods and services as a tool at the institutional/policy level (see for example Grimble and Wellard, 1996; Garrod and Willis, 1999; Farber, *et al.,* 2002; Turner *et al.*, 2003 & Mushove and Vogel, 2004).

It may well be, that for the peatlands of Northern Europe, as well as many other resource management problems, a combination of a local level knowledge and broad legislative and policy mechanisms is required to formulate, implement and sustain solutions that are both powerful and flexible enough to increase the longevity of the peat resource. That is, methodologies need to be developed that can combine the contextually sensitive, responsive nature of the data obtained at a local level with the broad, definitive and often quantitative data required by policy makers. For the longevity of peatlands then, the knowledge and experience of stakeholders such as farmers, extractors and conservationists would be of equal importance to further technical research on the degradation of peat soils and implications for peatland service delivery. That is, the detailed understanding of stakeholder priorities, interactions and levels of influence and entitlement derived from a stakeholder analysis is needed to ensure policy and legislation are effective and equitable. Equally, broad scale regulation and incentivisation mechanisms, often designed and chosen in a cost-benefit format, are required to protect rights and break down barriers in order that locally relevant solutions are feasible and sustainable. In this vein, there are increasing references in the literature to economic valuation and policy formation integration with, for example, stakeholder conflict mapping and some form of stakeholder analysis (for example de Groot, 2006 & Turner, 1993). In the operational research literature there is increasing reference to methodologies that can have practical outputs, in particular links with policy (for example Alfsen and Greaker, 2006).

To date, in this field, most work has been carried out on refining monetary valuation techniques into structured and consistent methodologies, with practically useful outputs. This is both to ensure they are used correctly by practitioners and to make it clear to policy makers what the results actually mean. One of the frameworks used to structure such analysis is what has become known as the ecosystem services framework. This has become increasingly popular since its use in several high profile research projects (for example Schuyt and Brander, 2004; Reid *et al,* 2005 & Defra, 2007). It has been successful in solidifying the multiple and interrelated benefits we derive from fully functioning ecosystems, and hence highlighting the importance of maintaining ecosystem integrity in order to maintain human well being. It is potentially useful therefore in the study of peatlands and their stakeholders given the diversity of benefits and interests these areas generate, from agricultural production through to hydrological regulation.

The ecosystem services framework links ecology and economics and hence enables the formalisation of the relationship between healthy ecosystems and human welfare (Turner *et al.*, 2000 & editor, 2002). By applying the framework to a specific resource situation, for example Northern European peatlands, it can help to interpret sustainable resource management. It facilitates the study of the flow of multiple goods and services from ecosystems, and differing stakeholder preferences for them. As such it can act as a suitably structured guide to policy and decision makers whilst the process of interpreting it for a given situation can encourage stakeholder engagement. Its use is likely to continue to grow.

Monetary valuations and cost-benefit analysis, by their nature, amalgamate differing stakeholder perspectives on different issues, or ecosystem services, into one single monetary figure. Therefore, even though they are generated out of a range of views or behaviours, through for example a contingent valuation survey of public perceptions of the existence value of peatlands or travel cost analysis of the recreational opportunities provided by peatlands, the intricacies of differing stakeholder preferences and the resultant state of various service provisions is not always evident in the single values derived. This denies decision makers the chance to consider these elements consistently even if they wanted to. Furthermore, it is not entirely in keeping with the ecosystem services framework, when its strength lies in the framing of problems involving multiple users and multiple benefit streams.

Multi-criteria analysis is another tool that has been commonly used for practical and research purposes in the field of natural resource management (Mendoza and Martins, 2006). It has been used both on a local level in a participative fashion and at a broad policy level, being conceived by experts or a single 'decision maker' (Mendoza and Martins, 2006). As such it is clear multi-criteria analysis is useful at both of these levels, and therefore maybe the ideal tool for bridging the gap between them. Furthermore, as suggested in its name, multi-criteria analysis is capable of dealing with and presenting multiple themes simultaneously. As a tool then it is in synergy with the ecosystem services framework and the problem of sustainable peatland management. Multi-criteria analysis can also be used to great effect with stakeholder analysis, as it deliberately seeks differing stakeholder perspectives. The potential of multi-criteria analysis is being recognised, and in the literature on this tool there is a great deal of interest in the use of multi-criteria analysis to bridge the gap between qualitative and quantitative paradigms and using it in a more participatory fashion than has been the case in the past (Mendoza and Martins, 2006). It is also recognised that multi-criteria analysis can cope with incomplete data, so often the case in natural resource management and in particular now researchers are looking at a wide range of ecosystem services. As yet however there has been limited or no use of multi-criteria analysis with the ecosystem services framework or specifically on peatlands.

It is proposed that combining stakeholder analysis with multi-criteria analysis, and framing the whole analysis in an ecosystem services format, is a potentially useful methodology for improving resource management in general, and in this case the peatlands of Northern Europe. It is considered that stakeholder analysis can ground multi-criteria analysis in the dynamic and intricate 'real world' and that multi-criteria analysis can transform some of the complexities and qualitative findings of the stakeholder analysis into quantitative outputs more useful to decision and policy makers.

In this context, the research applied the ecosystem services framework, through the sequential use of stakeholder analysis and multi-criteria analysis, to the challenges of lowland peatland use in Northern Europe. This was done with a view to increase understanding of the socio-economic dimensions of these systems, important in defining sustainable or appropriate use. In addition, it was the intention to examine the suitability of the ecosystem services approach, with a methodology of combined stakeholder and multi-criteria analysis, to successfully integrating rich, contextual understanding with policy formation, important in improving natural resource management in general.

This research was carried out as part of a European project called EUROPEAT.

1.2 Aims and Objectives

The broad purpose of this research is to help promote the wise use of lowland peatlands across Northern Europe.

This research aims to increase understanding and practical applications of the ecosystem functions, uses and values framework in order to assess its suitability for formulating solutions for and mechanisms to deliver the wise use of peatlands. It also aims to use the framework to identify potential policy responses that could help deliver wise use of lowland peatland areas in Northern Europe.

The objectives of the research were to answer the following questions:

1. What are the ecosystem functions and associated services provided by peatlands?

2. Given the current use of peatlands, how are these services distributed amongst stakeholders?

3. Given current stakeholder values, what is the impact of use on peatland services and stakeholder well-being?

4. What does this mean for policy in terms of achieving the wise use of peatlands?

In answering the questions above a subsidiary objective is to demonstrate how the combination of stakeholder and multi-criteria analysis might provide a useful methodology for interpreting the ecosystem services framework and therefore defining sustainable solutions to problems of resource management.

1.3 Structure of Thesis

Following this introduction, chapter 2, through literature review, expands on the importance of peatland ecosystem services to human well-being and consequently highlights why they are worth studying. It reviews the development of sustainable resource management as a concept and what this means for peatlands. It then presents the ecosystem services framework and discusses its relationship with policy development, and finally discusses the methods used to make decisions on resource use and the methods chosen to carry out the research. Chapter 3 outlines the approach taken to the research; its chronology and relevance to the research questions. It then presents relevant background on case study areas used in the research. Chapter 4 presents and critically discusses the methods and results of a stakeholder analysis. Chapter 5 does the same for the two multi-criteria analysis techniques. Both chapters refer back to the relevant research questions and briefly conclude against them. Chapter 6 presents the results of a stakeholder workshop on policy relevant to the research questions, outlining the approach taken and agreed stakeholder perspective. Chapter 7 then discusses the significance of the research findings and concludes against the research questions and the subsidiary objective, making suggestions for further work.

2. Sustainable Management of Peatlands

Through the review of relevant literature, this chapter introduces peat soils and ecosystems in more detail, discusses sustainability and the ecosystem services framework and examines the nature of policy and land management decision making. By so doing it defines the study topic and boundary, confirms the research questions are relevant and appropriate and helps justify the methods selection.

2.1 An Introduction to Peatlands

Peatlands generically comprise terrestrial areas dominated by peat soils. In their natural condition, they are wetlands. The definitions adhered to in this report are taken from a collaborative source and are therefore widely accepted. They are as follows:

Wetland – area of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, that is inundated or saturated by water at a frequency and for a duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soils.

Peat – sedentarily accumulated material containing at least 30% (dry mass) dead organic material.

Peatland – an area with or without vegetation, with a naturally accumulated peat layer at the surface.

Mire – peatland where peat is currently being formed.

(taken from Clarke and Joosten, 2002)

Peat forms in a landscape when the conditions are such that vegetation materials fail to decay properly. This is usually the result of anaerobic and acidic conditions resulting principally from a high water table. In the past, peatlands and mires have been classified based on their location within the landscape, and were divided into two distinct types: bogs (raised above the surrounding land) and fens (situated in depressions). More recently though there has been a shift towards classification on the basis of hydrological characteristics and mineral status: bogs being rain fed and therefore nutrient poor – ombrotrophic and fens being rain and ground water fed and nutrient rich - minerotrophic. These broad classifications can be further subdivided according to more detailed hydrological characteristics, topography and climate, giving rise to a great many peatland types. Peatlands can also be classified on the basis of peat type, which depends both on the dominant plant remains that comprise the peat and the degree of decomposition or, as it is commonly referred to, humification. There is a diversity of peat types that vary in chemical and physical characteristics. Classification based on peat type may be more useful when concerned with the relationship between people and peatlands because it affects potential use. Variation in peat type not only leads to differing ecological systems *in-situ* (where the peat is naturally occurring) but also to differing suitability to *ex-situ* uses (where the peat has been extracted from its natural setting). For example a 'poorly humified sphagnum peat' has Sphagnum mosses as the dominant plant remains, is likely to occur in the upper layers of a raised bog, be highly acidic and relatively nutrient poor, but it will have a high water holding capacity and be generally free draining and is therefore extremely good for horticulture. By comparison, a 'highly humified phragmites peat' has common reeds as the dominant plant remains, is likely to occur in a fen, be less acidic than a sphagnum peat and not very free draining, but will be denser than a sphagnum peat, relatively nutrient rich and is ideal for burning for as a fuel (IPCC, 2008).

Peatland areas in their many forms comprise half of the world's wetlands and play important ecological roles. For example peatlands support unique and specialised biological diversity, regulate hydrology and store and sequester greenhouse gases, with the peatlands of the world estimated to contain one third of the worlds' soil organic carbon (Clarke and Joosten, 2002). Furthermore, peatlands preserve the palaeo-archaeological record and archaeological artefacts, some highly significant such as the Danish bog man of Tollund dated as 4th century BC and the Neolithic Sweet Track of the English Somerset Levels and Moors. Peatlands regularly form the basis of human livelihoods and provide pleasing landscapes, artistic and spiritual inspiration and recreational opportunities. This multi-functionality gives peatlands substantial natural, social and economic value.

Despite the high value associated with them, peatlands are fast disappearing. It is estimated that across Europe alone 100,000km^2 of peatlands have been lost (predominantly in the last 50 years) and that the remaining 500,000km^2 are vulnerable. The primary cause of this loss is human activity; 50% of the mires destroyed worldwide have been lost to agriculture, 30% to forestry, 10% to peat extraction for fuel and horticultural purposes, and the final 10% to infrastructure development (Joosten, 2003). Peatland loss and degradation is widespread and current. In Indonesia drainage for logging has been found by WWF (2008) to have degraded 4.2 million hectares in the last 25 years in one province alone. In Eastern Europe recent admission to the EU leaves the pristine peatlands of countries such as Poland and Hungary increasingly vulnerable to drainage for agriculture (Turner *et al,* 2003) and in the UK use of peatlands for agriculture is estimated to cause a loss of peat at a rate of up to 3.83m per 100 years (Ramsar, 2005). This commonplace consumptive use of peatlands indicates that there is a perception that consumption, or 'use' of peat is more valuable than maintaining the *in situ* stock of peat and peatland ecosystems. It is indicative of a market failure, whereby 'non-market' benefits have not been accounted for. The consequence is that peatlands are one of the most vulnerable wetland types. This has direct consequences for ecosystem integrity and human welfare as it ignores the opportunity cost of consumption (Ramsar, 2004).

The value of 'non-use' peatland functions is however becoming more apparent and relevant with efforts being made to quantify their intangible benefits. For example, Costanza *et al* (1998) estimated a monetary figure of between US$ 16 trillion and US$ 54 trillion as the value of the worlds' natural capital in its entirety, of this it was suggested that 15% could be attributed to wetlands. Despite the still considerable debate regarding the methods used to derive the figures, that the proportion of 'value' attributed to wetlands has not been questioned highlights the global significance of wetlands including peatlands. In the UK and across Northern Europe increasing amounts of public money are spent on habitat restoration schemes that specifically target peat soils, and on research to find ways to increase the longevity of peat soils in use. Both these examples demonstrate an increasing understanding of the benefits of maintaining the *in situ* stock of peat soils and the ecosystems associated with them.

Governmental support of conventions such as the Convention on Biological Diversity and the United Nations' Framework Convention on Climate Change, both of which address issues of sustainable resource management generally, indicate a political willingness to reassess resource management in order to ensure a sustained flow of goods and services into the future. More specifically regarding peatlands, the 1971 Ramsar Convention on Wetlands currently has 138 contracting parties, and 1369 wetland sites (comprising 119.6 million hectares) on the list of Wetlands of International Importance. Furthermore, moves are being made to increase awareness of peatland issues and broader policy changes have been made that indirectly bode well for peatlands. The Guidelines for Global Action on Peatlands for example, now a document within the Ramsar framework, emphasise the conservation and wise use of peatlands at a national and regional level and aim to:-

'achieve recognition of the importance of peatlands to the maintenance of global biodiversity, storage of water and carbon vital to the world's climate system, and to promote their wise use, conservation and management for the benefit of people and the environment'.

The Global Peatland Initiative (a partnership of NGOs, science agencies, and the private sector) has been set up in order to provide a means to identify, develop, and fund projects essential to achieve the 'wise use' of peatlands. These projects include continued research into the physio-chemical aspects of peat soils i.e. the effects of rewetting on oxidised soils and dissolved organic carbon, the effects of climate change on peat soils release of carbon, and more general information on their ecosystem functioning, all essential to developing sustainable management strategies for peatlands (Cole *et al.,* 2002; Chow *et al.,* 2003 & Fisk *et al.,* 2003). Recent Common Agricultural Policy (CAP) reforms i.e. the decoupling of direct payments from production, the introduction of cross compliance (or the introduction of mandatory minimum environmental standards on farm in order to qualify for financial assistance), and increases in modulation (meaning more money is available for agri-environment and rural development schemes), have the potential to impact positively on agricultural use of peat soils (Defra, 2004a).

However, the Ramsar Convention has been criticised for being weak and ineffectual, the list being made up of wetlands put forward by the contracting parties themselves (who are obliged to nominate one site only) and having limited legal power with which to ensure the preservation of sites on the list – in fact a Ramsar site only has legal protection if the national and local policy and legislation of the Country containing the site affords it (Ramsar, 1971). It affords no protection to areas that may be currently undergoing degradation and little protection to those likely to be targeted for future degradation. This is particularly pertinent in Eastern Europe where pristine wetland areas are now threatened as the EU expands and globalisation trends intensify (Turner *et al.,* 2003). Furthermore, the Conventions Strategic Plan 1997-2002 identified peatlands as an under-represented wetland type in the list. It is the case then that despite a display of willing, there remains little existing enforceable and effective policy or legislation designed to maintain or protect peatlands and their benefit streams given the increasing recognition of their value. It may well be that this is due to a still incomplete understanding of peatlands, peatland use and its significance for human well-being. Further research into peatlands, peatland users and the values attached to differing benefits is then required in order to answer the difficult question of ‘what is sustainable or wise use of peatlands?’ and enable the derivation of policy that produces it.

2.2 Sustainable Resource Management

The concept of sustainable development entered mainstream politics and consciousness in 1987 when the report from the World Commission on Environmental Development offered it as an alternative to economic development. The 1987 Brundtland report suggested development should………*meet the needs of the present without compromising the ability of future generations to meet their own needs*… and in so doing ensure the survival of the human race. This prompted the UN Conference on Environment and Development and the 1992 Earth Summit in Rio (UN, 2003). This summit was successful in making the conservation of bio-diversity and sustainable management of our natural resources high profile issues on the international agenda. This was on the premise that they have value, both instrumental and intrinsic, for us and for future generations, and therefore need to be considered in development decisions. There have been other global initiatives relating to sustainability since the Rio summit, such as the 2002 World Summit on Sustainable Development held in Johannesburg, but to date none have been as successful in finding agreement or securing action.

Although the underlying principles of sustainability have been internationally endorsed, the conversion of theory to practice since 1987 has been slow. This time lag between conceptualisation and implementation could be attributed to the complexity and confusion that surrounds the process of interpreting and specifying the very general Bruntland definition for individual situations (Bowers, 1997). Indeed it is argued that true sustainability is impossible to attain whilst maintaining economic growth and supporting an ever-increasing global human population (for example Common, 1995; Czech, 2001; Seidl and Tisdell, 1999; Pender, 1998). For this reason there has been much work attempting to convert theory to practice and introduce identifiable and measurable criteria for sustainability (for example UN, 2001 & Alfsen and Greaker, 2007). One of the ideas to emerge from this work and used in practical situations is that of **degrees** of sustainability. Here, 'strong sustainability' is said to require the maintenance of constant stocks of natural capital, implying non-renewable resources can **never** be utilised, whilst 'weak sustainability' allows the depletion of natural capital as long as this is off set or substituted for by increases in other forms of capital (Turner *et al.,* 1994 & Hediger, 1999). Inherent within 'weak sustainability' however is continued environmental degradation. Therefore it is the ideal that 'weak sustainability' solutions be short term measures that are in effect whilst institutions and policies are put in place to allow for the often more radical 'strong sustainability' options (Turner *et al.*, 1994 & Hinterberger *et al.*, 1997). The achievement of 'strong sustainability' is dependant on the regenerative rate of the natural capital being utilised, which will depend on the type of natural capital (in the case of this research: peat) and the type of use as well as spatial and temporal environmental variability. Already it is clear that a wealth of very specific information is required before a real understanding of sustainability in a practical sense can be developed. However, defining the status of the resource under consideration, in terms of being renewable or non-renewable, is a sensible starting point. This means classifying peat as a renewable or non-renewable resource. This is supported by Daly's (1990) guiding criteria for sustainable resource use and the agreement that natural capital is the limiting factor to economic production and so determining rate of use is critical to sustainability (J. Farley and H. Daly, 2006).

Peat soils can be said to have characteristics of both renewable and non-renewable resource types (Schilstra, 2001) due to their regenerative rate. Peat is formed at a rate somewhere between that of renewable and non-renewable resources: peatlands have accumulated over the last 15,000 years whilst very early peatlands are one of the constituents of coal. Although this has only been discussed in the literature in terms of peat extraction, which requires removal of the peat, it is an issue for any use of peatlands including *in situ* use such as agriculture, which involves altering the hydrological regime. This is due to two important characteristics specific to peat soils:-

- Peat no longer accumulates when water levels are too low (or too high);
- If the water table is lowered oxidation processes occur which lead to subsidence, shrinkage and wastage of the peat that is often irreversible.

Therefore, any activity that lowers the water table not only halts the accumulation of peat but also starts the degradation of the existent peat at a rate faster than it can accumulate elsewhere. This suggests that peat can be treated as a non-renewable resource i.e. its use can be said to be weakly sustainable if there is matched investment in other capitals. However, although regeneration is very slow, peatlands unlike other non-renewable resources such as natural gas, are active ecosystems, so degradation leads not only to the direct loss of peat but also to the indirect loss of the goods and services provided by the peatland ecosystem.

The mimicking of peatland goods and services through sources other than natural capital is often impossible or very expensive, potentially leading to negative impacts on human well being. Of increasing interest and concern in this respect is the role of peatlands in the storage of green house gases, including carbon dioxide and methane, and the potential for a negative feedback loop that would seriously exacerbate current predictions for the impacts of climate change. Peatlands also provide less critical but still valuable services, for example, there is as yet no manufactured replacement for the natural beauty often associated with peatlands and the sense of connection with nature that they induce - proven to be an important contributory factor to human happiness (Marks *et al,* 2006). Furthermore, replacing the hydrological functions of peatlands with for example hard, structural flood defences is increasingly expensive especially with flooding in the UK for example being predicted to get worse over the coming years because of a) climate change (exacerbated by peatland degradation) and b) increasing development pressures on natural floodplains, some of which are peatlands. Treating peat as a non-renewable resource and aiming for weak sustainability then is at best a risky and potentially very expensive strategy. This is fundamental given that sustainability is a wholly anthropocentric concept, putting human welfare above all else (Clarke and Joosten, 2002), and implies that to treat peat as a non-renewable resource would be to abandon the key principle of sustainability. To treat peat as renewable resource however, and aim for strong sustainability (the weak option already being shown to be expensive and risky), would mean that management must maintain a near surface water table so as not to allow degradation at a rate faster than regeneration can occur. This requirement by its nature excludes all agricultural use of peatlands and that in some cases may not be reflective of the social, stakeholder values that exist in an area. Apart from the fact that to ignore stakeholder values again undermines a key principle of sustainability, to do so would seriously jeopardise the chances of solutions being effective or long lasting.

The conclusion then is that it is difficult to define criteria for sustainable resource use that can be satisfactorily applied to peatlands, and that sustainable use of peatlands at a local scale is not currently practical. It may be possible however to define an **approach** to determining the **wise** use of peatlands on a local scale that may help towards sustainable management of peatlands at a wider scale. Indeed, it has been said that applying the sustainability principle to practical situations will continue to result in difficult decisions and it is the role of science to inform these decisions and the approach, not to define a universal solution (Sexton, 1998).

2.3 Emerging Consensus: The Ecosystem Services Approach

A wealth of literature on sustainable resource management in specific situations and more generally on refining our understanding of it as a principle currently exists and continues to be produced (for example Behrens *et al.,* 2007; Cantlon and Koenig, 1999 & Hediger, 2000). Much of it advocates differing techniques and solutions but there is one approach that has rapidly grown in popularity and use. Regarding ecosystems as performers of various functions, which in turn provide a stream of goods and services has become known as the ecosystem services approach and allows direct analysis of the impacts of degradation of the natural environment on human welfare. This has led to interest, both in the literature and in practice, in ecosystem services as a means to identify and account for environmental goods and services in policy and conventional decision making methodologies.

The ecosystems services approach is based on the premise that ecosystems can change in a way that can make human existence difficult or impossible and therefore there is a need to understand and maintain them. Levin sums it up (editor, 2002) thus:

'It may well be that natural systems are not so very fragile: they are, after all, complex adaptive systems that will probably change and become new systems in the face of environmental stresses. What is fragile, however, is the maintenance of services on which humans depend. There is no reason to expect systems to be robust in protecting those services – recall that they permit our survival but do not exist by virtue of permitting it, and so we need to ask how fragile natures services are not just how fragile nature is'

The ecosystem services approach therefore takes a wholly anthropocentric view of the natural world, including peatlands, immediately aligning it with the concept of sustainability. The approach has already been widely adopted. Notably the 'functional' approach and the related policy objective of 'maintaining functional diversity' was recognised by the English statutory conservation body, English Nature as was, as being important for assessing the value of Nature Conservation (Turner *et al.,* 2001). It has been used by WWF in their document 'The Economic Values of the World's Wetlands' (Schuyt and Brander, 2004), of which peatlands are a type, and it was part of the methodology for the Millennium Ecosystem Assessment, which published its both disturbing and empowering findings in 2005 (Reid *et al,* 2005). More recently a primary UK governmental body (Defra) reported on a Valuing Ecosystem Services research project that examined the practicalities of translating the ecosystems approach into a usable tool in assisting and enhancing decision making at all levels (Defra, 2007). Combined, all of this work demonstrates both theory and practice of the ecosystem services approach and applicability to peatlands. Fundamentally, the ecosystem services approach depicts and so allows characterisation of the link between ecosystem integrity and societal well-being, it therefore begins to bridge the gap between the fields of ecology and economics. Figure 2.1 summarises the features of the approach, highlighting the functions, uses and values and the connections between them.

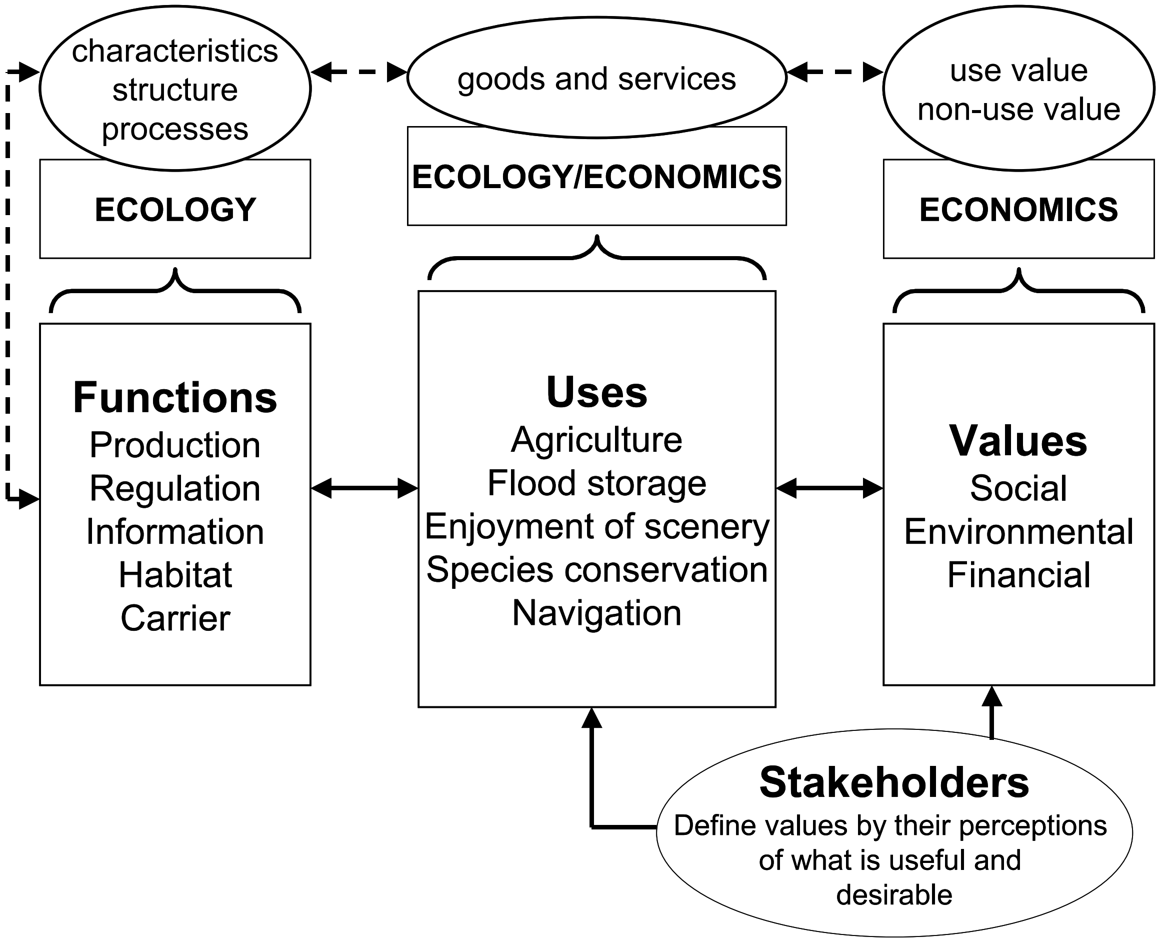


Figure 2.1. The Ecosystems Services Framework – functions, uses and values (adapted from Turner *et al.*, 2000)

Combining the fields of ecology and economics is not without its complexities and there has been considerable debate in the literature regarding the interpretation of the framework and its application. It is important therefore to expand the different sections of the framework and discuss the associated issues.

2.3.1 Functions

From an anthropogenic viewpoint, the concept of **'eco-system functions'** captures '*the capacity of natural processes and components to provide goods and services that satisfy human needs, directly or indirectly'* (de Groot *et al.,* 2002). Ecologists however may argue that such functions have an existence beyond their human interpretation, and humans would be ill advised to ignore this because doing so puts their own future at risk (Clarke and Joosten, 2002). Indeed, the anthropocentric nature of the approach and its focus on functions, implying usefulness, has led to criticism. It is perceived by some to undermine recognition of the intrinsic value of nature, and to imply a continued exploitative view of the environment (Osinski *et al,* 2003). It is the author's view however that it is precisely its focus on usefulness that could foster a greater sense of responsibility towards the environment. For example, greater understanding and quantification of the diversity of benefits we derive from peatlands, including the storage of greenhouse gases particularly pertinent at this time, maybe what leads to management decisions to conserve them. It is commonly agreed that neglect or over exploitation of our environment is endangering the longevity of *Homo sapiens* as a species and not natural systems themselves, which will adapt; therefore it is sensible to identify the aspects of the natural world upon which we rely for continued existence and quality of life (Limburg *et al*., 2002). Furthermore, given the ever-increasing global human population, in cases where preservation for preservations' sake is not possible, protection of economically or socially important functions (and associated goods and services) could be used to protect those aspects of ecosystems with ill defined or without any perceived human value. Knowing the relative value of the goods and services provided by ecosystems should in some cases allow development of rigorous arguments for uses that damage ecosystem integrity **least**. By maintaining ecosystem integrity we should automatically maintain that which has intrinsic value. The reality of the current situation however is such that market and institutional failures mean even those ecosystem services with instrumental value are often 'public goods' and inadequately incorporated in decision making processes. The ecosystem services approach has the potential to begin rectifying this.

For the purposes of analysis it is useful to divide ecosystem functions into groups, or categorise them. Ecosystems are highly complex and all aspects link with each other, therefore this process is incredibly difficult and may not be considered strictly 'correct' by ecologists, and at its very best practitioners must accept that it is arbitrary. In fact Brouwer (Brouwer *et al.*, 1999) goes so far as to say the interrelations between ecosystem structures and processes and the functions they provide mean it is in some cases impossible to distinguish between individual functions. Because of this it has emerged that there is not one ideal or perfect solution to capturing the complexity of services provided by nature in a small number of categories. However, five categories are widely used, these are:

- **Production functions** – *the capacity to provide resources i.e. water, food, raw materials, energy, e.g. peat provides a fuel or growing medium*

- **Regulation functions** – *the capacity to regulate essential ecological processes and life support systems i.e. regulating climatic, water, soil, ecological, and genetic conditions, e.g. peat soils store greenhouse gases and water*

- **Carrier functions** – *the capacity to provide space and a suitable subsoil for i.e. habitation and navigation, e.g. peatlands can be used for settlement*

- **Habitat functions –** *the capacity to provide unique habitat for plants and animals, helping with the conservation of genetic, species and ecosystem diversity, e.g. peatlands provide ideal breeding grounds for nationally endangered species like the Snipe and Black Tailed Godwit*

- **Information or cultural functions** – *the capacity to contribute to human mental well-being or happiness through e.g. spiritual experiences, aesthetic pleasure, cognition and recreation, e.g. peatlands provide pleasing landscapes and the opportunity to learn about the past*

As the approach has been developed several different combinations of these functional categories have been tried and tested. In the early stages of his work for example de Groot used the *regulation, habitat, production,* and *information* categories (de Groot *et al.*, 2002) but not the *carrier* group. Turner, in his work, does not refer to *habitat* functions but does refer to *carrier* functions (Turner *et al.,* 2003). These different applications arise due to early differences of opinion and a different research focus. Turner has a strong focus on wetlands, which in the UK at least are largely heavily disturbed systems, some even being completely man made through land reclamation from the sea for agricultural purposes. Therefore human intervention in Turner's work is commonplace. Where as de Groot has been primarily concerned with natural or semi-natural habitats, devoid of direct human intervention where carrier functions do not apply. De Groot recognises their existence but argues that in the analysis of natural systems they are not relevant and indeed they usually conflict with sustainability criteria (de Groot, 2003). Harris (Harris, 2003) however, has argued that from an ecological rather than economic view point *carrier* functions are in fact nonsense. This was on the basis that *Homo sapiens* are **part** of the ecosystem and not separate from it, meaning all functions within the carrier group can be divided among the other categories. For example human settlements might fall within the habitats category and navigation might fall within the information or cultural category if for work or recreational purposes and within the production category if for cultivation purposes (Harris, 2003).

The *habitat* category has been used by de Groot because of the explicit spatial component associated with the functions contained within it i.e. the need for a minimum critical ecosystem/habitat size to maintain the service, which he argues is absent from, or not so prominent in all other categories (de Groot, 2003). Turner however, with a mind to monetary valuation, has viewed biodiversity (captured in the habitat functions) as the 'primary value' of an ecosystem and that, he argues, cannot be valued in monetary terms. It is his view that the goods and services derived from the primary value of an ecosystem can be valued in monetary terms and are the 'secondary value' of an ecosystem i.e. all other function categories (Turner *et al.,* 2003). He adds to this argument by proposing that the introduction of a habitat category of functions automatically introduces double counting in to any valuation procedure because the biodiversity is the basis of all other functions (Turner, 2003), a sentiment echoed by de Groot who also sees the habitat functions as the basis for all other functions, but does not view this a problem (de Groot, 2003). The link between biodiversity (or primary production) and the ability of ecosystems to function has come under increasing scrutiny in the literature but there still appears no definitive agreement on how to treat it in terms of analysis. Some parties believe it to be the key to functionality and are therefore looking for ways to quantify the link between biodiversity and ecosystem value and others are taking the view that the link between biodiversity and ecosystem functions can be broken with human intervention (Costanza *et al.,* 2007 & Swift *et al.,* 2004).

If, as Brouwer suggests, distinguishing between individual ecosystem functions is at times impossible (Brouwer *et al.*, 1999) then ultimately the categories given above are an aid to analysis rather than a prescriptive list. Indeed the analyst may find more categories as did Clarke and Joosten (2002) or only wish to use a few. Furthermore, interpretation of what falls within each category can vary. De Groot in dealing with natural systems places cultivation within carrier functions and views production functions as non-assisted or subsistence level production (de Groot, 2006) where as Hindmarch *et al* (2006), with a greater focus on disturbed systems defines production functions simply as ‘providing natural resources from which to make goods’, and makes no stipulation that harvesting be within the natural production limits of the system. As a final example, the Millennium Ecosystem Assessment had a ‘supporting services’ category in place of a habitat category, including biodiversity and provision of habitat as well as functions more commonly referred to as regulation such as nutrient cycling.

It seems, despite criticism of the ambiguity, both in the categorisation of functions and in distinguishing between functions and services, and calls for a more formal classification and definition system (Wallace, 2007 & Boyd and Banzhaf, 2007) there is no single taxonomy. It is down to the individual analyst to decide how to structure the problem they are examining and ensure their choice is fit for purpose and transparent.

2.3.2 Uses

A **use** can be defined as *the act or practice of employing something for a purpose*. Humans use (in the loosest sense of the word) the ecosystem services provided by the various ecosystem functions. Uses can be diverse and are not always necessarily compatible. There is seldom a one to one relationship between uses and functions. In some cases a single ecosystem use is the product of two or more ecosystem functions, whereas in other cases a single ecosystem function contributes to two or more ecosystem uses (Costanza *et al.*, 1998). Untangling these relationships is as difficult and as ultimately arbitrary as separating functions. Again it is largely down to user preference and purpose as long as there is transparency and consistency. It is thought to be a process worth taking time over as it may eventually reduce double counting problems in a valuation exercise. In fact, Turner *et al* (2003) states that it is imperative that the full range of complementary and competitive uses are distinguished before any aggregated valuation is completed. In the case of peatlands this could mean determining whether an arable agricultural use is compatible with a tourism use and to what degree, and furthermore what functions contribute to the tourism value of the peatland (potentially habitat – wildlife, carrier – navigation and information/culture – beauty, recreation, inspiration).

Human use of ecosystems is perhaps the most easily identifiable and understandable aspect of the ecosystem services approach. It is the interface between that which people value and that which the ecosystem can provide. The nature of human use of systems is often easily explained by socio-economic context and so is often the most logical and easiest place to start with any analysis. An understanding of the use of different systems makes capturing the values associated with them that much easier.

2.3.3 Values

Value is a somewhat ambiguous term that should be used with care and explanation. It has a different meaning in the fields of economics and ecology.

Conservation of peatlands and indeed any ecosystem, habitat or specific species can be argued on the basis of its intrinsic value; that is the value which belongs to a thing by its very nature, or entities that are to be respected as such. From an ecocentric view this implies that all beings that are part of the natural whole have intrinsic value (an ecologists' view). Acknowledgement of the existence of intrinsic value and furthermore an ecocentric take on it infers a moral duty to make efforts to conserve all that we know exists. However, it is not always practical or indeed possible to demand that we conserve everything and the provision of sustenance and shelter for a growing human population may at times take precedence over the conservation of obscure species or habitats. Peatlands for example were historically important as a fuel, a source of warmth. This use required the digging of peat to the disadvantage of species associated with the peatland ecosystem. When few other options for fuel were available though, the need for warmth was more compelling than the desire to conserve species and habitats.

The far more pragmatic argument for conservation then, and that which an economist would state, is the instrumental value of ecosystems and species. The instrumental value lies in the beneficial effect of an entity on another entity or, taking the anthropocentric view, the beneficial effect of an entity on human beings, which is reflected through the satisfaction of human needs and wants (Farber *et al.,* 2002 & Clarke and Joosten, 2002).

Instrumental values associated with functions are commonly split into use and non-use values. Definitions for these values, as given by Pearce *et al*. (1998), are as follows: -

Use Values

- Direct use values – individuals make actual use of a resource for either commercial purposes e.g. commercial fishing, or recreational purposes e.g. swimming;
- Indirect use values – society benefits from ecosystem functions, e.g. watershed protection or carbon sequestration by forests; and
- Option values – individuals are willing to pay for the option of using a resource in the future, e.g. future visits to a wilderness area.

Non-use Values

- Existence values – reflect the fact that people value resources for 'moral' or 'altruistic' reasons, unrelated to current or future use; and
- Bequest values – peoples' willingness to pay to ensure their heirs will be able to use a resource in the future.

'Non-use' values can still be said to be instrumental rather than intrinsic values because they are still reflective of human preferences and humans still derive benefit even when a resource is not being directly utilised. For example, areas considered to be of extreme natural beauty, such as the Grand Canyon, for many people simply have existence value; that is people derive a 'warm glow' or some peace of mind from knowing they exist even though few people ever imagine seeing them in real life. The Flow Country in Scotland is an example of peatland landscape that has a similar effect for some people. It cannot be denied that non-use values start to blur the boundary between instrumental and intrinsic value.

The ecosystem services approach by its nature places precedence on instrumental values, and does so largely because they can be captured through various techniques, including expressed preference willingness to pay surveys. As discussed previously, this capturing of instrumental values may also help safeguard many aspects of the natural world with intrinsic value. Instrumental value is assigned by society at large and more specifically in individual cases by stakeholders.

2.3.4 Stakeholders

Stakeholders are individuals, groups or organisations with an interest in a given activity or area, further distinguished according to the degree to which they can influence the phenomenon of concern. They can be said to determine value by their perceptions of usefulness. For example, in the case of peatlands a farmer may place greater value on production functions than information functions as he or she utilises the production functions to derive an income and livelihood. A conservationist may however value the habitat functions more than the production functions as their own moral viewpoint dictates that conservation is more important than food production at a time when we are not in want. Armed with an understanding of why different stakeholders value different functions and a technical knowledge of the effects of this on associated ecosystem services, it may be possible to influence land use patterns for the benefit of society. Continuing the previous example, a farmer may value habitat functions more highly if there is a financial incentive attached and may reassess the balance struck between production intensity and wildlife interests. This policy is indeed already practiced in agri-environment schemes in the UK and is discussed in slightly more detail in the next section.

Turner *et al* (2000) identified nine stakeholder groups for wetlands in general. These were: *direct extensive users, direct intensive users, direct exploiters, agricultural producers, water abstractors, human settlements close to wetlands, indirect users, nature conservation and amenity groups* and *non-users*. Their interest in or usage of an area may or may not be compatible. Balancing the requirements of all stakeholders whilst, where possible, maintaining the integrity of the peatland ecosystem is a difficult task that requires a sound understanding of existing social, economic and environmental interactions (Ravnborg and Westermann, 2002). This indicates that at the very least some form of stakeholder analysis should be a key element of any sustainable development strategy and at best, full stakeholder participation would be sought. For peatlands this might involve deriving an understanding of the variety of objectives, degrees of influence and entitlement, perceptions of value, decision-making and coping strategies, stakeholder interactions, vulnerability, and the perceived suitability of alternative 'responses' in pursuit of wise management of peat resources.

Hence identification and understanding of peatland functions, uses, users and their value systems are fundamental to ensuring the 'wise use' if not strictly speaking sustainable use of peatland areas from a societal perspective. The ecosystem services approach can help in this process if, as Alfsen and Greaker (2007) suggest, due consideration is given to the effective utilisation of outputs and the linking of the approach to policy formation processes, such as Defra (2007) have begun.

2.4 Policy and Property Rights - a Shifting Paradigm

'Environmental policy is nothing if not a dispute over the putative right structure that gives protection to mutually exclusive uses of certain environmental resources. These disputes may appear to be 'environmental problems' but they are, in fact, problems of conflicting rights claims'

(Bromley, 1991)

Or, put another way, environmental policy is a set of socially constructed conventions, legal rules and regulations that confer property rights to people, as individuals, groups or organisations, enabling them to draw benefit from the control and use of natural resources. Therefore, environmental problems are likely the result of misguided or ill-informed distribution of these rights or unclear and ill-defined rights, and need to be addressed as such (North, 1990). Hence, 'entitlements to benefit' cannot be absolute, but rather derived in accordance with dominant societal preferences and priorities, and these vary spatially and temporarily. Indeed the definition and distribution of entitlements are likely to reflect the influence and serve the interest of dominant social groups (Tawney, 1948 & Bromley, 1991).

Property rights are bundles of claims or entitlements to a benefit stream usually associated with the use of resources, such as land. A single resource may have a number of valued attributes, the rights to which may be vested with more than one individual stakeholder (Baltzer, 1998 & Bromley, 1991). It can be said that property rights are essentially a means of reducing uncertainty in economic exchange by reducing the number externalities and so the imperfections of the market (North, 1990). Externalities occur when *'the consumption or production choices of one person or form enters the utility or production function of another entity without that entity's permission or compensation'* (Kolstad, 2000). So are associated with questions of who benefits and who bears the cost of resource use and possible degradation? The failure of property regimes to include the 'external' effects of transactions, whether positive or negative, can compromise social and ecological welfare (Adger and Luttrall, 2000). Hence inadequately defined property rights are considered to be one of the main factors associated with environmental degradation (Tietenberg, 2003).

Historically in Europe, since enclosure, property regimes have given precedence to private entitlement and production functions. This is reflective of viewing the natural environment as a stock of natural capitals to be utilised for conventional economic gain and growth. The story of agricultural policy, its assignment of property rights and consequent externalities, is a prime example of this. The 1947 Agricultural Act and subsequent introduction of the Common Agricultural Policy and production subsidies formalised a set of property rights, at the time considered to be in the interests of society, which promoted private financial gains and agricultural productivity, leaving other functions and services of the ecosystems to disparate policy or the chance of informal custom and practice. However, in predominantly private property regimes these other services are typically excluded from the decisions of 'profit-seeking' producers, as they can be passed on to third parties without compensation or payment. Therefore the not insignificant external costs (social, economic and ecological) of intensive agricultural management such as water pollution and soil erosion, the sum of which is still being evaluated (Hindmarch *et al.*, 2006), have been assigned to society at large (Hodge, 2000). The 'Polluter Pays Principle', thus, has historically not been followed in relation to farmers' use of natural resources (Baldock, 1992). What has been applied is a modified form of a 'Provider Gets Principle' (Hanley *et al*, 1998; Hodge, 2000; OECD, 1994 & OECD, 1996).

There are now many examples in policy of recognition of the limits and costs of previous property rights regimes and attempts to formalise entitlement to goods and services previously excluded from transactions and subject only to informal behaviours i.e. what were previously 'non-market' goods. Again some of the most clear examples of this are in the agricultural sector, where a change in society's lexicographic preferences, brought about primarily by food security attained through good trade relations, had until recently reduced the perceived need for self-sufficiency and furthermore the external costs of previous policy started to become apparent. Consequent changes in entitlement to ecosystem services are apparent in agri-environmental policies. This is demonstrated in the following section, using the

Drivers, Pressures, State, Impact, Response (DPSIR) framework and the literature relating to two UK peatlands areas.

The Cambridgeshire and Norfolk Fens and the Somerset Levels and Moors are two of England's largest remaining peatlands. They are used here to elucidate the property rights regimes encouraged by agricultural policy. The main **drivers** affecting peatlands reflect anthropogenic interests. In England, this has predominantly been food production, supported by the Common Agricultural Policy (CAP) (Winter and Gaskell, 1998). In some areas, in common with other parts of Europe, the demand for peat for fuel and horticulture has also been an important driver. The shift in the nature of CAP support away from production and towards conservation and other interests can be said to reflect a shift in societal priorities. It could be that this shift starts to alleviate **pressures** on peatlands. Water regime and soil management regimes suited to conventional farming are not conducive to the conservation of peat soils and their associated ecosystems (Clarke and Joosten, 2002). However, regimes designed for nature conservation can be compatible with peat resource protection. At present peatlands continue to face pressures, both directly and indirectly, from such things as continued drainage for agriculture and eutrophication of the water supply to these systems, which would naturally be nutrient deficient. As a result, the **state** of peat soils declines, defined in terms of the quantity and quality, as well as the goods and services provided.

Reduction in state is clearly evident in both the Fens of Eastern England and the Somerset Moors of South Western England, two of the biggest reserves of lowland peat left in England. Subsidence and shrinkage have occurred on the Somerset Moors where loss of peat is estimated to occur at a rate of 1-1.5cm per year even under extensive grazing regimes (Ramsar, 2005). In the Fens, it is estimated that agriculture will use up to 80% of the remaining peat soils in the next 20-30 years (Oates, 2002). In addition to this the National Trust Wicken Fen Nature Reserve is reported to be the last remaining 0.1% of undisturbed fenland in East Anglia, with its future threatened by water leakage into surrounding agricultural land (National Trust, 2004).

The **impacts** of peat degradation are the affects of the depletion in the state of the resource and associated functions on users or other stakeholders. These affects can be multiple and widespread (Oates, 2002). The most apparent impact may be the decline in agricultural productivity, whereby the natural production functions of peat soils are substituted by external inputs. This deterioration of productions functions is demonstrated by, and measurable in, the agricultural performance of the arable systems of the Fens (Oates, 2002). Simultaneously there may be a loss of other, less apparent functions. For example, intensification of drainage regimes on the Somerset Moors, coupled with 'improvement' of grassland have negatively affected the bio-diversity of the area (Hopkins *et al.*, 2001), reducing tourism and recreational values to some stakeholders.

Responses are interventions, undertaken by individuals, groups or organisations to achieve desirable outcomes and can act to alter **drivers**, alleviate or relieve **pressures**, improve or protect **state**, or, mitigate **impacts**. In the context of peat soils**,** these include actions to protect or enhance those functions that are valued by key stakeholders. Combinations of these responses have been applied across England and include: CAP reform, regulations of agro-chemical use and water abstraction, site designations and associated restrictions, and voluntary measures associated with Codes of Good Agricultural Practice (Defra, 2004b).

Thus far the nature of responses adopted varies between the peatlands of the Fens and the Somerset Moors due to the different agro-climatic and physical conditions and socio-economic circumstances. In the Fens, intensive vegetable farming is commercially driven with limited dependence on CAP support. Response mechanisms are predominantly a mix of mandatory (fertiliser and pesticide controls) and voluntary regulation, the latter promoted through supply chain protocols operated by supermarkets. The main focus has been on extending the life of peatland production functions in a farmed environment rather than enhancing their wider contribution (Morris *et al.,* 2000). Running along side this are projects examining the feasibility of new habitat creation in the area, demonstrating an increasing influence from environmental stakeholders (Morris *et al.,* 1996). In Somerset by comparison, the drivers and related pressures have changed in recent years as the commercial viability of livestock farming has declined and the environmental services that can be provided by rural land managers, such as biodiversity, flood management, recreation and amenity have become more important. Statutory designations and voluntary mechanisms have been used in combination and farmers in the area have responded to incentives provided through agri-environmental schemes to promote 'multi-functionality' as a basis for sustainable livelihoods (Hicklin, 2004; Land Use Consultants, 2001 & Parrett Catchment Project). For example, statutory designation of Sites of Special Scientific Interests and Scheduled Ancient Monuments secured important habitat and heritage functions for the public even on private agricultural land. In addition, agri-environment schemes 'compensate' farmers for providing environmental services over and above that required by compliance with minimum regulatory standards (indicating the reference point or boundary of environmental entitlement above which society must pay for extra environmental goods). This could be said to represent a kind of 'reverse enclosure' movement, limiting the freedoms of people and organisations to do as they please on privately owned land.

As this process progresses it may involve mandatory regulation, individual or collective voluntary agreements and actions, or negotiated financial settlements (Coase, 1960 & Bromley and Hodge, 1990). Importantly it may also require new forms of governance, including new private–public partnerships and trusts, as old ones become too complex with all their strings of often conflicting policy attached and especially regarding the simultaneous delivery of multiple rather than single streams of benefits to multiple rather than single beneficiaries (Morris, 2008).

This demonstrates that responses, relating to property rights systems, are dependant on the existing economic circumstances, which have been shown to vary dramatically from region to region. A key challenge facing decision makers then, if they are to fully integrate the ecosystems services approach into policy and so meaningfully promote sustainable development, is the development of adaptive and cross discipline responses to current environmental issues, that may require challenging existing institutional forms and the development of fresh and innovative property rights regimes that are able to cope with multiple, spatially and temporally dynamic benefit streams and beneficiaries. Thus decision makers currently need significant input from social and natural scientists, both to derive such responses and to inform on their actual and potential ecological and social implications.

2.5 Incorporating Ecosystem Services into Decision Making

Cost Benefit Analysis is probably the most commonly used procedure for comparison of different development options. Its objective is to maximise gains to social welfare, it is therefore an analysis from a societal view point where costs and benefits are defined according to the satisfaction of needs and wants; anything that increases human well being is a benefit and anything that decreases human well being is a cost. (Dasgupta and Pearce, 1978 & Turner *et al.*, 1993). Traditionally this technique incorporated only economic costs and benefits. As would be expected, this has changed with the development of economic valuation methods for social and environmental impacts (Tiwari *et al.,* 1999 & Turner *et al.*, 2000).

Market prices of goods and services are the most commonly used measure for comparison and exchange, and provide signals of resource scarcity (Brauer, 2003, & Clarke and Joosten, 2002 & Costanza *et al.,* 1989). Markets are most effective where there are large numbers of buyers and sellers and there are clear, enforceable and transferable property rights. Under these circumstances prices direct the allocation of scarce resources to their most efficient use, thereby maximising overall societal welfare (Costanza *et al*, 1989, & Hanley *et al.,* 2001 & Tietenberg, 2003).

These conditions however do not apply to all ecosystem functions, especially those generating indirect user values that are not traded in the market place (such as the flood management contribution of wetlands) and those associated with 'non-use' benefits (such as option, existence and bequest values of conserved peat soils and related habitats). In particular these ecosystem functions and benefits are not captured within the dominant system of entitlements and property rights that define market transactions and hence values. Consequently, thus far non-market goods and services provided by ecosystems have been under represented and considered in decision making processes, from policy through to individual development sites. In an attempt to redress this there has been a concerted effort to develop methods for valuing such functions.

Table 2.1 attempts to summarise some of the methods for assigning values and put them into the context of wetland valuation.

Table 2.1..Summary of Valuation Methods for a Hypothetical UK Peatland

Generic use type	Peatland use example	Example valuation method	Basis for valuation	Main stakeholder interest	Issues/Comments
Direct Use	Food production	Substitute goods (cost based)	Equivalent price of goods	Farmers; Defra	Have to determine what is an equivalent substitute good
		Market analysis (cost based)	Market prices of commodities	Farmers; Defra	Commonly used and facilitated by the publication of annual farm income data
	Recreation	Travel cost (revealed preference)	Amount spent on travel to get to area	Visitors; Local people; RSPB	Data needs much adjusting for e.g. income, sites available, personal interests etc before results are meaningful
	Nature conservation and landscape	Hedonic pricing (revealed preference)	Proportion of house price attributable to environmental quality	Local people; RSPB; Natural England	Relies on related market operating freely; Separating of all other variables takes a great deal of skill
Indirect Use	Flood storage	Defensive expenditure (cost based)	Price of defences that would have to be installed to give the same amount of flood relief	Environment agency; Farmers; Local people	Need to determine extent and location of flooding alleviated by using the site; May be several options for the alternative structural defence
		Damage costs (cost based)	Avoided costs of damage	As above	Need to determine extent and location of flooding alleviated
Option	Peat extraction	Contingent ranking (expressed preference)	Peoples willingness to pay for the future option of using peat determined through ranking	Public in general	Requires large sample; Statistically demanding
Non Use	Spiritual enrichment	Contingent valuation (expressed preference)	Peoples willingness to pay for spiritual enrichment	Public in general	High potential for bias; Time and resource consuming

(Based on Hanley and Spash, 1993 & Turner *et al.*, 1993)

As can be seen in Table 2.1, apart from market analysis (which in itself is not always easy but there are standardised techniques and the data are more readily available) there are difficulties associated with most valuation techniques pertaining to both the use of the techniques i.e. they can be theoretically technically complex, and the data requirements for them i.e. it is often not readily available and is therefore time and resource consuming to collect for each specific study. Another technique available for valuing the non-market benefits is benefit or value transfer. Boyle and Bergstrom (Kirchhoff *et al.,* 1997) define benefit transfer as "the transfer of existing estimates of non-market values to a new study which is different from the study for which the values were originally estimated". Due to the increase in the use of cost benefit analysis (CBA) by Government agencies and the budget constraints preventing original benefit estimate for every site, benefit transfer is potentially an extremely useful tool (Kirchhoff *et al.,* 1997). If developed to be effective it could, in the case of valuing peatland services identified through uses, negate the need for individual contingent valuation surveys each time a new management option is looked at. Unfortunately however the method has proved unreliable so far, as it incorporates unacceptably large errors during the transfer. Also the quality of existing values is not yet considered good enough to be transferred, with meta-analysis revealing large divergence between the values derived. It is therefore recommended that more site-specific valuing needs to be done before benefit transfer can be relied upon, and some literature even suggests, given the large differences between requirements of specific cases, generalisation of a single methodology for the technique may not be possible (Brouwer *et* al, 1999; Brouwer, 2000; Johnson and Button, 1997; Kirchhoff *et al.,* 1997 & Troy and Wilson, 2006).

There is a history of controversy and debate surrounding the valuation of non-market goods and services, not least because of the inconsistency in the estimates gained. However, the methods have been peer reviewed and endorsed over a long time period with contingent valuation (possibly the most controversial method) undergoing much refinement during 1970s and 1980s, to a point that it is now widely accepted by resource economists. Extensive literature now exists on individual valuation studies and using the methods (see Lee and Han, 2002; Lee and Mjelde, 2007; Shrestha *et al.,* 2002; Birol *et al.,* 2006 & Kong *et al.,* 2007 to name but a few). It is noted that values attained should be regarded as **indicators of relative value**, i.e. they indicate lexicographic preferences, rather than absolute values. (Farber, *et al.,* 2002, & Garrod and Willis, 1999 & Turner *et al.*, 2003).

Despite debate about methodological issues (for example Kumar and Kumar, 2008 & Barkmann, 2008) monetary valuations are useful in allowing comparison between different management options through the application of CBA, and by incorporating non-market ecosystem services into the decision making process. Turner (1993) and de Groot (2006), pioneers in the field of ecological economics, both see valuation of ecosystem services as the best way to ensure their wise use, and so the wise use of peatlands. The persistent issue though seems to be the data requirements and so resource intensity of the techniques (Defra, 2007, & Kroeger and Casey, 2007).

Given the resource intensity of valuation techniques and some well documented concerns over the compatibility of CBA with the concept of sustainable resource use (Farber *et al.,* 2002; Heal, 1997; Turner *et al.*, 1993; Nunes and van den Bergh, 2001 & Limburg *et al*., 2002) other decision making techniques could be examined.

Multi-criteria analysis (MCA) is set of decision-making tools that are used less commonly than CBA but which might be better suited to problems of sustainable resource use, where the purpose is often to satisfy a number of criteria at once. MCA is a plethora of techniques that are capable of handling data in different forms, without a common unit, in a consistent way. MCA is inherently transparent and explicit and can capture and quantify the value associated with differing ecosystems services. MCA techniques explicitly seek out differing perceptions of value from stakeholders and their transparency and ability to cope with multiple perspectives mean they are also helpful in culturing the stakeholder engagement and participation often thought to be key in identifying sustainable solutions to resource management at a local level (Roncoli, 2005; Roseland, 2000; De Marchi *et al.,* 2000 & Mendoza and Martins, 2006). Furthermore, as suggested by the name, MCA techniques have long been recognised as able to deal with multi-faceted problems, especially important in terms of resource decisions where there are invariably multiple users and multiple benefit streams as in the case in peatlands, with private landowner preferences for benefit streams or services often conflicting with other organisational preferences. Figure 2.2 demonstrates how preferences might vary from user to user in a hypothetical English peatland, where A is the optimum for conservationists and B is the optimum for agricultural producers, and also how preferences relate to differing benefit streams or services. For all of these reasons MCA is steadily growing in popularity and more attention is being paid in the literature to its potential compatibility with an ecosystems services approach (Sheppard and Meitner, 2005, & Curtis, 2004, & Martinez-Harms and Gajardo, 2008).

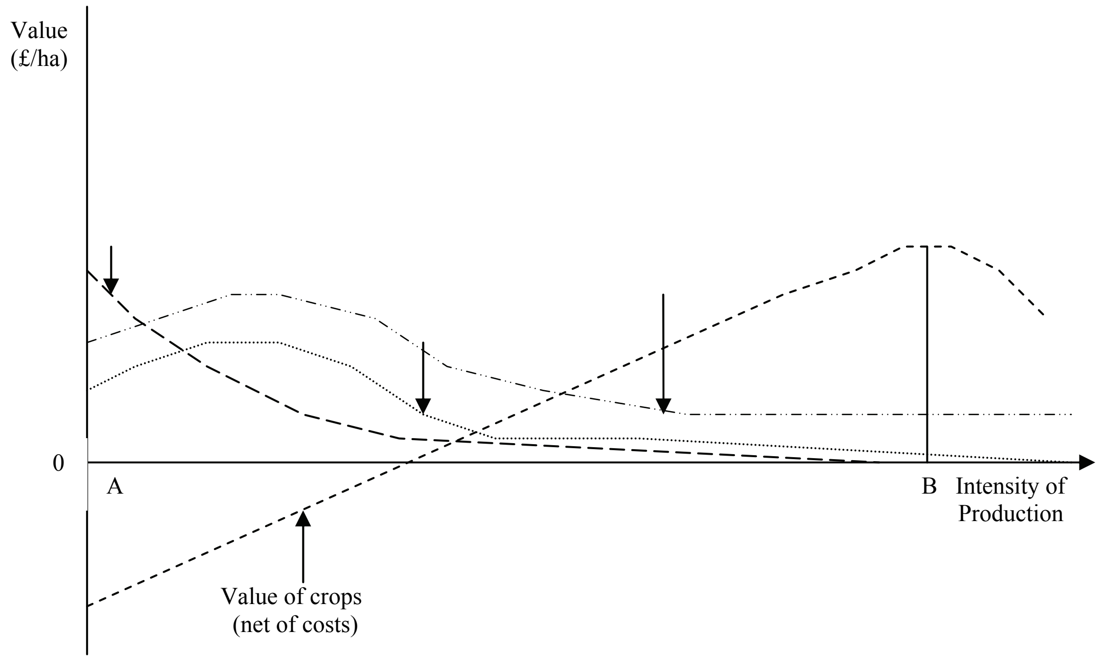


Figure 2.2. **Schematic analysis of multiple values and agricultural production**

(Based on Edward-Jones *et al.*, 2000)

MCA techniques, which normally focus around a decision matrix, effectively derive an indication of relative importance of criteria relevant to the decision in relation to each other and at differing levels. This can be done either by a single decision maker or by multiple stakeholders. The result is an indication of value for each potential option. Different MCA techniques vary in their method of collecting views of importance and in the way they combine the data. The techniques included under the title of MCA are wide ranging, have been developed to a greater or lesser degree and lend themselves to different types of problem. Techniques and theories incorporated under the broad title of MCA range from the Analytical Hierarchy Process (AHP) through to Multi-Attribute Utility Theory (MAUT). AHP is a linear additive model that has low data requirements and determines stakeholder preferences through a relatively easy to derive series of pair wise comparisons. MAUT can be non-linear and does not assume mutual independence of criteria relevant to the issue, i.e. if required, as maybe the case when examining peatlands, it can allow criteria to interact. However it does have a high data requirement and its model, and therefore data collection methods, can be highly complex. An AHP analysis may derive nothing more than an indication of subjective stakeholder perceptions of differing options performance against their preferences (which in itself may be of interest), where as MAUT analysis can inject more objectivity into the analysis.

It is the case that CBA compares options on the basis of derived monetary values, **with the support of** information on other issues deemed to be important. It screens for economic efficiency, supported by supplementary information likely to be regarding the societal or stakeholder context of the decision. Indeed there is increasing reference in the literature to the inclusion of some formal stakeholder investigation together with valuation exercises. This is because CBA does not explicitly state or investigate the distribution of costs and benefits among differing stakeholders, which is pertinent to issues of natural resources with multiple uses and users, such as peatlands (de Groot, 2006, & Kontogianni *et al.,* 2001). MCA techniques can incorporate monetary values as indicators of societal preference for differing levels of services and can already be used in combination with stakeholder analysis (SA), allowing stakeholder and societal well being to be embedded within the analysis.

SA has been referred to as '*a range of tools or an approach for understanding a system by identifying the key actors or stakeholders on the basis of their attributes, interrelationships, and assessing their respective interests related to the system, issue or resource'* (Mushove and Vogel, 2004). SA has been found to be particularly relevant for the study of natural resources (and hence peatlands) because it can cope with situations where there are:

- Multiple uses and users of the resource;
- Temporal trade-offs;
- Unclear or open access property rights;
- The presence of externalities;

- Imperfect markets.

(Grimble and Wellard, 1996)

This is significant for peatlands because:

- It can be said that peatlands have multiple **uses** and users, for example, peat extraction, various types of agriculture, nature conservation, and recreation. All these uses have a range of users attached;

- Discussion on the concept of sustainability hinted at the temporal trade offs to be made with **use** of peatland areas. If for practical purposes peat is defined as a non-renewable resource, then decisions need to be made as to whether to use it now or save it for use into the future;

- There are unclear or open access property rights pertaining to many peatland services, particularly those that do not adhere to land boundaries and are relevant to society as a whole. For example, the hydrological regulation **functions** and consequent flood management services, and the habitat **functions** and consequent species conservation;

- There are many externalities associated with the **use** of peatlands that have already been alluded to in previous sections. For example, in the case of agriculture, farmers have benefited from the production subsidies in the CAP, but the external costs of this management (many of which were actually unknown at the time or not considered serious) have been assigned to society at large i.e. water pollution, soil erosion (Hodge, 2000);

- There are market failures associated with some peatland functions, especially those generating indirect user **values** because they are not traded in the market place. For example, the option, existence, bequest, and altruistic **values** of conserved peat soils and related habitats are not represented in the property rights system and are therefore not captured in the market.

Within a stakeholder analysis the Drivers, Pressures, State, Impacts, Response (DPSIR) framework, a research tool used to structure the issues relating to a particular problem, commonly resource degradation, can be applied. This framework can help to further understanding of natural resources and their current policy and stakeholder context as was shown in the previous section. This is because it can be used to characterise the relationship between the environment and economic dimensions of sustainable development, as well as helping policy makers design policies that address problems at the appropriate level. It can be used to identify potential future trends in use of natural resources and opportunities and threats for wise use or sustainable use.

As well as being particularly relevant to issues of natural resource use, these methods (MCA and SA) are highly compatible. They both account for and try to identify differing stakeholder perspectives, MCA can cope with the qualitative data that the stakeholder analysis produces and the stakeholder analysis can elicit from the stakeholders themselves the criteria needed for the MCA (Grimble and Wellard, 1996 & Mendoza and Martins, 2006). Furthermore they are both compatible with the ecosystem services framework. Stakeholder analysis has the capacity to reveal uses, priorities, issues and stakeholder interactions that may affect use as well as alluding to values (Mushove and Vogel, 2004). Multi-criteria decision analysis can capture stakeholder values in numerical form and link these directly with resource use and underlying ecosystem functions (including indications of their state). Depending on how they are used, both methods also have the potential to promote stakeholder interaction, discussion and potentially consensus, putting resource users at the centre of resource decisions (Mendoza and Martins, 2006). Neither method is perfect however, both being particularly vulnerable to analyst bias and often reliant on subjective data. Stakeholder analysis in particular can lead to problems of data overload (Miles and Huberman, 1994) and multi-criteria analysis can be criticised for being too prescriptive if it is not carried out with sufficient stakeholder participation. Also, some of the mathematical assumptions of some multi-criteria techniques are quite rigorous and compliance with them can be difficult to prove. However, measures can be taken to address these challenges through for example well-planned data collection, inclusion of triangulation to corroborate data and taking a participatory approach.

Following this review it is concluded that a combination of stakeholder analysis (guided by the DPSIR framework) and multi-criteria analysis could provide a viable option for incorporating ecosystem services into the decision making process, leading to the wise use of peatlands.

2.6 Key Messages

This chapter has defined the study topic as the use of peatlands with particular reference to stakeholders, including their interests, influences and interactions as these bear relation to achieving wise peatland use. The review of literature regarding peatland characteristics and management leads to number of key messages, namely:

1. The multi-functional nature of peatlands makes them both valuable and vulnerable;

2. Sustainable or wise use of peatlands is yet to be defined;

3. The ecosystem services framework is a potentially useful and increasingly popular approach to defining wise resource management;

4. Use of the ecosystem services framework requires understanding of ecosystem functions, uses, stakeholders and values;

5. Policy change is likely to be needed to facilitate wise resource use, including peatlands;

6. Stakeholder analysis used in combination with multi-criteria analysis have the potential to incorporate the ecosystem services approach into the decision making process.

It has confirmed the research questions are relevant and appropriate given the interest in the ecosystem services framework and implications for policy, and has explained the selection of stakeholder analysis and multi-criteria analysis as methods. The relevance of these methods to the research questions and ecosystem services framework is outlined in the following introductory methods chapter.

3. Overview of Methodology and Case Study Areas

This chapter provides an overview of the methods adopted for this research. It establishes the research conceptual framework and presents diagrammatic representation of the chronology of research and data sources. It then introduces the case study approach to answering the research questions and provides contextual background to the case study areas. Detailed methodologies for the two main components of the research, stakeholder and the two multi-criteria analyses, are given within the following Chapters, 4 and 5 respectively.

3.1 Introduction to Methods

This section gives an overview of the methodological approach to the research and highlights the differing data collection techniques. Complete methodologies for the stakeholder and multi-criteria analysis are not been presented here but are presented and critiqued in their individual Chapters, 4 and 5 respectively. This is because the research process was highly iterative and progressive, building on the previous findings. In this way the MCA was developed out of the understanding derived in the stakeholder analysis and furthermore, the second of the MCA techniques applied drew on the results of the first. This made a concise account of the MCA methods in particular, without first presenting any results of the stakeholder analysis, near impossible, hence being presented sequentially.

Figure 3.1 reminds the reader of the details of the ecosystem functions, uses and values approach to resource management, which was adopted in this research as the conceptual framework. It was the intention that in identifying peatland functions, uses, stakeholders and values the two-way relationship between people and peatlands be unpacked, enabling recommendations for policy interventions to promote wise use of peatlands. Elaborating the various components of the framework, as required by the research questions, with a view to socio-economic contributions to knowledge required that the research design take a stakeholder focused approach.

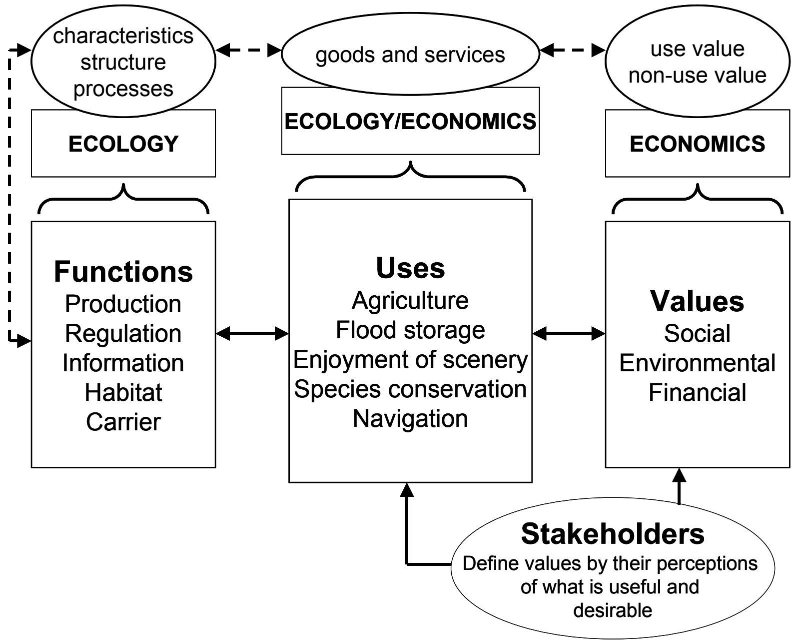


Figure 3.1. Reminder of the Research Conceptual Framework

Figure 3.2 shows the methods used to answer the research questions. It shows the connection between the research questions, data collection techniques and the main methods. It also shows how the research questions relate to the components of the conceptual framework: functions, uses, stakeholders and values. Stakeholder and multi-criteria analysis (Analytical Hierarchy Process: AHP, and Multi-Attribute Utility Theory: MAUT) were used in combination to answer the research questions and a range of data collection techniques were used to inform them. Figure 3.2 demonstrates the progressive building of knowledge around the elements of the ecosystem services approach, culminating in an informed response to the final research question relating to policy.

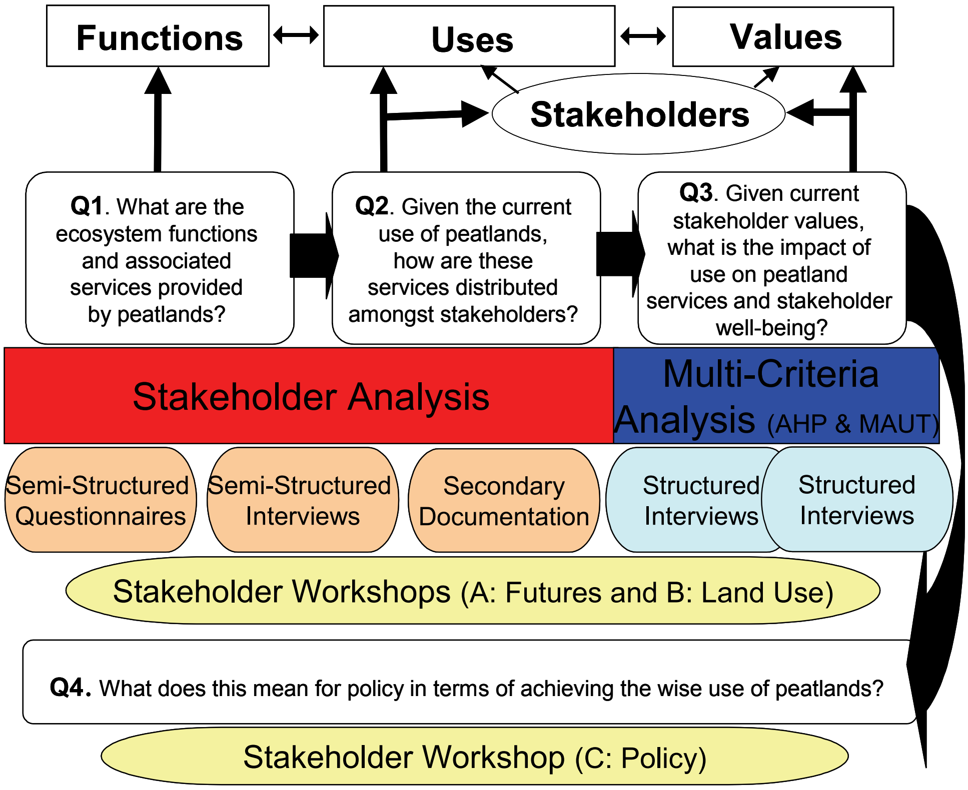


Figure 3.2. Methodological Approach

Figure 3.3 presents chronologically the different elements of the research, with each section being informed by those previous. It elaborates on the stakeholder workshops, indicates a case study approach was adopted and shows the necessarily different treatment of the English and European case study areas in terms of data collection. Data collection for the English case study areas was more intensive than for the Northern European ones. The stakeholder analysis was carried out in detail for the English areas and in less detail for the Northern European ones, and multi-criteria analysis was only carried out for the English areas. This was a deliberate attempt to keep the research manageable given the resources and time available.

Figure 3.3 also shows the focus of the stakeholder workshops. A detailed description of Workshops A and B is not included in this thesis as not all aspects of them are entirely relevant to the research questions. This is because they were carried out with the EUROPEAT project objectives in mind and were designed as such. They were used to gauge stakeholder opinion on the direction and focus of the project rather than as a data source. However, particular outcomes of the workshops are relevant to the research questions and help inform the analysis, hence their inclusion here. The reports from Workshops A and B can be found in Appendix I and II and relevant aspects of the workshop outcomes are referred to when appropriate throughout the remainder of the thesis. Workshop C however is reported in Chapter 6 because it was designed specifically to be a data source for this research. It was used to gain stakeholder perspectives on policy for peatlands.

It can be seen in Figure 3.3 that each EUROPEAT project partner had a stakeholder panel with which to consult in responding to questionnaires and with whom to confer on the direction of the research. Partner Countries arranged their own stakeholder panel. Panels were made up of around 6 people thought to be representative of some interest in peatlands, for example landowners, conservation organisations and government bodies. Each panel had a chairperson, who was invited to some project meetings and workshops as a representative of the whole panel.

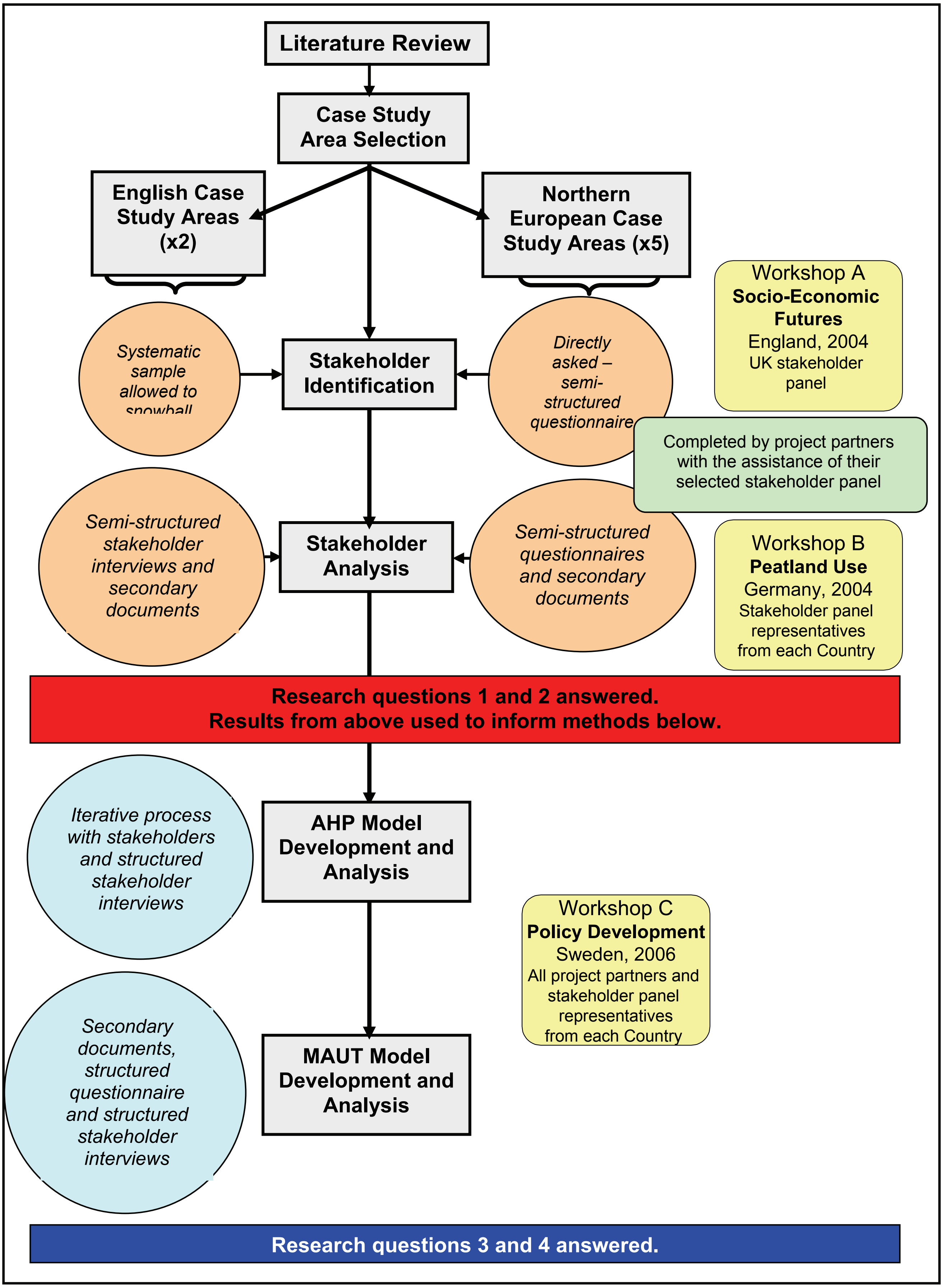


Figure 3.3. Research Chronology

3.2 Case Study Areas

This research used the case study approach to answer the research questions given the repeated reference in the literature to contextual heterogeneity and the need for further case specific studies. The case study approach is an **in-depth** study of a particular situation and context (Yin, 2003 & Hamel *et al*, 1993). Two English cases were chosen to allow for some comparative analysis and each of the EUROPEAT project partners (Norway, Sweden, Poland, Germany, Netherlands) chose an additional one case. In total 7 cases were examined in the manner previously presented.

3.2.1 Case Study Area Selection

In order to meet the requirements of the EUROPEAT project, case study areas needed to be predominantly in agricultural use and employ water level manipulation as part of their management system; for this reason the areas needed to be lowland peatlands. In England the Fens and the Somerset Moors were chosen (Figure 3.4). Both areas are heavily modified systems reliant on drainage and careful water management, and are both predominantly in agricultural use but due to their histories vary greatly in the type of agriculture present and approach to management. The two areas are therefore similar enough to be comparable in some aspects but different enough to demonstrate the variation in peatland management.

European partners in the EUROPEAT project (Norway, Sweden, Poland, Germany, Netherlands) were each asked to choose a case study that was 'typical' of national use and ownership patterns for peatlands, had multiple stakeholder interests and comprise a contiguous area. Partners were advised that areas owned by a research institute may not be appropriate because it was likely their historical use be different to that of surrounding peatlands, and stakeholder interests be different to those of a conventional site. European case study areas varied from extensively managed national parks to intensive dairy sites.

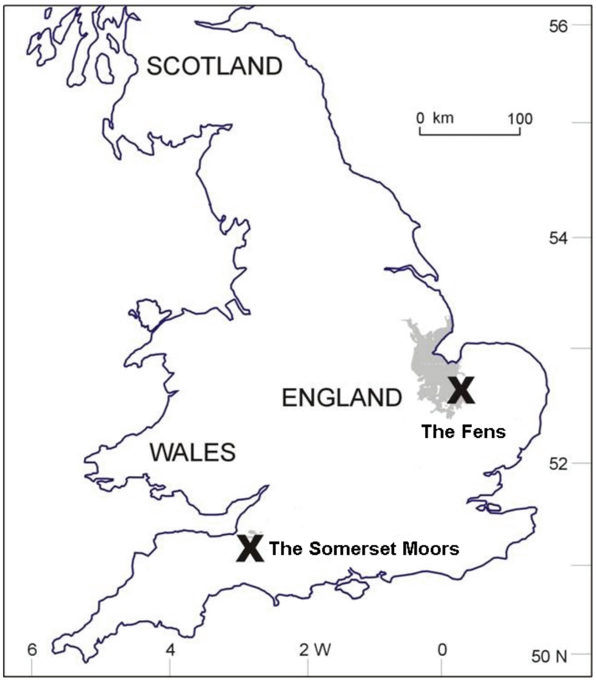


Figure 3.4. Location of English Case Study Areas

3.2.2 Background to the Fens

The Fens area of eastern England extends into the counties of Cambridgeshire, Lincolnshire, Norfolk and Suffolk (as shown in Figure 3.5). The Fens were once England's largest wetland, covering around 400,000ha, consisting of a matrix of different habitats. However, intensive drainage efforts started in the 16th century creating one of the largest areas of high-grade agricultural land in England (rated excellent or good quality, grades 1, 2 and 3a) (PACEC, 2004). Much of this agricultural richness can be attributed to the peat soils, which underlie the majority of the area (Oates, 2002). This means that arable cropping currently accounts for over 85% of the land use (Oates, 2002). Other land uses in the region are livestock farming and nature conservation.

Holding size in the Fens is relatively large (majority being 100ha and over) and the area has seen a 25% decrease in the number of farms over the past ten years, in line with the national average (PACEC, 2004).

Figure 3.5. The Fens: showing main towns and Royal Society for the Protection of Birds (RSPB) Nature Reserves (RSPB images)

Example 1. Intensive Arable Production

Methwold Fen is an arable farm in Norfolk Fens.
The farm is 1180ha, 800ha of which are on peat soils. The farm specialises in lettuce. For a typical year the farm consists of:

100ha potatoes, 120ha celery, 60ha onions, 300ha wheat, 400ha Chinese cabbage or lettuce, 100ha sugar beet, 100ha leeks, 60ha radish, 40ha red beet

Typically 8% of the land is 'set aside' each year. (up until 2007)
Irrigation requirements are relatively modest in an average year: (mm depth across whole crop)

Potato -	50
Onions -	75
Celery -	25*
Lettuce -	25*

*These crops would need five times the amount of irrigation shown here if the farm did not have controlled sub-surface irrigation.

Figure 3.6. Intensive Arable Production

Intensive arable farming, including root crops, is very important both in the Fens and nationally, with 38% of England's potato crop being grown in the region and sugar beet and potatoes remaining the dominant crops in the area (Lang, 2004). Financial returns can be high on the crops grown in an intensive system as compared to an extensive one (cereal crops) although they can be very variable. Therefore the possible reward for intensive arable is far greater than that for extensive arable (PACEC, 2004). Extensive arable may become more common if peat soils continue to degrade and the Fens loses its competitive advantage for intensive arable (increased inputs and costs against a possible decreased yield and commodity price), and the biofuels industry grows (Personal Communication, 2003-2008). Examples of gross margins on typical intensive and extensive arable crops for the year 2003/2004 can be seen in Table 3.1.

Table 3.1 Typical intensive and extensive arable crops and their gross margins for the year 2003/2004, the Fens

Regime	Crop	Gross Margin (£/ha)
Intensive Arable	Potato	5319
	Sugar Beet	1127
	Field Scale Vegetables	3513
	Winter Wheat	701
	Set Aside (until 2007)	240
Extensive Arable	Spring Wheat	566
	Winter Barley	533
	Rye	520
	Oil Seed Rape	635

(taken from Lang, 2004)

The other land uses in the Fens, livestock farming and habitat restoration, are currently not common. Livestock production and related skills are limited in the area. What little intensive grazing there is, associated with dairying, is declining and most extensive grazing is linked to conversation management by environmental organisations or occurs on Sites of Special Scientific Interest. It is likely at the present time, with the peat soils still performing well in terms of production, that major compensatory payments would be required for arable landowners to revert to grassland. This may change over time however as the condition of the soils deteriorates.

Habitat restoration, although limited in area, is an increasingly important land use in the Fens given the relative scarcity of areas of nature conservation in the region and the vulnerability of those areas that do exist. There is much momentum for large scale habitat restoration projects which aim to better protect, expand and enhance the very small existing areas of rare habitat, and to relieve some of the pressures associated population increase in the area (Personal Communication, 2003-2008). But even if all the wetland restoration projects are realised it would only amount to 3% of the land area (Oates, 2002) and agriculture would remain the dominant occupier.

Housing development is another possible future land use, though this is less likely on deeper peat soils liable to subsidence and flooding. However, there is pressure on marginal areas, especially given projections that Cambridgeshire and Peterborough alone will have to accommodate another 122,000 people by the year 2016 (Cambridgeshire County Council, 2006), equivalent to about 50,000 households.

Economic analysis of the Fens farming system and possible future scenarios carried out as part of the EUROPEAT project (EUROPEAT WP8.2/8.3) found that the use of remaining deep peat soils in the Fens for vegetable and salad cropping is likely to continue its important role in the Fenland economy for the foreseeable future. It was advised then that farmers must adopt management practices that ensure economic longevity of these fragile soils.

3.2.3 Background to the Somerset Moors

The Somerset Levels and Moors lie entirely within the County of Somerset and are 64,000ha of low-lying wet grassland. It is the largest remaining wetland network in England. Parts of the area are designated Special Protection Areas (SPA), Ramsar sites and Sites of Special Scientific Interest (SSSI). These designations emphasise the national and international importance of this wetland network in terms of biodiversity and nature conservation. The extent of these designations and the peat soils in the area are given in Figure 3.7 and show the importance of peat soils to conservation interest in the area.

Any area called a Moor within this region, for example, West Sedgemoor, contains peat soils, whereas the Levels comprise mainly mineral soils. For this reason, throughout this research, the area concerned will be referred to as the Somerset Moors.

Attempts to render the Somerset Moors suitable for habitation and utilisation started as long ago as the early thirteenth century but it is activity since 1939, with the backing of policy and therefore funding, that has been most effective to this end (Williams, 1970). There was a prolonged period then of arterial and field drainage works that supported improved, albeit relatively extensive, grassland systems and a lowland wet grassland environment that became rich in wildlife and landscape value. For this reason the Somerset Moors was one of the first Environmentally Sensitive Areas (ESA - an agri-environment scheme which rewarded farming with conservation and environment in mind) and is currently investigating obtaining World Heritage Site status.

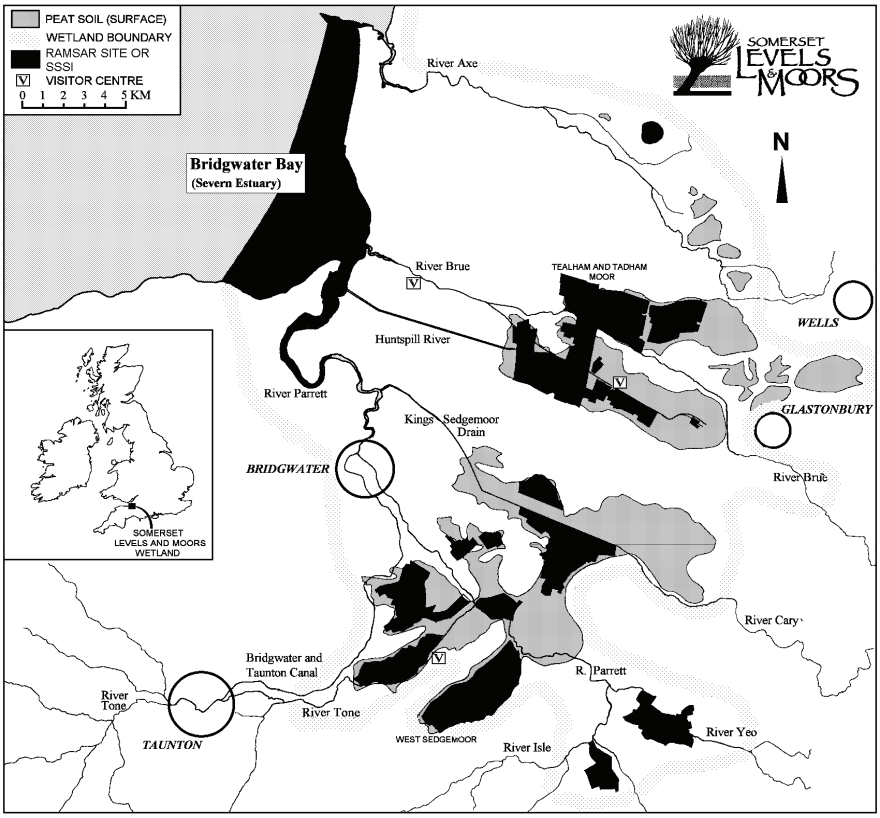


Figure 3.7. The Somerset Levels and Moors

The Somerset Moors comprises a great diversity of land uses. The dominant land use is cattle and sheep grazing (27%), then dairying (15%), then arable including horticulture and general cropping (18%) with an 'other' category including specialist forage, goats, horses and non-classified holdings (31%) (FWAG, 2002). Peat extraction, withy (willow) growing and conservation are also present in the area.

Most holdings in the area are relatively small, 5-20 ha, and are highly fragmented with each holding tending to combine land from a range of topographical and land drainage conditions (FWAG, 2002). However there has been a recent polarisation in holding size, with many farmers leaving the moors and selling their land, resulting in some landowners increasing the size of their farm and an increase in smallholdings predominantly for horse paddocks. A diversity of tenure type can be found on the Somerset Moors such as tenant farmers, graziers and grass keep but the majority of holdings are owned (Mills *et al*, 2002).

Extensive and intensive grazing for beef store cattle and dairy cattle respectively are very common land uses in the Somerset Moors. The viability of both regimes though has been declining. Beef grazing in the Somerset Moors was affected badly by the 30 month age limit introduced in response to the BSE crisis and dairy farming has suffered from low milk prices. Consequently cattle numbers on the Somerset Moors have declined and it is thought by many stakeholders in the area that this decline will be exacerbated by the recent changes in the funding mechanisms of the CAP, particularly the loss of the extensification payments in the Beef and Sheep Premium Scheme (Personal Communication, 2003-2008).

Stocking rates and yields for both beef and dairy cattle are typically lower on the Somerset Moors than regional averages. Fertiliser application in both systems is also relatively low due to the peat soils (Morris *et al.,* 2002).

Example 2. Extensive Beef Production

Farmer A is an extensive beef producer in the area. As is common only a percentage of his farm is on peat soils (41ha). He runs the farm with his brother and it consists of:

12ha owned, 100ha rented, plus a further 150ha temporarily rented grass and 30ha orchard.

In March 2005 they had 176 beef cattle and would build this up to 300 and run them on 162ha.

They have: 77ha in Tier 3 ESA (raised water levels), 41ha in Tier 1 ESA (extensive grass).

They think they will have 122ha in the Higher Level Scheme (New agri-environment scheme equivalent to Tier 3).

The loss of extensification payments will have a profound effect on the nature of their business and they are unsure at present what future direction they will take.

'we've sunk the money we've made in the last couple of years into machinery so we haven't got to worry about that and bought some more land and you know buffered ourselves in effect because we knew this was coming, so we got ourselves in to good shape financially. And then we will dive into anything, you know if the situation arises and there is income to be made in any sort of farming then we will go into it really.'

Figure 3.8. Extensive Beef Production

Arable is a current land use on the Somerset Moors but more extensive than intensive. Although arable farming of any description is not encouraged or considered desirable by the statutory bodies and the conservation lobby in the area. Indeed the large number (34 in total) of SSSIs designated in the 1980s was an attempt to halt the emerging conversion of permanent pasture to arable. Despite this however there has been and remains a degree of arable cropping on the Moors. The dominant arable crops in the area are cereals, particularly winter wheat and fodder maize.

Peat extraction has occurred in the Somerset Moors since they were first drained and is important to the local economy. Although because of conservation concerns extraction is now much reduced and new consents are increasingly difficult and expensive to agree (Personal Communication, 2003-2008) complete cessation of the practice is not likely in the imminent future. Policy towards extraction could change if for some reason it is deemed important again.

Since the Environment Act, nature conservation is the dominant after-use of extraction sites in the area and there is now an extensive network of nature reserves on old peat diggings. For example, the Avalon Marshes network as it is known consists of a range of wetland habitats including reed bed, wet grassland, wet woodland, open water and swamp. The area is important for bird watching and has a strong emphasis on cultural and heritage interpretation (Personal Communication, 2003-2008). Other than in extraction restoration sites conservation in the area occurs largely in conjunction with the extensive grazing regime, whether owned and managed by a farmer or conservation organisation.

Withy production, that is willow coppicing for basket, fencing and craft materials, is a traditional yet viable land use on the Somerset Moors and although it has declined in recent years it still covers an area of about 80ha. The majority of the crop is used for the production of artists' charcoal and the area is the largest producer of this worldwide. The Withy crop is also used for traditional crafts i.e. basket or fence making however this side of the industry is struggling in the face of growing importation of similar items at a cheaper price. There is also a growing market for coffins with the advent of 'green' funerals although this is still relatively small compared to the other uses (Personal Communication, 2003-2008). Withy production preferably occurs on soils with a mineral surface layer and peat sub-surface. This, according to the definitions given in Chapter 2, means strictly speaking withy production cannot be said to occur on peatlands. It does however occur on 'moors'.

There is concern from the statutory organisations and the nature conservation bodies that abandonment, (that is unmanaged land) is a very real possibility in the Somerset Moors because of the decreasing viability of livestock farming. It is thought that the future of farming in the area will manifest itself over the next few years and the conservation lobby will have to respond to this in terms of meeting their objectives on the moors. It is widely agreed that the area relies on management, particularly grazing, for its interest and therefore abandonment of land would be extremely detrimental from an environmental, social and economic perspective.

Economic analysis of the Somerset Moors farming system and possible future scenarios carried out as part of the EUROPEAT project (EUROPEAT WP8.2/8.3) and found that switching to wet grassland and raised water levels that will preserve peat soils has become more attractive in the Somerset Moors with recent changes in CAP support.

3.2.4 Background to Northern European Areas

Table 3.2 summarises the main features of the peatland sites chosen for review by partners across Northern Europe. There is considerable variation within each country in the management of peatlands, such that the sites chosen must be regarded as examples rather than typical or dominant cases. Most of the sites are down to grassland management, with varying intensities of water level management. In the past agricultural land use has been supported by the CAP or national agricultural subsidies, for example support for dairying in the Netherlands and arable cropping in Norway. More recent reductions in subsidies for agricultural production appear to have reduced the amount of arable cropping and promoted extensive grassland management. This may again change in light of recent food security concerns. In the German case, the site has been acquired by a conservation foundation for wetland recreation.

3.2.5 Summary

The Fens of eastern England are characterised by a dominant intensive arable system, including the production of root crops, vegetables and salad crops, often using irrigation. By comparison, in the Somerset Moors in South West England, land use is more mixed and predominantly extensive, integrated with considerable interest in conservation that is promoted through a range of agri-environment schemes. Farming systems in both of these areas are under pressure but for different reasons. In the Fens, intensively drained peat soils provide comparative advantage for high value cropping that will be lost if soil quality continues to deteriorate. In the Somerset Moors, continued falls in profitability of livestock farming could lead to abandonment of land from agriculture, with potential loss to nature conservation that depends on a managed, mainly grassland landscape. Northern European cases differ widely in their size, use and history giving further insight into the plethora of issues surrounding peatland areas. Methods used to study these areas and answer the research questions will now be outlined.

Table 3.2 Profile of Case Study Areas in Northern Europe

Country	Size (ha)	Land Use		Ownership/Occupancy	Water Level Management	Economic Viability
		Historic	Present			
Germany	400 (150 of which are peat)	Owned by nature conservation body but no active management	Extensive grazing of Holstein Friesian, Konik horses and heck cattle	Ownership is predominantly by the nature conservation foundation but 10% is still left in private ownership	Low flood risk. Drains and ditches to drain groundwater. Plan is to gradually stop the drainage by blocking ditches	Unclear. Suckler herd may be profitable and Heck cattle have niche market but the profitability is as yet unknown
Netherlands	1939	Dairy farming with slightly higher water levels and less intensive grazing than today	Permanent pasture for dairy farming and a small nature reserve	Private. Mostly family dairy farms. Experimental farm owned by research institute.	Limited flooding but some surface water (up to 10cm) in wet periods of the winter. Pump drained. Ditches 25-40m apart. Water level predominantly 50-60cm below mean field level but only 25-35cm in a small area.	Profitable dairy farming. It is increasingly difficult to make a living from this however due to CAP reforms, decrease in milk price, restrictions on stocking rates and restrictions on fertilizer application. Farmers are looking to alternative methods for generating income.
Poland	1500	Extensive	Meadow, and grazing, mowed 3 times per year.	Owned by Institute for land reclamation and Grassland Management	No flooding. Artificially drained. Mean water level is 50 cm below land level.	Hay production. Local dairy buys the milk. In 2005 mean price per litre was 1.26 PLN with production at 4500-5000l/head
Norway	3000	Grass production (95%) and arable cropping of carrots and Swedes (5%)	Grass production (95%) and arable cropping of carrots and Swedes (5%)	Privately owned farms (many)	Some permanent or seasonal standing water. Generally flooding is not an issue. Cultivated area is drained with plastic pipes at depth of 100-150cm. The rest is open ditches. No pumping	Agriculture only profitable because of subsidies. Future economic basis of land use unsure. As soil is on bedrock then decisions about investment in infrastructure, replacing machinery etc are based on how long people think the soil will last.
Sweden	1240	As now but more intensive agriculture when the drainage was better	Arable land, grassland, pasture, fallow (set-aside), forest	135 land owners._Private farmers (many farmers with only a few hectares of peatland and one big farmer who has almost 80 hectares of peatland), Uppsala University own more than 160 ha, the Bälinge parish owns 30 ha.	Ditch water levels are regulated by the legal act in 1994. With the subsidence of the peat, drainage levels are gradually getting shallower.	In general the profitability of agriculture is declining. Some areas already effectively abandoned. In intensive area profitability similar to that on mineral soils.

3.3 Key Messages

This chapter provided an overview of the methods and diagrammatic representation of the methodological chronology and data sources. It linked the methods to both the research questions and the ecosystem services conceptual framework. It has also introduced the case study approach to answering the research questions and provided some relevant contextual background to the case study areas used. It has shown:

1. Answering the research questions sequentially elucidates the components of the conceptual framework: peatland functions, uses, stakeholders and values;

2. Stakeholder and multi-criteria analysis are appropriate methods to answer the research questions;

3. The case study approach is an appropriate research method to carry out this exploratory research;

4. The research examines two English case study areas, the Fens and the Somerset Moors, and five Northern European case study areas.

The following chapters present the methods and results of the stakeholder and multi-criteria analysis concluding against the relevant research questions.

4. Stakeholder Analysis

This chapter presents the methods and results of the stakeholder analysis. Stakeholder analysis was used as a descriptive tool to answer the first two research questions, namely: What are the ecosystem functions and associated services provided by peatlands? And: Given the current use of peatlands, how are these services distributed amongst stakeholders?

This required developing an understanding of the functions, uses and stakeholder components of the ecosystem services framework as applied to the case study areas.

In order to determine what goods and services were relevant in the case study areas and how these were distributed among stakeholders it was necessary to identify case specific stakeholders and develop an understanding of their interests, influences and interactions. In addition to this, in recognition of the fact that stakeholder relationships with peatlands and with each other are not static, it was important to interpret the conditions under which the case study stakeholder-peatland dynamics currently exist in order to understand how they might change.

4.1 Stakeholder Analysis Methodology

This section explains the approach to stakeholder analysis and methods of data collection. A critique is also provided.

Literature review informed an otherwise inductive approach to the stakeholder analysis. That is an open and relatively unprompted approach, determining from stakeholders themselves what the important issues are rather than presenting them with preconceived ideas. The main steps of the analysis were identifying the stakeholders, a series of semi-structured interviews, data recording and coding, and semi-structured questionnaires for the European cases. These steps are reported in sequence in the following sections.

4.1.1 Identifying Stakeholders

Stakeholders in any given situation could, without imposed limits, extend as far as the global population at large. Stakeholders for the English case studies, however, were defined as:

Those individuals, groups or organisations that had an explicit, direct interest in and influence over the peatlands of The Fens or The Somerset Moors.

This was to ensure collected data was case study area specific rather than general. General data could be retrieved from documentation and was also likely to be captured or evident in local views and activities. Stakeholders were then identified through an initial systematic sample that was encouraged to snowball. Meaning, as a starting point known stakeholders were contacted and this initial sample was asked to identify other individuals or groups with an interest in or influence over the peatlands of the Fens and Somerset Moors. Furthermore, any other groups or individuals mentioned by identified stakeholders but not specifically identified when asked were investigated to see if they adhered to the definition.

A comprehensive list of all the individuals, groups and organisations originally identified, in the order in which they were identified can be found in Appendix III. 67 stakeholders were identified originally but it was necessary to reduce this to a manageable number. Therefore the following extra rule was cautiously applied:

Must have been referred to by more than one other stakeholder and so been found to have more than only a very limited interest in the specific case study areas.

This rule was combined with some investigation, through secondary data sources such as websites, into the organisation or group to ensure the legitimacy of applying the rule. In the case of the Somerset Moors this investigation led to inclusion of the regional flood defence committee even though they were only mentioned by one other stakeholder. It enabled strategic condensing of the stakeholder list to a manageable size in terms of data collection. The potential for omitting vulnerable or key stakeholders in this process was born in mind and guarded against by the short investigation. In this way all those finally included on the basis of being referred to by several other stakeholders were considered to have reasonable interests and influences to the specific case study areas. Finally thirty-four stakeholders were confirmed. These were collections of individuals or organisations that had a direct link with the peatlands of the case study areas.

There was some concern that the approach to identifying stakeholders may have introduced a conservation bias as the initial strategic sample encompassed a high proportion of conservation bodies or responsibilities. However, the identification process continued until there were no further stakeholders disclosed and care was taken to ensure that contacts within organisations were chosen because they had the greatest responsibility towards the case study areas and for no other reason. Furthermore, the interests of the key informants reflect high profile interests and active organisations in the areas and therefore it is felt that any leaning towards conservation in the stakeholders is a factor of policy, management and current issues rather than an introduced bias.

4.1.2 Semi-Structured Interviews and Secondary Data Sources

Having identified stakeholders the next stage was to collect information from them. The semi-structured interview was the main tool used for information collection in the English cases. This was because of its ability to derive rich information about the social process in the context of peatlands, and its accommodation of the inductive approach unlike a structured interview or questionnaire. The purpose of this section of data collection and so the semi-structured interviews was to generate an understanding of stakeholder interests, influences, entitlements, responsibilities, interactions and concerns regarding the case study peatlands. It also served to glean information on the socio-politcal context of the case study areas. This was necessary in order to address research questions 1 and 2.

The semi-structured interview uses a set of open-ended questions, the order of which can be changed, new questions can be added, and questions can be dropped at the interviewers' discretion depending on how the interview unfolds. Effort was made in the formulation of the questions to structure the research approach, as per Miles and Huberman (1994):

- **Time** – *a completely inductive approach can be very time consuming while the researcher identifies what is important.* With limited opportunity to revisit respondents with further questions, it was important some direction be given to the initial contact;
- **Existence of prior knowledge** – *researchers have background knowledge that may help identify what questions to ask, and to ignore this knowledge can be self-defeating.* As a smaller scale study on peatlands had been carried out immediately prior to this work and a literature review, insight gained into the issues of relevance was utilised;
- **Multiple cases** – *an inductive approach to more than one case study means the researcher can be receptive to local idiosyncrasies BUT cross comparability will be hard to obtain and the information load will be colossal.* Effort was made to maintain flexibility whilst maximising the comparability of data. This was done by allowing for the addition of new questions and the dropping of redundant questions, whilst maintaining the sequence and nature of the core questions.

In the formulation of the questions every effort was made to avoid leading questions, jargon, ambiguity, double-barrelled questions, questions beyond the capabilities of the respondents, and to build in triangulation on responses where appropriate (Neuman, 2003). An example set of questions can be found in Appendix IV. The questions started very open ended and then used a series of prompts on already recognised issues. For example, the initial question was always *'what is your interest in peatlands in this area?'* without presenting any peatland functions (it was legitimate to assume interest in peatlands as they had already been identified as stakeholders). This question was asked having already discussed the focus of the research with the interviewee and confirmed an understanding of the term peatland. Further into the interview a list of prompts asked such things as *'what are your opinions on recreation* *in the area?'* and so allowed the respondent to expand on their first answer if desired, but they did not assume importance of the issues, respondents were free to say they did not feel the prompt was of relevance to them. Then the final question was always *'what does the term peatland mean to you?'* and this served as a final confirmation, or not, of the first answer given. The question set was tested on two respondents to determine effectiveness and to generate feedback on its comprehensiveness. In light of the testing, minor changes were made to the question set before the full interview process began.

When the respondent was a member of an organisation or group he/she was asked to present the organisational viewpoint. When the respondent was an individual (for example farmers and local community members) then several individuals were interviewed to try and account for differing personal perspectives. Where it was deemed important to talk to an organisation but no specific representative could be recommended, the organisation was phoned and an appropriate person was always found. Identifying local residents for interview was slightly more difficult. Villages within the case study areas were chosen with a view to villages large enough to have people out on the streets in the day time but not so big there was likely to be a large visiting population on any given day. In these villages people on the street and in shops and garages were interviewed if they agreed and also asked if they knew of anyone who would be appropriate to interview, i.e. they had and keen interest in the surrounding area, were influential or had lived in the area a great many years and so were knowledgeable. This approach worked in both areas, resulting in visits to people's homes and places of work for interviews with for example local historical society leaders, long-term residents and local representatives. It was noted however that the process was much more successful in the villages of the Somerset Moors than in the Fens, where it appeared there was a greater sense of community and more people knew each other. It is recognised this approach may have introduced an age and occupation bias into this group but it is thought the snowball effect of directly asking for suitable interviewees and returning at a time convenient to them minimised this and resulted in a more diverse set of respondents than simply those on the street at the time.

Secondary documentation including plans and position statements were used as the primary data source instead of interviews in some instances. This was either when all attempts at contacting a respondent were unsuccessful, as with the Somerset Peat Producers Association, or when it was considered unnecessary to conduct an interview as the information was freely available in other sources; this occurred mostly within Councils, both County and District and within partnership organisations.

A total of thirty-six face-to-face interviews, varying in length from half an hour to two and a half hours, and twelve telephone or e-mail interviews were carried out over an eight month period. This includes multiple interviews with farmers and local residents, both of whom were counted as one stakeholder in the previously given total of 34 identified stakeholders. However, not all of those interviewed remained a stakeholder in terms of subsequent analysis due to the nature of their responses.

4.1.3 Data Recording and Coding

Face to face interviews were recorded using Dictaphone and then transcribed. Recording the interviews was considered the best way to minimise interviewer bias in the recording process. Previous experience had shown that just taking notes could lead to recording only the interviewers preconceived ideas of what was important. Meaning it would not allow a revisiting of early interviews if a theme that was not expected started to develop as the interviews continued. As all data analysis inevitably leads to selection and reduction of data at some point it was considered important to at least start with as much of the original data as possible. The recording and transcribing process also means a) the analyser becomes very familiar with the data and b) means the data are available in raw format for others to use.

The Dictaphone/transcription method had draw backs in terms of data quality however. For example, it was found to restrict what the respondent felt able to say, with respondents asking that the tape be turned off at certain junctures. This request particularly related to the stating of opinions potentially disagreeable to other stakeholders. Some respondents even asked that their transcript be sent to them to check through before it could be used. Furthermore, it was evident that some respondents were acutely aware they were being recorded. This meant they treated the process in a very official manner and consequently some of the informal chats, after the tape had been turned off, gave light to more interesting points than came up in the interview itself. Importantly, word for word transcriptions produced very lengthy pieces of prose with a multitude of themes and concepts incorporated within them. This had the potential to lead to problems of data overload. However, targeted analysis, with the conceptual framework and research questions in mind meant this was avoided.

Despite these negative points, it is considered the advantages of being able to refer to transcripts validated the process, especially given that the research was on hold for a period of time before being completed. However, for work with greater time constraints it may be that a more efficient approach would be to record the interviews and take notes in combination, without necessarily transcribing the entire interview.

From the transcriptions a contact summary sheet was completed for each interview, which related to key points and drew out the main concepts of each interview. Six interviews were not transcribed due to poor tape quality. For these a contact summary sheet was completed from memory of the interview as soon as the poor tape quality was realised (within a day). As is recommended all transcription and completion of contact summary sheets were done as soon after the interviews as possible, however, due to limited resources this was at times up to a month after the interview was carried out. All contact summary sheets and full interview transcripts can be provided upon request.

Telephone and e-mail interviews were not recorded. For e-mail correspondence the e-mails themselves were treated as primary documents and for telephone interviews notes were taken during the interview process and then reviewed and typed up after the interview. Primary documents then consisted of transcribed interviews, e-mails, notes from telephone interviews, and reports such as the Somerset Minerals Plan or Community Strategies.

All primary documents were then coded. There were two stages in the coding process. Firstly, open coding was carried out on the contact summary sheets only, which is a valid methodology (Miles and Humberman 1994), especially if primary documents are unwieldy. Open coding is a grounded and inductive approach to coding and was therefore compatible with the approach to the interviews. Carrying out this first stage of coding on the contact summary sheets allowed a feel for the issues and therefore codes to be developed quickly and without suffering data overload. The codes derived from this open coding exercise were then screened against the research aims and questions to ensure relevance and were also screened against the conceptual framework and analysis tools (ecosystem services and DPSIR) to ensure that a) the framework or tool was appropriate to the issues and b) the issues could be informatively examined using the framework or tool. From this a start list of codes and their meanings were derived. The start list of codes was used to code all primary documents, which were the full interview transcripts, e-mails, notes from telephone interviews and Plans and Strategies. Codes were derived on two levels: first level codes and pattern codes. A first level code describes and summarizes the data. They were based on the conceptual framework and analysis tool, the research aim and questions, previous coding of the contact summary sheets and Miles and Hubermans recommendations. A pattern code looks for themes, configuration or explanation. They were derived entirely from the data, including the open coding exercise. Examples of codes used and their meaning can be seen in Figure 4.1

Although a start list existed a grounded approach to the coding was still adopted, with the list being added to, adapted and redundant codes removed as and when it was necessary i.e. the data were not forced to fit the codes, rather the codes emerged from the data. The final list of relevant codes and their meaning can be provided upon request. Coding consistency (that is consistent application to strands of data) was checked during the process by revisiting samples of the previous days coding and ensuring it would be carried out in the same way. With only one analyst however consistency of coding was not a significant issue. Atlas.ti 4.2 software was used to manage the primary documents and carry out the coding. This was because the software made retrieval of quotes for particular codes, or codes for particular interviews quicker and easier than if just using Microsoft Word, and the software was available.

CODE	DEFINTITION
First level codes	
Stakeholders	
Existing stakeholder (S-ES)	Mention of a stakeholder already interviewed
New stakeholder (S-NS)	Mention of a stakeholder not previously interviewed
Individual positive reference (S-I/PR)	Reference to another stakeholder as an individual that says something positive about their role
Primary Interests	
Production -Agriculture (PU-P/A)	Statement or inference that the primary interest in peatland systems is agricultural production, either for the respondent or in reference to another stakeholder (the term agriculture is taken to mean any form of cultivation including forestry)
Habitat-Rare species (PU-H/RS)	Statement or inference that the primary interest in peatland systems is the conservation of rare species, either for the respondent or in reference to another stakeholder
Regulation-Flood water storage (PU-R/FS)	Statement or inference that the primary interest in peatland systems is flood water storage, either for the respondent or in reference to another stakeholder
Pattern codes	
Themes	
T: Landscape scale (T-LS)	Response from stakeholders to the growing complexity and multi-functional nature of peatlands to plan land use on a landscape scale
T: Multi-functional (T-MF)	Indication of movement towards a multifunctional land use or landscape and recognition of the value of maintaining differing interests
T: Climate change (T-CC)	Demonstration that climate change is a relevant but as yet unknown quantity in terms of peatlands
Causes/Explanations	
EX: Landownership (EX-L)	Indication that historic and current land ownership patterns affect the options for peatland management today
EX: Organisational politics (EX-OP)	Indication that organisational politics transcend peatland or area issues and therefore the decisions made
CA: High professional turnover (CA-PT)	Evidence of high professional turnover in the area that makes

Figure 4.1. Examples of First Level and Pattern Codes and their Meaning

4.1.4 Questionnaires

To investigate the Northern European cases the semi-structured questionnaire, with its relatively open questions coupled with some rigidity was considered an appropriate approach. This was because less detailed information was required on the Northern European cases and because a less time and resource consuming method than was used for the English cases was needed. The semi-structured questionnaire minimised the variability in interpretation of requirements and so the data provided from Country to Country, giving greater validity to comparison of results than would have been achieved with an open investigation. Furthermore, the semi-structured questionnaire allowed a better understanding of the Country specific issues to be gained than would have been achieved with a fully structured approach with closed questions and no investigation of opinions or insights.

Two questionnaires were circulated to research partners in Europe. The first was designed as a pilot survey and highlighted several problems with the sites being referred to i.e. they were completely unique in nature for the Country and therefore were not useful in providing general information on the national situation. It also allowed for improvement of the questionnaire structure. The second questionnaire aimed to a) gain an overview of each of the partner countries sites, past and present management, use and functions, and b) to identify whom the stakeholders are, what their interests are and how they interact. Relating specifically to the research questions the investigation hoped to answer. A copy of the second questionnaire can be found in Appendix V.

Given the unfamiliarity of questionnaire respondents (colleagues on the EUROPEAT project and their stakeholder panels) with the framework being applied the presentation of lists and example responses were necessary. Therefore, knowledge gained during the English investigation and examples of early results were used to inform the questionnaires and as example responses. It is thought this more deductive approach affected responses quite significantly and data from partner countries was variable in completeness and quality. Furthermore, given the limited time colleagues had to dedicate to responses it is thought they were often not informed by the views of the stakeholder panel, rather they represented the views of colleagues themselves, as academics in research institutes. In light of these issues, the results from Northern Europe should be viewed as the information available to collaborating researchers rather than agreed stakeholder responses. With this in mind however and with the support of relevant documentation the data can still be used to explore stakeholder interests for European sites and so start to describe the situation across Northern Europe.

4.1.5 Summary

This section has detailed and critiqued the data collection techniques used to inform the stakeholder analysis and by so doing answer research questions 1 and 2, relating to peatland functions uses and stakeholders, for the case study areas. It outlined the inductive approach to the stakeholder analysis and explained in detail how stakeholders were identified, how data was collected and how data was analysed for the English and Northern European case studies. It explained that semi-structured interviews and structured questionnaires were the main techniques for collecting data from the English case study areas and the Northern European areas respectively.

The data collection techniques led to a wealth of rich qualitative data on the case study areas and the stakeholder network that surrounds them, in particular for the English sites. The following section presents the results of this exercise, interpreting the data through appropriate displays and accompanying dialogues.

4.2. Stakeholder Analysis Results

This section presents the results of the stakeholder analysis. It presents in condensed form the messages from the qualitative data collected. It draws on semi-structured interviews and relevant Plans and Strategies in the case of the English case study areas and semi-structured questionnaires and relevant documentation in the case of the Northern European case study areas. It concludes against the research questions 1 and 2.

4.2.1 Stakeholders

By identifying the case specific stakeholders it is possible to develop an understanding of their interests and interactions. This helps in identifying socially relevant peatland functions and associated services, how these are distributed amongst stakeholders and the socio-political context of these conditions.

Stakeholders, as defined for the purposes of this research, were identified first through a systematic sample that was allowed to snowball and then filtered to a manageable number through a screening process, outlined in section 4.1.1. Stakeholders were then categorised using a quick and easy system, based on the **nature** of their interest in the case study areas, to bring order to the analysis in the early stages. This was done with a view to carry out more detailed and complex categorisation once a greater understanding of the stakeholders had been established. The categorisation system at this stage made no assumption about the **degree** of interest. Thus stakeholders were divided into three groups, primary, secondary and tertiary, defined as follows:

- **Primary stakeholders** are those *individuals* who will be directly impacted by changes in peatland management. Their interests will tend to be personal, often including livelihoods, cultural heritage and recreation;
- **Secondary stakeholders** are those *organisations* and *bodies* whose interests will be directly impacted by changes in peatland management. Their interests will be professional and representative of the priorities, duties and targets of the organisation or body. These interests will often include nature conservation, water management and development and transport;
- **Tertiary stakeholders** are those *boards, partnerships, panels* and *committees* that are made up of representatives from the primary and secondary stakeholders, whose interests will be directly impacted by changes in peatland management. Their interests will often be in the area as a whole and tend to

include reconciling the differing interests of primary and secondary stakeholders.

Under this system there were a great many secondary stakeholders. These therefore were categorised further according to organisational status. It was hoped this system would, as well as quickly enabling orientation of the stakeholders for each of the case study areas, allow identification of similarities and differences in value systems of stakeholders at different scales and with different roles.

Tables 4.1 and 4.2 show the stakeholders identified and their categorisation for the Fens and the Somerset Moors retrospectively. The category division is not absolute however. For example *individuals* within the Royal Society for the Protection of Birds (RSPB) may themselves be primary stakeholders in terms of living in the local community and/or working on a nature reserve in the area, and therefore be personally and directly affected by management decisions. However for the purposes of the study it was the *organisational* view that was of interest, and therefore the RSPB is defined as a secondary stakeholder even though their representative interviewee maybe a primary stakeholder. Equally, in the Fens, farm managers who work for a farm *group* run some farms. The farm group may own a substantial amount of land across the area and sometimes across the Country. Here it could be said that the farm manager is representing the views of the group and therefore the farm group is a secondary stakeholder. For the purposes of this study however it is the farm managers viewpoint as an *individual* that is of interest and they are therefore still considered a primary stakeholder. The distinction can then be said to lie in whether the interviewee has been asked to respond to the interview with personal opinion or an organisational perspective.

Table 4.1. List of Stakeholders Divided into their Categories for the Fens

Primary stakeholders (1^{o})	Local residents (R)
	Farmers/Farm Business (F)
Secondary stakeholders (2^{o})	**Statutory Bodies:** English Nature (EN) Environment Agency (EA) Rural Development Service (RDS) English Heritage (EH)
	Conservation Bodies: Wildlife Trust (WT) National Trust (NT) Wildfowl and Wetlands Trust (WWT) Royal Society for the Protection of Birds (RSPB)
	Representative Bodies: District Council (DC) County Council (CC) National Farmers Union (NFU) Countryside Landowners Association (CLA)
Tertiary stakeholders (3^{o})	Internal Drainage Boards (IDBs)
	Wet Fens Partnership (WFP)

Table 4.2. List of Stakeholders Divided into their Categories for the Somerset Moors

Primary stakeholders (1^{o})	Local residents (R)
	Farmers (F)
	Peat Extractors (PE)
Secondary stakeholders (2^{o})	**Statutory Bodies:** English Nature (EN) Environment Agency (EA) Rural Development Service (RDS)
	Conservation Bodies: Wildlife Trust (WT) Royal Society for the Protection of Birds (RSPB)
	Representative Bodies: District council (DC) County council (CC) National Farmers Union (NFU) Countryside Landowners Association (CLA)
	Advisory Bodies: Somerset Food links (SFL) Farming and Wildlife Advisory Service (FWAG)
Tertiary stakeholders (3^{o})	Internal Drainage Boards (IDBs)
	Regional Flood Defence Committee (FDC)
	Levels and Moors Partnership (LAMP)
	Parrett Catchment Project (PCP)

It can be seen that there are more stakeholders in the Somerset Moors than in the Fens region in general. This can be attributed to the greater diversity in land uses in the Somerset Moors than in the Fens and the different agricultural system, which is more compatible with uses such as flood storage and so has led to the use of one piece of land to meet several stakeholders needs, and therefore to the development of partnership groups.

The stakeholder list derived for Northern Europe as a whole, shown in Table 4.3, was compiled from EUROPEAT project partner responses to the questionnaires. They were asked directly who they considered to be peatland stakeholders for their case areas and what their interests were. A definition of 'stakeholder' and examples of stakeholders identified in the English cases were given, but no boundaries as to who should be considered a stakeholder were prescribed. Although agency or organisational names differed across partner countries, roles and responsibilities of dominant stakeholders were well aligned both with each other and with those identified for the English cases. Therefore the list in Table 4.3 is an indication of all the types of peatland stakeholder likely to be found across Northern Europe as a whole rather than a precise account of the specific stakeholders identified in the questionnaire responses. The lack of prescribed boundaries for identifying stakeholders meant stakeholders were identified for the European case study areas that were not considered in the English cases. A fourth category was added then, quaternary stakeholders, being: *individuals*, *groups*, *organisations*, *bodies* and *companies* whose interests will be indirectly affected by changes in the specific case study areas peatland management. For example, Government departments, whose interests bear relevance to the case study areas but who do not deal directly with the case study areas themselves. Rather, locally based agencies interact directly with the case study areas on their behalf. Quaternary stakeholder interests will often be associated with recreation, cognition, business or policy.

Table 4.3. List of Stakeholder Types Divided into their Categories for Northern Europe.

Primary stakeholders (1^o)	Farmers, including tenant, intensive and extensive
	Other landowners
	Local residents
Secondary stakeholders (2^o)	**Statutory Bodies** Regional conservation/environment authorities
	Representative Bodies Regional government Local government Farming representative bodies
	Non-Governmental Bodies Conservation organisations Farming and wildlife advisory bodies Landscape preservation organisations Culture and history organisations
Tertiary stakeholders (3^o)	Water and soil boards
	Farming boards such as the Dutch Dairy Board
Quaternary stakeholders (4^o)	**Recreation** Tourists and visitors including canoeists, hunters and fishermen
	Education and research Scientific community Schools
	National Interests Ministries – environment/agriculture/development/transport/water
	Farming Agri-business including animal feed and machinery Consultants/agents to farmers, including vets

4.2.2 DPSIR Overview

Figure 4.2 shows the DPSIR framework applied to the English case as a whole, giving an interpretation of the current socio-political context of peatlands in England and so generating some idea of the stability of all subsequent results. The Figure is constructed from the coding of the semi-structured interviews and so represents the views of the stakeholders interviewed. Where possible in the accompanying dialogue reference is made to literature that either substantiates or otherwise the stakeholder view. The Figure is constructed from commonly communicated issues only, so issues or themes apparent from the majority of interviews or from one specific stakeholder category, meaning it can be seen as the agreed or dominant stakeholder perspective. It is not a comprehensive discussion of every single policy, funding or other issue raised in the interviews.

Specific codes were developed for the mention of **Drivers,** and some theme codes became apparent as Drivers as analysis progressed (for example Climate Change). **Pressures** were taken from codes associated with peatland functions and use (stakeholder interest codes). Specific codes were developed for any mention of **State** (declining, constant or improving) in relation to peatland functions as well as the peat soil resource. **Impacts** and **Responses** were identified from pattern codes, for example T-DA and T-LS (declining agriculture and landscape scale planning respectively). Applicably coded strands of data (qualitative statements from semi-structured interviews) came predominantly but not exclusively from the middle section of the interviews, i.e. what are your concerns? (indicated pressures/impacts) What are your views on agriculture and other prompts? (indicated current state) How do you see the area going over the next 10 years? (indicated drivers and responses). Any explicit agreement or divergence between the English case and the questionnaire results from European partners is highlighted in boxes in the accompanying dialogue.

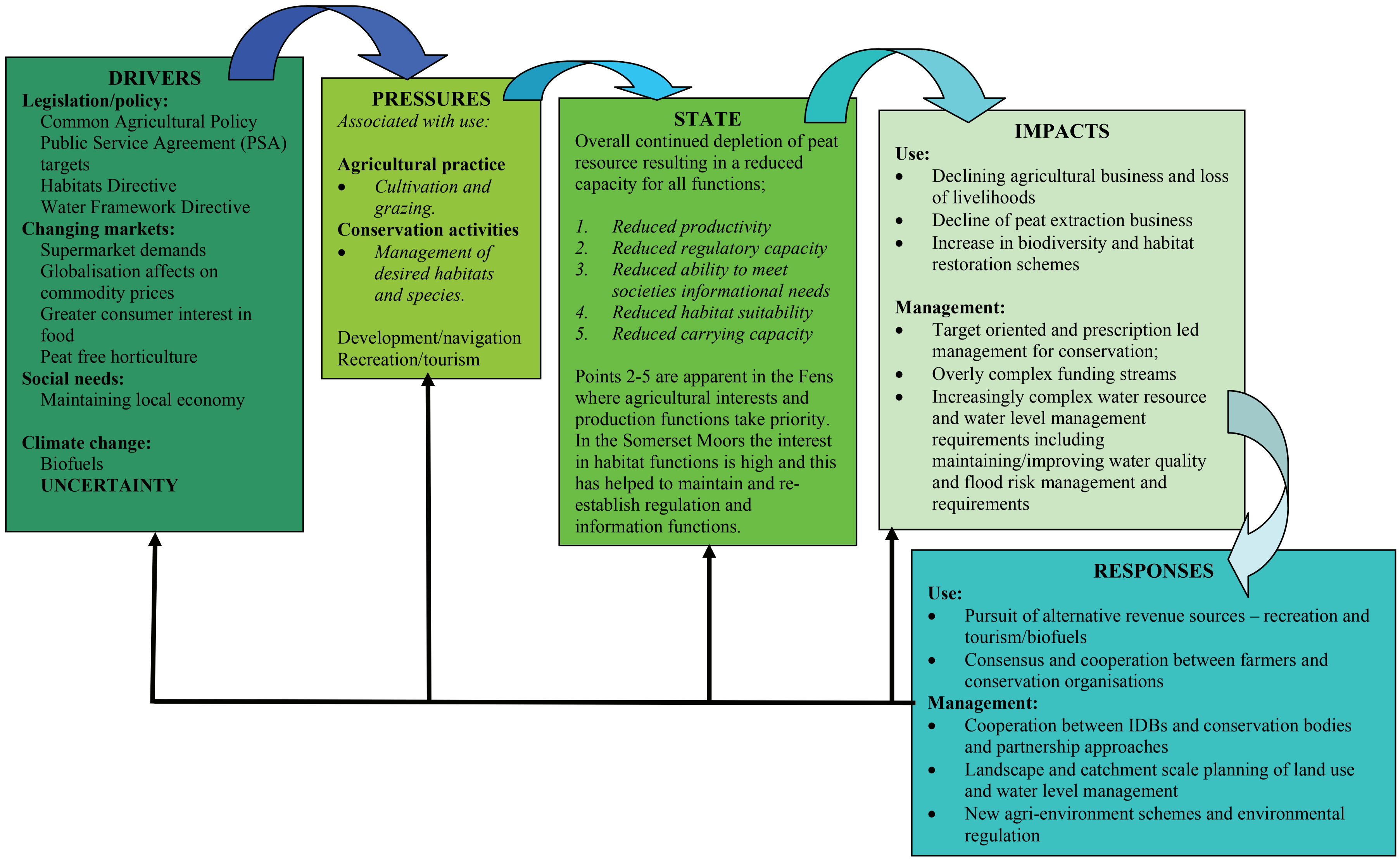


Figure 4.2 Application of the DPSIR Framework to the English Case

Drivers: Policy and legislative **Drivers** shown in Figure 4.2 were agreed at the time of interview (2005) across the Fens and the Somerset Moors but were considered significant for differing reasons and to varying degrees:

1. **CAP Reform.** Decoupling of support from production and the consequent increase and redirection of funding for environmental activities, either through cross compliance or agri-environment schemes (Defra, 2004a).

In the Fens CAP reform is of concern to farmers. In their view it puts greater constraints on what they can and cannot do at a time when margins are already tight. A Fens tenant farmer expressed the consequent mood of farmers in the area in the following way:

'I would like to say yes, I see myself having a future in farming, but just looking at it coldly I don't think I do, and most of the farmers are with me' **Tenant farmer, The Fens.**

At the time of interview, when world wheat prices were low, agri-environment schemes were growing in attractiveness in the area. Farmers felt they could help financially in meeting some of the cross compliance demands, such as field margins and chemical application.

In the Somerset Moors there is great concern within statutory bodies, conservation organisations, advisory bodies and among farmers that the loss of subsidies primarily from the Beef Special Premium and Extensification Payment Schemes will lead to a loss of cattle, affecting both the local economy and the nature conservation interest. Attention in Somerset is on the agri-environment schemes, where competitive payments have in the past been effective in maintaining both farming and the conservation interest. It is hoped that the Higher Level Scheme along with concerted efforts by the NFU and organisations like SFL to create a market for extensive beef will keep cattle on the moors.

2. **Public Service Agreement (PSA) Targets.** 95% of Sites of Special Scientific Interest (SSSIs) across the Country to be in 'favourable' or 'recovering' condition by 2010, helping the Government to meet its obligations under the Habitats Directive (Natural England, 2008).

PSA targets are of greater concern to stakeholders in the Somerset Moors than in the Fens. This is not surprising given that there are 32 SSSIs across the whole of the Somerset Levels and Moors (higher than average) and the Fens has less than 10% of the average land area of SSSIs. In the Somerset Moors a representative of the FDC summed up the enormity of the challenge in the following way:

'*The SSSIs in the Somerset Moors are one of the biggest chunks of land that have to be got into favourable condition by 2010 in the country, we have to get 2 ha per day is our target!! And we haven't done any yet!*' Somerset Moors, FDC

The PSA targets have underpinned agri-environment scheme development in both case study areas according to the RDS representatives and the schemes will be used to deliver on them. Stakeholders agreed that failure to meet the PSA targets would have funding and responsibility implications for the statutory bodies involved (EN, EA and RDS). Consequently the PSA targets were never far from the thoughts of all representatives of statutory bodies during the interview process.

3. **Habitats and Water Framework Directives.** As the forces behind some regularly referred to activities and legislation.

The Habitats and Water Framework Directives appeared, at the time of interview, of less importance to stakeholders in both case study areas than the CAP and PSA targets.

However, for example, the PSA targets were formulated to help achieve obligations under the Habitats Directive and the Directive is also leading to a reassessment of peat extraction permissions in Somerset, while the water Framework Directive is thought by some to be likely to encourage better management in terms of water quality and ecology.

In combination the policy and legislative drivers referred to by the English case study stakeholders show a move toward nature conservation, away from production, thus formalising society's rights to for example wildlife and clean water. This demonstrates a shift in societal preferences.

Northern European responses put greater emphasis on the Birds, Habitat and Water Framework Directives than did the UK. However, key legislative and policy drivers, both EU and national, were still loaded in favour of nature conservation and the CAP was still of fundamental importance to the future of agricultural peatland areas.

Figure 4.2 shows that changing markets is an important driver according to the stakeholders of the Fens and Somerset Moors. This breaks down into several key elements:

1. **Commodity Prices.** Low and decreasing at the time of interview due to global competition. Recently increasing again.

Decreasing commodity prices at the time of interview was thought likely to force farmers down more environmental routes because of the payments available.

2. **Consumer choices.** Consumers spending more 'ethically' with rapid increases in organic and fair trade sales, great interest in 'food miles', and local and seasonal produce (Co-operative, 2007).

Changes in consumer demands are thought by stakeholders to further encourage uptake of environmental payments, especially if people will pay more for the produce.

3. **Supermarket protocols.** Demanding increased environmental stewardship within the farming practice.

Many farmers sell exclusively to supermarkets (more common in the Fens than the Somerset Moors according to respondents). Farmers stated that the introduction of protocols such as within the farm assurance scheme mean they have to invest in environmental management without any extra return, rather just to ensure they have a buyer.

The extraction industry in the Somerset Moors is also suffering from changes in the markets, facing greater environmental demands on the extraction process itself and after use of the sites as well as Government targets for increased use of peat alternatives within the final compost product (Somerset Minerals Plan, 2007-2010).

Northern European responses showed that changing markets and difficulties associated with farming peat soils have led to land abandonment in some Northern European Countries, in particular Germany, and is likely to in others, especially Sweden. Farmers already diversify their incomes and in the Netherlands in particular, as well Germany, Norway and Sweden, are looking to environmental payments and recreation and tourism revenue to maintain their business.

Changing markets were at the time of interview then promoting habitat over production uses. It should be noted however that recent and rapid increases in commodity prices, coupled with the abolishment of ‘set aside’, is giving precedence back to productive uses in some areas. This is currently more notably the Fens than the Somerset Moors.

Another main driver shown in Figure 4.2 is the maintenance of and in the case of the Fens improvement of the local economy.

In the Fens there appear to be two perspectives on improving the local economy. Stakeholders with conservation priorities argue that habitat restoration in some areas and associated low impact livelihoods from carefully managed tourism and traditional crafts will serve to diversify the economy. Stakeholders believe this will help to buffer the economy against future hardships within the agricultural sector. NFU and CLA representatives however argue that conservation projects and the push to different agricultural systems, although only on a small percentage of the entire land area, is undermining the local economy. This is because the existing intensive salad and vegetable production is profitable to farmers and important nationally. This perspective is not really surprising given the NFU and CLA responsibility to represent the interests of their members; intensive Fens farmers.

The Fenland District Council reports that parts of the Fens are some of the most deprived in the country with levels of education being consistently low and access to services being inadequate (Fenland Sustainable Community Strategy, 2007). This suggests that although agriculture is the main constituent of the local economy, with the increase in mechanisation and scale of operations it is no longer actually benefiting the local area and its residents greatly. This is supported by the fact that the majority of labour on the farms in the area is now migrant not local and, according to the farmers, this is not because it is cheaper but because no one in the area wants to do the work.

In the Somerset Moors there is no such apparent conflict between conservation and farming/landowner perspectives. There is agreement that the current agricultural system is vitally important to the local economy and that efforts should be made to maintain it. According to stakeholders there are some on the conservation side who would rather see a semi-natural landscape with basically subsistence activities occurring on it and some on the agriculture side who would still like to be able to grow carrots but the majority are meeting in the middle. The issue in Somerset is maintaining the agriculture that exists when the changing agricultural policy and legislation is making it less and less viable. As the Somerset Moors NFU representative stated:

'All the dice are loaded against people rearing animals at the moment. All the legislation makes it harder and is harder to conform to with livestock – Water Framework Directive, Nitrate Vulnerable Zones, catchment sensitive farming, cross compliance - you get an over enthusiastic officer and they tell you, you mustn't damage the grass by trampling it!' **Somerset Moors, NFU**

In both case study areas the future of the local economy was in the balance at the time of interview and the outcome was heavily dependant on farmer response to CAP reform. Collapse of local economy could inadvertently be good for peat soils if drainage schemes are abandoned but is not considered to be a desirable outcome from a social perspective and therefore not a sustainable or wise solution to the use of peat soils.

The remaining driver in Figure 4.2 is climate change. UKCIP predictions show both areas will suffer increases in temperature, increases in winter precipitation and decreases in summer precipitation, with all of these effects likely to be greater in the Fens. Responses in both regions highlighted the potentially enormous impact of climate change on such low-lying areas. In the Fens though there was a sense of opportunity in terms of biofuel cropping and wind farms where as in Somerset it was felt by most stakeholders that the area would either stay largely the same or it would be inundated by salt or fresh water.

Reduced summer precipitation would make water storage from winter precipitation necessary in the Fens to meet the summer irrigation requirements. This was recognised by stakeholders, in particular farmers. Anglian Water also went on to state that the areas already higher than average water demand would only be exacerbated by Government housing development plans, which have a large centre around

Cambridge. This seriously calls into questions the future of arable farming in the area. In Somerset on the other hand the potential benefits of grazing on peat soils given a more drought inclined climate was highlighted by farmers, remembering drought years in the past when their peat fields were the only ones in the area still with green grass on them. It was thought by the EA that as long as enough water was coming into the system in the winter even under extreme drought conditions the moors would stay wet enough during the summer for the grazing regime because of the qualities of the peat soils.

In the Northern European responses the Netherlands was the only Country that specifically cited climate change as a potential issue because of sea level rise and increased costs of water management. Other Countries instead were more concerned with the effect of peatland degradation on climate change and considered peat soil loss, especially in Norway and Sweden, to be of greater influence on the agricultural future of the areas than potential climate change impacts.

In combination the drivers in both areas favour less intensive peat soil use and the development of a vibrant local economy around this.

Poland was the only Country in the Northern European responses where respondents considered agriculture would intensify over the coming years, most probably because of recent entry into the EU, a previously poor economy and so very extensive (more so than the Somerset Moors) existing agricultural system.

Pressures: The dominant **Pressures,** as shown in Figure 4.2 are associated with use. According to most stakeholder responses, both areas are under pressure from land drainage for production. They are also both under pressure to provide suitable habitats and breeding grounds for nationally and internationally rare species, especially birds. This may at times be good for peat soils but is still a demand on limited land. Furthermore, there is increasing pressure on these areas, more so in the Fens than the Somerset Moors, for development and navigation uses, in terms of housing and associated infrastructure, as well as for tourism and recreation opportunities.

State: The **State** of peat soils, as shown in Figure 4.2 is still declining. At the time of interview, the obvious move towards a more conservation minded management in both areas was not enough to conserve the peat soil resource. Even an extensive grazing regime has been found to suffer peat wastage at a rate of between 0.44 and 0.79 m/100 years and wetter habitat aspirations in both areas are for relatively small percentages of land over a long time frame. Neither area then is halting peat soil degradation completely, nor indeed creating conditions under which peat can again start to form. There was evidence of recognition of this in the interviews but to a greater extent in the Fens where it is perhaps more obvious than in the Somerset Moors, for example:

'a lot of peat is being oxidised, it's going down so there is less and less peat so we have to go to the deeper peats' **Fens Farmer.**

There was universal agreement among Northern European responses that peat wastage would continue for the foreseeable future. There were hopes though that current change in management would lead to a slowing of this loss and potentially in some circumstances to conditions that lead to peat formation.

If the peat resource is being degraded so then is the peatlands capacity for all ecosystem functions. This was evident to a degree from the interviews. Stakeholders referred to the reduced carrying capacities of the peatlands in both areas in the noting of poor road quality and subsidence. Reference to regulation functions was more often than not made only when they were no longer working effectively, for example water quality is now becoming an issue for the EN and EA in both areas as they perceive the systems are no longer able to process the quantities of nutrients entering them. There was evidence in the interviews however that, although depleted, some of the ecosystem functions were recovering from even worse states given more sensitive management of the soils or a switch to a different system, especially in terms of nature conservation. This was more prevalent in the Somerset Moors than in the Fens with local people recognising a notable increase in birds and wild flowers over the past few years as well as nature conservation professionals acknowledging there had been some improvements. This is substantiated to a degree by Breeding Wader surveys and monitoring reports of the ESA scheme.

Impacts: There were, at the time of interview, fears in the Somerset Moors in particular that there will be a wide spread abandonment of agriculture. Agricultural decline, in terms of numbers of farms and profitability of farming, was one of the most commonly referred to themes within the interviews. It was attributed to changing markets and increases in bureaucracy, leading to tighter and tighter financial margins, and to a lack of young people coming into the business. In both areas stakeholders all agreed that sudden and widespread loss of agriculture was not desirable. In the Somerset Moors the issue is compounded by the reliance of the nature conservation interest (simplistically being breeding waders and wintering wildfowl) on a grazing regime. The peat extraction industry is declining in Somerset and according to extractors may in the future be phased out entirely.

Feared decline in agricultural and extraction uses is coupled with an increase in use designed primarily for conservation purposes and an increase in the integration of conservation management with traditional agricultural systems. This can be said to be good for wildlife but may also be partly responsible for the potential collapse of the agricultural economy.

Impacts on peatland management evident from the interviews and presented in Figure 4.2 are three fold:

1. **Increase in target oriented policy.** It was apparent, particularly in the Somerset Moors that the PSA targets are restricting funds and management attention to the SSSI sites.

Particularly in the Somerset Moors stakeholders such as the RSPB, WT and LAMP expressed concerns that the targets prompt narrow site based management regimes and that these regimes may not be in keeping with current local topography.

Furthermore, there was agreement amongst the farming community that the conservation bodies themselves were not clear what they want the sites to deliver. Commonly, it appeared to farmers there was a conflict of interest between encouraging breeding waders and encouraging public access, which they were being asked to do simultaneously.

There was a general feeling, again primarily in Somerset that the targets, because of their legislative nature, are stifling creative solutions to the declining state of the areas (as exemplified below by the Somerset EA with regards to a potential new initiative in the area). In particular stakeholders other than statutory bodies felt the PSA targets allow little opportunity to simplify the water management systems. Rather, with the focus on isolated blocks, they encourage an increasingly complex water management system.

'That designation (Man and Biosphere) would look at core areas, perhaps the designated sites, and then buffer zones around it ... then a working zone around the whole of the levels and moors. It might include the communities, it might bring economic benefit to the area it might bring nature conservation benefit to the area it's just that at present, with our current thinking, we could not be distracted from trying to put in place everything we think needs putting in place to achieve the 2010 deadlines.' **Somerset Moors, EA**

There was no conclusive evidence from the Northern European responses of similarly target-oriented policy in place nationally. There was evidence however, that entire landscapes were protected and that there were local priorities in terms of nature conservation.

2. **Increased complexity of funding streams.** According to farmers there has been a large increase in the requirement for form filling and an overly complex set of rules and regulations developed.

This is the result of attempts in agricultural policy in general to maintain agricultural incomes and integrate conservation management into farming.

'I think anybody that is thinking about agriculture is going to need a qualification, otherwise Mr Tesco is not going to buy off of us.' **Somerset Moors dairy farmer.**

'*It's a bit putting red tape in front of us. We know what to do but it seems people are checking up on us as if they don't trust us; they do put a lot of red tape in front of us. Can't do this, can't do that, supermarket protocols, we understand the reasons, they're our customers and that's what we got to do, so we do it'* **Fens farm manager.**

'This is the reason for everybody not wanting to do it anymore!! (large pile of information, booklets, forms, etc dumped on the table) That is what you have got to sit down and read before you fill in your entry-level stewardship and single farm payment form. You give that to somebody who is 65, they think, well, I can't do that. And I have given all mine to an agent at 150 pounds an hour! If we don't do that properly we lose what bit of money we had been getting.' **Somerset Moors dairy farmer.**

Funding and complex funding streams are also an issue for statutory bodies, especially regarding flood management. Here the issue is the designation of funds to certain budgets, making it difficult to identify what money is available for projects or works that are not strictly flood defence or conservation but are trying to facilitate both. This did not appear in the interviews often but was apparent and may well become a more significant issue into the future.

3. **Increased complexity of hydrological management.** Stakeholders in both areas referred to the increase in water management structures in order to isolate blocks of land with higher water tables.

Stakeholders stressed that a degree of isolation from the main system is necessary to ensure no adverse affect to surrounding land. Their concern is that although this allows better control of the water table on the block in question it takes the system as a whole even further from a natural state. Also, the NT in the Fens reported increasing difficulties in keeping their reserve (Wicken Fen) wet enough. They attributed it to the continued degradation of the peat soils surrounding the reserve and consequent topographic elevation of the site in question. Stakeholders were convinced blocks of raised water levels have produced and maintained fragmented blocks of high biodiversity. However, there was consensus that this approach is not sustainable in the long term. Stakeholders in both areas attributed this growing problem to land ownership patterns and the voluntary nature of most agri-environment schemes.

Responses: Many of the **responses** to the drivers, pressures, state and impacts discussed above are more prevalent and obvious within the Somerset Moors than the Fens.

There are several types of response presented in Figure 4.2:

1. **Pursuit of alternative revenue sources.** In the interviews farmers in the Somerset Moors referred more often to the idea of pursuing alternative forms of revenue than they did in the Fens. This appeared to be synonymous with the agricultural regime.

According to Fens farmers the intensive arable cropping of the Fens requires large field sizes, large machinery and precision irrigation and chemical requirements. It is therefore less compatible with the general public than a low input grazing system because of health and safety implications, time requirements and general interest provided. Furthermore, the arable system, which is most efficient when fields and practises can be homogenised, is less compatible with agri-environment prescriptions than a grazing system that can look ‘scruffy’ and still be productive. In general it was apparent that farmers and peat extractors, especially in the Somerset Moors felt they had to start thinking differently about their business. This may have changed recently however with concerns over food security and high commodity prices.

2. **Increased cooperation between farmers and conservation organisations.** Reflective of the above acknowledgement by farmers a developing culture of cooperation between farmers and conservation organisations was apparent in both case study areas.

In the Somerset Moors environmentally sympathetic farmers are recruited by the EN to help them communicate with less sympathetic farmers. In the Fens there was evidence of farmers working with organisations such as the RSPB by letting them survey their land and at times advise them.

3. **Increased incidence of partnership working and cooperation.** With regard to higher-level management of the case study areas (that is management of the system as a whole) there was evidence of increased incidences of partnership approaches in general and cooperation between various organisations with differing roles.

This was notable between the IDBs and conservation bodies, in particular EN. In the Somerset Moors EN have appointed an ecologist to work within the IDBs to help them understand and meet environmental obligations. In the Fens no such initiative was apparent but the IDBs had been working with organisations such as the NT and WT on proposals for larger scale habitat projects and acknowledged that into the future they will have to pay greater attention to environmental legislation and policy.

Most Northern European responses gave account of some form of partnership working and increased interaction between farmers and higher-level management bodies and conservation bodies.

4. **Landscape and catchment scale planning and management.** In order to reduce the complexity of the hydrological systems and to buffer fragmented and so

vulnerable areas of habitat, secondary and tertiary stakeholders in both areas are interested in landscape scale projects and whole moor water management.

The emphasis is slightly different in the two areas. In the Fens, in order to protect existing biodiversity rich sites a major change is required in the surrounding land use. Faced with the limited likelihood of farmers converting from intensive arable to a land use more sympathetic to conservation interests, conservation bodies in the Fens seek to buy up large tracts of land. By so doing they aim to join together key sites and create new habitats in between, for example the Great Fen Project and Wicken Vision Project. In the Somerset Moors the emphasis is on creating whole-moor water level agreements with existing landowners via the new agri-environment schemes. Both approaches have their problems. In the Fens, unless they want to pay a premium for the land (which they were clear they did not and would not) then conservation bodies have to wait until landowners want to sell. This may not be until production starts to decline and so the peat soils are nearly gone. They also have to find the funding when landowners are ready to sell, and should they manage this then have to fund the ongoing management of these large areas once they have bought them. In the Somerset Moors they have to persuade all landowners on a moor-by-moor basis to accept the proposed water level plans. This, according to the IDB, EN, EA and RSPB, will almost certainly involve financial persuasion and at times potentially even compulsory purchase of land. But both approaches hope to achieve similar outcomes:

- Safeguarding and improving priority conservation sites
- Returning to a simpler and so cheaper water management system
- Creation of new habitats on the basis of the topography as opposed to the ‘gardening’ approach of the past
- Creation of potential flood storage areas
- Creation of tourism and recreation opportunities

The success of both approaches is dependant on the response of current private landowners. This has, in the Somerset Moors at least, prompted some stakeholders to start considering alternative land ownership arrangements, for example:

'There could be potential for say community trusts or partnerships to acquire land, and I mean acquire in the broadest sense, doesn't necessarily mean buying it' **RSPB West Sedgemoor SSSI nature reserve, Somerset Moors**

'(I'm one of those people who) would really like to see at least parts of the Levels go back more to a common moor system that they had before the enclosures' **WT, Somerset Moors**

'In some areas we've actually got to change the way in which the ownership is thought about. If you think that two hundred years ago the majority of that was common land. In some areas we need to go back and say well OK let's think about finding a way of putting that ownership back into some form of public or community ownership and you have grazing rights.' **LAMP, Somerset Moors**

But all acknowledged it might not be practical over the entire Somerset Moors system, rather on smaller parts of it.

There was evidence from most Northern European Responses that landscape scale management was already practised successfully. Furthermore, from Sweden and Norway there was also evidence of cooperatively managed systems whereby for example, decisions regarding water management were taken by all land owners collectively or harvesting, processing and marketing produce was a communal activity.

5. **New agri-environment schemes.** The agri-environment schemes (Entry Level Scheme – ELS and Higher Level Scheme - HLS) launched by RDS at the time of

interview (2005) may well go some way to helping both areas improve the overall state of the system.

During the interviews potential users and the designers of the schemes (notably farmers and RDS) appeared confident they address problems with previous schemes. Old schemes, and the ESA scheme in particular were criticised for being overly prescriptive and inflexible. This rigidity meant agreements could not adapt to annual climatic changes i.e. whether it was a wet or a dry year, or any other variable circumstances such as which fields birds were actually in. Furthermore, the ELS addresses issues of equity with regards who qualifies for payments. Previous schemes had only offered payment to *new* or *extra* activities, excluding for qualification those farmers who had never overly intensified their land. The ELS however, offers payments to farmers who are already operating with some environmental conscience. All those interviewees who had seen the scheme were positive about what it could achieve in terms of multi-functional use of sites and were pleased with the payment levels. What is more, in reference to peatlands specifically, the HLS schemes have a new secondary objective of resource protection which is currently being viewed as a means of protecting or improving water quality and sedimentation but that has the potential to be expanded to include peat soil protection measures.

Summary: To summarise, it is clear from the DPSIR analysis that at the time of interview the trend was away from production and towards conservation uses. This was occurring to greater and lesser extremes in the two case study areas. At the time of interview there were no signs that the drivers would cause a widespread cessation of peat soil degradation. However, it was evident the policy and economic climate was set to at least to slow the peat degradation process and in some specific sites had already improved conditions. At the time of interview the main stakeholder concern in both areas was the sudden collapse of the agricultural economy and the negative impacts this would have on social well-being. Concerted efforts were being made to try and prevent this from happening. A move towards landscape or moor based planning of water levels and habitats in both areas was apparent, as was a substantial increase in partnership approaches and cooperative action. Very recent changes in global markets and increases in commodity prices however are likely to stall and possibly reverse the trend in land use found at the time of interview. Informal conversations with stakeholders in both areas since this change suggest the effects will be more pronounced in the Fens. In the Somerset Moors uncertainties surrounding the EAs approach to flood management, the high number of designated sites, high fuel costs and lack of funding for drainage schemes is hoped by stakeholders to make it unlikely there will be large scale conversion to arable cropping. It may mean however that, for the time being, landowners are reluctant to enter into high water level agreements. In the Fens, with the abolishment of set aside stakeholders are already noticing fields being ploughed that have been fallow for a great many years and conservation bodies involved in large scale projects are expecting a slow down in land acquisition for the foreseeable future.

It seems then that in both areas private landowner interests still manage to supersede the interests of the area as a whole when push comes to shove and there is money to be made. This makes the use of peatlands, the services provided and the associated stakeholder interests dependent on a fluctuating and at times unpredictable market system. It is possible that soil longevity, climate change impacts and external factors such as development pressures will ultimately determine how long the intensive cropping can persist in the Fens, rather than stakeholder preferences. In the Somerset Moors even within SSSIs, ownership is a key determinant of what can be achieved. Despite large investment of public money in these sites, their management for conservation still tends to be based on short-term, voluntary, management agreements. Substantial change in the Somerset Moors then may only come about if there is funding for land swaps, changes in approach to land drainage and flood management, and perhaps, in the longer-term, might be forced by climate change.

Norway and Sweden

Both case study areas appeared to be located on bedrock, therefore soil loss was fundamental to continued agricultural productivity. Abandonment of land in the case study areas appeared likely in the foreseeable future.

Netherlands
Responses indicated that this case study area would follow a similar pattern to the UK with a greater interaction between agriculture and conservation and a diversification of farm incomes but an overall slightly less intensive continuation of the present agricultural system.

Germany
This nature conservation project area was recreating a highly extensive grazing regime on abandoned land. It was experimental in nature and responses indicated an uncertainty regarding its long-term future, indicating that it is likely to follow policy, which at present is generating funding for habitat restoration.

Poland
The Polish case study area was a National Park and was therefore a unique peatland area, already important in terms of cultural history, art and nature conservation. This 'living landscape' will, according to the responses potentially increase in agricultural value as agriculture gradually intensifies, ensuring continued livelihoods and food security but marginalizing conservation interests. As the stock of peat soils declines however responses indicated this trend would once again reverse.

It is worth noting that it appears peat loss or degradation itself is not a prominent issue for peatland stakeholders. It is all the associated features (ecosystem services) that are of importance. As an RSPB representative in the Fens, summarised for their organisation:

'you could look at wetlands as a way to safeguard peat… but not all of the wetland creation aspirations we have in the organisation nationally will be delivered on peat…the term peatland probably in a way means very little to us' **The Fens, RSPB**

Reference specifically to peat loss or degradation was much more prevalent in Northern European responses than in the UK. However, it is possible that this is due to the questionnaires being completed by academic partners with an interest in peat soils rather than because peat degradation itself is of greater importance to stakeholders on the continent than those in the UK.

4.2.3 Stakeholder Interests and Relevant Functions

By identifying the stakeholder interests in the case study areas it is possible to develop a list of the currently socially relevant peatland functions and associated services.

Tables 4.4 and 4.5 show the primary interests stakeholders have in the Fens and the Somerset Moors retrospectively. That is issues of relevance to stakeholders associated with use of the areas. Primary was taken to mean the main use/interest i.e. those features of peatlands that form organisational or individual priorities or objectives, central to well-being. For example a farmer's priority may well be income for livelihood; therefore livelihood was taken as the primary interest. The secondary interests of stakeholders were also determined but are not presented in this thesis; rather they are referred to as and when necessary. Secondary was taken to mean useful or important asides i.e. those features of peatlands that organisations or individuals are some policy/view on them. These issues are often complimentary with or a threat to the primary interests. For example, a conservation organisation maybe interested in recreational opportunities when this is compatible with their priority (likely to be nature conservation); recreation was therefore taken as a secondary interest.

Secondary interests are largely issues that:

- Affect primary interests either in a positive or negative way, for example water table management;
- Are features of primary interests, for example large scale habitat creation lends itself to increased recreation opportunities;
- Are not urgent enough to be a priority yet and may not be adequately accounted for in current policy, for example climate regulation, or the release of climate change gases from peatlands.

Primary interests were identified from the first part of the semi-structured interviews, before any prompting on specific issues occurred. Often they were immediately evident in the response to the first question – *what is your interest in the area?* And then backed up by the answer to the final question – *what does the term peatland mean to you?*

Secondary interests were identified as those interests mentioned in addition to the primary interests, including discussion around the prompts. Only <u>active</u> statements were coded i.e. those where the respondent expressed a clear opinion, either in a positive or negative way, to an issue. For example a response such as – *that is an issue in the area but not really our area of expertise* was not coded.

Identified interests are categorised according to the ecosystem services framework using 5 function groups:

- **Production functions** – *the capacity to provide resources i.e. water, food, raw materials, energy*

- **Regulation functions** – *the capacity to regulate essential ecological processes and life support systems i.e. regulating climatic, water, soil, ecological, and genetic conditions*

- **Carrier functions** – *the capacity to provide space and a suitable subsoil for i.e. habitation and navigation*

- **Habitat functions –** *the capacity to provide unique habitat for plants and animals, helping with the conservation of genetic, species and ecosystem diversity*

- **Information or cultural functions** – *the capacity to contribute to human mental well-being or happiness through e.g. spiritual experiences, aesthetic pleasure, cognition and recreation*

In addition to these core categories a 'Livelihood' and 'No Fit' category was utilised.

Provision of livelihoods is currently associated with the production functions (agricultural and extractive uses) but is thought to be significant enough in the case of peatlands to be treated as a sub category of the production functions. That is, stakeholders may value the provision of livelihoods independently of how the livelihoods are made. In this case livelihoods need not necessarily remain associated with production functions into the future but will still be of importance in their own right. Therefore categorising all references to incomes and businesses solely under the production functions was felt to be potentially misleading in describing the situation. The 'Livelihood' category then exists in this work as a sub category to the production functions and as such is always presented in conjunction with the production functions.

The 'No Fit' category is used for those interests or uses that are relevant to the peatland area but are not necessarily directly associated with peatland management. For example, in the case of local residents, primary interests often relate to the character of the case study areas and so refer to the community structure and 'feel' of the areas, rather than specifically to the peatlands themselves. That is, the character of the area would remain largely similar irrespective of soil type and it relates to factors beyond the ecosystem services framework such as community structure in terms of age and socio-economic background. The 'No Fit' category then is used for all interests found to be relevant to the research but not directly attributable to peatland management and the ecosystem services provided by peatlands.

The following colour coding system for the function categories and sub categories is used throughout the remainder of this thesis to help clarify the presentation and interpretation of results.

Production	***Livelihood***	**Regulation**	**Carrier**	**Habitat**	**Information**	**No Fit**

Table 4.4. Stakeholders and Priority Interests in the Fens

Stakeholder		Priority Interest		Related ecosystem processes and components giving rise to services	Function Group
1^o	R	No Fit	Enjoying the sense that it is home and engaging with the community		
		Recreation	Bird watching, walking	Variety in landscapes and natural features with potential recreational uses	Information
		Cultural Heritage	Learning about and communicating the local history and draining of the Fens	Variety in natural features with cultural and historic value	Information
		Landscape	Enjoying the flat, open spaces and big skies	Attractive landscape features	Information
		Livelihood	Earning a personal livelihood and protecting the livelihood of others, especially farmers	Any if value can be realised in an income – here it is largely conversion of solar energy into edible plants and animals	Production (livelihood)
	F	Livelihood	Running a profitable business	Any if value can be realised in an income – here it is largely conversion of solar energy into edible plants and animals	Production (livelihood)
		Agriculture	Carrying out arable agricultural production	Conversion of solar energy into edible plants and animals	Production
2^o: Statutory Bodies	EN	General Conservation	Maintaining/enhancing biodiversity and improving general habitat	Suitable living space for wild plants and animals	Habitat
		Habitat	Maintaining/ enhancing specific wetland habitats and designated sites	Suitable living space for wild plants and animals	Habitat
		Rare Species	Conserving rare species	Suitable reproduction habitat	Habitat
	EA	General Conservation	Maintaining/enhancing biodiversity and fisheries	Suitable living space for wild plants and animals and suitable reproduction habitat	Habitat
		Habitat	Helping to deliver improved wetland habitat and designated sites	Suitable living space for wild plants and animals	Habitat
		Recreation	Maintaining the fisheries	Variety in landscapes and natural features with potential recreational uses	Information
		Water Quality	Maintaining/enhancing water quality, specifically nitrates and phosphates	Role of vegetation and biota in removal or breakdown of xenic nutrients and compounds	Regulation
		Water Resources	Balancing differing needs for abstraction and levels within the system	Filtering, retention and storage of freshwater	Regulation
	RDS	General Conservation	Funding land owners to maintain/enhance biodiversity and improve general habitat	Suitable living space for wild plants and animals	Habitat
		Habitat	Funding land owners to maintain/ enhance specific wetland habitats and designated sites	Suitable living space for wild plants and animals	Habitat
		Rare Species	Funding land owners to preserve rare species particularly farmland birds and bats	Suitable living space for wild plants and animals and suitable reproduction habitat	Habitat
		Cultural Heritage	Funding land owners to maintain/enhance archaeology	Variety in natural features with archaeological value	Information
		Landscape	Funding land owners to preserve the landscape	Attractive landscape features	Information
		Recreation	Funding land owners to promote public access to the countryside	Variety in landscapes and natural features with potential recreational uses	Information

		Livelihood	Protecting rural livelihoods through grants for business diversification and expansion	Any if value can be realised in an income – here it is largely conversion of solar energy into edible plants and animals	Production (livelihood)
	EH	Cultural Heritage	Preserving and recording archaeological information in organic remains, palaoenvironmental archives and prehistoric and historic settlement remains, all found within peat	Variety in natural features with archaeological value	Information
2^o: Conservation Bodies	**WT**	General Conservation	Maintaining/enhancing existing general wetland habitats, wildlife and designated interest as well as creating new wetlands	Suitable living space for wild plants and animals	Habitat
	NT	General Conservation	Maintaining/enhancing existing general wetland habitats and designated interest wildlife as well as creating new wetlands	Suitable living space for wild plants and animals	Habitat
		Habitat	Protecting and buffering rare remnant habitats and creating new wetland habitat	Suitable living space for wild plants and animals	Habitat
	WWT	General Conservation	Maintaining/enhancing designated sites	Suitable living space for wild plants and animals and suitable reproduction habitat	Habitat
		Rare Species	Protecting rare species, in particular breeding waders and over wintering wildfowl	Suitable living space for wild plants and animals and suitable reproduction habitat	Habitat
	RSPB	General Conservation	Maintaining/enhancing designated sites and important bird populations wetland habitat and specifically protecting rare species, particularly birds	Suitable living space for wild plants and animals and suitable reproduction habitat	Habitat
		Habitat	Maintaining and creating specific wetland habitat for specific bird species	Suitable living space for wild plants and animals and suitable reproduction habitat	Habitat
		Rare Species	Protecting and encouraging rare species in particular breeding waders and over wintering waterfowl	Suitable living space for wild plants and animals and suitable reproduction habitat	Habitat
2^o: Representative Bodies	**DC**	Cultural Heritage	Understanding and communicating local history	Variety in natural features with cultural and historic value	Information
		Landscape	Maintaining the unique landscape of open views and large skies	Attractive landscape features	Information
		Development	Providing for existing settlements and planning new ones	Providing suitable substrate for human infrastructure	Carrier
		Agriculture	Maintaining the economy of the area, based largely on the high grade agricultural land	Any if value can be realised in an income – here it is largely conversion of solar energy into edible plants and animals	Production (because economy)
		General Conservation	Maintaining and enhancing the general wildlife interest in the area	Suitable living space for wild plants and animals	Habitat
		Rare Species	Protecting rare species	Suitable living space for wild plants and animals and suitable reproduction habitat	Habitat
		No Fit	Maintaining the 'special' character of the area and developing a community identity		
	CC	Navigation	Maintaining and improving the rights of way network in the area	Providing suitable substrate for human infrastructure	Carrier
	NFU	Agriculture	Maintaining viable agriculture and defending its interests	Conversion of solar energy into edible plants and animals	Production
		Livelihood	Maintaining members livelihoods by defending their interests	Any if value can be realised in an income – here it is largely conversion of solar energy into edible plants and animals	Production (livelihood)

	CLA	Livelihood	Maintaining members livelihoods by defending their interests	Any if value can be realised in an income – here it is largely conversion of solar energy into edible plants and animals	Production (livelihood)
		Agriculture	Maintaining viable agriculture and defending its interests as it is a dominant livelihood	Conversion of solar energy into edible plants and animals	Production
3°	**IDBs**	Water Table	Managing and balancing differing the water levels within the system	Filtering, retention and storage of freshwater	Regulation
	WFP	General Conservation	Maintaining/enhancing designated sites and general wildlife interest	Suitable living space for wild plants and animals	Habitat
		Habitat	Creating new specific wetland habitats	Suitable living space for wild plants and animals	Habitat
		Rare Species	Protecting and encouraging rare species in particular breeding waders and over wintering waterfowl	Suitable living space for wild plants and animals and suitable reproduction habitat	Habitat

Table 4.5. Stakeholders and Priority Interests in the Somerset Moors

Stakeholder		Priority Interest		Related ecosystem processes and components	Function Group
1^{o}	R	No Fit	Enjoying that it is home, it is rural and quiet and the sense of community		
		Recreation	Walking, dog walking, cycling, bird watching, enjoying flora	Variety in landscapes and natural features with potential recreational uses	Information
		Landscape	Enjoying the open landscape surrounded by hills, the seasonality and the skies	Attractive landscape features	Information
		Extraction	Peatland to local people means the extraction areas	Conversion of solar energy into biomass for human construction and other uses	Production
	F	Livelihood	Running a profitable business	Any if value can be realised in an income – here it is largely conversion of solar energy into edible plants and animals	Production (livelihood)
		Water Table	Arranging suitable water levels	Filtering, retention and storage of freshwater	Regulation
		Landscape	Enjoying and maintaining the open, agricultural and unique landscape	Attractive landscape features	Information
		Agriculture	Carrying out extensive livestock grazing or dairying	Conversion of solar energy into edible plants and animals	Production
		General Conservation	Enjoying and maintaining/enhancing the local wildlife	Suitable living space for wild plants and animals and suitable reproduction habitat	Habitat
	PE	Extraction	Extracting peat for sale to the horticultural industry	Conversion of solar energy into biomass for human construction and other uses	Production
		Livelihood	Running a profitable business	Any if value can be realised in an income – here it is largely conversion of solar energy into biomass for human construction and other uses	Livelihood
2^{o}: Statutory Bodies	EN	General Conservation	Maintaining/enhancing biodiversity and improving general habitat	Suitable living space for wild plants and animals	Habitat
		Habitat	Maintaining/ enhancing specific wetland habitats and designated sites	Suitable living space for wild plants and animals	Habitat
		Rare Species	Conserving rare species	Suitable living space for wild plants and animals and suitable reproduction habitat	Habitat
		Extraction	Monitoring extraction and new permissions as well as helping and advising on restoring extraction areas to conservation after use	Conversion of solar energy into biomass for human construction and other uses	Production
	EA	General Conservation	Maintaining and enhancing biodiversity in the area	Suitable living space for wild plants and animals	Habitat
		Habitats	Maintaining and enhancing designated sites	Suitable living space for wild plants and animals	Habitat
		Recreation	Maintaining the fisheries	Variety in landscapes and natural features with potential recreational uses	Information
		Water Resources	Managing and maintaining the main river water courses and regulating abstraction	Filtering, retention and storage of freshwater	Regulation
		Water Table	Regulating levels in the main rivers and designated sites	Filtering, retention and storage of freshwater	Regulation

		Water Quality	Regulating discharge into main rivers	Role of vegetation and biota in removal or breakdown of xenic nutrients and compounds	Regulation
	RDS	General Conservation	Funding landowners to maintain and enhance local biodiversity	Suitable living space for wild plants and animals	Habitat
		Cultural Heritage	Funding landowners to protect the historical landscape	Variety in natural features with cultural and historic value	Information
		Landscape	Funding landowners to maintain the landscape character i.e. open wetland	Attractive landscape features	Information
		Recreation	Funding landowners to improve pubic access to the countryside	Variety in landscapes and natural features with potential recreational uses	Information
		Water Quality	Funding landowners to carry out measure that will improve water quality	Role of vegetation and biota in removal or breakdown of xenic nutrients and compounds	Regulation
		Soil Condition	Funding land owners to adopt management practices that minimise soil erosion	Role of vegetation root matrix and soil biota in soil retention	Regulation
		Livelihood	Protecting rural livelihoods through grants for business diversification and expansion	Any if value can be realised in an income – here it is largely conversion of solar energy into edible plants and animals	Production (livelihood)
2^o: Conservation Bodies	**WT**	General Conservation	Maintaining and enhancing local biodiversity	Suitable living space for wild plants and animals	Habitat
		Habitat	Protecting and enhancing remnant habitats and developing new wetland habitat	Suitable living space for wild plants and animals	Habitat
	RSPB	General Conservation	Maintaining and enhancing local biodiversity	Suitable living space for wild plants and animals	Habitat
		Habitat	Maintaining and enhancing existing wetland habitats including designated sites as well as creating new ones	Suitable living space for wild plants and animals and suitable reproduction habitat	Habitat
		Rare Species	Protecting and enhancing rare species in the area, in particular breeding waders and over wintering water fowl	Suitable living space for wild plants and animals and suitable reproduction habitat	Habitat
2^o: Representative Bodies	**DC**	Navigation	Improving services for local communities in particular public transport	Providing suitable substrate for human infrastructure	Carrier
		No Fit	Maintaining, supporting and cultivating the special sense of community the area has		
		General Conservation	Promoting and maintaining the special wildlife interests in the area	Suitable living space for wild plants and animals	Habitat
	CC	Cultural Heritage	Preserving and recording archaeological information in organic remains, palaoenvironmental archives and historical landscape, all found within peat	Variety in natural features with archaeological value	Information
		Navigation	Maintaining and improving rights of way and access to the countryside	Providing suitable substrate for human infrastructure	Carrier
		Extraction	Planning., authorising and monitoring extraction of peat for sale to the horticultural industry	Conversion of solar energy into biomass for human construction and other uses	Production
	NFU	Agriculture	Promoting productive agriculture as a benefit in the area and defending its interests	Conversion of solar energy into edible plants and animals	Production
		Livelihood	Protecting and improving the livelihoods of farmers by promoting agriculture	Any if value can be realised in an income – here it is largely conversion of solar energy into edible plants and animals	Livelihood

	CLA	Livelihood	Maintaining and improving the livelihoods of its members by protecting their interests and lobbying on their behalf	Any if value can be realised in an income – here it is largely conversion of solar energy into edible plants and animals	Livelihood
		Agriculture	Promoting the interests of agricultural businesses in debate in order to protect the livelihoods of its members	Conversion of solar energy into edible plants and animals	Production
2^{o}: Advisory Bodies	**SFL**	Livelihood	Maintaining and improving rural livelihoods, specifically agricultural incomes	Any if value can be realised in an income – here it is largely conversion of solar energy into edible plants and animals	Livelihood
		Agriculture	Maintaining the agricultural system by adding value to the extensive agricultural products of the area	Conversion of solar energy into edible plants and animals	Production
	FWAG	General Conservation	Advising farmers on management and funding for maintaining and enhancing local biodiversity	Suitable living space for wild plants and animals	Habitat
		Habitat	Advising farmers on management and funding for maintaining and enhancing wetland habitat including designated sites	Suitable living space for wild plants and animals and suitable reproduction habitat	Habitat
3^{o}	**IDBs**	Water Table	Managing and balancing the differing water levels within the system	Filtering, retention and storage of freshwater	Regulation
		General Conservation	Delivering water levels that maintain and enhance specific wildlife interests within the area	Suitable living space for wild plants and animals	Habitat
		Habitat	Delivering water levels that maintain and enhance differing wetland habitats including designated sites	Suitable living space for wild plants and animals and suitable reproduction habitat	Habitat
		Rare Species	Delivering water levels that favour rare species such as breeding waders, over wintering waterfowl and ditch flora and fauna	Suitable living space for wild plants and animals and suitable reproduction habitat	Habitat
	LAMP	No Fit	Engaging local communities in debate about the management and future of the area they live in		
	PCP	Flood Storage	Encouraging catchment scale solutions to the flooding problems	Role of land cover in regulating runoff and river discharge and influence of ecosystem structure on dampening environmental disturbances	Regulation
	FDC	Flood Storage	Directing the flood defence spending for the region	Role of land cover in regulating runoff and river discharge and influence of ecosystem structure on dampening environmental disturbances	Regulation

Tables 4.4 and 4.5 in combination provide a complete list of the ecosystem functions and associated services found in this research to be of priority to the stakeholders of the Fens and the Somerset Moors peatland areas. They also show how these are distributed amongst stakeholders. It is clear that a great diversity of peatland functions are of importance to stakeholders. From the refugium function through to the substrative function, peatlands are providing services of value to stakeholders. These functions may be of importance for differing reasons to differing stakeholders. Primary stakeholders, particularly those with a high degree of influence such as landowning farmers, tend to draw direct benefit from the functions significant to them. For example primary stakeholders were found to prioritise derivation of livelihoods through the production functions. Where as secondary and tertiary stakeholders tend to be interested in functions that are failing or are vulnerable and need rehabilitation or protection, such as flood water storage and wildlife conservation. With the latter indicating benefits streams that are being lost because they have been 'under-valued' in the past. This indicates difference in entitlement between the categories, especially related to land ownership and associated levels of stakeholder influence. In addition, as it is known many of the interests are not compatible, this indicates there are likely to be tensions between stakeholders based on their differing interests, levels of entitlement and degree of influence.

Tables 4.4 and 4.5 show stakeholder priority interests are diverse, with the habitat, production (including livelihood), regulation and information functions dominating in both the Fens and the Somerset Moors. Regulation and information functions were found to dominate as secondary interests. This is particularly prevalent for secondary stakeholders.

A high interest in habitat functions is perhaps not surprising given the environmental drivers currently operating. As discussed in detail in the previous section, governmental targets, high level policy and climate change are all forcing environmental concerns up the agenda of most stakeholders. Furthermore habitat and species conservation have long since been the priority of many non-governmental organisations given their previous lack of representation in formal policy and economic systems. The interest in habitat functions however can be organisationally specific and not always compatible. For example, the RSPB prioritises birds in its conservation work, specifically in terms of peatlands breeding waders and over-wintering wildfowl, whereas the Wildlife Trust has a greater habitat focus, being remaining fen fragments in the Fens and remaining raised bog fragments in the Somerset Moors. The ecological conditions required for breeding snipe and breeding lapwing are in themselves quite different, and the general conditions required for breeding waders and the maintenance of pristine habitat are different again. All this means that despite apparent agreement that habitat functions need to be protected and enhanced interpreting this across an entire peatland system and meeting the needs of all stakeholders is still an extremely complex task.

Production functions are of interest to those stakeholders trying to make a living from the peatlands, representative stakeholders, and those stakeholders who rely on the agricultural system for some other benefit such as landscape quality, character of the area or conservation interest.

Regulation functions are of interest as areas of required intervention. For example flood storage is an issue because the natural hydrological regulation functions of the peatlands have been lost through agricultural drainage and rural development. Water quality is of interest because, according to stakeholders (EN and EA) the water quality in both areas is declining. It is worth remembering that all case study areas, including Northern European, are land management systems modified by human intervention, especially drainage activities. This means that the natural regulation functions of the peatlands are inevitably affected and typically depleted by human activity, often requiring remedial measures such as structural flood defence and soil conservation. Only returning to a natural regime tautology, which is unlikely in most case study areas that include human settlements, can reinstate the systems' natural regulation functions. The reality of the situation is that the land use in both areas is for the most part incompatible with the natural peatland ecosystem. The growing interest in habitat, information and regulation functions however, evident in the tables presented here, may well be an indication that tensions exist between primary and secondary stakeholder interests and values. This could potentially prompt a change in human intervention (evident already in the DPSIR analysis). The challenge becomes achieving a more natural system without compromising primary stakeholder needs, which in both areas are clearly and inextricably linked with the production and information functions performed by the current land use regime. For example, information functions can be protected by a more natural regime but local residents like what is currently there in terms of landscape and nature, created by the current agricultural systems. Also, livelihoods are currently linked to productive agriculture, where even the extensive system of the Somerset Moors has to deliver a viable product. This makes changes in management to more natural regimes currently unacceptable to primary stakeholders, further indicating likely tensions between primary and secondary stakeholders.

Of particular note in terms of regulation functions is the relative unimportance of the influence of land cover and biologically mediated processes on climate function that leads to maintenance of a favourable climate for human habitation i.e. the potential impact of peat degradation on green house gas emissions and therefore global climate change. Those actively involved with the management of both case study area peatlands seem thus far to not be aware of or not interested in this function. Given the growing concern about climate change however, it is extremely relevant on a societal level. This oversight could be attributable to a predisposition for serving private needs ahead of societal, a prioritisation of short-term gain over long-term well-being or a lack of awareness about the significance of the function to society at large. The role of peatlands in climate regulation also has great potential to be used as a tool or incentive for wetter water regimes and therefore is likely to become of interest to those stakeholders whose agenda this helps to promote.

Information functions are largely compatible with conservation interests and so habitat functions, for example beautiful landscapes are often associated with naturalness and biodiversity, archaeological preservation is served better with higher water tables and much of the cognitive interest in peatlands is currently focused around soil longevity and habitat restoration. Information functions are being highlighted as secondary benefits to conservation management, especially recreation and tourism, particularly among those stakeholders for whom conservation is a main priority.

There is little difference in the type of stakeholder interests between the Fens and the Somerset Moors, allowing the development of generalisations about stakeholder interests in peatlands. **Primary** stakeholders, those who will be affected personally and directly by changes in management, are most interested in the information and production functions (including livelihood) as well as 'no fit' features. **Statutory bodies** are most interested in habitat, regulation and information functions (particularly designated sites, water management and public access). **Conservation organisations** are almost exclusively concerned with habitat functions (but, as explained earlier, for different reasons). **Representative bodies** are interested in a mix of production functions (including livelihood), carrier functions (navigation and development), no fit features and to a lesser degree information functions. **Advisory bodies** are concerned most with production functions (because of livelihoods) and habitat functions. **Tertiary** stakeholder interest is split between regulation and habitat functions in the Fens and more dominated by regulation functions in the Somerset Moors, reflective of the greater issues surrounding loss of biodiversity and flooding in the areas respectively.

Importantly, Table 4.5 shows that few stakeholders prioritise just one peatland function. This indicates a widespread preference, particularly among secondary stakeholders, for multi-functional land uses.

Table 4.6 shows the primary interests of stakeholders across Northern Europe based on the questionnaire survey. The dominance of regulation functions is not compatible with the results from the English case studies, mainly reflecting a bias in the responses from participants in the survey. As project partners predominantly completed the questionnaires, rather than their stakeholder panels, the results indicate what the research community sees as important issues in terms of peatland management. This confirms a view that most regulation functions are of interest because they are failing. Research is commonly a response to a problem and the search for a solution, indicating peatland regulation functions are failing.

Table 4.6. Stakeholders and Primary Interests Across Northern Europe

Stakeholders	Primary Interest		Related ecosystem processes and components	Function Group
1°	Agriculture	Arable, dairy, extensive grazing, wild animal grazing	Conversion of solar energy into edible plants and animals	Production
	Water Table	Maintaining water levels that can live and farm with	Filtering, retention and storage of freshwater	Regulation
	Soil Condition	Maintaining productive soils	Role of vegetation root matrix and soil biota in soil retention	Regulation
	Water Resources	Drinking and irrigation supplies	Filtering, retention and storage of freshwater	Regulation
	Flood Storage	Protection of property and effects on agriculture	Role of land cover in regulating runoff and river discharge and influence of ecosystem structure on dampening environmental disturbances	Regulation
	Landscape	Enjoyment of scenery	Attractive landscape features	Information
	General Conservation	Enjoying and maintaining/enhancing the local wildlife	Suitable living space for wild plants and animals	Habitat
	Navigation	Off road and via water ways	Providing suitable substrate for human infrastructure	Carrier
2°	Agriculture	Represent the interests of farming community	Conversion of solar energy into edible plants and animals	Production
	Soil Condition	Maintain condition for heritage, conservation and agricultural purposes	Role of vegetation root matrix and soil biota in soil retention	Regulation
	Water Table	Maintain levels for heritage, conservation and agricultural purposes	Filtering, retention and storage of freshwater	Regulation
	Flood Storage	Protecting people and property as well as high value agricultural land where possible	Role of land cover in regulating runoff and river discharge and influence of ecosystem structure on dampening environmental disturbances	Regulation
	Cultural Heritage	Preserving and learning from the archaeology and heritage present in peatlands	Variety in natural features with archaeological value	Information
	Landscape	Protecting the historic and scenic landscape	Attractive landscape features	Information
	General Conservation	Maintaining and enhancing local wildlife	Suitable living space for wild plants and animals	Habitat
	Habitat	Conservation and rehabilitation of locally and nationally important habitats	Suitable living space for wild plants and animals and suitable reproduction habitat	Habitat
	Rare Species	Conservation and rehabilitation of locally and nationally important species	Suitable living space for wild plants and animals and suitable reproduction habitat	Habitat
3°	Water Table	Managing levels to meet every ones needs	Filtering, retention and storage of freshwater	Regulation
4°	Agriculture	Supplying serving and monitoring agriculture	Conversion of solar energy into edible plants and animals	Production
	Soil Condition	Research and maintenance of soils	Role of vegetation root matrix and soil biota in soil retention	Regulation
	Water Table	Maintenance of water levels that can be used for recreation	Filtering, retention and storage of freshwater	Regulation
	Landscape	Enjoyment and protection of the landscape	Attractive landscape features	Information
	Cognition	Research, especially soils, and education	Variety in natural feature with educational and research relevance	Information
	General Conservation	Maintaining and enhancing wildlife	Suitable living space for wild plants and animals	Habitat
	Navigation	Off road and via water ways	Providing suitable substrate for human infrastructure	Carrier

4.2.4 Stakeholder Mapping

Stakeholder mapping is a data reduction and analysis process. It is a way of visually representing differing elements of the stakeholder network in isolation or in combination. It improves analyst ability to interpret the data making the identification of patterns and anomalies relatively easy as compared to examining raw data. Stakeholder mapping can be carried out in different ways, leading to insight into differing aspects of the stakeholder network. The type of map used can therefore be chosen to best suit the purposes of the exercise. Indeed according to Miles and Huberman (1994) there are as yet very few tried and tested display types for qualitative data, meaning each analyst derives displays according to their particular circumstances. Here, because there is interest in the services peatlands deliver and how these are distributed amongst stakeholders', two key aspects of the stakeholder network are of relevance. Firstly, the degree of influence and interest stakeholders have in peatland management is important in understanding why peatlands services are distributed as they currently are. Secondly, how stakeholders interact with each other, be it cooperatively or antagonistically, and over what issues (or functions), is useful in identifying key functions of peatlands and so key issues in determining wise use. Two existing peer reviewed mapping techniques relating to these issues were applied.

Although appearing in the literature (see for example Olander and Landin, 2005 & Grimble ad Wellard, 1997) there is little information available on how these displays are derived from the data, meaning it can at times be rather subjective. Attempts were made in this analysis to reduce the subjectivity of the displays by relying heavily on the direct interview responses rather than what could be inferred from them. However, of course at times inferences were necessary and considered legitimate given the quantity of data they came from. Furthermore, especially in the case of the interest/influence displays secondary data sources (websites, mission statements) were also used in the derivation of the displays.

4.2.5 Influence/Interest Maps

The interest/influence stakeholder mapping attempts to identify both the relative influence of stakeholders on the phenomenon of concern and the degree of interest they have in it. Plotting both of these factors together enables effective assessment of stakeholders' ability to pursue their interests and develops the categorisation of stakeholders as key players, context setters, crowd and subjects dependant on their levels of influence and interest. Influence/interest mapping helps to understand how and why services flowing from peatland functions are distributed among stakeholders.

Figures 4.3 and 4.4 show the influence interest maps constructed for the Fens and the Somerset Moors respectively in relation to peat land and water management. Here influence and interest was being assessed over peat land and water management systems. Effort was made to treat stakeholders in a consistent manner, using a quantitative scale (1-10). Personality, property and organisation were used as sources of influence (Galbraith, 1983) and ecosystem function categories as a basis for interest. By the nature of the analysis though there was still a high degree of subjectivity involved in deciding stakeholder position on each scale. Table 4.8 demonstrates the framework of analysis used to construct the maps, with the scale position entered only for the highest scores in each of the influence and interest sections. The colour of the data labels in Figures 4.3 and 4.4 indicates the function category the interest level refers to, i.e. the functions the stakeholder has most interest but bearing in mind most stakeholders have multiple interests in peatlands. Full supporting tables for the maps showing the score for each stakeholder for influence and interest, the main source of influence, the main ecosystem function category of interest, a supporting dialogue and evidence from the interview transcripts can be found in Appendix VI.

Table 4.7 Framework of Analysis for Stakeholder Influence and Interest

	Influence			Interest					
	Sources of influence			*Ecosystem function category*					
Stakeholder	Personality	Property	Organisation	Production	Livelihood	Information	Habitat	Regulation	No Fit
Farmers		**6**			**10**				
English Nature			**7**				**7**		
Wildlife Trust		**5**					**6**		
District Council			**6**						**7**
Food Links			**3**		**5**				
Flood Defence Committee			**7**					**4**	

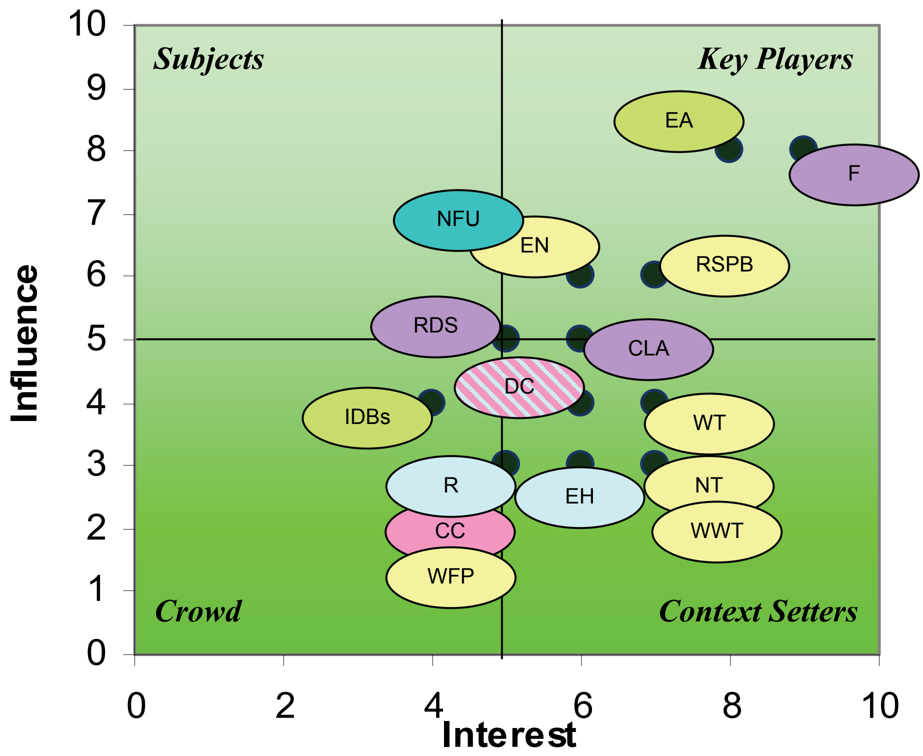


Figure 4.3. Influence/Interest Map of the Fens Stakeholders

Important points coming out of the Fens map:

- Stakeholders are relatively few in number in the Fens region, probably reflective of the uniformity of land use;
- Due to the relatively large size of the farms and their relatively strong economic viability, farmers or farm *businesses* are firmly in the key players stakeholder category in the Fens. It should be noted however that tenant farmers on peat soils feel vulnerable and powerless relative to their land owning counterparts;
- The WT and NT may increase their influence as they purchase more and more land for their projects, but even if they are fully successful in their acquisition plans they are still likely to have less influence than farm businesses;
- Local communities in the Fens seem to be disengaged from their surroundings and uninterested in its management.

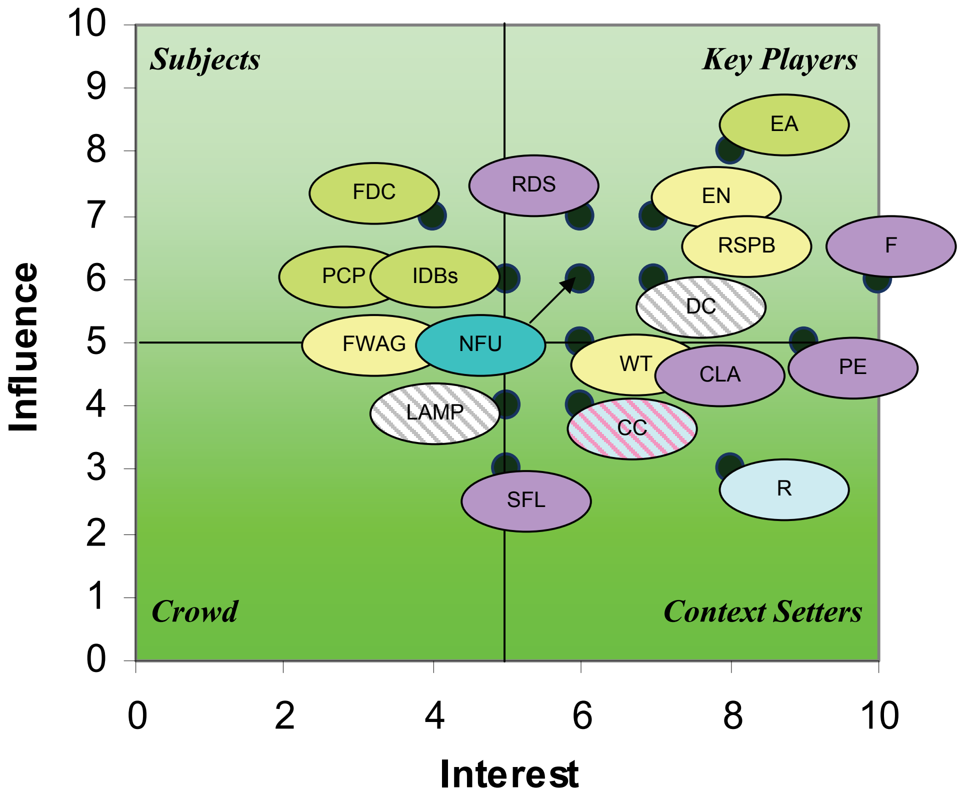


Figure 4.4. Influence/Interest Map of the Somerset Moors Stakeholders

Important points coming out of the Somerset Moors map:

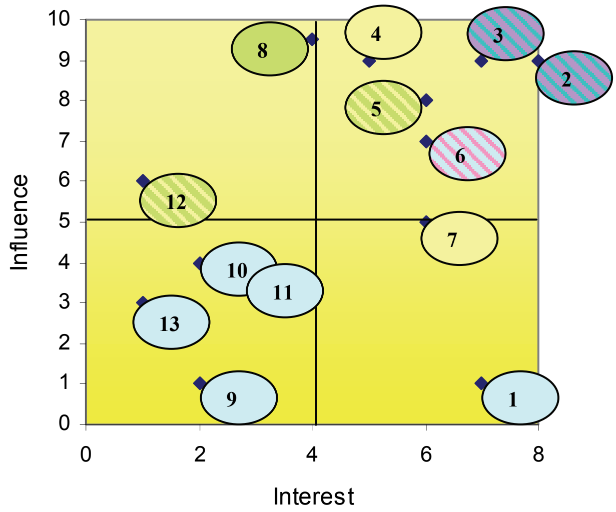
- There are a large number of stakeholders, reflecting the diversity in land use;
- There are a high number of key players, probably due to the nature of the agricultural system, allowing multi-purpose land use. Therefore there is much partnership working and many people have a strong and legislatively protected interest in the area;
- Local residents are a primary stakeholder, meaning they will be personally affected by change. They are also context setters, meaning although they have a high interest in peatland management they only have a low influence. Therefore care needs to be taken by key players to engage them in peat land and water management decisions and ensure their views are adequately represented otherwise they may be discriminated against and marginalised by management decisions. This group could potentially become more powerful if

a common cause unified and rallied them into action, for example wide spread flooding;

- Farmers, although still key players, have limited power in the Somerset Moors relative to the Fen case due to the amount of legislation and designations associated with the area and its wildlife importance. They are more restricted in what they can and cannot do with their land.

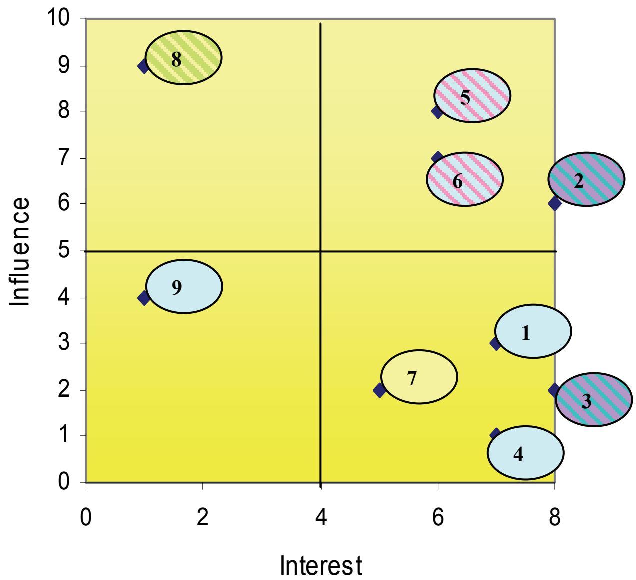
The influence interest mapping exercise it became clear that property rights, in this case largely associated with the ownership of large amounts of land, and affiliation with a strong organisation are the main sources of influence in peatland management today. This means large landowners i.e. farmers, and organisations such as the EA and RSPB have a high influence in peatland areas. The EA is the statutory organisation with the greatest degree of responsibility to peatland areas in terms of hydrology and the RSPB is an organisation with very well developed lobbying capacity, born out of high public membership. If in the future however, the are policy induced increases in restrictions on the activities of private landowners, then the property rights of land owners will be significantly reduced, leaving organisations such as the EA and RSPB as the key players. The mapping exercise also highlights evidence of the greater balance of interests in the Somerset Moors amongst production (including livelihood), habitat and regulation functions than in the Fens.

Figures 4.5 to 4.9 show the influence/interest maps for the Northern European case study areas. The maps are based on an interest metric derived from the stakeholder categories (primary = 7 or 8, secondary = 5 or 6, tertiary = 3 or 4 and quaternary = 1 or 2) and on questionnaire responses, including informed portrayal of stakeholder influences.



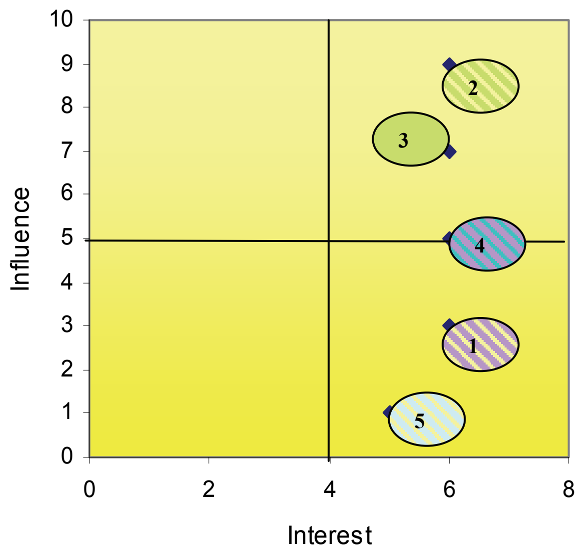
No	Stakeholder
1	Local people
2	Farmers with contracts in the project area
3	Farmers without contracts in the project area
4	Nature conservation foundation
5	Regional environmental agency
6	Municipality
7	Regional nature conservation authority
8	Local water and soil board
9	Visitors
10	Hunters
11	Fishermen
12	Federal environmental agency
13	University

Figure 4.5. Influence/Interest Map of the Stakeholders of the Eider Valley peatland, Germany



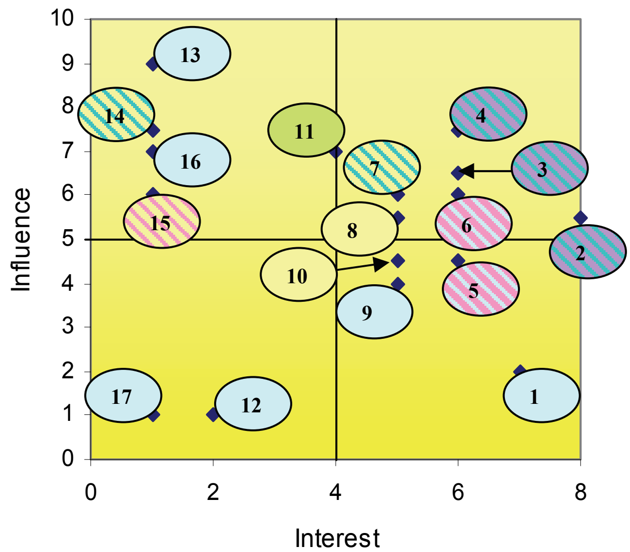
No	Stakeholder
1	Bodo people
2	Bodin Farm
3	Bodin 4H farm
4	Bodin Leir (military camp)
5	Nordland County
6	Community Council
7	Bodø Ornitologisk
8	Ministry for environment
9	Vågønes Research St.

Figure 4.6. Influence/Interest Map of the Stakeholders of the Bodin peatland, Norway



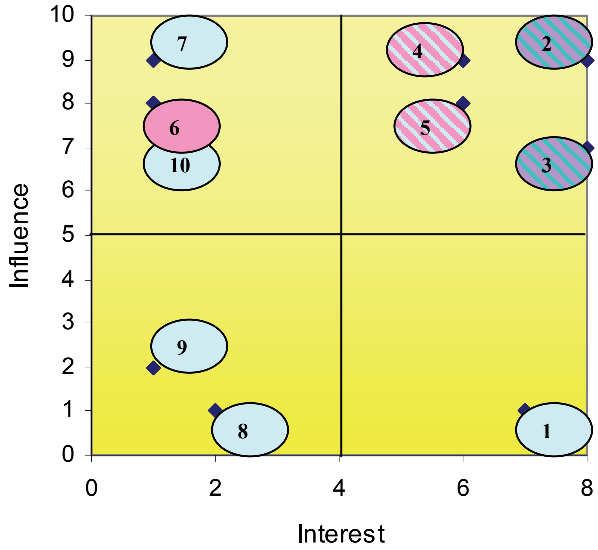
No	Stakeholder
1	Biebrza National Park
2	The National. Found for Environmental Protection and Water Management
3	Agency for Land Reclamation and Water Management, Bydgoszcz
4	Polish Peat Association
5	The Friends of Lower Vistula Society

Figure 4.7. Influence/Interest Map of the Stakeholders of Biebzra National Park, Poland



No	Stakeholder
1	Local people
2	Local farmers
3	Western agriculture farmers organisation
4	Dutch Dairy Association
5	Local County Council
6	Province of Utrecht
7	NGO for Agricultural Nature Conservation
8	NGO for the Dutch Nature Inheritance
9	Utrechts Landschap - Landscape NGO
10	Dutch Partner of BirdLife International
11	Local water board
12	Visitors
13	Research Institute for Animal Husbandry
14	Ministry of Agriculture, Nature and Food
15	Ministry of Housing and Environment
16	Clients, e.g. Research Institutes, Universities
17	All Non Users

Figure 4.8. Influence/Interest Map of the Stakeholders of Utrecht peatland, Netherlands



No	Stakeholder
1	Local people
2	Low intensity Farmers
3	Intensive farmers
4	Bälinge parish
5	County council
6	Swedish National Road Administration
7	Uppsala University
8	Visitors
9	Researchers
10	The public interest

Figure 4.9. Influence/Interest Map of the Stakeholders of Bälinge mossar peatland area, Sweden

Although they vary there are points of commonality in the Northern European influence interest maps, for example for the most part they attribute relatively high influence to farmers, indicating that entitlements contained within land tenure arrangements is a key element in influence across Northern Europe as well as in the English cases. Furthermore, for the most part all the maps gave local residents a very low influence, and an even lower influence than was found in the English cases. This perhaps indicates an assumption that local residents' views are not sought or important in peat land and water management decisions. Or it is possible that, given the greater availability of space in most partner countries, there are fewer settlements within the peatlands across Northern Europe than in the English cases. That for the most part settlements are on the edges of the peatlands not within them as is the case in England, potentially making local residents opinion less important in the management decisions made as they are less likely to be affected by them.

Most of the Northern European maps have key players with interests in production and livelihood suggesting a much greater emphasis on maintaining productive agriculture in the key stakeholders across Northern Europe than in the English cases. However, most maps also have key players with interests in information and carrier functions indicating that capture of local residents priorities by more influential stakeholders, mobilised but the network of democratic representatives, is occurring across Northern Europe.

Although on close inspection there are some similarities between the Northern European influence interest maps, they are on the face of it very different for each of the partner countries. This may be because of the very different nature of the countries represented, their priorities and their use of peatlands. This suggests that despite the ability to make generalisations contextual heterogeneity makes it difficult to formulate locally relevant high-level policy regarding the equitable and sustainable management of peatlands. This might mean that policy should remain flexible and open to local adaptation.

In an attempt to minimise analyst subjectivity in the influence/interest maps a version of the mapping was carried out for the English case study areas that was based entirely on stakeholder responses in the semi-structured interviews. This version is useful in demonstrating the beginnings of a metric base for this kind of analysis and also in showing the difficulties associated with such a process. Although it gives an indication of how stakeholders perceive themselves, showing some striking similarities between the two regions, it is felt it does not give an accurate representation of actual degree of influence and interest. This may be partly because stakeholders were not asked directly how they felt the map should look, and partly because even if asked directly it is common for stakeholders to overlook obvious elements of the stakeholder network. It seems then that the technique of visualisation is important in eliciting stakeholder perceptions and of influences and interests of other stakeholders. It is thought this version is of interest both for its results and the process of constructing it and for this reason can be viewed upon request.

4.2.6 Interaction Matrices

Stakeholder analysis considers the extent to which stakeholders interact and the nature of this interaction, whether conflicting or harmonious, antagonistic or cooperative. The interaction matrices are derived from the *conflict*, *cooperation*, *consensus,* *compromise* and *mechanism failure* codes of the primary data set. The coding process started with the notion that stakeholder interactions were important but the types of interaction present in the case study areas were initially assumed to comprise conflict, cooperation and consensus, with compromise and mechanism failure added as they became apparent.

For the purposes of this analysis, based on what became apparent in the data, the codes incorporated:

Conflict – included conflicts of interest, personality clashes and specific incidences of conflict within otherwise amicable relationships. They may have been mentioned directly, alluded to or mentioned by third parties. They may be current, past or likely in the future.

Cooperation – included formal and informal, compulsory and voluntary incidences of cooperative action, as well as general cooperative working relations with no specific action attached. They may have been mentioned directly, alluded to or mentioned by third parties. They may be current, past or likely in the future.

Consensus – included general agreements as well as agreements with the promise of action, and refer to specific issues between specific parties as well as general issues relating to the areas as a whole. They may have been mentioned directly, alluded to or mentioned by third parties. They may be current, past or likely in the future.

Compromise – included obvious cases of voluntary compromise of stakeholder interests for the sake of ease, consideration for other stakeholders and the benefit of the area as a whole. They were mentioned directly.

Mechanism Failure – included all clear incidences of ineffective or non-existent communication/action pathways, as well as specific cases of normally effective pathways breaking down. They were mentioned directly.

There are many differing stakeholder interactions in both case study areas. Figures 4.10 and 4.11 show the interaction matrices for the Fens and the Somerset Moors respectively and refer to those interactions that are considered reference worthy. The size of the symbol indicates how important the interaction was found to be to land use and decisions within the case study areas, with a small, medium or large symbol reflecting the occurrence of the theme within the interview transcripts and a general understanding of the magnitude of the issue developed throughout the interview process. It is therefore only an arbitrary measure.

	R	F	EN	EA	RDS	EH	WT	NT	WWT	RSPB	DC	CC	NFU	CLA	IDBs	WFP
R	©≠															
F	x≠															
EN		x©														
EA			©+													
RDS		x+	©+	©+												
EH			©	©	©≠											
WT	+÷	x©+÷	+	+	+	©										
NT	x+	©+	+	+	+	©	©+									
WWT	©		+	©			+	+								
RSPB	©	X	©+	x©		©	©+	©+	©							
DC	©≠		+				+	+								
CC	©≠	x≠	+				+	+								
NFU		©≠	+	+	©+											
CLA			x+	+	©+		x	x		x			+			
IDBs		©≠	x÷	x©		©		©		x©						
WFP			©≠	©			©≠	©≠	©≠	©≠						

x = conflict; © = cooperation; + = consensus; ÷ = compromise; ≠ = mechanism failure

minor; moderate; **significant**

Figure 4.10. Stakeholder Interaction Matrix for the Fens

Areas of significant conflict in the Fens are:

- Between the farming community and the RSPB regarding farming and farmer image. Firstly farmers feel the RSPB are asking the impossible in terms of farming practice and that there is a movement to see the cessation of arable agriculture in the Fens. Secondly farmers feel the RSPB are instrumental in culturing bad feeling towards the farming community from the general public through their media campaigns;

There are no areas of significant cooperation in the Fens, areas of moderate cooperation are:

- Between the conservation organisations, in terms of sharing expertise and resources both for campaigns and lobbying and habitat restoration projects;
- The RDS cooperated with most other stakeholders in the development of the Higher Level Scheme.

There are no areas of significant consensus in the Fens, areas of moderate consensus are:

- The new agri-environment schemes, where RDS consulted heavily in the development process as indicated above, finally producing a scheme that most stakeholders are satisfied with;
- Farmers themselves are satisfied with the environmental steps they are being asked to make as they feel they already take them.

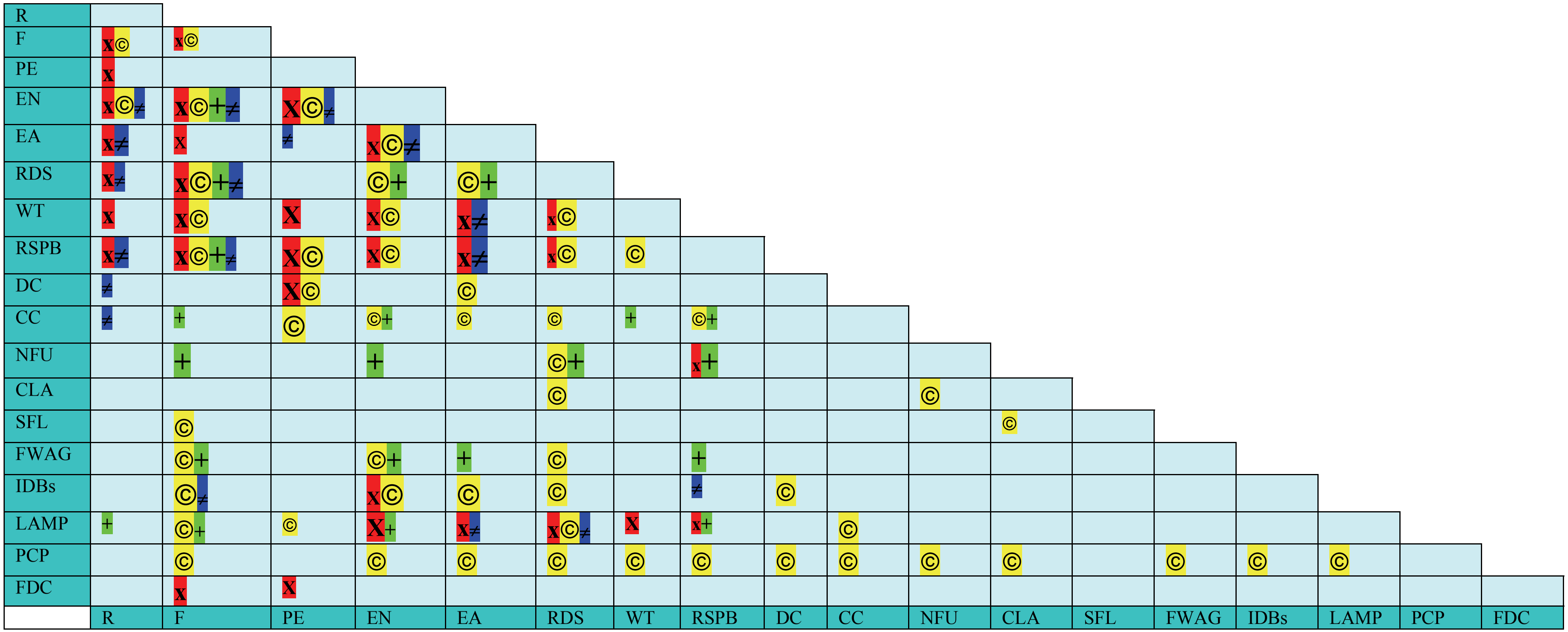
There are no areas of significant compromise in the Fens, areas of moderate compromise are:

- The WT being prepared to compromise their aspirations for the Great Fen project in order to ensure primary stakeholders are not marginalised by it, including taking the time needed by tenant farmers to change the land use and listening to local opinion on how the project should pan out especially in terms of recreation;
- The IDBs are increasingly willing to compromise their historical commitment to drainage for conservation interests.

Areas of significant mechanism failures in the Fens are:

- Farmers feel the NFU are failing in their responsibility to represent and protect farming interests especially in terms of the image of British farming, in that they feel they had allowed conservation lobbies to blame farmers for the majority of British environmental problems. There is recent evidence to suggest the NFU are trying to address this with the publication of 'Why Farming Matters'.

It is worth noting that there is conflict between conservation bodies, such as the WT and NT, and the CLA. The conflict is largely a defence of the current agricultural system by the CLA, suggesting the reasons conservation bodies give for habitat restoration schemes, such as the rate of peat soil loss and economic vulnerability of homogenised land use, are unfounded. It is currently of moderate significance but it could increase in significance and engage the NFU (who have already published a 'Why Farming Matters' report in defence of the regions agriculture) as time goes on. This is because it appears to be based on a perceived as opposed to a real risk, meaning potentially the higher the profile of large-scale habitat restoration schemes the greater the perceived threat to the current agricultural system and so the higher the risk of major conflict between these stakeholders.



x conflict; © cooperation; + consensus; ÷ compromise; ≠ mechanism failure

minor; moderate; **significant**

Figure 4.11. Stakeholder Interaction Matrix for the Somerset Moors

Areas of significant conflict in the Somerset Moors are:

- Between the farming community and most of the conservation and statutory bodies, primarily in the past when SSSIs were first designated in a mandatory fashion with limited compensation. Also in the present, some farmers regard some views on the conservation potential of the area as extreme and farmers are frustrated with the confused nature of the response to the PSA targets, i.e. they are not clear what is being asked of them;
- Between the conservation bodies (RSPB and WT) and the EA regarding their approach to meeting the PSA targets, as both organisations considered it thus far to be inadequate and too status quo.

Areas of significant cooperation in the Somerset Moors are:

- Between RDS and most other stakeholders regarding the formulation of the new agri-environments schemes, with the RDS consulting heavily and listening to other stakeholder needs;
- Between some conservation bodies (RSPB and EN), the CC and peat extractors over the after use of sites, with the CC drawing up concise guidelines on after use and extractors consulting EN and also handing land over to the RSPB and EN for very reduced rates;
- IDBs, EN, EA and farmers over water level management plans, with the statutory bodies and the IDBs working hard together to develop plans that will best improve the conservation status of the area and working closely with farmers to realise the plans.

Areas of significant consensus in the Somerset Moors are:

- Over the new agri-environment schemes, specifically HLS, were by most parties agreed that what was produced was a significant improvement on the previous ESA scheme and that the scheme has the potential to help meet the PSA targets.

Areas of significant mechanism failures in the Somerset Moors are:

- Regarding the PSA targets and how to respond to these and improve the conservation status of the area, with the EA feeling that the consultative approach of the past has been time consuming and ineffective, with the result that no-one has been happy with the outcomes.

To compare the case study areas, it is immediately obvious that there is a lot more stakeholder interaction in the Somerset Moors than in the Fens, and that a lot of this interaction is more significant than in the Fens, i.e. it engages more stakeholders, takes up more time and more often results in action. As well as having a considerable degree of conflict in the Somerset Moors there is also a great deal of cooperation, both of these likely results of the more multi-functional system that exists in the area. This forces stakeholders to interact to reach acceptable solutions to everyone. Where as in the Fens one piece of land is only expected to perform one function and therefore stakeholders need not interact as often.

The PSA targets, SSSIs (habitat functions) and water level management in general (regulation functions) featured heavily in the interactions in the Somerset Moors but much less so in the Fens. This is indicative of the number of SSSIs present in the areas. Flooding appeared as a point of interaction regularly in the Somerset Moors and much less so in the Fens. This is again most likely due to the fact that the Somerset Moors is a more multi-functional system that already uses the farmland as flood storage in the winter. Furthermore the area had recently suffered severe flooding that was damaging to the agricultural land and also very nearly flooded major towns and roads. In the Fens however, flooding is not really important at present because it is simply not allowed to happen.

Compromise was only present in the Fens. This is potentially due to the fact that stakeholders in the area have only recently come together and in the short term compromise is easier to achieve than consensus; with the development of consensus requiring in depth interaction and time to be reached meaningfully.

In both areas farmers are expressing concerns over the farming image amongst the general public and a feeling of victimisation. Both areas also had a ‘them and us’ nature to the language in the interview responses. Demonstrating that even in Somerset, where agricultural land can be very rich in biodiversity and farmers work closely with the conservation bodies, there is still a sense that you are either a farmer foremost or a conservationist foremost and that conservationists do not understand the farming perspective.

Stakeholder interactions focus around the whole range of function groups but the significant interactions predominantly focus around habitat and production functions and often the interface between the two, including livelihoods. This is reflective of the dominant interests in both areas as discussed previously. The regulation functions also feature often. This is possibly not surprisingly, again as discussed previously, given that these are the points where intervention is required and so decisions and action needed. In terms of wise peatland use then it appears balance needs to be struck between use of the production and habitat functions, and between peatland use and the integrity of the regulation functions.

Table 4.8 shows the interactions that were found across Northern Europe. From the table it can be seen that:

- The majority of conflicts are between production and habitat functions;
- Of these conflicts the majority involve farmers and all involve land owners, and the conflict is generally with a range of other stakeholders;
- There is general consensus that open landscapes should be protected and that agriculture helps maintain these landscapes;
- There is general consensus that landscapes form part of local heritage;
- There is a degree of cooperative action in most countries but it varies in type.

As with the stakeholder interests the regulation functions appear more commonly in the Northern European interactions than they did in the English interactions. Also more common across the Northern Europe interactions was the appreciation of the landscapes peatlands delivered and the historical and aesthetic importance of these landscapes. However, as with the English case study areas the key areas, especially in causing conflict are the habitat and production functions, and the regulation functions are the key point of intervention.

Table 4.8. Interactions Found Across Northern Europe

Country	Consensus	Cooperation	Conflict	Associated Function Group
Germany	Between farmers and all nature conservation bodies that the area be grazed and kept open			Production – agriculture & Habitat – nature conservation
		Between Regional Environmental Agency, University, local water and soil board, Regional nature Conservation Authority, and Nature Conservation Foundation working in partnership on the Eider valley project		Habitat – nature conservation
			Between farmers and stakeholders interested in nature conservation over cattle density and increased water levels.	Production – agriculture & Habitat – nature conservation, and Regulation – water table
Nether-Lands	The landscape is unique and a cultural inheritance that should be protected. Without farmers it will be very expensive to conserve this landscape.			Production – agriculture & Information – cultural heritage
	Meadow birds should be protected			Habitat - conservation
		All stakeholders cooperate on some level to achieve the vision of the consensus		Production – agriculture & Information – cultural heritage, and Habitat - conservation
			Between farmers & Ministry of Agriculture Nature and Food Security, and Dutch dairy board, Agriculture and Horticulture farmers organisation North, Province of Utrecht, Ministry of Housing,	Production – agriculture & Habitat – nature conservation, Regulation – climate,

			Country planning, Health and Environment, Nat. Cons NGO, Ministry of Agriculture, Nature and Food Security over water level management and implications for subsidence, nature reserves, soil condition, water management costs, infra structure and greenhouse gas production	soil and water table, and Carrier – infrastructure	
			Between farmers, and local water board about water levels in the spring	Production – agriculture & Habitat – nature conservation, and Regulation – nutrients and water table	
			Between farmers and local water board over who has control of water levels	Regulation – water table	
Poland	Co-funding from the resources of the National Fund (NFEPWM) may be requested for environmental protection and related water management activities			Habitat – conservation, Regulation – ecosystem functioning and hydrology	
		Research Institutes, National Fund, Ministry of Environment, other parties carrying out environmental research/practice all work together (funding, sharing ideas) to develop Polish environmental protection legislation and policy		Habitat – conservation, Regulation – ecosystem functioning and hydrology	
			Between peat extractors and organisations for environmental protection	Production – extraction & Habitat – conservation, and Regulation – ecosystem functioning and hydrology	
Norway	Hunting and fishing are			Production –	

	acceptable and landowners and interested parties operate this without problem			agriculture, and Information - recreation	
		Between the farmers themselves in the harvesting, storing, washing, packing and selling of carrots and Swedes		Production - agriculture	
			Between farmers, owners, and agricultural authorities & conservation authorities about the extent of the peat conservation area	Production – agriculture & Habitat - conservation	
Sweden	Ditch levels are regulated by a legal document (agreement) – 1994			Regulation - hydrology	
	Current land use should be maintained as far as possible, but in the long run the open landscape will gradually turn into forest if the drainage intensity is too low.			Production – extraction & Habitat – conservation, and Regulation – ecosystem functioning and hydrology	
		Water management is regulated by the Swedish Environmental Code and big drainage schemes are organised in associations (joint-ownership units), associations are obliged to maintain the ditches at the levels decided in 1994 and costs are paid by the land owners, relative to their benefit		Production – extraction & Habitat – conservation, and Regulation – ecosystem functioning and hydrology	
			Between different intensity farmers over water level management	Regulation – water table	
			Some landowners and the National Heritage Board to do with tree planting in The Bälinge Mossar area which is declared a site of cultural significance due to the Stone Age landscape being well interpreted by the open landscape of today. Some farmers have got permission to plant limited areas with trees	Production – timber & Information – cultural heritage and landscape	

4.3 Key Messages and Conclusions

This section draws out the key messages of the methodological approach and concludes against the first and second research questions, namely: What are the ecosystem functions and associated services provided by peatlands? And: Given the current use of peatlands, how are these services distributed amongst stakeholders?

The SA relied heavily on semi-structured interviews with stakeholders, and so on qualitative data. It demonstrated the lack of guidance on practical use of analysis techniques for qualitative data but applied several more well developed techniques with some success. The following bullet points summarise the approach taken to the SA and highlight some of the strengths and weaknesses of this approach:

1. Stakeholder analysis was used as a descriptive tool to help answer research questions 1 and 2 relating to peatland functions and stakeholders and proved useful to this end, providing rich, detailed case study data;

2. An inductive approach was taken to the analysis. This increased the data load considerably, with open ended stakeholder interviews, but uncovered themes and constructs relating to both higher level socio-political issues and local level specific case study area issues, that would not have been captured had a more deductive approach been used;

3. Full interview transcription was carried out, with some benefit in terms of this specific research project, but upon reflection is considered an unnecessarily time consuming approach to take;

From detailed coding and analysis of large amounts of qualitative data, derived mainly directly from stakeholders, the SA was successful in developing an understanding of the socio-economic aspects of peatland management. In particular it shed light on the contextual heterogeneity of the issues relating to peatlands as well as identifying commonalities. The main conclusions of the stakeholder analysis, relating to research question 1 and 2 are:

1. The current socio-political context of peatlands, although highly susceptible to changes in agricultural policy and markets, is largely promoting extensive uses of peatlands over intensive uses;

2. Even peatlands under one dominant land use provide multiple services of value to a wide range of stakeholders, although the more intensive the use for agriculture, the lower the diversity of services provided;

3. Stakeholders are interested in peatland functions for different reasons, with primary stakeholders drawing direct personal benefit from services provided and many secondary and tertiary stakeholders restoring or protecting threatened functions for the benefit of others, namely primary stakeholders and the general public;

4. Stakeholder interest is currently spread among the habitat, production, regulation and information functions, with very few stakeholders indicating a strong preference for only one peatland function, suggesting stakeholders have preferences for multi-functional land uses;

5. Stakeholder interactions centre around the habitat and production (including livelihood) functions as the two priorities for land use and the regulation functions as the main point of required intervention;

6. Stakeholder influence is largely dependant on property rights, especially the ownership and occupancy of land, and organisational strength. Stakeholder interest, when refined to individual functional categories revolve largely around the habitat, production and regulation functions as above, with local residents being in the minority with interests in information functions. Local residents are also the stakeholder group most commonly at risk of exclusion from land management decisions that have implications for the public good.

A qualitative, inductive approach to SA combined with the ecosystem services framework has been useful in developing some understanding of the relationship between people and peatlands. Specifically, as presented above, it has allowed elucidation of the peatland functions of relevance in the case study areas and how these functions are distributed among the stakeholder network given current use of the systems. This understanding could be used to inform policy and decision makers on the effects of changes in peatland use on stakeholder well being. However, in this qualitative form quick, easy and consistent interpretation of the information under differing circumstances is not possible. The stakeholder analysis can though ground a quantitative multi-criteria analysis, more useful to decision makers, in stakeholder preferences. The following chapter explains how the results presented here were used to build two types of multi-criteria analysis model and presents the results obtained.

5. Multi-Criteria Decision Making with the Analytical Hierarchy Process (AHP) and Multi Attribute Utility Theory (MAUT)

This chapter sequentially presents the two MCA analyses, AHP and MAUT. It establishes the purpose of the MCA in general and the approach taken to it before briefly reviewing existing literature and studies that have used the two methods applied here. It then outlines the AHP technique and critiques the model development process and data collection methods. It then discusses the results obtained from the AHP, comments on their significance for wise peatland management and concludes against the relevant research questions. This sequence is then repeated for the MAUT analysis before a final summation of the collective findings and a comparison of the two techniques.

The purpose of the MCA in general was to answer the third research question, namely: given current stakeholder values, what is the impact of peatland use on peatland services and stakeholder well-being? It does this by developing an understanding of the values section of the ecosystem services framework as applied to the English case study areas. At the same time building on the information already gained from the stakeholder analysis on the functions, uses and stakeholder elements of the framework. MCA was also used to address parts of the fourth research question, namely: what does this mean for policy in terms of achieving the wise use of peatlands? 'This', in the question, is the conclusions to the previous research questions. The MCA addresses this question by highlighting potential policy strategies, mechanisms and points of focus that might begin to deliver the wise use of peatlands.

MCA techniques were used to capture the often differing and potentially conflicting stakeholder value systems with regard to peatland functions, and to identify how these combine in feasible land use options that vary in their delivery of ecosystem services. In this way MCA techniques can derive measures of stakeholder well-being under differing peatland uses. Both the MCA models are built largely from the results of the preceding SA. They are designed and utilised as exploration and decision-support tools to inform policy formation, rather than as decision-making or predictive tools per se. In keeping with the approach to the SA both the AHP and MAUT were carried out in a ‘bottom up’ manner. That is the options for screening and criteria against which to screen them were developed out of the results of the SA and stakeholder preferences or value systems were sought from the stakeholders themselves rather than assumed from existing knowledge of the researcher.

In an attempt to make the results comparable across the case study areas and to identify national generalisations two generic ‘English’ models were developed (one AHP, one MAUT), and responses sought from the two case study areas.

AHP is regarded as an MCA technique that is relatively simple to use yet sufficiently robust to handle real world decisions and complexities. It allows the evaluation of quantitative and qualitative criteria on a verbal scale, for example, with regard to ecological integrity extensive grazing might be very much more preferred as a peatland use to arable cropping, and extremely much more preferred to extraction. This kind of scale is widely considered to be more user-friendly than a numerical scale, for example, with regard to below ground archaeological preservation, extensive grazing might be -3 as compared habitat restoration. This is due to the more common use by humans of language rather than numbers as a descriptor. Furthermore, a verbal scale affords a degree of ambiguity when no certainty exists (Ishizaka *et al*, 2005). Because of this it has been widely applied as a decision making tool across many disciplines, and especially in the areas of resource allocation, conflict resolution and planning (Saaty, 1987; Vargas, 1990; Farber, 2000 & Vaidya and Kumar, 2006).

There is a general consensus that the AHP model development can be quick and does not require specialist technical knowledge or large quantities of data. This means it can be constructed and carried out by both researchers and practitioners alike (Vaidya and Kumar, 2006). The simplicity of AHP is considered to be one of its greatest advantages, not least because of the flexibility it affords, allowing the technique to be combined relatively easily with other, optimising, MCA techniques such as linear programming and fuzzy logic. Furthermore, the technique can and has been relatively easily adapted to suit differing problems, for example by condensing the 9 point ratio scale originally suggested by Saaty (1980) to decrease the cognitive burden of the response collection, screening of large numbers of options, use of large numbers of criteria and using it to great effect in group decision making (Vaidya and Kumar, 2006).

Although the large part of the literature regarding AHP is concerned primarily with its application to a specific problem rather than its validity or robustness as a technique (Ying *et al,* 2007; Wong and Li, 2008 & Karami, 2005), not all of the literature views AHP as a perfected technique. For example, there seems to be some controversy around the appropriateness of conversion of the verbal scale to a simple linear scale (i.e. a numerical scale from 1-9, with each step representing an identical increase in the strength of preference), with some authors suggesting alternative scale types, such as geometric and balanced, would be preferable, yielding more meaningful results and increasing the sensitivity of the analysis (Lootsma, 1989 & Salo and Hamalainen, 1997). Ishizaka *et al* (2005) go on to suggest that the use of the linear scale causes bias in AHP analysis away from any low risk or compromise options. For example, in the case of peatlands, an improved grazing regime might be an option that represents a balance between two differing extreme options, namely peat extraction and habitat restoration. Improved grazing then would be automatically disadvantaged, therefore being unlikely to be found as the preferable option, before preferences are even collected in an AHP analysis using a linear scale. It appears however that use of the linear scale persists in applications of AHP, potentially because of its mathematical simplicity and ease of use as compared to the suggested alternatives, as well as the lack of agreement on the alternative scale that should be used.

Ozdemir (2005) highlights the trade-off required in AHP between validity and consistency. In order for the results to be valid, responses are needed to redundant questions i.e. the answer can be deduced from previous answers (assuming the respondent is consistent). With regard to peatlands for example, if a respondent has told you how much more they prefer livelihoods to ecological integrity, and they have also told you how much they prefer ecological integrity to archaeological preservation, if the respondent is answering in a consistent way, you can deduce how much they prefer livelihoods to archaeological preservation without asking the question directly. Consistency however, decreases as the number of questions increase. The implication is that in practical applications of AHP validity may be inadvertently compromised in order to achieve consistency, devaluing the results. It could be said then that there is a danger AHP is too simple to be practically useful, in that it fails to accurately capture complex and dynamic value systems and through its prolific use the details of its validity or robustness may have been lost or forgotten.

MAUT is another MCA technique that was properly developed some ten years later than AHP. Like AHP, MAUT has been used across many disciplines, such as business decision making, engineering and management decisions and health as well as, and for a large part before, being used in natural resource management (Min, 1993; Bedford and Cooke, 1998; Mussi, 1999 & Brennan and Anthony, 2000). It is possible that the data intensive nature of MAUT has in the past made it unappealing as an aid to decision makers in natural resource management given the often incomplete understanding of ecosystem service provision and ecosystem critical limits, as discussed in chapter 2. MAUT however, unlike AHP, can accommodate gaps in existing knowledge in a highly transparent way, where the AHP can hide such issues, allowing them to persist unchecked. MAUT is also compatible with several different methods for developing weights, some of which (trade-offs and specific action sequences for example) can be argued to move the technique from expressed preference to revealed preference. That is, weights or preferences for differing peatland ecosystem services are determined through behaviours or priorities that become apparent without directly asking ‘do you prefer x to y and by how much?’ as AHP does. This is a distinct advantage for an MCA technique as Bedford and Cooke (1998) highlighted. In advocating trade-offs as a means to ascertain preference levels they state that respondents will express the same preference for differing levels of an ecosystem service even when the units have been changed, invalidating the weight derived on the basis of this. Furthermore, many of the methods used in MAUT for ascertaining weights can utilise visual aids such as graphical displays, something which is not possible with the AHP and that makes MAUT particularly useful when generating responses from directly from stakeholders as is the case in this study. All of this means MAUT might actually be better at reducing the cognitive burden on respondents than AHP. By enticing preferences from respondents through trade-off questions and displaying options visually MAUT can avoid asking experts or stakeholders to provide their knowledge and opinions in abstract and general terms, something they are known to struggle with (Mussi, 1999).

A further strength of MAUT is that is recognises that preferences may not be consistent over differing time scales, or that they may not increase smoothly or consistently over differing levels of service provision, this enables the researcher to glean more information on the nature of the relationship between stakeholders and the state of a resource from the results of an MAUT analysis than an AHP. For example, Gomez-Limon *et al* (2002) used MAUT to examine risk aversion in farmers in Spain and were able to ascertain, not just point levels of risk aversion but how these change with time and the magnitude of risk. This kind of information, that cannot be inferred from an AHP analysis would allow, for example, the development of maximum risk levels in crop yield, where an AHP analysis could only tell you that at some point between x and y the risk level becomes unacceptable. As with AHP however, there is some criticism levelled at MAUT, primarily because of its inherent mathematical assumption that all aspects of the decision are preferentially independent. That is, a respondent's preference for a given level of a decision attribute is not linked to the levels of another, potentially associated attribute (Bedford and Cooke, 1998). This can be particularly difficult when examining issues of natural resource management and in particular ecosystem services, where, as detailed in Chapter 2, there is a great deal of interaction between services. Even when it fully exists preferential independence can be hard to demonstrate, test or prove and therefore this is an area of MAUT that users should be wary of.

Given its simplicity, AHP was considered to be an ideal technique to begin framing peatland use in a multi-criteria decision format. Its relatively quick generation of a ratio-based understanding of stakeholder preferences for differing land uses was considered potentially useful in matters of resource management decisions. AHP was therefore applied first. MAUT was chosen as the second MCA technique as, as alluded to previously, it has potential to address some of the shortfalls of the AHP analysis. MAUT increases the objectivity of analysis, derives precise measures of well-being and explicitly addresses changing values at the margin. It does this primarily by directly linking stakeholder preferences (values) to actual data and deriving an understanding of how well-being changes with differing levels of service provision. By its nature MAUT allows for more detailed analysis of results, potentially facilitating the development of precise measures for intervention strategies. MAUT analysis then has the potential to provide a more practically useful understanding of the relationship between stakeholders and peatland use than AHP. It is however more data intensive and therefore more time consuming to develop and carry out than AHP. Carrying out both an AHP and MAUT analysis for the peatlands of the Fens and the Somerset Moors allowed a comparison of the methods and a testing of the assumption that, although more time consuming, MAUT might ultimately be more effective in securing sustainable resource management because of its more direct link to practical decision making and policy formation.

5.1. Analytical Hierarchy Process Methodology

AHP was proposed by Saaty (1980) and is designed for situations where it is necessary to prioritise, as objectively as possible, differing alternatives that are multi-faceted and distinguished from each other by the feelings and emotions attached to them. The AHP quantifies those feelings and emotions based on subjective judgement in order to provide a numerical scale for prioritising decision alternatives. For these reasons AHP is a suitable technique for capturing stakeholder values regarding differing peatland functions (*the feelings and emotions attached*) and identifying how these combine in feasible land use options, giving a relative indication of stakeholder well-being (*provide a numerical scale for prioritising decision alternatives*).

The essence of AHP decision-making is the hierarchy shown in Figure 5.1. It allows elements of the decision problem to be considered independently of each other in a systematic manner thereby treating each element consistently. The terminology shown in Figure 5.1 for each of the hierarchy levels is that adhered here. However it is worth noting terminology does vary from study to study. With some calling the goal the ‘focus’ or ‘aim’, some calling the criteria ‘objectives’ or ‘attributes’ and some calling the options ‘alternatives’.

In this instance the ‘Goal’ was to identify the peatland management option that maximises stakeholder well being. This means developing a series of feasible land use options and a series of criteria through which the options will be compared. The option that meets the goal for each stakeholder is dependant on the relative importance of the criteria to stakeholders (the value placed on them), and how stakeholders perceive the various land use options perform against these criteria. The following sections outline the process of option development and criteria selection and then give an account of how stakeholder values were collected and formalised.

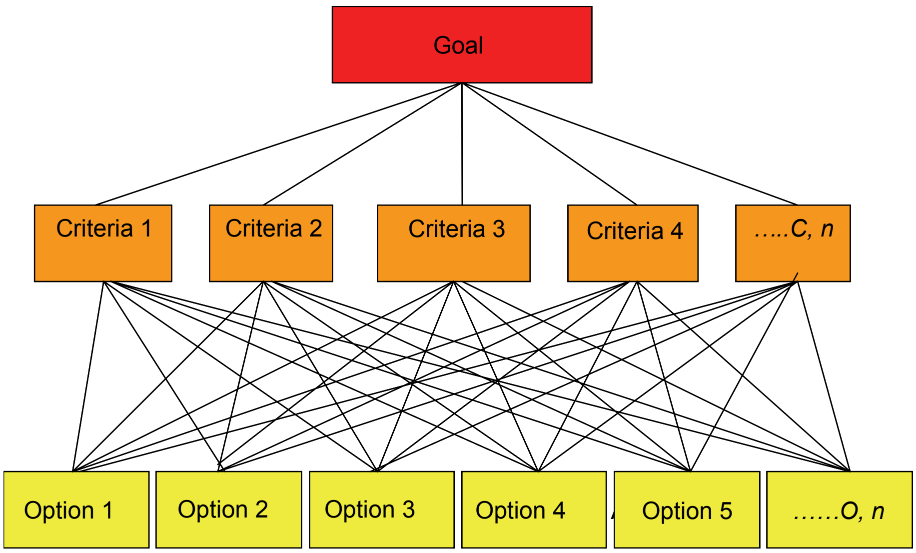


Figure 5.1. The AHP Hierarchy

5.1.1 Option Development

Options here are decision alternatives. They are used to compare stakeholder preferences for peatland delivery of ecosystem services at differing levels. They should be based on feasible scenarios that generate differing outcomes, which can be assessed against underlying stakeholder preferences. It was considered reasonable to define alternative land uses, with implicit water management regimes, and then work backwards to consider what socio-economic factors, such as Government policies, might bring them about. The chairs of all stakeholder panels at Workshop B (Peatland Use, see Figure 3.3) took the process forward by expressing their interest in a set of options based on different types of land use along some scale of intensity.

The following framework was suggested:

Human Intervention					
High					Low
Dominant Peatland Uses:					
Extraction	Arable	Grassland	Forestry	Nature Conservation	Abandonment

Stakeholders suggested these land use options could be assessed against the following broad aspects of peatland management:

Soils, Water, Emissions, Landscape, Biodiversity, Farm incomes

This framework was used to inform the land use options displayed in Table 5.1. Informal discussion with stakeholders in the Somerset Moors in October 2004, partner responses to questionnaires and the results of the semi-structured interview process detailed in Chapter 4 were used to augment the framework and adjust it for the following reasons:

- Nature conservation, as an option in its own right, was inappropriate as it is possible to have elements of nature conservation in most land use systems. Therefore nature conservation was changed to habitat and taken to indicate non-cultivated land managed predominantly for the purpose of habitats and species;
- Each land use category, although broadly indicating the extent of human intervention, covered a range of degrees of intensification i.e. forestry on peat soils could be natural implying limited human intervention, or it could be actively managed with drained areas of intensive timber cultivation implying a high degree of human intervention, both within the same scenario. It was therefore decided the options needed to be classified by intensity as well as purpose.

The options in Table 5.1 comprise *major broad* possibilities. The table reads from the most intensive to least intensive land use options.

Table 5.1. Representative Land Use Options

Scenario	**Description**
Extraction (E)	Deep drainage, open cast mining of peat.
Intensive arable (IA)	Deep drainage, rotation with root crops.
Extensive arable (EA)	Deep drainage, rotation without root crops.
Intensive forestry (IF)	Deep drainage, conifer plantation crop.
Withies (W)	Medium drainage, withy/willow crop.
Intensive grazing (IG)	Medium drainage, improved grassland for predominantly dairy cattle.
Extensive grazing (EG)	Limited drainage, unimproved rough grazing of predominantly beef cattle.
Extensive forestry (EF)	Little or no drainage, Birch/Alder woodlands, occasionally be harvested.
Habitat restoration (HR)	No drainage, fen/mire habitat/ecosystem actively restored.
Abandonment (Ab)	Drainage structures abandoned, land abandoned. Outcome dependant on surrounding land use and species present. Over time would in theory return to fen/wet woodland mosaic.

Several stakeholders mentioned Biofuels as potential new land use option. It was decided not to include this as a land use scenario however as little information existed on it in England at the time and was not a widespread land use. Also its success depends largely on associated infrastructure such as specialised power plants, which again were not prevalent at the time. It was thought that the regime required for Miscanthus and Short Rotation Willow Coppice (potential biofuel crops) is similar to that of the extensive arable and withy scenarios and the effects therefore, in terms of peat soils and stakeholder values, can be elicited from these two scenarios.

For the purposes of the AHP analysis, in order not to tire stakeholders with data requirements, the ten land-use options were reduced to six by combining very similar options and considering the likelihood of occurrence in the English case study areas. The six chosen land use scenarios were:

Arable (Ar)

Intensive grazing (IG)

Extensive grazing (EG)

Withies (W)

Fen/mire habitat restoration (HR)

Abandonment (Ab)

5.1.2 Criteria Selection

Criteria are peatland attributes by which stakeholders can judge the relative importance or value of the differing land use options. To ensure the criteria were relevant to stakeholders they were initially drawn from the open coding stage of the stakeholder analysis (detailed in Chapter 4.1.3). That is the initial coding carried out on the contact summary sheets of the semi-structured interviews. During the semi-structured interviews stakeholders were given much opportunity to discuss issues of peatland management they considered relevant but were not directly asked for ecosystem functions or services perceived to be important. Issues of importance to stakeholders were captured in the open coding as ecosystem services. Relevant services were assembled under the main functional categories of production, regulation, information, habitats and carrier. They were then translated into easily recognisable criteria against which to screen land use options, such as maintenance of ecological integrity and livelihood provision.

The criteria list derived was confirmed for relevance with stakeholder representatives from each of the main categories (primary, secondary, tertiary) in both study areas. Stakeholders were given the opportunity to add or remove criteria. Largely stakeholders were happy that the criteria were comprehensive and relevant. It is noted that the criteria agreed with the English stakeholders capture all but the 'emissions' criteria suggested by participants of Workshop B. This is consistent with the results of the stakeholder analysis where it was found that at the time of interview English stakeholders did not consider the potential effects of peat soils on climate change a significant aspect of management.

The initial process of criteria identification resulted in a long list, which would have ultimately led to a long and tiresome questionnaire. This would have meant a reduced chance of stakeholders consenting to complete it, and a reduction in the quality of responses obtained if they did. Furthermore, in order to avoid double counting and ensure criteria were not directly correlated it was necessary to omit some criteria. Therefore those stakeholder representatives with whom the list was confirmed were asked to order criteria from most important to least important. The criteria most commonly appearing top three were taken as the criteria for the AHP analysis.

The criteria can be found in Table 5.2, linked to ecosystem functions and services. The list now only captured three of the original criteria suggested in Workshop B, biodiversity, farm incomes and water, demonstrating differing stakeholder perspectives within Northern European Countries to those in England. Next, the derived criteria were reformed into narratives and used to support the assessment of preferences (stakeholder value systems). The narratives can be seen within the questionnaire used to collect preference sets, in Appendix VII.

The hierarchy for AHP that the options and criteria produced can be seen in Figure 5.2.

Table 5.2. Priority Criteria Identified for the AHP

Functions/Services		Criteria	Use
Production	Food production through the conversion of solar energy into edible plants and animals and their products.	**Livelihood provision**	Agriculture - Direct Use
	Conversion of solar energy into biomass for human construction and other uses.		Peat extraction - Direct Use
Regulation	Filtering, retention and storage of fresh water.	**Contribution to hydrological management**	Flood storage, nutrient cycling, wet fences – Direct and Indirect Uses
Information	Variety in landscapes with potential recreational uses.	**Public access provision (walking, cycling, horse riding, bird watching, fishing, shooting)**	Recreation - Direct Use
	Variety in natural features with cultural, artistic, spiritual and historical value.	**Cultural heritage compatibility, including archaeology**	Satisfaction - Non-Use
Habitat	Suitable living and reproduction habitat for wild plants and animals.	**Maintenance of ecological integrity**	Satisfaction – Non-use

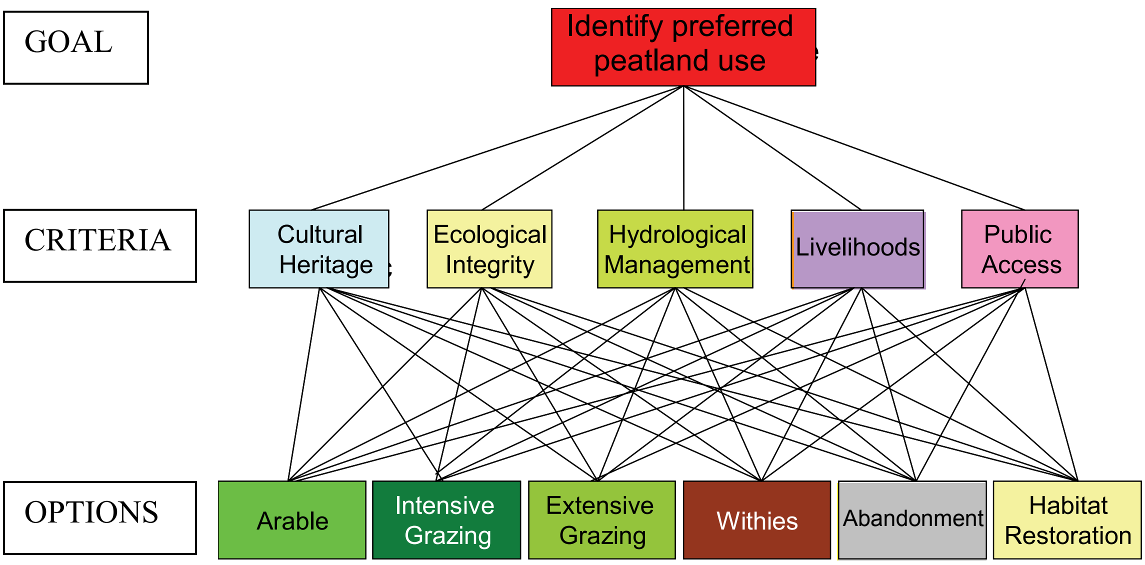


Figure 5.2. Hierarchy for peatland land use decisions in the English case study areas

5.1.3 Deriving Indications of Well-Being

Having established the land use options and criteria, the next step of the AHP was to evaluate the hierarchy according to stakeholders' preferences. This was done by deriving what will be referred to here as weights, which indicate relative importance or value of elements of the hierarchy (Harker and Vargus, 1987). When combined weights derive an indication of well-being for each of the land use options, or, as more commonly referred to, an understanding of stakeholder priorities for land use.

Weights in AHP are determined through pair wise comparisons of the hierarchy attributes on a predefined numerical scale: –9 to 9 (extreme importance of one criteria relative to another, positive or negative), where 0 indicates equal importance. A questionnaire was designed in order to collect stakeholder preferences in a systematic way. For example, respondents were asked if they prefer cultural heritage to ecological integrity and by relatively how much, subsequently they were asked if they prefer arable to intensive grazing in terms of performance against ecological integrity and if so by how much. The questionnaire along with a dialogue for the numerical scale can be seen in Appendix VII. The AHP form of pair wise questioning gives rise to matrices as shown in the example in Table 5.3. If there are n attributes, this results in an n × n matrix in which elements in opposite positions across the leading diagonal are reciprocals of one another, as highlighted in Table 5.3.

Table 5.3. A Hypothetical Stakeholder Preference Matrix Associated with the Criteria Level of the Hierarchy in Figure 5.2

GOAL	Cultural Heritage	Ecological Integrity	Hydrological Management	Livelihoods	Public Access
Cultural Heritage	**1**	½	½	1/9	3
Ecological Integrity	2	**1**	1	**7**	5
Hydrological Management	2	1	**1**	7	5
Livelihoods	9	**1/7**	1/7	**1**	1/2
Public Access	1/3	1/5	1/5	2	**1**

If stakeholder responses and so the matrices are fully consistent, the rows of the matrix are multiples of one another, there is a single non-zero eigenvalue (λ_{max}) equal to n, and the corresponding eigenvector, when normalised, contains the appropriate weights. The columns of the matrix are multiples of this weight vector. It is these weights that are important in distinguishing between land use options. Matrices are typically not fully consistent, meaning stakeholder responses do not always assign scores to give a consistent view of their preferences for differing elements of the hierarchy. Saaty has shown that, provided the consistency index, (λ_{max} – n) / (n – 1), is below 0.1, the normalised principal eigenvector provides a good estimate of a set of weights that capture the respondent's preferences. Where there were incidences of inconsistency greater than 0.1 the relevant responses, normally easily identifiable, were revisited with respondents via telephone conversations.

Each stakeholder had their own set of matrices, six in total (1 of the criteria against each other and 5 for the land use options against each other for their performance on each of the criteria in turn) referred to as a preference set. Once the required consistency was achieved for each matrices, scores of priority were calculated for each of the land use options according to each stakeholder preference set and associated weights according to the following equation:

$$y_j = \sum_{i=1}^{n} \alpha_{ij} x_i$$

Where the value of criteria i is x_i and the weight linking criteria i to stakeholder j is α_{ij}, y is the priority score and j is the stakeholder.

The statistical package Logical Decisions for Windows was used to process the stakeholder responses according to the process described above. The Logical Decisions package then presented the land use options in order of predilection according to the stakeholder preference set and assigned measures of priority to each option. Priority levels derived for the AHP range from 0-1 and sum to 1, with each option level being proportional to the others.

Ten stakeholder representatives, five from each of the English case study areas completed the AHP questionnaire. Representatives from all of the main stakeholder categories (primary, secondary and tertiary) were sought. Where possible and appropriate the respondent was a stakeholder who had also been interviewed as part of the stakeholder analysis process. This added a degree of triangulation in methods, confirming or otherwise previous results and adding new information. To ensure the best quality in the data collected questionnaires were completed face-to-face. This way any problems that occurred were resolved on the spot. It also ensured a timely response. Each interview lasted about one hour.

Respondents were presented with the land use options and the criteria narratives before being given asked to complete the questionnaire. They were given time to read and digest the information, ask questions or seek points of clarification. The criteria were explained verbally and discussed with respondents immediately prior to the AHP data collection, supported by examples according to needs and requests for further information. Fuller explanations were required for local residents more than for other stakeholders for whom operational and professional knowledge was greater. During the completion of the pair wise comparisons varying degrees of help were needed. Some respondents needed no help at all, very quickly becoming comfortable with the numerical scale, the use of reciprocals and being consistent in their responses. It was obvious these stakeholders had a very clear view in their mind of what each of the land use options and criteria entailed and where their preferences lay. Other stakeholders needed a great deal of help in determining the number from the scale they should choose, remembering what the question was, and how the land use options actually performed in reality against each of the criteria. There was no obvious pattern in which stakeholders required the most assistance in this part of the exercise.

The data collection process relied heavily on the existing knowledge of the stakeholders, providing only a short narrative for each land use option as assistance and no real data on the criteria levels within the options. The analysis then examined stakeholder *perceptions* of land use option performance in terms of the criteria. This is thought to be the reason for some of the difficulties stakeholders had in completing the questionnaires. Stakeholders less familiar with the land use options found the process much more difficult than those stakeholders who had greater existing knowledge. One clear positive aspect of the data collection process was being present during the completion of the questionnaire as it was strongly felt this helped resolve issues such as lack of knowledge and problems with the scale that may have otherwise compromised successful completion.

5.1.4 Summary

This section has detailed and critiqued the data collection methods used to both build the AHP models and derive stakeholder preferences for ecosystem services (criteria). It explained that relevant functions and services, derived from the stakeholder analysis, were presented as a set of easily recognisable criteria. It outlined that the MCA process captures in quantitative form the value structure of peatland stakeholders and so derives an indication of well-being or priority for different peatland use options. This generates incite into the functions and services of most relevance to stakeholder well being. The following AHP results section presents the weights and stakeholder priorities for land use derived in the analysis as individual stakeholder preference sets.

5.2. Analytical Hierarchy Process Results

This section presents the results of the AHP. It discusses the relevance of the results to peatland management and concludes against research question 3, namely: given current stakeholder values, what is the impact of peatland use on peatland services and stakeholder well-being? Some conclusions are also made against research question 4 relating to policy to deliver wise use of peatlands. Results of the AHP are compared with the results of the SA in order to establish agreement and disparity between methods.

The ‘Goal’ of the AHP was to identify the peatland use option that maximised stakeholder well-being given their preferences for different criteria. In this section it is assumed the higher the land use priority score, the greater the stakeholder well-being if that land use is delivered. The results the AHP are presented according to stakeholder groups and by location. Analysis of results according to stakeholder groups, namely primary, secondary and tertiary show how the views of stakeholders vary with priorities, scale of interest and degrees of entitlement.

It is noted that the number of stakeholder representatives taking part in the AHP survey is relatively small. The AHP was designed to both inform the MAUT analysis and be used as a comparison to the MAUT, rather than as the primary MCA. This means however, that results can only be regarded as indicative of a particular stakeholder group and not be regarded as representative.

5.2.1 Derived Weights

This section presents the weights or measures of importance assigned by stakeholders to the criteria of the AHP. Weights were derived through pair wise comparisons presented to stakeholders in the form of a structured questionnaire. Weights in the AHP are proportional and therefore sum to unity. The weights are used to help understand stakeholder priorities and finally to derive an indication of stakeholder well-being delivered by differing peatland use options.

Primary Stakeholders: Local Residents (R, 2 respondents) and Farmers (F, 2 respondents)

Table 5.4 shows the weights derived through the AHP questionnaire for each criterion according to local residents and farmers of the Fens and the Somerset Moors.

Table 5.4. Primary Stakeholder Preference Weights

	Weight				
	Cultural Heritage	**Ecological Integrity**	**Hydrological Management**	**Livelihoods**	**Public Access**
Fens R	0.06	0.07	**0.44**	**0.30**	0.12
Somerset R	0.08	**0.31**	0.19	**0.29**	0.11
Fens F	0.03	0.07	**0.23**	**0.60**	0.05
Somerset F	0.03	0.09	**0.41**	**0.40**	0.04
Arithmetic Mean	0.05	0.14	**0.32**	**0.40**	0.08
Range	0.03 – 0.08	0.07 – 0.31	0.19 – 0.44	0.29 – 0.60	0.04 – 0.12

In the case of the Fens, local people are particularly concerned about hydrological management. This is thought to be linked to knowledge of the drainage history of the area, a realisation that without hydrological management the area would be uninhabitable, and an increasing awareness of climate change and consequent vulnerability of the Fens area given its low lying nature. In the case of the Somerset Moors, local people give a more even spread of weights for the various criteria as the multi-functional nature of the landscape appeared to be well understood. Relatively more weight is given by people of the Somerset Moors (compared to people of the Fens) to ecological integrity, less to hydrological management, but about the same weight to livelihoods. Public access to the countryside is relatively important for local people and given similar weight by both sets of respondents.

These weights are consistent with the results of the stakeholder analysis, where it was found that in the Fens local people were primarily concerned with local history and drainage and the landscape that is born out of that history, as well as with the livelihoods of themselves and farmers and with recreation opportunities. Although in the stakeholder analysis the interest in hydrology was captured in the information functions, through culture and landscape rather than directly in the regulatory functions the results are not dissimilar. In the case of the Somerset Moors, it was clear in the stakeholder analysis that local people used local recreational opportunities (namely nature reserves) to a greater degree than people in the Fens, potentially explaining their greater weight on ecological integrity. Furthermore an important part of the character of the area identified in the stakeholder analysis as of primary concern to local people was the working nature of the landscape, the fact that people made their living from it.

Table 5.4 shows that farmers place relatively high importance on two criteria: hydrological management and livelihoods. This is consistent with a stakeholder group that is most closely linked to the production functions of peatlands, and where hydrological regulation in this case is linked to agricultural production to support livelihoods. The Fens farmer, operating in an intensive commercial farming area, is predominantly interested in livelihoods: the weight placed on livelihoods is greater than the combined weights on all other measures. The Somerset Moors farmer views hydrological management of similar importance to livelihoods. These results confirm the results of the stakeholder analysis where livelihoods were found to be of primary interest to farmers in both case study areas and water table to be of primary interest to farmers in the Somerset Moors and of secondary interest (to livelihoods and production) to farmers in the Fens.

Clearly there is general agreement amongst primary stakeholders and a preference for livelihood provision and hydrological management as demonstrated by the average weights for this group as shown in Table 5.4.

Secondary Stakeholders: Statutory Bodies (2 respondents, the EA, RDS), Conservation Organisations (2 respondents, the WT, RSPB)

Table 5.5 shows the weights derived through the AHP questionnaire for each criterion according to representatives of a statutory body and conservation organisation of the Fens and the Somerset Moors.

Table 5.5. Secondary Stakeholder Preference Weights

	Weight				
	Cultural Heritage	**Ecological Integrity**	**Hydrological Management**	**Livelihoods**	**Public Access**
Fens EA	0.10	**0.34**	**0.30**	0.11	0.13
Somerset RDS	0.15	0.20	**0.23**	**0.32**	0.07
Fens WT	0.07	**0.38**	**0.38**	0.12	0.04
Somerset RSPB	0.12	**0.47**	**0.25**	0.10	0.04
Arithmetic Mean	0.11	**0.35**	**0.29**	0.16	0.07
Range	0.07 – 0.15	0.20 – 0.47	0.23 – 0.38	0.10 – 0.32	0.04 – 0.13

Table 5.5 shows that the representative from the Environment Agency, reflecting the interest of a regulatory body, places greatest weight on ecological integrity and hydrological management, and then equal weight on cultural importance, livelihood and public access. This reflects the Environment Agency's responsibilities for environmental protection and flood risk management. In the Somerset Moors, the Rural Development Service, responsible for promoting sustainable rural development in the Somerset region, give greatest importance to livelihoods, followed by hydrological management (especially flood risk management). These weightings

appear to reflect the emphasis in responsibilities of the regional offices of the organisations concerned. They are also consistent with the results of the stakeholder analysis where the EA representative in the Fens was found to be primarily interested in the habitat and regulatory functions, specifically relating to habitats and water level management. In the Somerset Moors the RDS representative was found to be primarily concerned with funding various activities associated with habitat, information and regulatory functions and so livelihood provision.

The weights given by conservation organisations, as shown in Table 5.5 are broadly similar between the Fens and the Somerset Moors. Although the Somerset Moors representative placed greater relative importance on ecological integrity and less on hydrological management than the representative from the Fens. The Somerset Moors are currently more ecologically diverse and 'interesting' from a wildlife viewpoint, whereas hydrological management in the fens is still key to managing ecological interests. Much of what can be achieved in the Fens depends on intensive management of the hydrology or abandonment of the existing system and is currently most viable on land owned by a conservation body. These results are largely consistent with the findings of the stakeholder analysis where the RSPB were found to be primarily interested in general conservation, specific species and specific habitats explaining the weight given to ecological integrity, whereas the WT was found to be primarily interested only in general conservation and within that in habitat restoration. Furthermore, caught up in the secondary interests of the both the WT and RSPB was a large amount of emphasis on the importance of hydrological management in delivering effective habitat restoration schemes.

There is agreement amongst secondary stakeholders in their preference for ecological integrity and hydrological management, with these criteria having the highest average weights in this group. It is likely the interest of primary and secondary stakeholders in hydrological management is for differing reasons. With primary stakeholders placing weight on the maintenance of water tables suitable for agricultural livelihoods and flood prevention, and secondary stakeholders (except RDS) valuing high water tables and their associated species and habitats.

Tertiary Stakeholders: IDB (1 respondent) and FDC (1 respondent)

Table 5.6 shows the weights derived through the AHP questionnaire for each criterion according to the tertiary stakeholders of the Fens and the Somerset Moors.

Table 5.6. Tertiary Stakeholder Preference Weights

	Weight				
	Cultural Heritage	**Ecological Integrity**	**Hydrological Management**	**Livelihoods**	**Public Access**
Fens IDB	0.04	0.09	**0.30**	**0.52**	0.03
Somerset FDC	0.10	0.23	**0.24**	**0.30**	0.11
Arithmetic Mean	0.07	0.16	**0.27**	**0.41**	0.07

As shown in Table 5.6 the weights from the Fens tertiary stakeholder representative are more concentrated that those for the Somerset Moors representative. The Fens IDB representative selected Livelihoods as the most important Measure, followed by Hydrological management. Ecological integrity, Cultural heritage and Public access have a relatively low weighting. The Somerset Moors FDC representative had more closely matched weights. Livelihoods were given the highest weight, followed by Hydrological management and Ecological integrity respectively. Both the respondents rated public access and Cultural heritage as the two lowest priorities. These weights are surprising given the results of the stakeholder analysis, where the Fens IDB and the Somerset Moors FDC were found to be primarily concerned with water level management, not livelihoods. This discrepancy could be attributed to the fact that the interviews were concerned with the stakeholders role and interaction with peatlands and each other, where clearly the IDBs and FDCs purpose is water level management, where as the AHP questionnaire was asking how important stakeholders thought differing criteria were, indicating a belief within IDBs and the FDC that livelihoods should take precedence over other concerns.

There is agreement amongst the tertiary stakeholders that livelihood provision and hydrological management are the most important aspects of peatland use. Although it is evident, especially in the Somerset Moors that water management bodies are also increasingly concerned about ecological integrity.

The results presented in this section show that hydrological management is a key criterion for all stakeholders in peatland use preferences. This is because peatland systems are wetlands. It is likely stakeholders value hydrological management for differing reasons, some because it allows cultivation and protects homes from flooding and others because it encourages wildlife. Ecological integrity is a priority for secondary stakeholders and livelihoods are a priority for primary and tertiary stakeholders. The three priority criteria identifying peatland uses that maximise stakeholder well-being are therefore hydrological management, livelihoods and ecological integrity.

5.2.2 Preference Rankings and Stakeholder Priorities

This section presents the stakeholder preferences for peatland use options and their associated priority scores. This demonstrates which of the options compared in the AHP are likely to maximise stakeholder well-being and which likely to minimise it. These results also allude to general features of land use options, such as being fundamentally use or non-use, which may make them more or less acceptable to the different stakeholders. This section shows how, according to the results of the AHP, land use might affect stakeholder well-being.

Table 5.7 summarises the rankings of land use options derived by combining the criteria weights and stakeholder perceptions of land use performance against the criteria. The abbreviations used are as follows: Abandonment (Ab), Habitat Restoration (HR), Extensive Grazing (EG), Intensive Grazing (IG), Withies (W) and Arable (Ar).

Table 5.7. Option Preference Ranks According to the AHP Analysis

Stakeholders	Ranking					
R (Somerset), RSPB (Somerset)	HR	EG	Ab	W	IG	Ar
R (Fens)	HR	W	EG	IG	Ar	Ab
F (Fens)	Ar	EG	IG	HR	W	Ab
F (Somerset)	EG	HR	W	Ab	IG	Ar
EA (Fens)	HR	EG	W	IG	Ab	Ar
RDS (Somerset)	HR	EG	IG	W	Ab	Ar
WT (Fens)	HR	Ab	EG	W	IG	Ar
IDB (Fens)	Ar	HR	IG	Ab	EG	W
FDC (Somerset)	HR	W	Ab	EG	IG	Ar

Table 5.7 shows that despite the similar criteria weights derived for the stakeholders, there is a low degree of agreement in the ranking of peatland use options. This is attributed to differing perceptions of how the land use options perform against the criteria or to stakeholders valuing the criteria for differing reasons, or a combination of the two. Indeed, it was evident in the stakeholder analysis that stakeholders of the Fens and Somerset Moors differ in their ideas of land uses that provide livelihood, with stakeholders seeing the dominant use in each area as the best livelihood provider. Furthermore, stakeholder interactions show a degree of conflict over water management indicating that stakeholders have differing ideas on what constitutes good water management. Despite the limited agreement on the whole ranking however, 7 out of the 10 stakeholders, according to their responses, perceive the Habitat Restoration option to best meet their requirements and 7 out of the 10 stakeholders perceive the Arable option to least meet their requirements. This indicates a consensus to move towards much more extensive uses of peatlands and by so doing maintain or reinstate some of the habitat, information and regulation functions that have been depleted by more intensive uses. It is interesting that Arable is repeatedly the least preferred option, when Withy production, arguably as intensive in terms of cultivation as Arable, is often ranked as the second, third or fourth most preferred option and only once the least preferred option. It is thought this is for several reasons. Firstly Withy cropping is more compatible with a higher water table than arable cropping although it still requires low levels for harvest and planting. Secondly, withy production is viewed as a traditional wetland livelihood, especially in the Somerset Moors, and is therefore thought of as low input, extensive production and as part of the cultural heritage, even though it is now heavily mechanised and a

withy field is relatively uniform. Thirdly, given the current limited area of withy cropping it is possible stakeholders, especially in the Fens actually have relatively little operational knowledge of the land use and therefore no strong views on it, either positive or negative.

As with Withy production, the Abandonment option occurs at all levels of the ranking, bar the top position, at least once when it could be argued to be the most extensive land use option over and above habitat restoration. This suggests that stakeholders have an aversion to complete abandonment and opinion on this land use is very divided, making it an area of potential controversy and conflict. Or that the outcomes of the abandonment option are so uncertain stakeholders were not able to respond on this option in an informed manner. It is thought it is likely to be a combination of the two, with organisations such as the RSPB and WT interested in the results of abandoning the water level management systems altogether in some areas i.e. to see what happens, but maintaining some management of the land, and the EA seeing this as counter to their responsibilities as they would no longer be able to control flood events and so protect people and property, nor would they be able to deliver the specific conservation objectives of the PSA targets.

Tables 5.8 to 5.10 summarise the priority scores derived for each land use option according to the AHP analysis. The tables are a part answer to research question 3 according to the AHP. Assuming a high relative importance for a land use indicates a high degree of well-being if the land use is delivered, the Tables present how stakeholder well-being is affected by changes in peatland use according to their value systems.

Table 5.8. Priority Scores Derived for Land Use Options from Primary Stakeholder Preference Sets

Option	Priority Score (relative importance)					
	R Fens	R S/set	F Fens	F S/set	Mean	Range
Arable	0.12	0.07	0.44	0.04	0.17	0.04 – 0.44
Withies	0.22	0.14	0.12	0.19	0.17	0.12 – 0.22
Intensive Grazing	0.13	0.12	0.14	0.10	0.12	0.10 – 0.14
Extensive Grazing	0.21	0.17	0.16	0.31	0.21	0.16 – 0.31
Habitat Rest.	0.27	0.36	0.12	0.21	0.24	0.12 – 0.36
Abandonment	0.05	0.15	0.04	0.16	0.1	0.04 – 0.16

Interestingly it can be seen from Tables 5.7 and 5.8 that the preferences of the Fens resident suggest priority for habitat restoration, willow production and extensive grazing, rather than the dominant land use in the area, arable farming. It appears that habitat restoration might deliver well-being in the Fens because of the nature of its hydrological management rather than its delivery of ecological integrity. It is noted at this point that the respondent from the Fens had a greater operational knowledge than those interviewed during the stakeholder analysis. The respondent informed the interviewer that she worked on a community development project linked to the environment and access to the countryside. It is felt then, given the apparent indifference of local residents interviewed in the stakeholder analysis to their surroundings but their general consensus that the arable landscape is desirable, that the Fens respondent may not be very representative of local views. In the case of the Somerset Moors the resident showed clear preference for habitat restoration, giving the highest priority score to this option, followed by extensive grazing and abandonment. Here, habitat restoration was perceived to perform well against the range of criteria, maintaining important services such as ecological integrity, livelihoods and hydrological management.

As might be expected, the Fens farmer places greatest priority on land-use options, especially arable, that are perceived to perform best in terms of Livelihoods. Arable is the preferred land-use by a clear margin. Other options perform poorly compared to arable, with Extensive and Intensive grazing being the next most prioritised scenarios respectively. It is noted that grassland farming and the skills associated with it, are relatively uncommon is the Fens. Tables 5.7 and 5.8 indicate that the Somerset Moors farmer shows preference for extensive grazing, followed by habitat restoration. This is perceived to be the most beneficial land-use for the provision of livelihoods, hydrological management and ecological integrity. Alternative land use options gain more consistent priority scores from the Somerset Moors farmer than for the Fens farmer, reflecting the more even weighting of criteria for the Somerset Moors farmer. This reflects circumstances in the Somerset Moors, where farming is much more fully integrated with nature conservation, with farmers drawing financial reward from participation in agri-environment schemes.

There is some agreement amongst primary stakeholders that the Habitat Restoration and Extensive Grazing options for peatland management maximise stakeholder well-being. Although it should be noted there are relatively high ranges associated with the average priority scores, due not least to the high priority given by the Fens farmers to arable agriculture.

Table 5.9. Priority Scores Derived for Land Use Options from Secondary Stakeholder Preference Sets

Option	Priority Scores (relative importance)					
	EA Fens	RDS S/set	WT Fens	RSPB S/set	Mean	Range
Arable	0.04	0.03	0.03	0.03	0.03	0.03 – 0.04
Withies	0.12	0.11	0.12	0.10	0.11	0.10 – 0.12
Intensive Grazing	0.07	0.12	0.10	0.06	0.09	0.06 – 0.07
Extensive Grazing	0.29	0.30	0.15	0.28	0.26	0.15 – 0.30
Habitat Rest.	0.41	0.36	0.39	0.35	0.38	0.35 – 0.41
Abandonment	0.06	0.07	0.21	0.17	0.13	0.06 – 0.21

From Tables 5.7 and 5.9 it can be seen that the Habitat Restoration and Extensive Grazing options are the two most preferred peatlands uses for most secondary stakeholders. These land use types are shown to deliver on the criteria in a balanced way in both regional situations. Arable land use is the least preferred land use option for peatlands in all cases.

There is strong agreement amongst secondary stakeholders that the Habitat Restoration and Extensive Grazing options for peatland management maximise stakeholder well-being. There are relatively low ranges for the priority scores of the secondary stakeholder group, especially in the case of the low priority score derived for the Arable option.

Table 5.10. Priority Scores Derived for Land Use Options from Tertiary Stakeholder Preference Sets

Option	Priority Score (relative importance)		
	IDB Fens	FDC S/set	Mean
Arable	0.30	0.07	0.19
Withies	0.12	0.22	0.17
Intensive Grazing	0.15	0.09	0.12
Extensive Grazing	0.13	0.14	0.14
Habitat Rest.	0.16	0.29	0.23
Abandonment	0.15	0.20	0.18

From Tables 5.7 and 5.10 it can be seen that the preferred land-use option for the Fens IDB is Arable. This is consistent with the top priority of the Fens farmer. Arable farming is well established as the dominant land use in the Fens and as a main source of livelihood. The IDB plays a major role in providing standards of land drainage services and water regime management, including flood alleviation that maintain the Arable system. However, habitat restoration has the second highest priority score, closely followed by Intensive Grazing and Abandonment. This may well be because IDBs are increasingly involved in water level management for nature reserves and sites of special scientific interest in their areas and are under increasing pressure, as demonstrated in the stakeholder analysis, to account for biodiversity interests in all their activities. The Somerset Moors FDC representative has highest priority for the Habitat Restoration land-use option. This ranking reflects the multi-functional nature of habitat restoration, where it is perceived to deliver well against livelihoods, hydrological management and ecological integrity. The FDC representative, as with the Somerset farmer, favours a mixed landscape.

There is a degree of agreement amongst tertiary stakeholders that Habitat Restoration and Arable options for peatland management maximise stakeholder well-being. There is a large difference in the priority scores associated with the Arable option however. There is some regional agreement in preferences for the differing options between the tertiary stakeholders (in this case just water management bodies) and farmers.

These weights and priorities all suggest that the existing system of the Somerset Moors peatland is better at maximising stakeholder well-being than that of the Fens. In this form, the results suggest that the well-being of the Fens farmers is heavily favoured by current legislation and policy, over the well-being of other stakeholders, for the Arable land use option to be persisting and so widely. It should be noted however, the results are not adjusted for the size of the stakeholder groups, under which conditions primary stakeholder priorities would become more significant in the region as whole, potentially explaining this apparent disparity. It is not clear if the basis of farmers well-being in the Somerset Moors is more in line with other stakeholders than in the Fens because policy, legislation and accepted practice in the area has forced it in this direction or if it has always been better aligned because of other cultural reasons. The latter suggests this alignment might be difficult to achieve in the Fens without substantial conflict. Indeed the Somerset Moors NFU representative suggested in the stakeholder interviews that it is the latter:

'(the Somerset Moors) have maintained a local character and identity because people in the area have always been a bit resistant to change and wanted to keep doing things the old fashioned way. That is what gives the area its character, makes it very special and stopped it becoming like the Fens.' **Somerset Moors NFU.**

Figures 5.3 through to 5.6 show the perceived performance of the land use options against the criteria for some of the stakeholders of the Fens and the Somerset Moors. The results for Local Residents and Water Management Bodies are used by way of example, as the difference in perception between the two regions is most pronounced in their responses. It is clear that the stakeholders of the Somerset Moors perceive the land use options to perform across the range of criteria in a relatively even fashion. Where as the stakeholders of the Fens focus on the performance of the land use options against one or two dominant criteria. The difference in perceived performance of land use options against the criteria is magnified by the more even spread of weights attributed to the criteria by the stakeholders of the Somerset Moors than the stakeholders of the Fens. In combination this demonstrates a more developed understanding of the diversity of goods and services provided by peatlands in the Somerset Moors than the Fens.

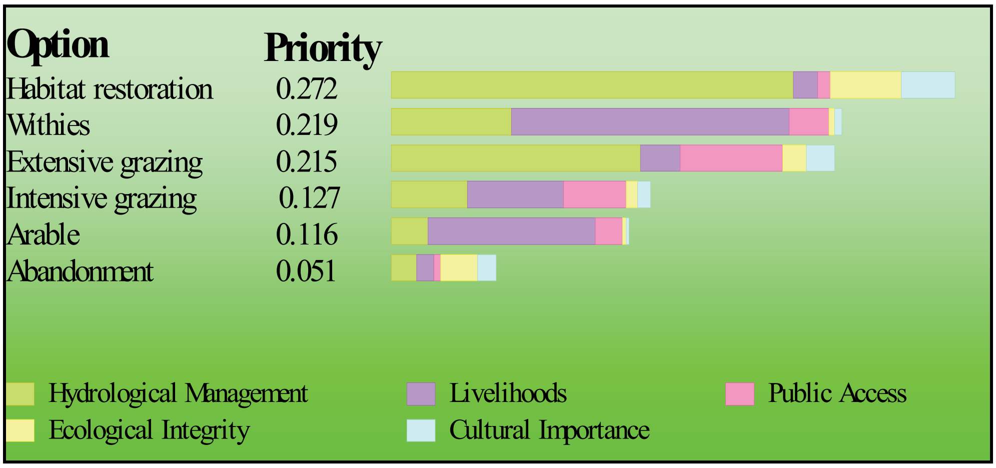


Figure 5.3. Priority Scores of a Fens Local Resident for the Land Use Options

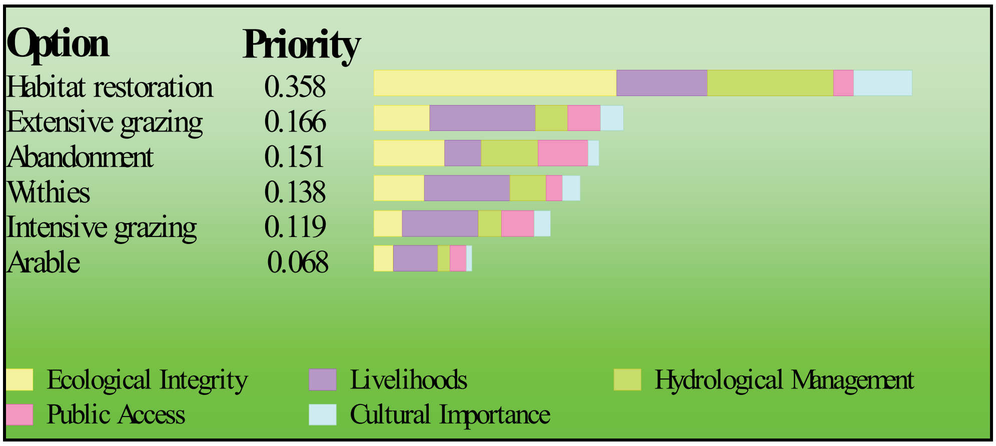


Figure 5.4. Priority Scores of Somerset Moors Local Resident for the Land Use Options

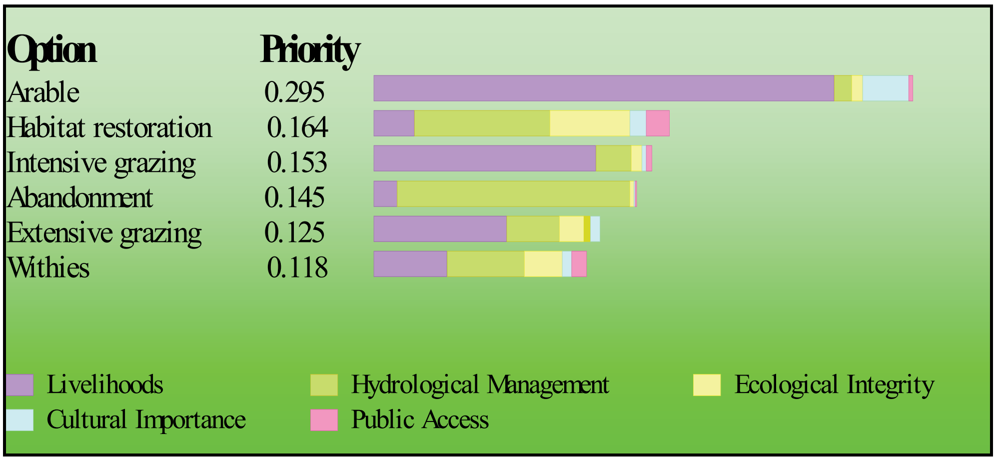


Figure 5.5. Priority Scores of a Fens IDB Representative for the Land Use Options

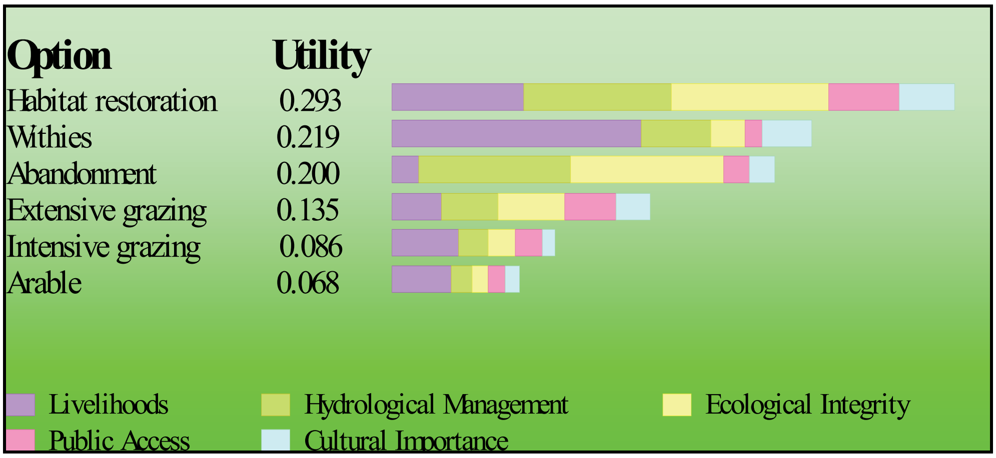


Figure 5.6. Priority Scores of a Somerset Moors FDC for the Land Use Options

Figures 5.7 to 5.11 show the relative distribution of a sample of stakeholder preferences for land use on peatlands based on the priority scores derived through the AHP analysis. Although they do not indicate the absolute preferred spatial distribution of land uses (in terms of an optimum land use distribution), they indicate the mix and relative proportion of the land use options examined in this analysis that might find acceptance amongst the different stakeholder groups.

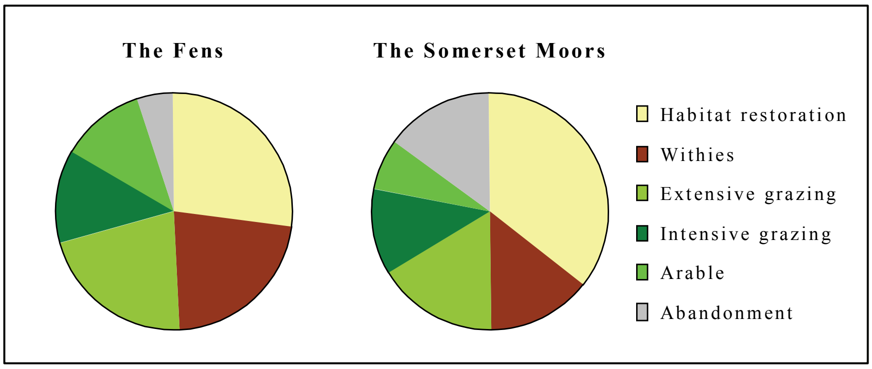


Figure 5.7. Proportion of Land Uses Potentially Acceptable to Local Residents

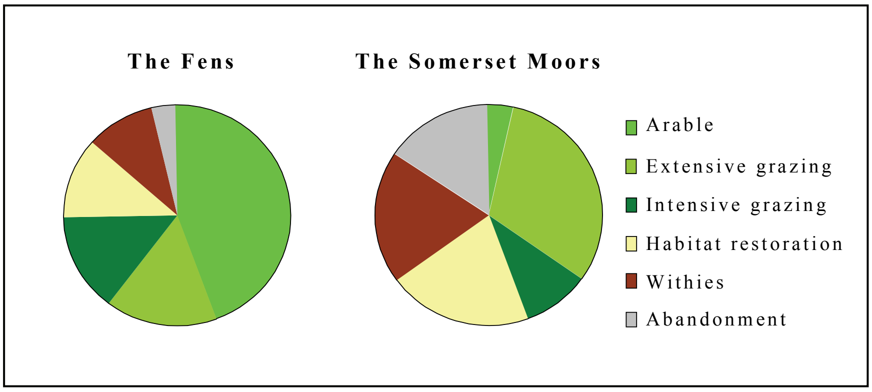


Figure 5.8. Proportion of Land Uses Potentially Acceptable to Farmers

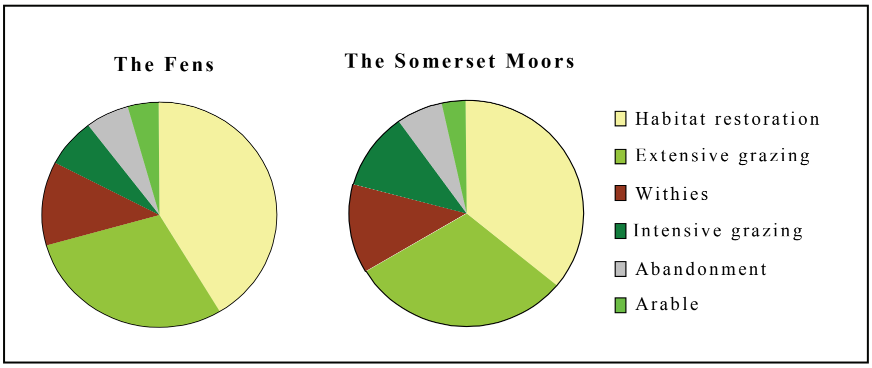


Figure 5.9. Proportion of Land Uses Potentially Acceptable to Statutory Bodies

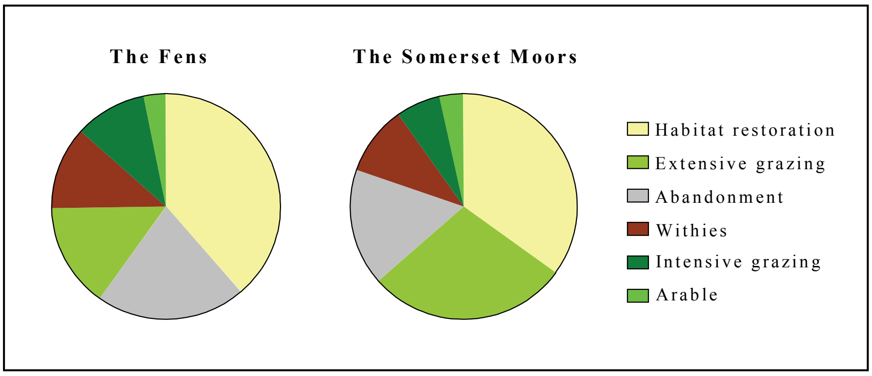


Figure 5.10. Proportion of Land Uses Potentially Acceptable to Conservation Organisations

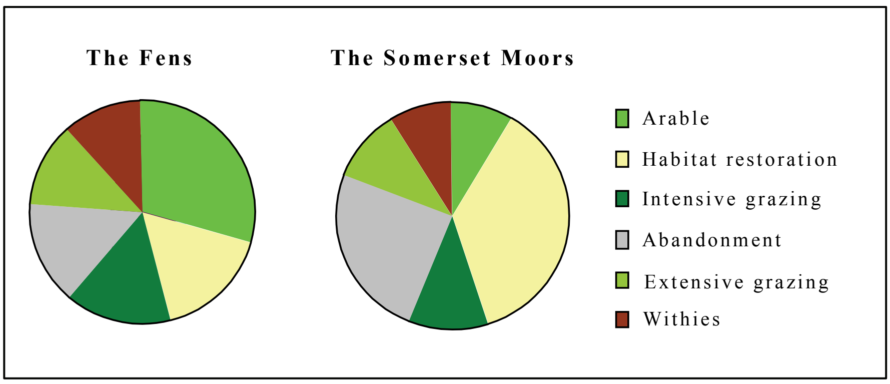


Figure 5.11. Proportion of Land Uses Potentially Acceptable to Water Management Bodies

Figure 5.7 shows clearly that the value systems of **local residents** in the Fens and the Somerset Moors lead to a similar distribution of potentially acceptable peatland use, rather than reflecting their actual surroundings, which might be expected. It was noted in the process of obtaining preferences with local residents that this group, more than others, had a less complete understanding of the criteria used for preference ranking and of the land use options being compared. This group needed much more information to complete the preference ranking exercise, and it was not always clear whether they had sufficient information to make informed choices.

It is clear from Figure 5.8 that the Somerset Moors farmer has a preference for a more mixed landscape than the Fens **farmer**, who has a preference for a landscape dominated by arable farming. This is reflective of the current situation in each of the region.

Figure 5.9 shows that despite the differing roles of the two **statutory bodies**, the very different contexts in which the respondents' work and the slight differences in their assignment of weights their preference for land use is almost identical. This might indicate that Government priorities are being consistently disseminated amongst its agencies, or might be reflective of the particular representative interviewed.

Figure 5.10 shows that, not surprisingly, **conservation bodies** would prefer a landscape dominated by Habitat Restoration and other extensive systems, with only a limited proportion of the more intensive land use options. The Figure also shows that agricultural land uses of any kind are much less likely to find acceptance amongst conservation bodies in the Fens than in the Somerset Moors, again indicating the potential for conflict in the future between the 'agricultural' and 'conservation' stakeholders in the Fens.

It can be seen in Figure 5.11 that there is a difference among the **water management** stakeholders. The Fens IDB prefer a landscape dominated by agriculture, whereas the Somerset Moors FDC favours a landscape that is dominated by habitat restoration and abandonment. The Somerset result is somewhat surprising given that the highest weighting was given to livelihoods. This potentially demonstrates the very differing ideas amongst stakeholders about what constitutes a livelihood. There is a clear distinction between the two water management stakeholders. The Fens IDB respondent sees the peatland landscape largely as a means of facilitating agriculture: a traditional Drainage Board view. The Somerset Moors FDC respondent prefers a landscape given over to habitat restoration and nature. This is probably because the Somerset respondent, a local politician and farmer as well as chair of the regional FDC perceives that conservation land use can provide many services, including still providing livelihoods through niche marketing of any agricultural produce and the regeneration of local, traditional, low impact skills and trades such as reed cutting for thatching.

The results of the AHP presented in this section suggest a consensus amongst stakeholders at the time of interview that favours an increase in the extensive use of peatland areas with high associated water tables. Although low impact use (towards 'non-use', i.e. no **direct** benefits being drawn from peatlands), can be said to be already prevalent in the Somerset Moors case, the area is still predominantly an agricultural area and as such must be productive. The Somerset Moors area in general is probably more intensively farmed than the results of the AHP suggest the majority of stakeholders would like it to be. In the Fens case, with the area being dominated by a salad and vegetable-cropping regime, the area is currently favouring the priorities of farmers and, according to these results, IDBs. It should be highlighted that on a national and international level, precisely because of the intensity of management, the Fens land use provides valuable services in terms of food production and income generation. These results though, on a regional scale, indicate the current distribution of property rights associated with agricultural tenure give prominence to farming and in the Fens in particular this means other interests maybe compromised.

5.2.3 Analytical Hierarchy Process Sensitivity and Risk Analysis

Stakeholder values are not constant over time and capturing them in a quantitative form can never be a precise process. Sensitivity analysis identifies small changes in the weights that have a notable impact on stakeholder priority scores for a given land use option or change the land use option preference rankings. Risk analysis identifies external circumstances that might change stakeholder values and seeks to understand the potential effect of these changes on stakeholder priorities and therefore land use option preferences.

For the sensitivity analysis, areas were identified in the preference rankings where the utility values were very similar for different land uses, implying a slight shift in the weight applied to the criteria, or perception of land use performance against the criteria, could cause a change in the land use preference ranking and the utilities derived. Any two land uses separated by only 0.05 units of utility were considered to be sensitive to change. 0.05 was chosen because at units below this the majority of rankings were sensitive to change allowing little to be gained from the analysis.

The results effectively show those points in the preference ranking where stakeholders are indifferent to the different land use options. Relatively little extra information was gleaned from the sensitivity analysis therefore the full results are not presented. By way of summary though, the analysis shows there is little sensitivity in the utilities and preference ranking of the top two land use options but that for the lower ranked land use options sensitivity varied considerably from stakeholder to stakeholder. There is no consistent trend in which stakeholders' preferences contained high levels of indifference. However, a large proportion of the points of sensitivity or indifference centred on the withy land use option, potentially indicating this is the option respondents were least familiar with and so least confident of how they perceived it to perform against the criteria.

For the risk analysis respondents were asked directly subsequent to completing the AHP questionnaire what factors might affect their responses. Respondents identified three main sources of risk: international conflict that would increase the demand for domestically produced food, climate change affecting land and water management and increased legislation especially with regards the environment. These factors could affect stakeholder preferences for the use and management of peatlands in a variety of ways, as shown in Table 5.11, where arrows indicate the likely direction of change, three arrows indicate a strong change and one arrow indicates a weak change and a dash indicates no change. As there are two types of pressure associated with climate change (land and water), and they have potentially different outcomes in the case of peatlands, the climate change scenario is divided into **a** and **b.**

In two of the four scenarios the result is a more extensive land use, preserving peat soils for future use or continued non-use, favouring stakeholders with priorities for ecological integrity and marginalizing those stakeholders with priorities for livelihood provision. In the remaining two, where a critical need takes precedence, the result is a more intensive land use, depleting peat soils and their associated ecosystem functions such as habitat, favouring stakeholders who prioritise livelihoods, marginalizing those who prioritise ecological integrity and eliminating the option of using the peatland into the future. It is noted that in all four scenarios the importance placed on hydrological management is likely to increase but for differing reasons. A more extensive use requires higher water levels and can be compatible with floodwater storage, and a more intensive use requires precision water table management.

The risk analysis indicates that despite the recent drivers towards environmental protection identified in the DPSIR analysis, given the voluntary nature of most mechanisms used to protect and enhance habitat and compatible information functions, peat soils and associated services are still vulnerable to changes in external circumstances. Furthermore, the future of peatlands is likely to be shaped by Government policy on climate change and whether it promotes the use of the production functions of peatlands, to ensure food security, reduce food transportation green house gas emissions and the ‘growing of fuel’, or promotes the reinstating of the regulation functions of peatlands, to cope with rising sea levels and increased incidences of flood and drought events. This response is as yet unclear and may well vary in the Fens and the Somerset Moors regions.

Table 5.11. Risk Analysis of AHP Results

Criteria	Risk Scenario			
	International Conflict (leading to issues of food security)	**Climate Change (a) (leading to increased drought and flood risk)**	**Climate Change (b) (leading to intensive bio-fuel cropping and issues of food security)**	**Environmental Legislation (leading to legal protection of biodiversity and the state of water and soil resources)**
Cultural Heritage	Weight likely to decrease or in the case of heritage organisations increase ↓↓↓ ↑	- ↓	Weight likely to decrease or in the case of heritage organisations increase ↓↓↓ ↑	-
Ecological Integrity	Weight likely to decrease or in the case of conservation organisations increase ↓↓↓ ↑	↑↑↑	Weight likely to decrease or in the case of conservation organisations increase ↓↓↓ ↑	↑↑↑
Hydrological Management	↑↑↑	↑↑↑	↑↑↑	↑↑↑
Livelihoods	- ↑	- ↓	- ↑	Weight likely to stay the same or in the case of farming stakeholders increase - ↑
Public Access	↓↓↓	- ↓	↓↓↓	-
Likely Outcome	Trend towards more intensive land use for food production such as arable cropping.	Trend to more extensive land use with more natural water management such as habitat restoration.	Trend towards more intensive land use for bio-fuel and food production such as arable cropping.	Trend towards more extensive land use with emphasis on biodiversity and resource maintenance such as habitat restoration.

5.3 Key Messages and Conclusions of the Analytical Hierarchy Process

This section summarises the results of the AHP, drawing out conclusions against the original research questions. It also highlights key messages from the investigation, both with regards to the implication of the results for management of peatlands and to the methodology and technical issues that arose.

Table 5.12 summarises the dominant criteria and weights assigned them as well as the preferred land-use options for peatlands according to stakeholder responses to the AHP questionnaire. The estimates must be treated cautiously as indicative only. This was an investigative analysis and the estimates are based on limited respondents. As such it is not possible to say whether these are representative of widely held stakeholder preferences. However, apart from the results for the Fens local resident it is an informed guess that these results are reliable and for the most part they are highly consistent with the findings of the stakeholder analysis.

The results show convergence amongst stakeholders in the relative importance placed on peatland services. Hydrological management and livelihoods are clearly perceived to be important criteria for the sustainable management of peatlands, together with ecological integrity. The latter is particular important to conservation organisations, as might be expected. While arable farming is the preferred land use on the Fens of East Anglia according to farmers and drainage authorities, habitat restoration is the preferred land use on peatlands for other stakeholders and the one which gives greatest achievement of their expressed preferences, and so maximises well-being.

Table 5.12. Summary of Dominant Criteria and Preferred Land Uses

	Farmers		Drainage organisations		Local residents		Conservation organisations		Statutory Bodies	
	Fens	**Som**	**Fens**	**Som**	**Fens**	**Som**	**Fens**	**Som**	**Fens**	**Som**
Cultural importance										
Ecological integrity						0.31	0.38	0.47	0.35	
Hydrological management	0.23	0.42	0.30	0.25	0.44		0.38	0.26	0.31	0.23
Livelihoods	0.60	0.40	0.52	0.31	0.30	0.29				0.33
Public access										
Land Use										
Pref 1	Ar	EG	Ar	HR	HR	HR	HR	HR	HR	HR
Pref 2	EG	HR	HR	W	W	EG	EG	Ab	EG	EG

Although the interest in the sustainable management of peatlands varies amongst stakeholders there does appear to be a degree of consensus that can potentially be mobilised, especially by initiatives that combine hydrological management (water level and flood risk management), ecological integrity (biodiversity and habitat management) and rural livelihoods (employment and incomes to rural people and support to the rural economy). Joining up policies on flood risk management, conservation management and rural development could help, through for example agri-environment schemes that target peatland areas.

There are some methodological issues that are worthy of comment:

- There is a range of MCA techniques with different advantages and disadvantages. The AHP method is amongst the simplest to apply. It is relatively easy for researchers and respondents to use. It adopts a systematic staged approach to ranking of criteria and options.

- AHP shows how people perceive the relevance of criteria for their decision-making.

- MCA techniques, including AHP, assume that respondents are clear and well informed about the criteria and options put to them. It was apparent that this varied considerably amongst respondents. It was felt in some cases, that informed respondents needed more quantification of criteria whereas other ones, especially members of the general public, required much guidance on the interpretation of the criteria before they could respond confidently. It is thought quantitative definition of land use performance levels against the criteria as opposed to the narratives used in this exercise could help in this respect.

- Although results were largely consistent with the stakeholder analysis results the weights placed on the hydrological management criteria were in general higher than might have been expected based on the stakeholder analysis, and hydrological management was also a key criteria in the risk analysis. As in this analysis the hydrological management criteria narrative described a combination of field water tables and flood storage it is felt this criterion needs refining in future analysis. This is primarily to ensure preferences for it cannot be misinterpreted due to several meanings.

- Results indicate there are differences amongst stakeholders in their interpretation of livelihoods, with some viewing it as the existing dominant land use and income generation method and others seeing potential livelihoods in low impact activities such as reed cutting for thatch and semi-wild cattle and indeed recreation and tourism activities. Different interpretations of livelihood may be minimised by increased quantification of this criterion.

- Abandonment as a land use option was hard to define given that the result is open ended and largely dependant on the previous land use and surrounding land use. Stakeholders therefore found it particularly difficult to countenance. It is felt therefore that it has limited use as a land use option in this type of analysis.

AHP was used here as a preliminary investigation into the use of MCA techniques for explaining the socio-economic aspects of wise peatland management. More specifically it was used to begin to assess how land use changes affect stakeholder well-being. The method showed the techniques have promise, broadly capturing aspects of the results of the stakeholder analysis in quantitative form, allowing for easier interpretation. Results clearly identify priority criteria for stakeholders in peatland use and show how peatland use affects stakeholder well-being by deriving measures of importance for each land use option. They also begin to highlight potential policy requirements to ensure the wise use of peatlands into the future. The AHP analysis is limited however in that it is largely subjective, can only derive proportional indications of option importance or stakeholder priorities and can only be applied to fixed option performance levels, so is unable to cope with the concept of changing marginal values. The following sections outline the MAUT MCA technique, which is used to address some of these shortfalls.

5.4. Multi-Attribute Utility Theory Methodology

Developed by Keeney and Raiffa (1993), MAUT or MAVT (multi-attribute value theory) is used for decision problems with multiple objectives and that force preference and value tradeoffs. By capturing and quantifying the results of these tradeoffs and developing a 'value function' for each element of the decision problem MAUT derives measures of utility for a set of possible outcomes. A value function is the mathematical explanation of stakeholder preferences for peatland service delivery over a range of levels (to be revisited later). Utility is an arbitrary measure of well-being, used here from 0-1, with 0 being 'not at all happy' and 1 being 'as happy as can be'. MAUT is suited to the problem of wise use of peatlands, where stakeholder interest in multiple ecosystem functions that are not always compatible, leads to multiple objectives for one piece of land and necessitates a trading off on the delivery of the various functions/services according to stakeholder values.

MAUT adopts a similar hierarchy to that in AHP but with slightly different terminology as shown in Figure 5.12. MAUT requires options to be described as precisely as possible by either quantitative or qualitative measures of the attributes. It is these measures directly that the decision maker or stakeholder expresses preference for and trades off between and so the selection of measures in a MAUT analysis is important for reliable results.

Although MAUT can cope with uncertain outcomes, in this instance it was used assuming certainty in outcomes. This was not because outcomes are certain but because data were not available to make sensible judgements on probability and range outcomes. Given the exploratory nature of the analysis, as opposed to decision making, this was not considered a problem.

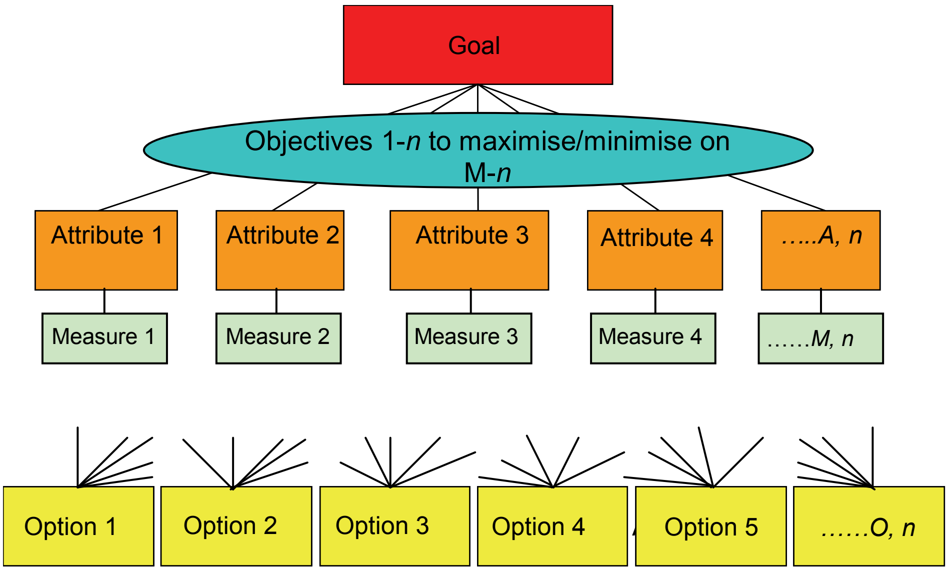


Figure 5.12. MAUT Decision Structure

As with the AHP the 'Goal' of the MAUT was to identify the peatland management option that maximises stakeholder well being. The following sections outline the option development process, the attribute and measure selection process and then give an account of how stakeholder values were collected and formalised.

5.4.1 Option Development

As in AHP, options here are decision alternatives. They are used to compare stakeholder preferences for peatland delivery of ecosystem services. They should be based on feasible scenarios that generate differing outcomes, which can be assessed against underlying stakeholder preferences.

The land use options used for the MAUT analysis were:

- Extraction (Ex - for growing media);
- Intensive arable (IA - salad and vegetable cropping);
- Intensive grazing (IG - improved grass, dairy);
- Extensive grazing (EG - unimproved grass, beef cattle);
- Habitat Restoration to Fen/Bog (HR - no landscaping, water levels restored to surface, likely to become sparsely wooded over time).

This differed to the options used for the AHP analysis in several ways: withy production and abandonment were omitted, extraction was added and arable was specified as intensive. This is because subsequent to the AHP analysis discussion with withy producers showed withy production to be unlikely on peatlands (i.e. areas with a layer of naturally accumulated peat *at the surface*). It was found that traditional varieties of willow such as those used for charcoal production or crafts, fair better on soils with a mineral top layer and peat soils subsurface. New varieties grown for biomass purposes can be easier grown and managed in upland areas with high rainfall than on lowland peat soils with water table management requirements for harvest (Personal Communication, 2003-2008). Furthermore, there was evidence in the AHP analysis to suggest that withy production was not a land use that stakeholders were familiar with; further suggesting it is not a common option for peatland use. It is a use in the Somerset Moors, as shown in Chapter 3, but only in limited areas and tends to occur at the edges of moors. Abandonment was omitted due to the high degree of uncertainty surrounding its outcomes and so performance against the criteria, making it difficult to describe by measures as required for the MAUT analysis.

Given the removal of two land use scenarios it was feasible to add another from the original list developed (Table 5.1). Extraction was previously omitted, as its occurrence within England on lowland peat soils is so limited; even within Somerset where it does occur new permissions are difficult and expensive to obtain. However, extraction is a current land use in England (where forestry is not) and is ongoing across Northern Europe. As the most intensive of land uses in terms of rate of peat soil loss it was considered appropriate to include. Arable was specified as intensive i.e.

salad and vegetable cropping, because this is where the comparative advantage lies with peat soils and as such is a large constituent of the Fens cropping regime.

5.4.2 Attribute and Measure Selection

Attributes are the means by which stakeholders can judge the relative importance or value of the differing land use options. Measures are the means of describing levels of attribute provision. These elements are critical to a MAUT analysis that determines utility for land use options based partially on their levels of attribute provision. In developing a MAUT analysis then there are two main challenges: first selecting the correct attributes and second selecting appropriate measures, including units and range.

Attribute selection for the MAUT analysis was, as with the criteria for the AHP, a highly iterative process based formerly on the ecosystem services found to be of importance in the stakeholder analysis. As such the attributes selected are directly representative of stakeholder views rather than analyst judgement. Furthermore, attribute selection for the MAUT analysis benefited from the experience and understandings gained in the AHP analysis.

The first step in attribute selection was to identify, from the full coding of the semi-structured interviews and associated secondary documentation, all those features of peatland management that are priorities for stakeholders. These features were then assembled under the appropriate function categories as services, as shown in Table 5.13. Particular services in Table 5.13 can be broken down, for example, cultural heritage comprises multiple variables such as local history/culture and archaeology, archaeology itself comprises the paleoarchaeological record contained within the peat, buried archaeological artefacts, built monuments and landscape features like flood banks.

Table 5.13. Start List for Attribute Selection Based on Results of the Stakeholder Analysis

Function Category	Service
Carrier	Support of development (housing, recreational facilities, industrial infrastructure associated with i.e. extraction or farm business)
	Support of navigation (road, water ways, tracks – car, bicycle, walking, boat, horse riding)
Habitat	Support of general biodiversity
	Support of rare habitat
	Support of rare species
Information	Provision of artistic and spiritual inspiration
	Provision of cognitive opportunities (including education about food and farming and opportunities for increased scientific understanding of the systems and for example how to produce favourable condition)
	Conservation of cultural heritage (paleoarchaeological record, artefacts, built monuments, landscape features)
	Provision of pleasing landscapes
	Provision of recreation opportunities (walking, cycling, horse riding, fishing, shooting, canoeing)
Production	Support of livelihoods (predominantly associated with production at present but valued independently)
	Support of agriculture (arable, dairy, beef and withy)
	Provision of fuel
Regulation	Provision of flood storage
	Maintenance of soil condition
	Maintenance of water quality
	Regulation of water table/resources
No Fit	Maintenance of 'feel' of the area (often associated with the agricultural landscape and the rural and 'working' nature of the communities)
	Promotion of communication (the facilitation of communication between organisations by a third party)

The next stage was to reduce the list in Table 5.13 to a manageable set of attributes. This was done primarily by eliminating double counting, i.e. valuing the same peatland feature twice. In this process it was found there was a distinction between those peatland services stakeholders want to see delivered and those services that enable or support their delivery, and therefore introduce double counting. For example, stakeholders value the 'support of development' service because it enables infrastructure for agriculture and recreation, to include both development and recreation opportunities as attributes then immediately introduces double counting. Removing such overlaps reduced the number of potential attributes by around half.

Furthermore, feel of the area was thought to be dependant on all the services of peatlands and the degree to which they are delivered under differing land uses, as well as other factors not covered in this work, such as community structure in terms of age and socio-economic background. It was too ill defined, open to personal interpretation, immeasurable and disconnected from actual peatland management be included as a MAUT attribute.

Subsequent to removing double counting ‘provision of artistic and spiritual inspiration’ was removed as a potential attribute as it was only referred to as a priority feature of peatlands by stakeholders on one occasion. This was in reference specifically to pristine peat bogs, which are not the focus of this research.

The final stage of attribute selection was to confirm the preferential independence of the remaining potential attributes. This implies that preferences for alternative levels of any attribute do not depend on the levels of all other attributes. Preferential independence is important in determining the utility associated with individual attributes and how they combine in differing land use options. The matrix in Figure 5.13 represents the preferential relationships between the potential attributes, on the basis of which two more were removed from the analysis – support of biodiversity and support of resource production.

Preferential dependency between two attributes was assumed when one could not exist with or without the other, or when one *directly* affects the other. This would mean a decision maker or stakeholder’s preference for a particular level of one attribute is highly likely to depend on the levels of another. For example, in the case of a heritage stakeholder their preferences for different levels of production are likely to be dependant on the associated levels of above and below ground archaeological features a particular level of production allows. This is because increases in production intensity and associated increases in soil tillage and lower water tables preclude the maintenance of above and below ground archaeological features and in the extreme of peat extraction all above and below ground features are removed. Equally a farmer’s preference for differing levels of above and below ground archaeology is likely to be dependant on the associated level of production a particular level of features allows. This is because the presence and maintenance of a great deal of above and below ground archaeology precludes an increase in production intensity, as it would not for example allow for lowering of the water table, tillage of the soils, increases in field sizes or removal of inconveniently shaped/placed features.

However, attributes can at times appear related without being dependant when there is a correlation (positive or negative) between them rather than a causal relationship. Correlation was assumed rather than dependency when:

a) **A third feature connects the two.** This means they are both dependant on the same external variable rather than on each other. For example both the preservation of below ground archaeology and provision of habitats and rare species are reliant on a high water table, therefore if there is good preservation of the below ground archaeological record there is also likely to be a high incidence of the habitats and so rare species associated with peatlands. However, the archaeology is not well preserved *because of* the presence of good habitats, neither are the habitats present *because of* the archaeology.
b) **One or other of the attributes is multi-faceted.** This means that one or other of the attributes involved in the relationship has several facets to it and therefore may not be completely dependant on any other one attribute. For example, with regard to landscape quality, it would be untrue to assume dependency between landscape quality and production when landscape quality will also be affected by setting, topography, wildlife and other natural features, meaning production can only ever be part of what comprises landscape quality. Therefore it can never be entirely dependant on productivity, as it cannot be entirely dependant on topography or wildlife either.

Habitat and Rare Species	=							
Above Ground Archaeology	-/+	-/+						
Below Ground Archaeology	-/+	-/+	+					
Landscape Quality	-/+	-/+	+	X				
Recreation	-/+	-/+	+	+	+			
Flood Water Storage	-/+	-/+	-/+	+	-/+	-/+		
Livelihood	-/+	-/+	-	-	-/+	-/+	-/+	
Production	=	=	=	=	-/+	-	-/+	+
	General Conservation	Habitats and Rare Species	Above Ground Archaeology	Below Ground Archaeology	Landscape Quality	Recreation	Flood Water Storage	Livelihood

= = dependency; + = may at times be a positive correlation; - = may at times be a negative correlation; x = no known relationship

Figure 5.13. Correlation Matrix for Potential MAUT Attributes

Having removed double counting, attributes found to be insignificant in terms of stakeholder priorities, those not directly related to the research and those with obvious dependant relationships with other attributes, the attributes of the MAUT analysis were: **wildlife interest, above ground archaeology, below ground archaeology, landscape quality, recreation, floodwater storage** and **livelihood.** From a decision maker's perspective these transformed into the following objectives for peatland use:

- Maximise wildlife interest;
- Maximise preservation of above ground archaeology;
- Maximise preservation of below ground archaeology;
- Maximise landscape quality;
- Maximise recreation opportunities;
- Maximise flood water storage;
- Maximise livelihood provision.

Measures of these attributes needed to satisfactorily encompass all relevant features of the attribute and in a way that was transparent and simple in order that stakeholder respondents were not overly challenged in understanding them. There is no single solution to defining measures and therefore no right or wrong answers, but it was necessary the measures be rational. Table 5.14 shows the measures selected for the attributes, their units and range, and gives the rationale for their use. These were arrived at on the basis of communication with stakeholders during the development of the AHP criteria, trial and error and data availability.

The recreation attribute was replaced by 'practicability of access' at this stage as recreation potential is related to both the interest provided and the practicability of access. It was thought including recreational interest risked double counting wildlife interest and landscape quality. The Floodwater Storage measure was compatibility with land use option rather than the possibly more expected quantity of water able to be stored. This was because flood water storage and management decisions are affected more by land use than by existing water table, i.e. assuming two sites are located suitably and of the same area, an extensive grazing site would be used for flood water storage purposes in preference to an arable site as the damage to the system would not be as great. Therefore it is often the resilience or compatibility of a system or land use to flood events that is important to flood storage decisions rather than the volume of water that might be stored.

Defining a measure for wildlife interest needed to be done carefully given the knowledge that stakeholders themselves disagree on how it should be interpreted. As discovered during conversations with stakeholders over the AHP criteria some stakeholders felt strongly that the measure should be habitat not species related, whilst others felt strongly in the other direction. It was felt there was some political motivation for the habitat rather than species focus, in that it is much easier to derive targets for rare species, e.g. that a site should support 10 pairs of breeding Snipe. This kind of target can be difficult to meet and can lead to a very narrow management focus especially if failure to meet them has funding and ultimately job security implications as with the PSA targets (as shown in the DPSIR section of the stakeholder analysis). Potentially because of this, Government regulated organisations showed an aversion to species related measures with regards to this research. In response to this a measure was derived that attempted to incorporate several aspects of wildlife interest but that could not be translated into specific management targets.

The livelihood measure also needed to be treated with care given the evidence in the AHP analysis that stakeholders interpret it in different ways. Several measures were considered, including potential employment numbers and net margin. Gross margin or more accurately a Present Value gross margin (that is an annual gross margin discounted over a 30 year period and adjusted at intervals according to the remaining soil and so likely income) was decided on for several reasons:

- Most stakeholders seemed to regard livelihood as a living from the land that is dependant on land use performance rather than a profession with an attached salary. Furthermore, determining employment numbers can be difficult when a lot of work is seasonal, dependant on the size of operation, volunteers are commonplace and work is contracted out;
- Net margin, although potentially a better measure as it shows actual profit is a complex calculation dependant on fixed and variable costs of business. It can

therefore only be determined if data are available. In the case of agriculture this data is published but this is not the case for peat extraction and the data required was not obtainable within the time frame.

- A discounted and adjusted gross margin could be determined for extraction with the data available and this measure provides an indication of the income generating capacity of the different land uses.

Table 5.15 shows how the attributes and measures were used to describe each land use option, i.e. how the land use options perform against the selected attributes by the selected measures. Table 5.15, together with the measure ranges displayed in Table 5.14 formed the basis of the MAUT analysis.

Table 5.14. Attribute Measures and Rationale

Attribute	Measure	Range	Rationale
Wildlife interest	% of what is possible on lowland peat soils	0-100	The percentage represents the potential contribution to wildlife interests, namely rare bird species, vascular plant species richness and rarity of habitat (accounting for rare species, general biodiversity and habitat). Potential rare bird species supported were totalled together with vascular plant species richness figures and habitat rarity featured as a multiplication factor. The resulting figures were then translated into a percentage with the highest figure being taken as 100%.
Above ground archaeological interest	Score relating to a narrative	3-15	The score represents the potential conserved value in terms of above ground archaeological interest where: • 3-6 = LOW • 7-11 = MEDIUM • 12-15 = HIGH The score assumes the initial presence of high value above ground archaeological features and attempts to capture the value likely to be remaining after 10 years if land use activities are carried out without special measures taken to protect these features. The score does not relate to built monuments given that they are likely to be Scheduled and their interest is often independent of the peatland, rather it looks at features such as flood banks and ridge and furrow evidence. The method used to derive the score attributes value on the basis of likely remaining abundance, likely remaining prominence and likely remaining cohesiveness.
Below ground archaeological interest	% of peat stock left after 100 years	0-100	The percentages represent the amount of peat stock remaining after 100 years assuming a start depth of 2 metres. They are based on measures of peat loss under different land uses. Peat loss is important here because degrading soil means reduced quality of buried artefacts and a loss of the record within the peat itself.

Landscape attractiveness	Score relating to a narrative	0-5	The scores given here represent public opinion on the attractiveness of differing land uses when asked to score photographs using the scale: • 0 = not at all attractive • 1 = very low attractiveness • 2 = low attractiveness • 3 = average attractiveness • 4 = high attractiveness • 5 =very high attractiveness Around 80 people from peatland communities were surveyed. Attractiveness of peatland landscapes was found to relate to primarily to openness, seasonal change and variety in landscape features, with variety in landscape features being of most importance. Public opinion was sought here as the criteria is extremely subjective and it was not the intention to assess respondents views of the attractiveness of different land uses but rather to assess how important public perception of attractiveness was to them.
Practicability of access	Score relating to a narrative	3-9	The score is a combined measure of how well each land use might perform against several attributes of site access, meaning: • 3-4 = LOW • 5-7 = MEDIUM • 8-9 = HIGH The scores are derived by combining a score out of at least one out of three on each of health and safety implications of site access, variety in potential types of access and the contiguity of rights of way likely to be found. With these three features being found to be important in terms of recreational access.

Compatibility of land use with: a spring/summer flood or an autumn/winter flood	Score based on a narrative	-1-1	The scores here represent the potential effect of a flood event of duration less than one month on a land use, where: • -1 = negative impact • 0 = neutral impact • 1 = positive impact A negative impact means damage is done to a land use and a positive impact means an enhancement of a land use.
Livelihood provision	£/ha/yr	0-981	The figures given here represent an estimate of the potential average annual gross margin for each land use scenario, based on current commodity values and likely impacts of reduced productivity over time with peat wastage. These values do not represent profit as they do not account for fixed costs of production or any likely subsidies but they do indicate relative potential incomes for each of the land use scenarios. Livelihood is taken here to mean a means of supporting ones existence from the land, rather than a means of supporting ones existence through business or professions relating to land management or tourism.

See Appendix VIII for associated calculations and survey methodologies where appropriate.

Table 5.15. Land Use Options as Defined by the Attribute Measures

Land Use and Associated Water Table (Average cm below mean field level)	Peat extraction (180-200)	Improved grassland grazing (50-60)	Habitat restoration to sparsely wooded bog/fen (0)	Unimproved grassland grazing (20-40)	Intensive arable (60-150)
Attribute					
Wildlife interest	3	30	88	100	20
Above ground archaeological interest	5	10	11	14	8
Below ground archaeological interest	0	74	100	85	17
Landscape attractiveness	1	3	4	3	3
Access practicability	3	6	8	6	4
Spring/summer flood event compatibility	-1	-1	1	-1	-1
Autumn/winter flood event compatibility	0	0	0	1	-1
Livelihood provision	981	653	0	176	817

These figures are estimates based on the literature, expert opinion, practical knowledge and survey results. They represent a point estimate only of what is possible, based on the performance of existing areas under these land uses, rather than certain outcomes or probability based ranges. Associated calculations and survey methods can be found in Appendix VIII

5.4.3 Deriving Measures of Well-Being

MAUT derives measures of utility for differing options through a two-step process. First deriving the value function for each of the attributes (mathematical representation of the rate of utility changes with attribute level change) and second deriving a weight (measure of importance) for each of the attributes. In this analysis the trade-off method was used to determine weights, i.e. how much of attribute x would you give up to keep your most preferred level of attribute y? This information is then combined for each land use option to derive a utility measure in the following way:

$$v(x_1,x_2,\ldots,x_n) = \sum_{i=1}^{n} \lambda_i v_i(x_i)$$

Where $v(x_n)$ is the value function (or utility) for the land use option at attribute levels x_n, λ_i is the weight for each attribute, v_i is the individual value function for each attribute and x_i states the attribute. This equation scales v and v_i from zero to one, meaning the utility measures derived for each land use option in MAUT are out of one rather than summing to one as in AHP.

An interview process was developed to take stakeholders through each of the two steps in a sequential and standardised fashion. A small number of pilot interviews were carried out with members of the general public in order to ensure the selected attributes and measures were appropriate and to develop an interview technique. These interviews exemplified some of the issues surrounding 'expert' and 'lay person' knowledge with the pilot respondents, although coping without difficulty with the concepts (well-being curves and trade-offs) and the attributes, demonstrating an incomplete understanding of their own feelings towards peatland attributes having not considered them directly for some time, if ever. Logical Decisions for Windows was used as an aid to the interview process because of its graphical displays. All interviews were recorded via Dictaphone to allow a revisiting of stakeholder reasoning when analysing the results.

Respondents were first asked rank the land use options in an intuitive fashion, from most preferred to least preferred on the basis of their priorities for land use. This was later used to ensure the MAUT results were reliable in representing stakeholder values. Secondly stakeholders were asked to draw utility curves for each of the attributes. That is a graphical representation of how their utility (well being) increases (or otherwise) with increased levels of an attribute, indicating marginal utility at differing attribute levels (the change in utility with one unit change in attribute level). This process derived the value function for each attribute. That is the equation that best fits the utility curve derived. Finally respondents were asked to establish weights for the attributes by going through a series of tradeoffs, identifying one point on an indifference curve. That is the line over which a respondent would not be able to choose between point *a* and point *b*, where the levels of the two attributes being traded off are different at points a and b. For example, a respondent might not be able to choose between 80% wildlife interest and 50% below ground archaeology and 75% wildlife interest and 100% below ground archaeology. The form the questions took forced respondents to give a point on the indifference curve that yielded the highest utility. The value functions already derived for the attributes allowed the completion of the indifference curve by the Logical Decisions software, allowing a reduction in the number of questions required and so length of interview. The indifference curves allowed the derivation of weights. For instance, in the wildlife interest and below ground archaeology example, wildlife interest is of more importance to the respondent than below ground archaeology, with a 50% increase in below ground archaeology only compensating for a 5% drop in wildlife interest along that indifference curve. Weights were determined in a ratio fashion as in AHP and therefore weights for all attributes summed to 1.

Only samples of tradeoffs were carried out during the initial interview, enough for the remaining tradeoffs to be inferred assuming the respondent would have answered consistently. This again reduced the length of the interview and so reduced poor quality responses due to tiredness. A sample of follow up phone calls was made subsequent to the interviews to carry out consistency checks, which were establishing if the respondent was in agreement with the inferred tradeoffs. For example, in the interview they may have indicated indifference at maximum livelihood provision and 50 percent wildlife interest, and at maximum wildlife interest and 60 percent below ground archaeology. In this case a consistency question would carry out a trade-off between livelihood provision and below ground archaeology assuming it would result in indifference at around maximum livelihood and 30 percent archaeology. If this was not the case then adjustments were made with the stakeholder to the trade-off in question or to associated trade-offs (where ever the inconsistency was felt to lie) until there was reasonable agreement.

After the sample of phone calls, targeted at stakeholders considered most likely to have answered inconsistently and some of those who were thought to have been consistent, consistency checks were done by the analyst on the basis of their understanding of the stakeholder priorities and with the aid of the interview recording, which captured stakeholder reasoning from the original interview. Most stakeholders required little adjustment in responses in the consistency check stage, even those where it was thought some tradeoffs might need to be revisited. The adjustments required for consistency in the MAUT analysis were then considerably less than those required for AHP.

Stakeholder responses to the above process, stored as individual preference sets, were collected during face-to-face interviews. Subsequent to pilot interviews outlined previously 28 interviews were carried out. Each interview lasted about one hour and was carried out with representatives of the stakeholders in the Fens and the Somerset Moors. Generally one individual from each stakeholder (i.e. EA, IDB) was interviewed in each of the regions and was asked to respond from an organisational perspective rather than an individual one. Representative bodies were interviewed in place of primary stakeholders as the stakeholder analysis showed their views were largely similar. It was hoped interviewing one member of a representative body would give a similar result to interviewing many individual primary stakeholders, as they would be representing the dominant and most abundant opinions of their constituents or members. It was felt, given some of the anomalies that occurred with the AHP results from individual representatives of primary stakeholders, specifically local residents, more responses than could be feasibly collected in the time using the method derived would be needed from primary stakeholders to make the results meaningful.

Respondents were given tables 5.14 and 5.15 to help them make their decisions and in Table 5.15 the land uses were deliberately presented randomly rather than along an intensity spectrum to try and avoid implied value judgement. Although respondents were asked to look at the tables prior to commencing the interview they predominately they relied on information provided by the interviewer. In order to help respondents with the utility curves and trade-off process examples were presented and talked through before commencing and respondents were offered the chance to try a practice version. This presenting of examples proved extremely useful in helping respondents understand what was being asked of them.

As with the AHP analysis ability of stakeholders to understand what was being asked of them was variable but surprisingly over all most respondents found the MAUT format of questions easier to cope with than the AHP, most probably because of their more tangible nature, dealing in units and visual representations rather than an unfamiliar and abstract scale.

The unstructured approach to deriving utility curves was successful in that it:

- forced respondents to think about how their utility increased in relation to the attribute
- ensured the respondent understood the attribute and measure units
- allowed for unexpected or unusual curves and for respondents with very clear ideas on minimum acceptable levels
- encouraged discussion over why they chose the curve they did

The method was not so successful in that it:

- was very open and therefore led to some particularly complicated curves
- was intimidating to respondents who were least comfortable with what was being asked of them and least certain of their opinions

In cases where respondents struggled to start the process it was found extremely useful to get them to explain their views on the attribute to the interviewer who then translated this into a potential curve for them and explained what it meant. This was usually enough to make respondents comfortable. Other methods may have been used, such as asking respondents to chose from a set of predefined curves or go through a stepwise process, identifying midway points. It was felt that some detail and flexibility would have been lost with predefined curves but that potentially a step wise process could have alleviated the issues of complexity. In general it was felt that the face-to-face open style of interview and the discussion that facilitated allowed for added insight into the reasons behind choices and therefore an easier and potentially more accurate interpretation of results.

5.4.4 Reliability of Results

In order to determine if the MAUT model was effective in capturing and describing stakeholder values the option ranking results of the MAUT analysis were compared with the intuitive option ranking stakeholders were asked to carry out prior to interview. Each individual respondent's intuitive option ranking was compared to the option ranking derived from the MAUT analysis on the basis of their responses. Those comparisons that had a 60% match or above i.e. there was only one point of disagreement centring around two land uses, perhaps the MAUT results ranked extraction above arable when the respondent intuitively ranked arable above extraction, were considered a reasonable agreement. 79% of the MAUT results had reasonable agreement with the stakeholders' intuitive rankings, with 29% at 100% agreement. After minor adjustments to weights (changing any single weight by no more than 4% and only when it was felt this was consistent with the stakeholders views) reasonable agreement was raised to 93% and 100% agreement to 32%.

Ensuring agreement between stakeholders' intuitive ranking and the model result was considered to be of particular importance regarding the most preferred land use option. That is, if the stakeholder intuitively ranked intensive grazing as their most preferred land use then it was considered important the MAUT results, based on their responses, reflect that. Agreement in the highest-ranking option after the minor adjustments to weights described above was 68%. Agreement on the least preferred option was not nearly so good, at only 43%.

Disagreement between intuitive ranking and analysis results for the most preferred option was normally over the swapping places of the habitat restoration and extensive grazing options. For the least preferred option disagreement was normally due to the swapping places of the extraction and intensive arable options. Rarely was the disagreement larger than a one ranking shift or between land use options that are substantially different in their performance against the peatland attributes being measured.

Despite the above problems it was felt the MAUT model reliability was good, indicating the attributes chosen and measures used to describe them are effective in capturing stakeholder values towards peatlands. Furthermore, this suggests the stakeholder analysis process prior to the model development was effective in informing the model development, both from the point of view of providing the attributes for assessment and also in informing the analyst of some of the intricacies of stakeholder values.

Persistent points of disagreement between stakeholder intuitive ranking and analysis results are thought to be attributable to issues with the livelihood measure in particular. It is thought this leads to a systematic error in the value functions derived for the livelihood attribute and so for the overall value functions. However, it is also due to a degree of inconsistency between the stakeholder original rankings and the way they respond in the interview process.

All results presented are based on the responses after the agreement rate was improved and persistent problems are discussed throughout the results section when appropriate.

5.4.5 Summary

This section has detailed and critiqued the data collection methods used to both build the MAUT model and derive stakeholder preferences for ecosystem services (attributes). It explained that relevant functions and services, derived from the stakeholder analysis, were converted into a set of easily recognisable attributes with associated measures. It also described the process of ensuring the results are reliable. It outlined that the MAUT process captures in quantitative form the value structure of peatland stakeholders over a range of attribute levels and so derives measures of utility for different peatland use options. This indicates the functions and services of most relevance to stakeholder well being and their marginal utility at differing levels. The following MAUT results section presents the attribute weights, utilities associated with land use options and attribute marginal utilities derived in the analysis.

5.5 Multi-Attribute Utility Theory Results

The 'Goal' of the MAUT was to identify the peatland use option that maximised stakeholder utility given their preferences for different peatland attributes.

MAUT was carried out with more respondents than the AHP and so can be regarded as more conclusive. The MAUT analysis was designed to address some of the shortfalls of the AHP analysis, to shed light on the effect of peatland use on peatland services and to confirm or otherwise the results of the AHP with regard to the effects of peatland use on stakeholder well-being. As a relatively large number of stakeholders took part in the MAUT analysis results will be examined as aggregates (arithmetic means) for the most part and individual responses only referred to by way of example. This section presents and discusses the results of the MAUT analysis. It examines the relationship between peatland use and ecosystem service delivery before presenting and discussing the attribute weights, utilities associated with land use options and attribute marginal utilities derived in the analysis.

5.5.1 Peatland Use and Ecosystem Services

No physical data was collected as part of this research project to assist in answering the ecosystem services element of research question 3, regarding the effects of peatland use on the capacity of peatlands to deliver various services. Ideally this part of the research question would be answered by collaboration with specialists in areas such as hydrology, ecology and soil physics. In the absence of such collaboration (a feature of time and resources) this section is a discussion about peatland use and peatland services based on indicative levels of the attributes derived for land use options: **Extraction, Intensive Arable, Intensive Grazing, Extensive Grazing** and **Habitat Restoration**. These levels were derived for the purposes of the MAUT analysis and given in Table 5.15 above. The levels were derived according to the rationales in Table 5.14 and details on derivation can be found in Appendix VIII.

Figures 5.14 through 5.21 show the performance of the land use options against each of the attributes in turn. The attribute measures are the y axis in each figure and are those used for the MAUT analysis.

Figures 5.14 to 5.21 show the relationship between peatland use and delivery of ecosystem services is complex. It is not as simple as the more intensive the use, the more depleted the level of service delivery. Most obviously, as shown in Figure 5.18, the provision of livelihoods by peatlands increases significantly with intensity of use. Also, whilst an extraction site is in use it provides a degree of flood storage capacity, that is, the hole left in the ground can be filled with water if required during the winter months. This service is only effective however while the site is still in use as this means it is pumped dry again in between times. Services derived from information functions can also increase as intensity of use increases. For example, some respondents considered an area of arable cropping of higher landscape quality than an area of extensive grazing. The average scores come out at the same level for each arable and extensive grazing but at an individual level intensive use can deliver a better quality landscape. This demonstrates the often subjective nature of the information functions.

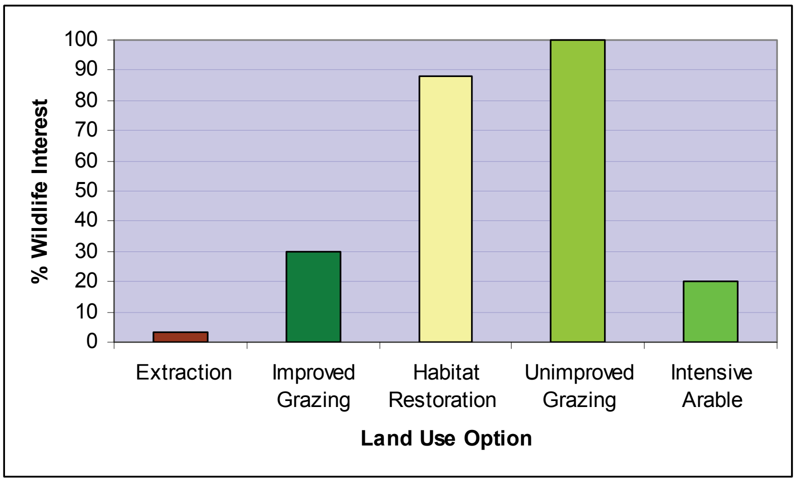


Figure 5.14. Land Use Option Performance in Wildlife Interest

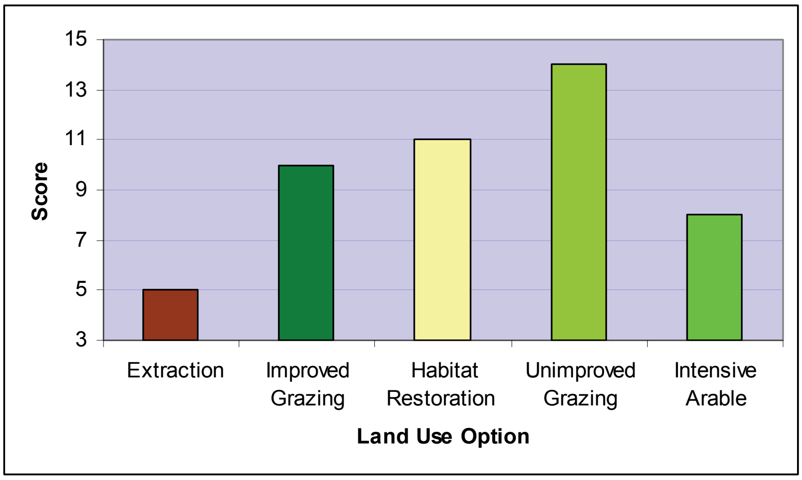


Figure 5.15. Land Use Option Performance in Above Ground Archaeology

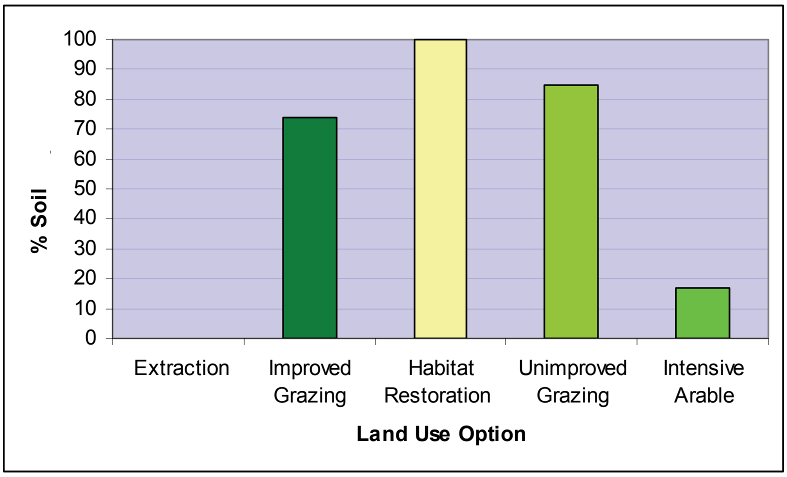


Figure 5.16 Land Use Option Performance in Below Ground Archaeology

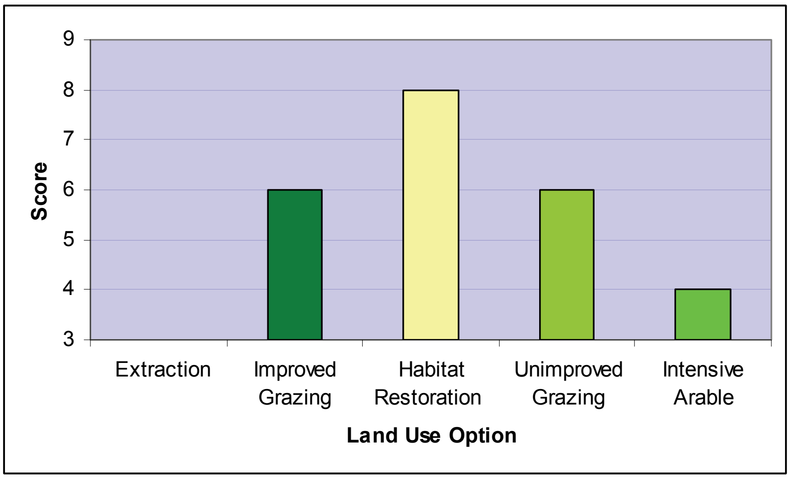


Figure 5.17. Land Use Option Performance in Access Practicability

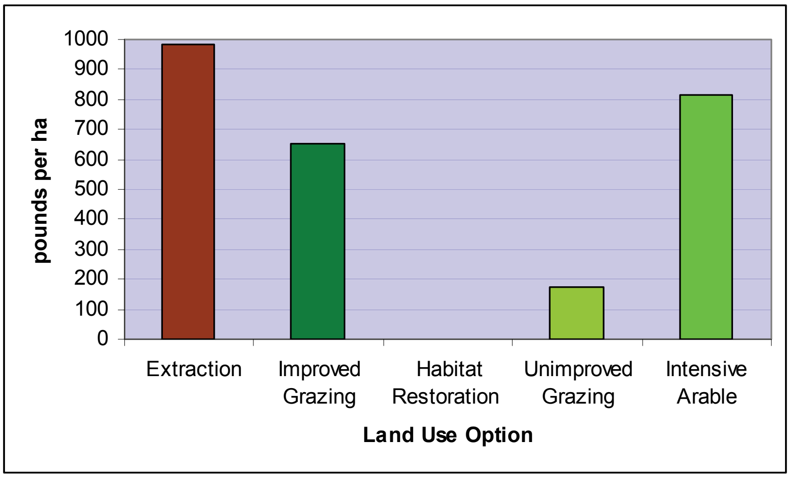


Figure 5.18. Land Use Option Performance in Livelihood Provision

Figure 5.19. Land Use Option Performance in Spring/Summer Flood Storage

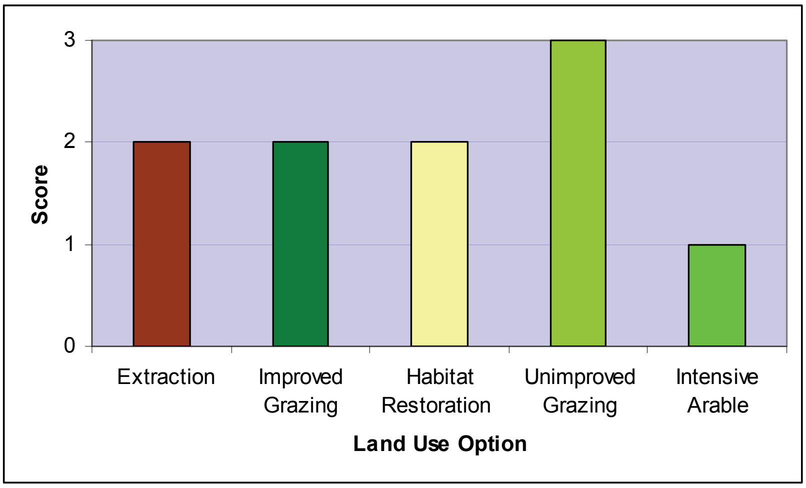


Figure 5.20. Land Use Option Performance in Autumn/Winter Flood Storage

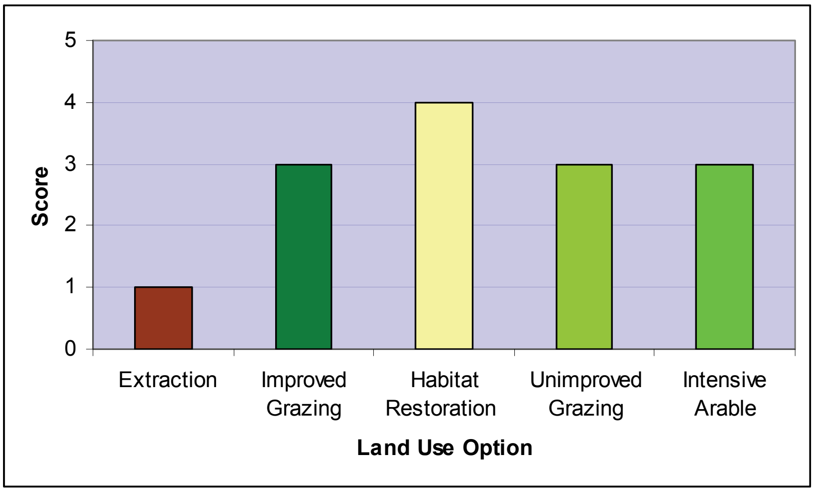


Figure 5.21. Land Use Option Performance in Landscape Quality

Habitat restoration and extensive grazing, the most extensive use options screened here, perform consistently well on the peatland attributes under review except in the case of livelihood provision. Eventually, any use that permanently lowers the water table leads to a depletion of the peat resource and peatland services. The ecological system switches to a different regime. In the case of the peat extraction use option this is a relatively quick process, with the loss of wildlife interest, archaeology, landscape quality and other services only being compensated for by livelihood provision for a relatively short period, until the livelihood service also starts to fail. At this point the site would be restored to another use such as conservation or agriculture but is no longer a peatland system as it no longer has a naturally accumulated layer of peat at the surface. Extraction persists as a land use because it has been allowed to move on to other peatland sites. In the case of the extensive grazing option, progression towards critical limits of peatland services is a much slower process, to the point it is almost not noticed or regarded as an issue. Indeed many stakeholders currently consider the wildlife interest of an extensive grazing regime to be higher, or of more importance, than that of a bog or fen habitat.

The use of MAUT and its implicit attribute measures can help identify stakeholder preferences for specific attribute levels, thereby combining knowledge of the impacts of use on the delivery of ecosystems services and stakeholder well-being, and answering research question 3, namely: what is the impact of peatland use on peatland services and stakeholder well-being?

5.5.2 Derived Weights

This section presents the weight assigned by stakeholders to the differing peatland attributes included in the MAUT analysis. Weights in MAUT sum to unity in individual preference sets, combined as averages presented here have not been adjusted to sum to 1. In this section weights for spring/summer and autumn/winter flood storage compatibility and above and below ground archaeological preservation are combined to give an overall weight for flood storage compatibility and cultural heritage preservation respectively. Where appropriate the break down of weights within these aggregated attributes is discussed in the accompanying narrative. The weights are used to help understand stakeholder priorities and finally to derive measures of utility delivered by differing peatland use options.

Results are first presented (for the most part as averages) for stakeholder groups according to the initial categorisation (primary, secondary – statutory bodies, conservation organisations, representative bodies, advisory organisations., and tertiary). Then results are presented (for the most part as averages) for stakeholder groups according to the influence/interest mapping categorisation (crowd, key players, context setters and subjects). Individual weights are referred to throughout the discussion when deemed appropriate and a full list of all these individual weights and intuitive land use rankings can be viewed upon request. All stakeholders were asked to respond from an organisational perspective and were chosen as respondents because in their role within the organisation they have the greatest dealings with the peatlands of the Fens or the Somerset Moors. However, it should be remembered that responses are still open to personal biases, reflective of personal interests, which it is felt is evident in some preference sets more than others.

Primary Stakeholders: No primary stakeholders were interviewed in the MAUT exercise for several reasons. Firstly they were the stakeholder group that required most assistance with the AHP questionnaire and so there was some concern they would struggle with the MAUT questions making responses unreliable. Secondly the stakeholder analysis shows primary stakeholder values are reasonably reflected in the values of representative bodies. As primary stakeholders were responding as individuals a large sample size would be required to extrapolate responses confidently to the group as a whole. This was not practical given the resources and time available and so it was considered reasonable to interview representative bodies rather than primary stakeholders themselves.

Secondary Stakeholders: Table 5.16 shows the particular organisations interviewed in each region. These are consistent with the identified stakeholders for each region listed in Chapter 4. Where possible respondents were the same as those questioned for the SA. Where this was not possible, for reasons of staff turn over or availability a comparable alternative was found.

Table 5.17 shows the weights derived for each peatland attribute through the MAUT question process according to the secondary stakeholder groups.

Table 5.16. Secondary Stakeholders Interviewed

Secondary Stakeholder Group	Organisations Interviewed	
	The Fens	The Somerset Moors
Statutory Bodies	EA **(Environment Agency)**	EA **(Environment Agency)**
	EN **(English Nature)**	EN **(English Nature)**
	RDS **(Rural Development Service)**	RDS **(Rural Development Service)**
	EH **(English Heritage)**	
Conservation Organisations	WT **(Wildlife Trust)**	WT **(Wildlife Trust)**
	RSPB **(Royal Society for the Protection of Birds)**	RSPB **(Royal Society for the Protection of Birds)**
	NT **(National Trust)**	
	WWT **(Wildfowl and Wetlands Trust)**	
Representative Bodies	CC – **access (County Council)**	CC – **access**
	DC **(District Council)**	CC – **archaeology (County Council)**
	NFU **(National Farmers Union)**	CC – **minerals planning (County Council)**
	CLA **(Countryside Landowners and Business Association)**	DC **(District Council)**
		NFU **(National Farmers Union)**
		CLA **(Countryside Landowners and Business Association)**
Advisory Bodies		FWAG **(Farming and Wildlife Advisory Group**
		SFL **(Somerset Food Links)**

Table 5.17. Secondary Stakeholder Preference Weights

		Weight					
		Cultural Heritage Preservation	Wildlife Interest	Flood Storage Compatibility	Livelihood Provision	Practicability of Access	Landscape Attractiveness
Fens	Statutory Bodies	0.29	**0.17**	**0.20**	**0.25**	**0.02**	**0.08**
	Conservation Organisations	**0.14**	**0.24**	**0.29**	**0.11**	**0.14**	**0.09**
	Representative Bodies	**0.09**	**0.07**	**0.18**	**0.52**	**0.06**	**0.08**
	Arithmetic Mean	**0.17**	**0.16**	**0.22**	**0.29**	**0.07**	**0.08**
	Range	**.09–.29**	**.07-.24**	**.18-.29**	**.11-.52**	**.02-.14**	**.08-.09**
Somerset	Statutory Bodies	0.22	**0.19**	**0.38**	**0.15**	**0.04**	**0.03**
	Conservation Organisations	**0.16**	**0.38**	**0.30**	**0.09**	**0.04**	**0.03**
	Representative Bodies	**0.25**	**0.16**	**0.13**	**0.32**	**0.05**	**0.05**
	Advisory Bodies	**0.03**	**0.35**	**0.39**	**0.20**	**0**	**0.04**
	Arithmetic Mean	**0.17**	**0.27**	**0.30**	**0.19**	**0.03**	**0.04**
	Range	**.03-.25**	**.16-.38**	**.13-.39**	**.09-.32**	**.00-.05**	**.03-.04**

The **Statutory Bodies** in the Fens place greatest importance on the preservation of cultural heritage and provision of livelihoods and the statutory bodies in the Somerset Moors place greatest importance on preservation of cultural heritage and floodwater storage. In the Fens this is likely to be because the EH representative weighted only the archaeological attributes, deeming it inappropriate to weight anything else when as an organisation they are not involved in decisions on land use management. This gave the heritage attributes comparatively very high weights from EH and therefore affected the average. Immediately this raises important questions regarding the use of 'average' responses, particularly if they are used without knowledge of the individual responses of which they constitute, which is not the case here.

In the Somerset Moors, several of the organisations gave the archaeological attributes relatively high weights. This is probably because there is substantially more archaeology in the Somerset Moors than there is in the Fens. In the Somerset Moors the landscape itself and integral features of management such as flood banks are considered of great importance and a major objective of the agri-environment schemes that operate in the area. There is also great interest in the buried archaeology with the Somerset Moors already boasting the find of important archaeological artefacts such as the 'Sweet Track'. Furthermore, in the Somerset Moors archaeology and heritage is the basis for several visitor facilities. Archaeological preservation is another argument (aside from conservation) for higher water tables across the whole area. With regard to flood water storage, a high weight on autumn winter flood storage from the statutory bodies was to be expected in an area where winter flooding is common and rural flood storage is used to alleviate flooding in downstream urban areas.

In reference to landscape quality the Fens EN respondent felt personally very strongly that as the organisation serves the public the landscapes it creates must be appealing to the public. Such a strong view was not held in the Somerset Moors where the representative acknowledged a responsibility to the public and for access in discussion but then failed to represent this in responses. This demonstrates that it is relatively easy to incorporate services to the public in an organisations agenda but when it comes to difficult decisions these obligations may be the first to be compromised.

Table 5.17 shows that **Conservation Organisations** in both areas view wildlife interest and floodwater storage as the most important peatland attributes. For the WT, consistent with their similar roles (in charge of specific wildlife reserves and projects), representatives from both regions view wildlife interest and flood storage as priority peatland attributes. In this case the interest in flood storage is likely to be positive, i.e. seeing some potential to combine floodwater storage with conservation land use over the **winter** months. For the RSPB both representatives were responsible for overseeing activities in the area rather than for one specific reserve. The weights obtained for the RSPB showed a more balanced distribution of weights from the Fens representative than from the Somerset Moors, who weighted heavily in favour of wildlife. This is surprising given the more multi-functional nature of the Somerset Moors as compared the Fens. The NT respondent has responsibility both for a vulnerable piece of remaining habitat and for a habitat restoration project designed to buffer the existing habitat fragment. The weights derived are much more evenly distributed than might have been anticipated, with wildlife interest not standing out as a priority. The WWT representative is the warden of a high profile visitor reserve in the area. The WWT weights give more importance to flood storage, most probably in this case due to some of the reserves prime wildlife interest (ground breeding wading birds) being under threat from increasing incidents and severity of **spring and summer** flooding in the area.

Table 5.17 shows that in both regions the **Representative Bodies** view livelihoods as a priority in peatland management, but that the second highest priority is floodwater storage in the Fens region and cultural heritage preservation in the Somerset Moors region. It is clear that the emphasis on livelihoods in the Fens is substantially stronger than that in the Somerset Moors. The difference in second highest priorities maybe explained by both the fact that a heritage stakeholder was interviewed in the Somerset Moors and not in the Fens and the fact that the cultural significance of the Somerset Moors landscape is such that it is part of the Environmentally Sensitive Area scheme in an effort to protect it. This means many stakeholders are aware of its cultural importance. A prioritisation by the Fens Representative Bodies of floodwater storage is due to the inevitability of flooding in the area in the absence of suitable interventions. Most of the Representative Bodies in the Fens recognised a need for flood storage to protect people and property but also to protect the agriculture and therefore appeared to view it as something that would happen elsewhere. This is different from the view in the Somerset Moors, where winter flood storage on agricultural land in order to protect developed areas and roads is viewed as necessary and expected.

It is noted at this point that the minerals planning representative in the Somerset Moors also has conservation responsibilities within the Council and has private interests in an extraction business. It is felt the weights derived for this respondent are reflective of this somewhat unique set of roles and responsibilities, but give precedence to livelihoods. From the District Councillors, contrary to most of the previous results there is a stark difference between the two areas, with the Fens respondent heavily leaning towards livelihoods and the Somerset Moors respondent heavily leaning towards wildlife interest. This is reflective of what already exists in both areas and a desire to maintain the status quo. The derived weights from the NFU representatives show a greater spread in the Somerset Moors than the Fens, consistent with an area where farming is integrated with other forms of land management and in the Fens agricultural livelihoods take precedence almost entirely. As with the NFU, the weights derived for the CLA representatives show a greater spread in the Somerset Moors than in the Fens, with the Fens again being strongly inclined towards livelihoods. These individual results explain the greater balance of weights in the group as a whole found in the Somerset Moors than the Fens.

Table 5.17 shows that the **Advisory Bodies** in the Somerset Moors collectively view flood water storage and wildlife interest as the priority attributes of peatland management. The weights derived for the FWAG representative reflect the FWAG role of reconciling agriculture with conservation interests in a lowland area where autumn winter flooding is commonplace and where spring summer flooding may become more common place in the future with climate change impacts. The weights derived for the SFL representative appear somewhat inconsistent with an organisation seeking to promote livelihoods in the area through environmental branding and marketing of the produce. The weights place relatively low importance on livelihood provision.

In combination the results of the MAUT analysis show a difference in priorities in the secondary stakeholders of the Fens and the Somerset Moors, with the Fens prioritising livelihood provision and flood water storage and the Somerset Moors prioritising wildlife interest and flood water storage. This is perhaps consistent with the agricultural systems in each area and may also reflect the perceived threat to livelihoods in the Fens with the advent of large conservation projects, environmental legislation and (until recently) decline of agricultural profitability. The results of the representative bodies also indicate the likely priorities of primary stakeholders in the different regions, being heavily livelihood followed by floodwater storage in the Fens and livelihood and preservation of cultural heritage in the Somerset Moors.

The results for the secondary stakeholders are consistent with the AHP and stakeholder analysis in identifying floodwater storage, wildlife interest and livelihood provision as the key attributes of peatland management. In the MAUT analysis preservation of cultural heritage is nearly as important as the other top three attributes, especially in the Somerset Moors.

Tertiary Stakeholders: Table 5.18 shows the weights derived for the tertiary stakeholders available and still in existence (some bodies did not have spokespeople available, being partnership organisations or projects, such as the Wet Fens Project, or too busy and unable to respond, such as the Regional Flood Defence Committee. Others had disbanded since the stakeholder analysis, such as the Levels and Moors Partnership in Somerset).

Table 5.18. Tertiary Stakeholder Preference Weights

		Weight					
		Cultural Heritage Preservation	Wildlife Interest	Flood Storage Compatibility	Livelihood Provision	Practicability of Access	Landscape Attractiveness
Fens	IDB	0.02	**0.13**	**0**	**0.78**	**0**	**0.07**
Somerset	IDB	**0.09**	**0.12**	**0.25**	**0.50**	**0.01**	**0.03**
	IDB (ecologist)	**0.20**	**0.17**	**0.20**	**0.27**	**0.10**	**0.06**
	Arithmetic Mean	**0.15**	**0.15**	**0.23**	**0.39**	**0.06**	**0.05**

A representative of an Internal Drainage Board in the Fens and two representatives of an Internal Drainage Board in the Somerset Moors were interviewed. Two respondents were sought in the Somerset Moors as the initial contact was the Boards ecologist and it was not clear whether this was adequately representing the wider views of the Board. The results in Table 5.18 show tertiary stakeholders have a preference for livelihood provision and floodwater storage. In both regions the IDBs reflect the interests of the Board members and their rate payers and so their attribute preferences relate to what exists already. However, the IDB ecologist is less bound by this. Although still weighting livelihoods the heaviest, he weights it considerably less than the other two IDB representatives. As with the representative bodies, such as the NFU and CLA, the Fens IDB representative weights livelihoods extremely heavily, whereas there is a greater degree of balance in the representative of the Somerset Moors whilst still favouring livelihoods.

The results from the tertiary stakeholders show agreement with those of the secondary stakeholders in highlighting livelihood provision and flood water storage as the priority attributes of peatland management, closely followed by wildlife interest and cultural heritage preservation.

Influence/Interest: Table 5.19 shows the MAUT weights derived according to the groups classified previously in the stakeholder analysis maps, excluding primary stakeholders and those tertiary stakeholders not presented in Table 5.18.

Table 5.19 shows that in both the Fens and the Somerset Moors the key players (with high influence and a high interest in peatland management, even without responses from primary stakeholders, in particular farmers and peat extractors, give highest weight to livelihood provision and flood water storage. This could then be said to explain the current management systems in each of the regions, with agricultural livelihoods and a floodwater storage regime compatible with the agricultural system being the priority considerations in management decisions and expenditure in the areas. The substantially higher weight on livelihood provision by the key players of the Fens than the Somerset Moors supports the continuation of intensive arable agriculture in the Fens area. Furthermore, the more balanced distribution of weights between peatland attributes of the key players of the Somerset Moors has promoted the development of the existing multi-functional system. Table 5.19 also exemplifies how wildlife interest has been overridden as a consideration of peatland management in the past and that without legislative support it is likely to continue to be of lower priority than livelihoods and flood water storage if the current stakeholder influence and interest network persists.

Table 5.19. Influence/Interest Stakeholder Groups Preference Weights

		Weight					
		Cultural Heritage Preservation	Wildlife Interest	Flood Storage Compatibility	Livelihood Provision	Practicability of Access	Landscape Attractiveness
Fens	Key Players	0.06	0.16	**0.21**	**0.47**	**0.04**	**0.07**
	Context Setters	**0.29**	0.16	**0.24**	**0.11**	**0.11**	**0.10**
	Crowd	**0.02**	0.13	**0**	**0.78**	**0**	**0.07**
	Subjects						
	Mean	**0.12**	0.15	**0.15**	**0.45**	**0.05**	**0.08**
	Range	**.02-.29**	.13-.16	**.00-.24**	**.11-.78**	**.00-.11**	**.07-.10**
Somerset	Key Players	**0.19**	0.20	**0.26**	**0.26**	**0.03**	**0.03**
	Context Setters	**0.19**	0.22	**0.20**	**0.22**	**0.06**	**0.06**
	Crowd						
	Subjects						
	Mean	**0.19**	0.21	**0.23**	**0.24**	**0.05**	**0.05**

The weights presented in this section are both reflective and causative of the existing peatland management systems of the Fens and Somerset Moors. They demonstrate the perceived importance of the production functions as the dominant form of livelihood provision, the regulation functions in terms of floodwater storage and the habitat functions in providing wildlife interest, closely followed by the information functions, specifically the preservation of cultural heritage. This exemplifies the difficulties involved in identifying sustainable or wise peatland management systems when, as shown in Figures 5.14 to 5.21, not all of these peatland attributes (functions and services) are compatible. Combined with the value functions derived for each peatland attribute the weights presented here can be used to distinguish between different peatland management options as presented in the following section.

5.5.3 Preference Rankings and Stakeholder Utilities

This section presents the stakeholder preferences for peatland use options and their associated utilities using the MAUT approach, showing how land use affects stakeholder well-being. This analysis derived relative utilities that are not interpersonally comparable. For example, it is not possible here to say person A with a utility of 0.4 is happier than person B with utility 0.3. Therefore direct comparison of utilities between individuals and stakeholder groups is avoided.

Tables 5.20 and 5.21 show the land use preference rankings for the stakeholders of the Fens and the Somerset Moors respectively. In both of these Tables land use options are abbreviated as follows: Habitat Restoration (HR), Extensive Grazing (EG), Intensive Grazing (IG), Intensive Arable (IA), Extraction (Ex).

Table 5.20. MAUT Preference Ranks for Land Use Options by Fens Stakeholders

Stakeholders	Ranking				
EN, EH, WT, NT, CC	HR	EG	IG	IA	Ex
NFU, CLA, IDB	Ex	IA	IG	EG	HR
EA	HR	EG	IG	Ex	IA
RDS	IG	EG	IA	HR	Ex
RSPB	EG	HR	IG	IA	Ex
WWT	EG	HR	IG	Ex	IA
DC	IG	EG	IA	Ex	HR

Table 5.20 shows the most common ranking of peatland use options is negatively correlated with intensity of use, with Habitat Restoration being the most preferred option and Extraction being the least preferred option. However, the second most common ranking of peatland options is positively correlated with the intensity of use. Extraction in this case is the most preferred option and Habitat Restoration is the least preferred option. This exemplifies the extreme polarisation of use currently occurring within the Fens region and highlights the potential for conflict in the future.

In the second row of Table 5.20 Extraction is hashed as all the respondents associated with it (NFU, CLA, IDB) strongly disagreed with the MAUT model finding

Extraction the most preferred option according to their responses. Indeed, they considered Extraction to be the least preferred option despite it being relatively profitable. Consideration of Extraction as the least preferred option in the Fens was not attributable to its consumptive nature (as in the Somerset Moors) but because it is not a current land use of the Fens and therefore not a desirable land use. This implies an embedded problem with the livelihoods measure, generating consistently higher than expected by utilities for the Extraction land use, and also a preference by some stakeholders for the maintenance of the status quo. For example, many stakeholders appear to view livelihoods not as a measure of income but as the dominant income generating activity currently existent in the area. This means stakeholders from the Fens who weighted livelihoods very heavily and had a preference for higher incomes were actually only referring to Intensive Arable. In the same vane, a stakeholder from the Somerset Moors may weight livelihoods heavily and expect this to favour a grazing regime in the model results. This becomes so evident in the Fens results as opposed to those of the Somerset Moors because of the otherwise consistent preferences for intensive land uses in Fens stakeholder responses. Capturing the dominant land use in a generalised (across differing peatlands) livelihood measure would be extremely difficult, both because dominant land uses differ from peatland to peatland and because this desire to maintain the status quo is not evident in all stakeholders.

Table 5.21. MAUT Preference Ranks for Land Use Options by Somerset Moors Stakeholders

Stakeholders	Ranking				
EA, RSPB, SFL, IDB (ecologist)	EG	HR	IG	IA	Ex
EN, CC - access, CC – archaeology	HR	EG	IG	Ex	IA
RDS, FWAG	EG	HR	IG	Ex	IA
WT	HR	EG	IG	IA	Ex
CC – minerals	IG	IA	EG	Ex	HR
DC	EG	IG	HR	IA	Ex
NFU	IG	EG	IA	Ex	HR
CLA	HR	EG	Ex	IG	IA
IDB	EG	IG	IA	Ex	HR

Table 5.21 shows that contrary to the Fens none of the three most common option rankings were correlated with intensity of use and so peat soil loss. Instead they all place Extensive Grazing above Habitat Restoration or Extraction above Intensive Arable or both. This is indicative of both the conservation interest associated with extensive grazing, developed in the area over a long time period, and of the cultural importance of the extraction industry in the area, with peat digging being a traditional local livelihood.

Tables 5.22 to 5.24 show the utilities or measures of stakeholder well-being associated with each of the peatland use options by stakeholder groups.

Table 5.22. Relative Utilities Derived from Land Use Options for Secondary Stakeholders

		Utility				
		Habitat Restoration	Extensive Grazing	Intensive Grazing	Intensive Arable	Extraction
Fens	**Statutory Bodies**	0.44	0.45	0.37	0.21	0.13
	Conservation Organisations	0.64	0.64	0.35	0.24	0.20
	Representative Bodies	0.31	0.34	0.60	0.59	0.58
	Arithmetic Mean	0.46	0.48	0.44	0.35	0.30
	Range	.31-.64	.34-.64	.35-.60	.21-.59	.13-.58
Somerset	**Statutory Bodies**	0.61	0.68	0.44	0.18	0.31
	Conservation Organisations	0.66	0.67	0.26	0.19	0.10
	Representative Bodies	0.50	0.59	0.44	0.36	0.36
	Advisory Bodies	0.53	0.62	0.40	0.28	0.29
	Arithmetic Mean	0.58	0.64	0.39	0.25	0.27
	Range	.50-.66	.59-.68	.26-.44	.21-.59	.13-.58

Table 5.22 shows clearly the highest utilities of secondary stakeholders are derived from the Habitat Restoration and Extensive Grazing options, or options that favour habitat functions and the reinstatement of natural regulation functions, as opposed to production functions and heavily modified regulation functions. The utilities for these land use options have low ranges in the Somerset Moors as compared to the Fens, owing to the differences between the preferences of representative bodies and other secondary stakeholders. In the Fens the representative bodies as a group gain greatest

utilities from the existing dominant land use (Intensive Arable) and the next most productive agricultural use (Intensive Grazing).

Table 5.23. Utility Derived from Land Use Options for Tertiary Stakeholders

		Utility				
		Habitat Restoration	Extensive Grazing	Intensive Grazing	Intensive Arable	Extraction
Fens	IDB	0.22	**0.29**	**0.58**	**0.67**	**-**
Somerset	IDB	**0.32**	**0.51**	**0.50**	**0.50**	**0.50**
	IDB (ecologist)	**0.50**	**0.57**	**0.38**	**0.29**	**0.28**
	Arithmetic Mean	**0.41**	**0.54**	**0.44**	**0.40**	**0.39**

Table 5.23 shows the utilities of tertiary stakeholders derived by the differing land use options are markedly different to those of the secondary stakeholders. Stakeholders of both regions gain highest utility from more intensive land uses than the secondary stakeholders.

Table 5.24. Utility Derived from Land Use Options for Influence/Interest Stakeholder Groups

		Utility				
		Habitat Restoration	Extensive Grazing	Intensive Grazing	Intensive Arable	Extraction
Fens	Key Players	0.40	**0.48**	**0.57**	**0.46**	**0.41**
	Context Setters	0.52	**0.49**	**0.32**	**0.23**	**0.19**
	Crowd	0.22	**0.29**	**0.58**	**0.67**	**0.74**
	Subjects					
	Arithmetic Mean	0.38	**0.42**	**0.49**	**0.45**	**0.45**
	Range	.22-.52	**.29-.49**	**.32-.58**	**.23-.67**	**.19-.74**
Somerset	Key Players	**0.54**	**0.64**	**0.43**	**0.30**	**0.30**
	Context Setters	**0.52**	**0.55**	**0.37**	**0.27**	**0.27**
	Crowd					
	Subjects					
	Arithmetic Mean	**0.53**	**0.60**	**0.40**	**0.29**	**0.29**

The results shown in Table 5.24 for the Fens key players is somewhat surprising, with this stakeholder group gaining greatest utility from two peatland use options that are less intensive than the existent system. It should be remembered at this point that these results do not include responses from primary stakeholders, notably farmers, and that this may affect the average utilities derived. This result indicates that although the key players weight livelihoods as a peatland attribute most heavily, they vary in the utility gained from differing levels of livelihood, with several of the key players gaining relatively high utility from land uses with relatively low present value gross margins. The results from the Somerset Moors are less surprising, although the high utilities derived by key players from the least intensive land uses might still be somewhat unexpected.

The preferences for less intensive land use options, as demonstrated in the results presented above indicate that although there is obvious importance placed on livelihood provision, the financial rewards required to maximise stakeholder well being is perhaps lower than might be expected, with the exception of the Fens CLA, NFU and IDBs. This is likely to be because an acceptable livelihood level, as defined by an organisational representative whose own livelihood is not in question, need not consider the realities of living on a given level of income. Rather they will consider the wildlife conservation and conservation based employment implications implicit in differing livelihood levels. Indeed it was regularly stated during the interview process that some livelihood was desired, as it was good for the local economy and potentially conservation interests, but that it was not desired to see private individuals making large amounts of money. This indicates a relatively low value placed on the service farmers and peat extractors provide to society, indicative of living in 'a time of plenty' with no pressing food or energy deficits. Where an organisational representative, who is charged with expressing the views of those who would be directly affected by the livelihood question i.e. farmers and land owners, consider the private individuals needs above all else and this inevitably leads to a preference for high income land uses.

5.5.4 Stakeholder Preference Limits

The following section examines a sample of stakeholder utility curves, as derived in the MAUT interview process, and discusses how they indicate acceptable minimum levels of peatland attributes. This understanding is useful for formulating policy to deliver wise use of peatlands.

Each stakeholder respondent in the MAUT process constructed their own utility curve for each of the eight peatland attributes examined. Here example stakeholder utility curves are presented for each of the attributes. For the most part the selected curves are representative of the most commonly derived curve shapes and proportions. Marked deviations from the sample curves, by particular stakeholder groups, are discussed, with accompanying utility curves in some cases. The utility curves indicate whether attributes are associated with increasing or diminishing marginal utility. That is, do increases in utility increase with attribute level or decrease? The diagonal dotted line on each curve is the line of indifference, that is, along that line each unit of provision gives equal units of utility. The x axis represents the range in measure units as displayed in Table 5.14. The measure levels for each of the land use options are indicated using the abbreviations as previously.

Figure 5.22 shows that with regard to wildlife interest stakeholders gain half of their utility from the last roughly 20% of possible wildlife. This means stakeholders have a marginally increasing utility with regard to wildlife, with higher relative value placed on higher levels of provision. This suggests that stakeholders will take some risks to achieve higher levels of wildlife. Stakeholders were not at all satisfied with low levels of wildlife. This is true for the majority of stakeholders with the curve varying in severity only slightly around the presented example. This indicates, assuming the aim is to maintain stakeholder utilities of at least 0.5 (half as happy as they can be) that policy should be encouraging conservation uses, with only the extensive grazing and habitat restoration options examined in this analysis delivering over 80% of the possible wildlife. Significant divergence from the curve presented in Figure 5.22 did occur in some cases, notably among stakeholders with low levels of conservation expertise such as the representative bodies, being of the opinion that any wildlife at all is substantially better than none, demonstrating a diminishing marginal utility for wildlife. This suggests they will be easily satisfied and opt for low risk strategies.

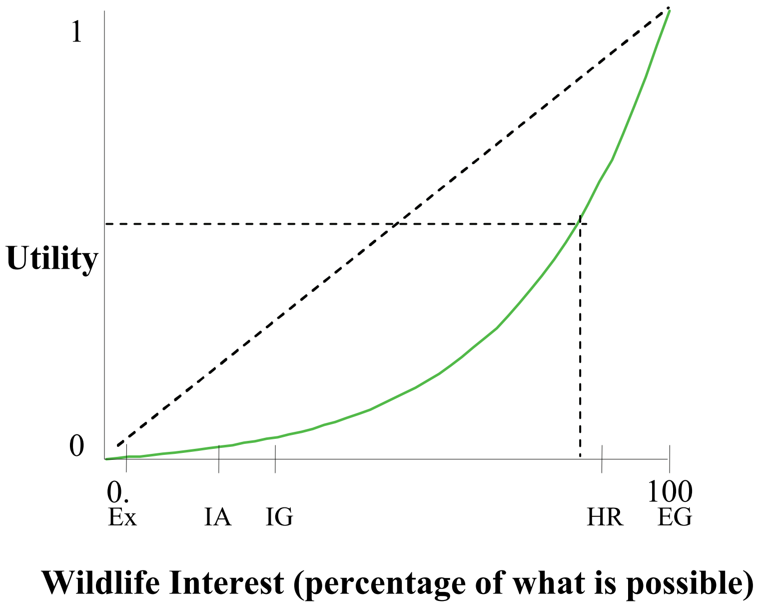


Figure 5.22. Example Utility Curve of the Fens WT for the Wildlife Interest Peatland Attribute

Figure 5.23 shows that with regard to livelihood provision stakeholders have a diminishing marginal utility and gain half of their utility from the first roughly 200 pounds per ha per year. This is true for the large part of stakeholders with the curve varying in severity only slightly around the presented example. It means stakeholders put a greater relative value on relatively low incomes as opposed to very high ones, suggesting they are risk adverse and therefore will be satisfied with steady albeit low incomes. This indicates, assuming the aim is to maintain stakeholder utilities of at least 0.5 (half as happy as they can be) that policy should be encouraging land use options that deliver livelihoods that satisfy rather than maximise income objectives. Indeed this curve indicates most stakeholders appear relatively happy with gross margins around those delivered by the current extensive grazing regime, excluding subsidies and agri-environment payments. Significant divergence from the curve presented in Figure 5.23 did occur in several cases, most notably in the representative bodies, especially the NFU and CLA of the Fens, where stakeholders demonstrated an increasing marginal utility for livelihood, but reached satisfaction (via a short range of diminishing marginal utility) before the maximum level, indicating they would rather a high risk and relatively high reward strategy (Figure 5.24). Furthermore, some conservation organisations, including the NT in the Fens and the WT in the Somerset Moors gained greatest utility from a livelihood at level zero, and least utility from very high levels (Figure 5.25). As discussed previously this is likely to be because it is not their livelihood in question.

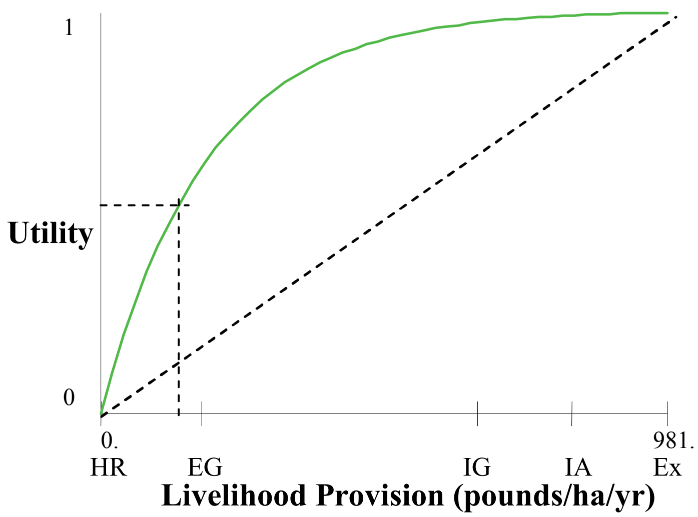


Figure 5.23. Example Utility Curve of the Somerset Moors EA for the Livelihood Provision Peatland Attribute

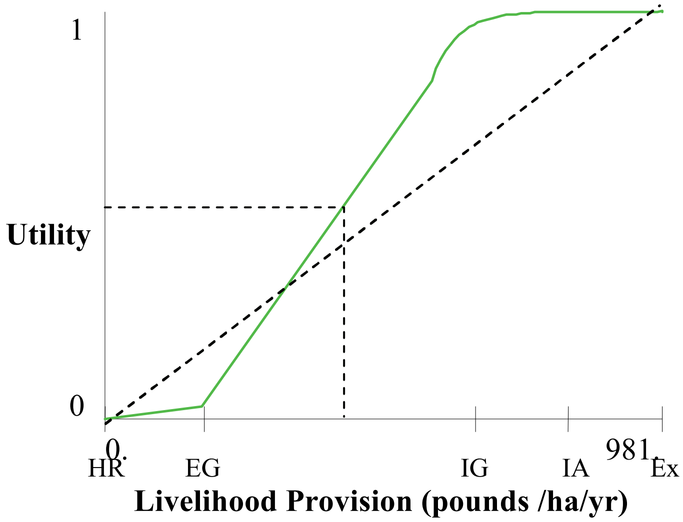


Figure 5.24. Example Utility Curve of the Fens IDB for the Livelihood Provision Peatland Attribute

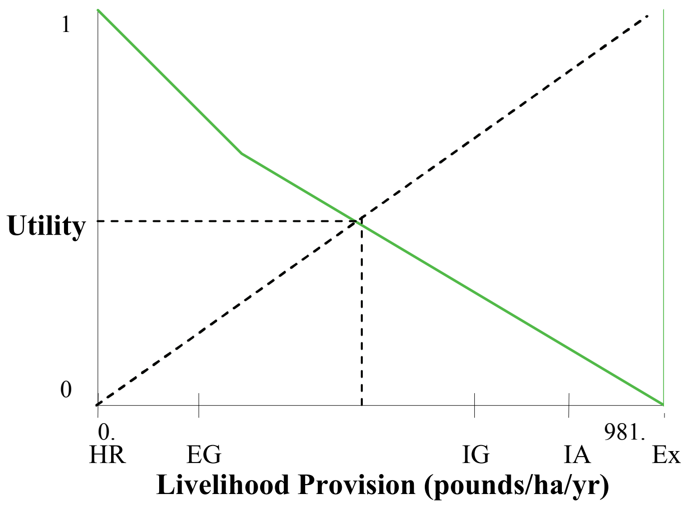


Figure 5.25. Example Utility Curve of the Fens NT for the Livelihood Provision Peatland Attribute

Figure 5.26 shows that with regard to autumn/winter flood water storage only a narrow band of provision alters stakeholder utility, creating a marked s-shaped curve. Furthermore, it shows that stakeholders gain the majority of their utility over the change from a negative to positive compatibility with floodwater storage. Not surprisingly stakeholders were not at all satisfied with negative flood storage compatibility (i.e. a land use that is negatively impacted by autumn/winter flood storage) and their increase in utility levels off once there is positive flood storage compatibility (i.e. a land use that is positively impacted by autumn/winter flood storage). This is true for almost all the stakeholders with the curve varying in severity only slightly around the presented example. This indicates that stakeholders are satisfied with any land use that is not negatively affected by an 'average' flood event (classified as less than a month in duration and less than 1m deep by Somerset EA) in the winter. This excludes the Intensive Arable option examined in this analysis. Because of the discrete rather than integral nature of the scale none of the divergences from the curve presented in Figure 5.26 change the implications for peatland use options.

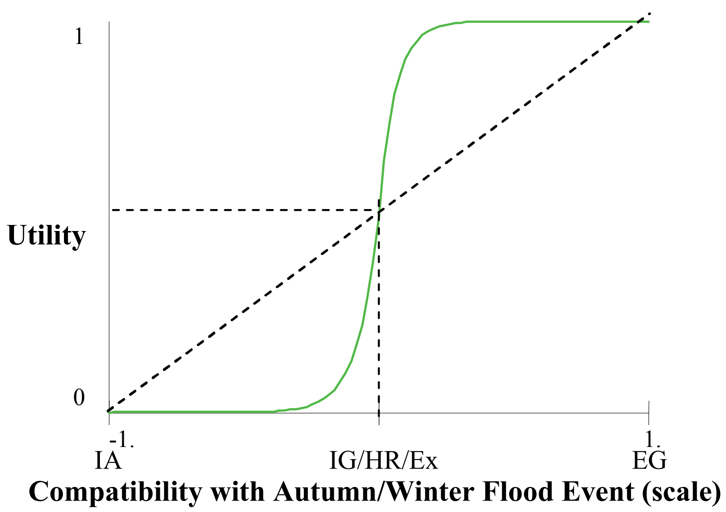


Figure 5.26. Example Utility Curve of the Somerset Moors FWAG for the Autumn/Winter Flood Storage Peatland Attribute

The curves derived for spring/summer compatibility are similar to that in Figure 5.26. This means that policy should be encouraging peatland use options that at the least have a neutral relationship with spring/summer flood water storage. This demonstrates recognition that spring/summer flooding may become increasingly frequent with climate change and therefore there is a need to identify land use options that can absorb it. The only stakeholder to significantly diverge from the presented curve was the Fens NFU who did not want to see compatibility with spring/summer flood storage because of the implications of this for arable cropping and so the interests they were representing.

Figure 5.27 shows that with regard to above-ground archaeological preservation stakeholders have a near constant marginal utility, with a slight increasing marginal utility and so preference for higher levels of preservation. Stakeholders indicated only mild satisfaction with low levels of above ground archaeological preservation. This is true for almost all the stakeholders with the curve varying in severity only slightly around the presented example. This indicates, assuming the aim is to maintain stakeholder utilities of at least 0.5 (half as happy as they can be) that policy should be encouraging land uses that preserve at a minimum medium levels of above ground archaeological interest, assuming there is above ground archaeology present, again favouring the extensive grazing and habitat restoration land uses.

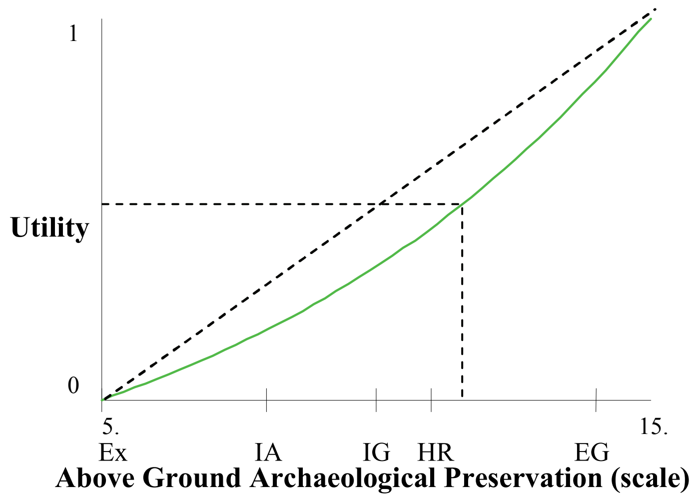


Figure 5.27. Example Stakeholder Utility Curve for the Above Ground Archaeology Peatland Attribute

Figure 5.28 shows that with regard to below ground archaeology stakeholders have an increasing marginal utility, gaining half of their utility from the last roughly 20% of preserved archaeology (peat soil). Stakeholders were not satisfied with low levels of below ground archaeological preservation. This is true for the majority of stakeholders with the curve varying in severity only slightly around the presented example. This indicates stakeholders will take risks in order to achieve higher levels of preservation. Assuming the aim is to maintain stakeholder utilities of at least 0.5 (half as happy as they can be) policy should be encouraging conservation uses, with only the extensive grazing and habitat restoration options examined in this analysis delivering over 80% below ground archaeological preservation. Significant divergence from the curve presented in Figure 5.28 did not occur.

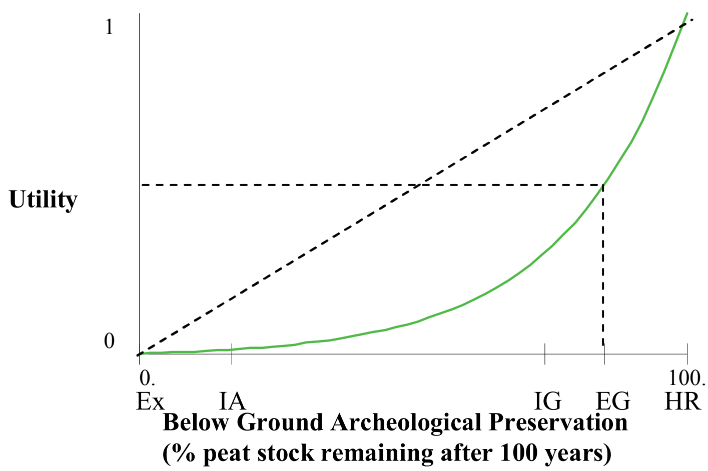


Figure 5.28. Example Utility Curve of the Fens EN for the Below Ground Archaeology Peatland Attribute

Figure 5.29 shows that with regard to landscape quality stakeholders have constant marginal utility, that is, utility increases equally with each increase in the quality scale. Stakeholders expressed a positive relationship with improvements in landscape quality. Responses diverge only slightly from the presented curve with the Fens EN representative being the most extreme example, expressing an increasing marginal utility, with strong preference for high and very high landscape attractiveness. This indicates policy should be encouraging land uses that are at least of average attractiveness according to local residents, only excluding peat extraction of the options compared in this analysis.

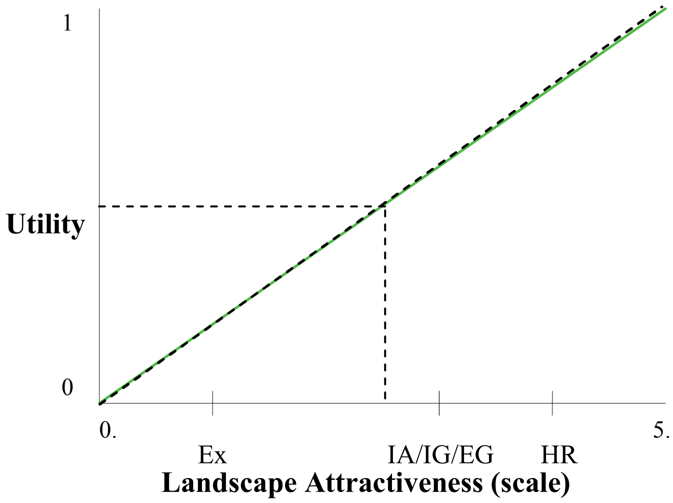


Figure 5.29. Example Utility Curve of the Fens District Council for the Landscape Peatland Attribute

Figure 5.30 shows that, with regard to public access, stakeholders demonstrate mild increasing utility, gaining roughly half their utility from medium to high public access potential. Stakeholders indicated only a low satisfaction with low levels of access practicability. This is true for almost all the stakeholders with the curve varying in severity only slightly around the presented example.

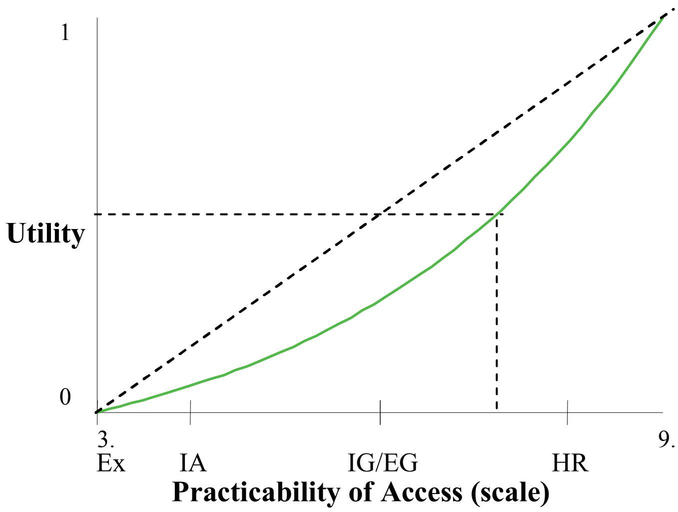


Figure 5.30. Example Utility Curve of the Somerset Moors RSPB for the Public Access Peatland Attribute

Significant divergence from the curve presented in Figure 5.30 did occur, primarily within representative bodies concerned with agricultural interests. These bodies had a constant marginal utility but gained most utility from low levels of access practicability and low levels of utility for high access practicability (Figure 5.31). This is because they were considering the views of landowners on access.

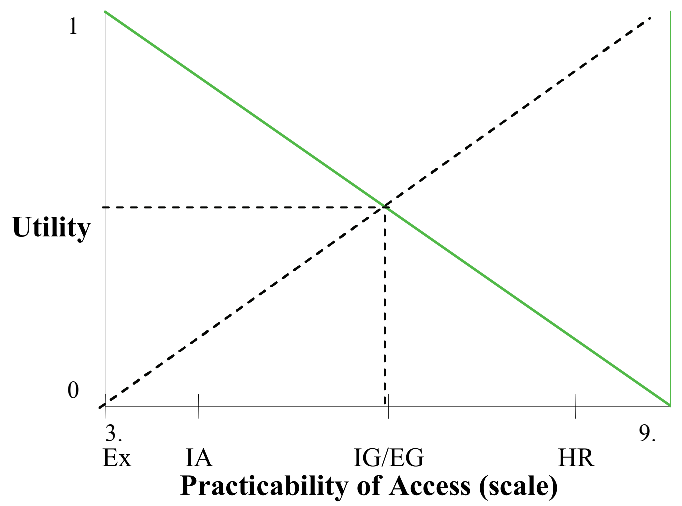


Figure 5.31. Example Utility Curve of the Somerset Moors NFU for the Public Access Peatland Attribute

This section confirms it is possible to provide quantified support of qualitative insights derived from qualitative assessment and narrative with MAUT analysis. This could be important in maximising stakeholder well being. It also shows however that deriving precise quantitative measures of attribute levels relies on an entirely quantitative tautology. Here, even though considerable effort was made to ensure measures were transparent and representative, scales are semi-quantitative and some measures are amalgamations of different features of individual attributes. This means translating optimal attribute provision levels according to stakeholder well-being into specific management practices or guidelines would be difficult in this case. Here rather the results still only indicate the preferable type of land use, i.e. intensive or extensive.

5.5.5 Multi-Attribute Utility Theory Sensitivity Analysis

As with the AHP the stakeholder value systems elicited in the MAUT analysis are not constant over time. It is therefore important to carry out sensitivity and risk analysis. The sensitivity analysis identifies areas where small changes in the quantification of stakeholder values have a notable impact on stakeholder utility for a given land use option and thereby change the ranking of land use options. Risk analysis identifies external circumstances that might change stakeholder values and seeks to understand the potential effect of these changes on stakeholder priorities and therefore land use option preferences. By this definition the risks associated with the MAUT analysis are the same as those associated with the AHP analysis, i.e. being external factors the differing data collection and analysis techniques do not affect them or their potential impacts on stakeholder values. For this reason only sensitivity analysis was carried out on the MAUT results and the risks are assumed to be the same as those of the AHP analysis and not reported here.

The sensitivities associated with the analysis pertain to both the stability of the stakeholder responses (weights) and consequent land use option preferences, and the likelihood of the land uses performing as predicted in a given situation. As the analysis was unable to incorporate metrics of uncertainty or probabilities into the definition of the land use options it is unlikely any practical translation of the options will actually perform, to the number, as suggested in Table 5.15. For example, attributes such as wildlife are, aside from creating the appropriate conditions in terms of water table and sward management, beyond the control of any peatland manager. Therefore there is no way of guaranteeing the discrete single estimates used in this analysis (based on literature) will be matched precisely in reality. Furthermore, the livelihood measures used in the analysis are based on current market prices and an 'average' system and year. However, market prices fluctuate significantly and each farm or extraction site is different, in size, assets and standard practice. This means that again the estimates used in the analysis cannot be guaranteed, rather they are indicative. The sensitivity analysis therefore identifies both:

- Small changes in stakeholder preferences (weights) that significantly affect the utility delivered by the land uses, and;

- Small changes in land use performance that significantly affect the stakeholder utility they deliver, and so identifying criteria where a range of values and associated probabilities would be extremely important if using the analysis in a practical situation.

For the sensitivity analysis the three priority criteria (livelihood provision, flood water storage and wildlife interest) and a sample of stakeholder weights were screened for impacts on the analysis results (land use preference rankings) from small changes (+ or – 10%). The full results can be found in Appendix IX but the main messages are:

With regards to stakeholder weights

- Less than half of the changes made resulted in a change in the preference ranking;
- In both regions the preference rankings are most sensitive to changes in weight assigned to flood storage, then livelihood provision and finally wildlife interest;
- Attribute weights derived for the Somerset Moors stakeholders are more sensitive than those of the Fens;
- There is no obvious relationship between stakeholders initial distribution of weights and sensitivity to changes in weights;
- The changes affect preferences for all the land use options almost equally, but with Habitat Restoration and Extensive Grazing changing rank in both regions slightly more than the other land uses;
- The preference rankings of the District Councils are the most sensitive to change.

With regards to attribute measure levels

- Around 10% of the changes made resulted in a change in the preference ranking;
- The degree of sensitivity to changes was almost identical across the attribute measures, with the sensitivity to Livelihood Provision being marginally less than Wildlife Interest and Flood Water Storage;

- Option rankings from the Somerset Moors are more sensitive than those in the Fens;
- There is no obvious relationship between how evenly the stakeholders initially distribute weights and sensitivity to changes in measure levels;
- There is no particular land use that is most sensitive;
- The preference rankings of the District Councils and the Somerset Moors IDB are most sensitive to change.

All this suggests that the MAUT results are fairly robust, for the most part absorbing changes of 10% (a substantial change) in both stakeholder weights and land use performance against the priority attributes. It also suggests that the results are more sensitive to changes in stakeholder preferences than to changes in land use performance and that in general the results of the Somerset Moors are more sensitive than those of the Fens, probably because the results of the Somerset Moors tend to be more evenly spread in terms of derived utility than the results of Fens. There is also an indication that the results from respondents with the least operational or professional understanding of peatland systems (the representatives from the District Council in this sample, local councillors) are more prone to sensitivity, implying the MAUT method, or at least the data collection method used here, may be most suited to expert respondents, suggesting a different data collection method or different MCA technique may be required to generate responses from the general public.

5.6 Key Messages and Conclusions of the Multi-Attribute Utility Theory

The results of the MAUT analysis inform on the effects of peatland use on both ecosystem service provision and stakeholder well-being and therefore answer research question 3. The results also begin to inform the types of policy intervention required and appropriate in delivering wise use of peat soils relevant to research question 4.

Collecting data to describe the land use options of the MAUT analysis by the attribute measures allowed some examination of the effect of land use on ecosystem service provision. It was shown that the depletion of peatland services as the peat resource is utilised is not a straightforward linear relationship and that some services (livelihood provision and for some people landscape quality) can increase as resource depletion increases. It is clear though that the diversity of services delivered by degraded peatlands is significantly reduced as compared pristine peatlands and that degraded systems also loose the option of service provision into the future. It was found that extraction as the most consumptive use quickly (a matter of years) switches the system from peatland to something else, potentially open water wetland, and that it would take many more years to re-establish a peatland system, if it can be re established at all.

The results of the MAUT in terms of stakeholder preferences and well-being show encouraging agreement within stakeholder groups. They show clearly that there is agreement not only within groups, but also between groups. Statutory bodies, conservation organisations, access and archaeology focused representatives and advisor bodies, across both regions, all gain greatest utility from, or value peatland uses that deliver wildlife interest and floodwater storage in particular, as well as cultural heritage, landscapes and livelihoods. These involve land uses that combine habitat, regulation and information functions. These stakeholders show great acceptance of the extensive grazing and habitat restoration land uses, which to a degree reinstate the floodwater management regulatory function and the habitat functions of peatlands that have been being degraded by drainage and cultivation. There is also agreement however within and between certain representative bodies and the IDBs, representing the interests of primary stakeholders, namely private land owners, that livelihood provision, or more precisely existent livelihood provision should persist as the main focus of peatland management. This leads to these stakeholders placing greatest value on the production functions, at times to the exclusion of all other functions.

It is clear then if those secondary stakeholders that have preferences for more extensive land uses wish to promote this use in peatland areas they need to find ways to make more extensive land uses deliver livelihoods at a level considered acceptable to land owners. Although several conservation representatives say there is potential for livelihoods (in this case living from the land) in land uses such as habitat restoration through traditional crafts and potentially tourism this is yet to become a reality. Indeed, in the Somerset Moors an RSPB reserve has to sell the cut reed compost produced on the reserve at local markets for barely more than the wages spent attending the markets rather than sell it to local peat producers as anticipated. This is because, as with most low impact activities, it is not produced in a reliable or large enough supply for local peat producers to make it worth their while. Furthermore, the extensive grazing regime, also in the Somerset Moors, would collapse without the support of the agri-environment payments, exemplifying further that at present financial incentives are needed to encourage a large scale conversion to extensive use and habitat management if it is desired. Alternatively, new land ownership models need to be developed, where profit is no longer the goal and multi-functional/stakeholder use is promoted.

The results consistently show that the three most important peatland attributes are livelihood provision, wildlife interest and floodwater storage showing that peatland stakeholders gain most utility from and place most value on these three peatland functions. This is consistent with the results of the AHP and so adds credence to the AHP conclusion that policy to encourage the wise use of peatlands needs to capitalise on this consensus joining up policy on these priorities and so mobilising action towards multi-functional peatland systems.

Several methodological issues arose during this analysis:

- **The suitability of the livelihoods measure.** Despite efforts prior to the interviews to find a measure that satisfactorily captured livelihood provision it was evident this measure was not entirely appropriate. Attempts were made throughout the interview process to add new attributes and adjust the existing ones in a way that might help address the consistent errors in option preference ranking brought about by the livelihoods measure but with no success. All alterations were either ineffectual or caused problems else where. It is clear that monetary income failed to encapsulate satisfactorily the differing perceptions of livelihood that exist among stakeholders or to interpret stakeholder biases to particular types of income.
- **The validity of the results.** It was found the option rankings obtained from the analysis were relatively accurate when a stakeholder had preferences for a

more extensive land use but that it was less reliable when a stakeholder had preferences for a more productive land use or when stakeholders had preferences for a mix of productive and extensive uses. It is thought this is in a large part due to the problems described above with the livelihood provision attribute. It may also be a feature of stakeholders not using a logical and consistent screening process in their initial intuitive rankings.

- **The use of peat extraction as a land use option.** Repeatedly in the analysis the disagreement between intuitive and model option rankings centred on peat extraction. This was at times because its performance against certain particular attributes was not considered in the initial preference ranking, at times because it bears a historical and cultural significance not captured in the attributes and at times potentially because it is just not currently or in the recent past an option in the Fens and therefore is not relevant to stakeholders.

These points suggest the need to develop a common narrative or measure for both the livelihoods provision attribute of peatland management and the peat extraction land use.

5.7 Closing Comments on the MCA

This section draws out the key messages of the general methodological approach. It briefly compares the AHP and MAUT techniques and concludes against research question 3 according to the AHP and MAUT findings. It also comments on research question 4, again according to the AHP and MAUT conclusions. Thus, it concisely demonstrates the fulfilment of purpose of the MCA process.

This chapter has shown that multi-criteria decision techniques show great promise in quantifying stakeholder preferences and values for peatland functions and uses. Both the AHP and MAUT analysis generated meaningful results that were largely consistent with the stakeholder analysis. The AHP model was quicker and easier to generate than the MAUT, being less data intensive and requiring less detailed specialised knowledge. The AHP results were also quicker to obtain than those of the MAUT, with the questionnaire being very simple to develop and complete. However, AHP was also limited in terms of manipulating and getting the most out of the data. Here MAUT performed well, and this is important in linking the analysis to policy formation. That is, MAUT helps develop an understanding of acceptable levels of service provision, lending itself to the potential development of intervention measures and points of intervention. From a stakeholder perspective it seemed, although the MAUT interviews took longer, that respondents were more comfortable with the MAUT format of questions, finding the pair wise ratio comparisons of the AHP confusing over time due to their ambiguity and repetitive nature. The MAUT questions on the other hand, dealing with specific levels of service provision, appeared to engage stakeholders and challenge their own assumptions. It is noted however, that more than one stakeholder found the MAUT questions difficult to answer without a specific area in mind. Furthermore, the suitability of the MAUT questions to general public respondents is questioned. This is because meaningful response to the MAUT questions requires an understanding of the chosen indicators and a familiarity with specific peatland functions that the general public may not have.

It is thought that there is the potential for further work with the MAUT technique. This could include further development of the livelihoods criteria and measure, which were found to be of significant importance in peatland management but also complex in terms of generating a consistently understood measure. Work could also be done on incorporating ecosystem critical limits into the model, including developing the interaction of criteria i.e. moving away from the often spurious preferential independence assumption. Furthermore, there is the potential for the development of more land use options, in particular degrees of intensity or management approaches within the basic options already derived.

Based on this study, it is thought that if the objective is to gain a broad understanding of stakeholder feelings towards a resource and its services then AHP is an adequate technique. Here AHP would be preferable to MAUT because of the speed with which it can be constructed, responses sought and results interpreted. It should be noted here that it is not felt the speed or simplicity of AHP does anything to reduce the cognitive burden on respondents inherent in many MCA techniques. Indeed, the experiences in this study suggest that AHP in a sense shifts the cognitive burden from the researcher to the stakeholder (respondent), calling into question the reliability of the results. If however, the objective is to identify policies, intervention measures and a greater understanding of the value stakeholders place on ecosystem services at different levels, then MAUT would be the most suitable technique. This is because of its use of real data, direct comparison of differing service levels related to the differing options, and consequent identification of marginal utilities.

MAUT, because of its explicit use of measures, is much more likely than AHP to misrepresent stakeholder preferences if there is a disparity between stakeholder understanding of a measure and indicator and its actual meaning, or if a preference is based more on emotions than logic. It is more important in the use of MAUT than AHP therefore that time be taken to engage stakeholders at all stages of the analysis. In the development of the MAUT model stakeholder input is required to ensure the measures and indicators are aligned with stakeholder perceptions. Time should also be spent in the results interpretation, identifying possible misrepresentations of preferences, that are easily spotted by the respondents themselves, and the possible reasons for them. This can also be seen as an advantage of MAUT over AHP however. This is because, given that a lack of consistency in stakeholder interpretation of attributes and the performance of differing options can exist in an AHP analysis, but because of the higher degree of subjectivity in AHP overall are much more difficult to identify, potentially persisting through any decisions made on the basis of the analysis. In conclusion, this study shows if time is taken to ensure options, measures and indicators are relevant and accurate, then MAUT has the potential to be a much more powerful tool than AHP in formulating solutions for improved resource management.

The following bullet points summarise the approach to the MCA and highlights some of the strengths and weaknesses of it:

1. MCA techniques were used as investigative tools to help answer research questions 3 and 4 relating to peatland use, ecosystem service delivery and stakeholder well-being and policy; they were found to be effective.

2. A ‘bottom-up’ approach was taken to the analysis with criteria and scenario development originating with stakeholder views; again this was found to be effective in ensuring the analysis encompassed the ‘correct’ aspects of peatlands.

3. Structured questionnaires were the main data collection tools although the nature of the questionnaires varied between the two techniques applied; these varied in their effectiveness, with problems in maintaining respondent concentration and lucidity with the AHP questionnaire, and concerns over the length of the MAUT interview process.

4. Logical Decisions for Windows software was used to process the data; it proved a useful tool to this end and also in collecting the data, with the graphical displays allowing an interactive interview process, important in the MAUT data collection phase.

5. The AHP and MAUT techniques generated a more quantitative understanding of stakeholder perceptions and value systems than that derived through the stakeholder analysis, making results easy to interpret and useful in policy formation.

Given the agreement between the results of the differing MCA techniques, and previously with the stakeholder analysis, it is possible to conclude from the MCA that:

1. Livelihood provision, floodwater storage and wildlife interest are the three priority attributes of peatland management to peatland stakeholders. They are closely followed by archaeological preservation;

2. In the current socio-political climate, of the options screened, more extensive peatland use options such as extensive grazing and habitat restoration are perceived to maximise well-being for the majority of stakeholders. However, in stark contrast, more intensive uses such as intensive arable maximise well-

being for several representative body stakeholders and the Fens IDB and farmers;

3. Intensive peatland use and so peat soil degradation depletes the diversity of ecosystem services delivered by peatlands, making them more vulnerable systems ecologically and less valuable socially;

4. In order to maximise stakeholder well-being efforts should be made to find land use options that provide levels of livelihood akin to an extensive grazing regime, adequately accommodate floodwater storage (summer and winter) and provide a high level of wildlife benefit;

5. Peat soils are currently vulnerable to changes in markets and climate change responses despite recent policy promoting environmental management;

6. In order to deliver wise use of peatlands into the future, policy needs to continue and broaden financial incentives for desired ecosystem services or promote the development of innovative land ownership and use regimes.

6. Policy for Peatlands: Stakeholder Perspectives

This chapter introduces a series of stakeholder workshops relevant to policy for peatlands. It first establishes the purpose of the workshops before focusing on the third of the series, Workshop C, relating how it was carried out and with whom. Finally it presents the findings of Workshop C and in light of these concludes against the relevant research question.

The purpose of the workshops was to both inform and guide the research process and specifically to answer the fourth research question, namely: what does this mean for policy in terms of achieving the wise use of peatlands? ‘This’ here referring to the conclusions to the previous research questions. The stakeholder workshops, particularly Workshop C, do this by drawing on previous results to derive an understanding of potential points of policy intervention and an appraisal of the mechanisms that might be employed.

The first two workshops, that is Workshops A and B, were designed and used primarily as steering for the research. They employed the UKCIP socio-economic future scenarios and the DPSIR framework to inform the SA (particularly the DPSIR) and MCA (particularly the option development). Their outcomes suggested that peatland use options and management practices could vary with differing futures and between peatland areas, and that policy now should protect against the potential declines in stakeholder well-being and ecological integrity that result from these futures (full workshop notes in Appendices I and II)

Workshop C was designed specifically to address the issue of policy for peatlands from a stakeholder perspective. The remainder of the chapter focuses on this workshop C.

6.1. Policy Workshop Methodology

This section outlines the methodology of Workshop C. That is why, how and where the workshop was carried out and with whom, introducing the analysis tool employed and detailing the programme of the day.

To ensure effective utilisation of the research outputs Workshop C was designed specifically to translate the SA and MCA findings, on peatland functions, uses and stakeholder values, into practical suggestions for the policy framework. This linked the research outcomes with the policy formation process and thereby ensured the research is effective in its aim of promoting the wise use of peatlands. Furthemore, the workshop outcomes were used to confirm the SA and MCA findings. It did this with the participation of the scientific community and representatives of wider stakeholder interests alike.

The workshop took place in Sweden in as part of the EUROPEAT research project, of which this work was a part, in 2005 as part of a closing EUROPEAT partner meeting. As such workshop participants consisted mostly of the scientific researchers on the EUROPEAT project. They brought expertise in such areas as soil physics and chemistry and peatland hydrology and ecology. Each partner country also brought one stakeholder representative from their advisory panel who brought a peatland user perspective to the discussions and who tried to account for other stakeholder views in their contributions. In total six Northern European Countries, including England, took part in the workshop and 23 individual participants.

For the purposes of the workshop the SWOT (strengths, weaknesses, opportunities and threats) analytical framework was applied to the existing practical and legislative systems across Northern Europe, with consideration given to their institutional and legal backdrops.

SWOT was used because it can be used in a participatory fashion as a decision support tool and is often used in conjunction with multi-criteria analysis tools when choices need to be made between different strategic approaches to a problem. When used correctly it has been proved to provide a good basis for strategy formulation and group-wise analysis. It is especially effective for focussing discussion on a perceived challenge (Srivastava *et al.*, 2005). Use of the SWOT analysis can highlight ways or means of further exploiting opportunities and strengths, and also of converting the threats into opportunities, and offsetting the weaknesses against the strengths. It can be used at different institutional levels and on internal and external factors (Leskinen *et al.,* 2004) and might look like the example in Figure 6.1.

Once the strengths, weaknesses, opportunities and threats have been identified it is possible to determine strategies that maintain and increase the strengths, offset the weakness, realise the opportunities and convert the threats to opportunities as shown in the example in Figure 6.2. This list can form the basis of actions and policy formulation.

1. Strengths:

- Sights of special scientific interest designations halted the drainage process in some important peatland areas;
- The Environmentally Sensitive Area agri-environment scheme also helped slow the drainage of some peatland areas;
- Agri-environment schemes make less intensive agricultural systems viable;
- Habitats and Water Framework Directives include elements that should improve management of peat soils;
- Strong conservation lobby that recognizes the multifaceted importance of peatland areas.

Weaknesses:

- Peat is as yet not recognised in policy as a resource that needs protection;
- Where drainage has occurred and no statutory designations exist management is almost entirely the decision of the land owner;
- Funding obligations for alternative peatland uses such as flood storage are unclear;
- Nutrient loading of water courses due to peat degradation is not covered in any policy;
- There is a lack of scientific understanding of what actually constitutes good management of peat soils;
- No requirement for a restoration plan for agricultural use of peat soils despite the long-term effect being effectively the same as that of extraction.

Opportunities:

- Climate change may force higher water tables as flood defence becomes uneconomical and flood events increase in frequency;
- CAP reform has provided more funding for environmental management practices.
- New agri-environment schemes have a new resource protection objective that is currently not viewed as a means to encourage better peat management but which has the potential to be;
- Increasing drainage and flood defence costs due to decreasing land levels are promoting discussion of the long-term sustainability of agriculture on peat soils.

Threats:

- Climate change may cause more frequent drought events, reducing the amount of water in peatland systems;
- Public Service Agreement targets for getting SSSI sites into favourable condition by the year 2010 are using large amounts of resources and tying the Government Agencies into narrow approaches;
- New EU Countries (mainly eastern Europe) have plentiful stocks of peat soils that agri-businesses will move to once the peat in the UK is finished, reducing the need to improve management to increase the life of peat soils;
- Non-market nature of the benefits derived from ‘sustainably used’ peatlands means these uses are not always viable.

Figure 6.1. Example SWOT Analysis of the Legislation and Policy Related to Peatland Management in England

Strategies derived from the SWOT profile of the UK legislative and policy framework for peatlands:

1. *Subsidise reservoirs and encourage storage of excess water in flood events that can be subsequently used in drought events;*
2. *Increase the deadline on Public Service Agreement targets and develop methods for encouraging landscape scale planning and action as opposed to isolated site scale priorities;*
3. *Attach financial reward (possibly through the use of agri-environment schemes) to the non-market benefits of peatlands;*
4. *Require restoration/after use plans for 'intensive' use of peatlands;*
5. *Encourage cooperative or community land ownership ventures;*
6. *Free the movement of funds between flood defence and agricultural budgets;*
7. *Further investment in R&D into preferable water level management and technical solutions to help achieve it;*
8. *Utilise the resource protection objective of the new agri-environment scheme to subsidise the implementation of technical solutions already identified i.e. subsurface irrigation/drainage channels.*

Figure 6.2Strategies Identified from the SWOT Analysis

The day began with a brief introduction to the workshop, agreeing amongst participants a common understanding of the concept of 'wise use of peatlands' and the range of policy mechanisms and sectors that could be applicable. Participants were then divided into three smaller working groups for break out session 1, during which participants were asked to do the following:

A. Briefly confirm the main challenges facing the management of peatlands in your country situations.
B. Briefly identify the main policy methods that are currently used in your country situations that have implications for the sustainable management of peatlands.
    1. Identify their main Strengths and Weaknesses in terms of their ability to improve the sustainability of peatland management.
    2. Identify the main opportunities for and threats to improving the sustainable management of peatlands, now and into the foreseeable future.

This involved confirming the understanding already developed on the range of issues facing peatlands as a resource and their managers across Northern Europe. The larger part of the session focused on discussing the main strengths, weaknesses, opportunities and threats of and to existing national policy frameworks pertaining to peat soils. Participants were provided with a series of prompts on each of these four points to be utilised if the group was having difficulty engaging with the subject. These prompts were informed by the results of the SA and MCA in terms of what might become apparent and what it would be useful to explore. Prompts were mostly open ended questions including for example ‘What are the major achievements of current policy in terms of wise peatland management?’ and ‘What are the main limitations of the current policy methods for encouraging the wise use of peatlands?’

Groups were made up of the representatives from two partner countries with similar pealtand management in order to allow some common understanding. These groups reported their discussion to the whole group and an amalgamated, European list of strengths, weaknesses, opportunities and threats was drawn up.

Following the round up of break out session 1 participants were divided at random into three working groups for break out session 2. Groups were presented with the ideas generated from breakout session 1 and the proceeding discussion. By addressing this list they were asked to identify and prioritise actions to promote wise peatland use.

SA and MCA previously identified several potential policy options for improving the management of peatlands from a stakeholder and ecological perspective. These included greater environmental legislation, new institutional arrangements for land ownership and increased/continued economic incentives for service delivery. Therefore stakeholders were asked two questions:

- What actions can be taken by policy makers and managers to help promote the sustainable management of peatlands?
- What choice of policy instrument will work best – compulsory regulation, economic incentives, voluntary agreement, or other methods?

In short, it was hoped the discussions would help identify actions to:

- Maintain and improve **strengths?**
- Overcome **weaknesses?**

- Realise **opportunities?**
- Alleviate **threats?**

Each group contained representatives from several countries with a range of skills, expertise and experience.

All participants then reconvened for a feed back session and workshop round up and closure.

In order to ensure participants were fully able to participate in the workshop they were sent prior documentation on the current peatland policy framework, the purpose of the workshop and the approach to be adopted. This allowed them to prepare and therefore contribute as fully as possible. Furthermore, the approach to the workshop outlined above encouraged maximum participation by creating small, more personal working groups and allowing participants to start the day with some people they knew, whilst also allowing for full group discussion and encouraging participants to mix. Furthermore it encouraged dialogue between different professions and specialisms, giving practitioners insight into issues concerning the research community and vice versa. The following section presents the outcomes of the workshop.

6.2 Policy Workshop Results

This section presents the results of Workshop C. That is, it presents the outcomes of both of the breakout sessions as reported by the groups themselves with some general discussion on the issues raised.

Table 6.1 contains a European level list of strengths, weaknesses, opportunities and threats of and to policy. The list was derived by the amalgamation of the outputs from individual groups in breakout session 1 that were drawn up with national policies in mind.

Table 6.1 shows stakeholders found a great many issues to discuss with regard peatland policy. Identified strengths focused primarily on recent policy reforms and introductions that promote multi-purpose/functional use and appreciation of peatlands. The weaknesses identified relate largely to a lack of policy specifically for peatlands, a lack of 'joined-up' policy and funding streams and the often regulatory and target oriented nature of policy. The opportunities identified highlight recent conventions and directives, brought about as a result of concerns over environmental/resource degradation and how these could be utilised for the benefit of peatlands. Conversely, many of the threats identified also relate to environmental and resource degradation such as sea level rise and water quality, or responses to these problems such as biofuel cropping. Also highlighted as threats were continued population pressures, the changeability of policy and current failure to recognise/promote the 'non-use' value of peatlands in agricultural use, being viewed as only useful for production purposes.

This all suggests that stakeholders and the scientific community agree there is currently great potential for promoting the wise use of peatlands. However, as identified in the MCA, success will involve a more coherent approach than currently exists, joining elements of differing policy frameworks for the benefit of peatlands and society.

Table 6.1. Strengths, Weaknesses, Opportunities and Threats in Peatland Policy

Policy Strengths	Policy Weaknesses	Policy Opportunities	Policy Threats
Protection of wetland often a national priority	Environmental policy focus is often regulatory/protection oriented rather than creative/enhancement oriented	GHG/Kyoto/Climate change/carbon trading	Dependency on policies which could change
Greater awareness and of acceptance of ‘some’ eco-system values	Preservation of peatlands per se not a priority: no peatland policy	New policy directions: Habitats/WFD	Conservation bodies work independently, reluctant to cooperate with other interests
Water use/users are commonly regulated	Agri environment tends to focus on specific targets: do not explicitly relate to peatlands	Raised awareness of water as a limited resource	Climate change/sea level rise
Integration of some functions: flood management/catchment/river basin management	Policies (and funding) do not ‘join-up’ and may actually be in conflict	Education regarding importance of ‘environment’	Population pressure
CAP reform now promotes extensive farming/agri-environment	Policy makers unaware of linkages between various policies and potential role of peatlands	New Rural Development Programme: diversified rural economies	Increased water resource problems: quality and quality
Policies are in place for a range of objectives, social, economic and environmental e.g. national parks, recreation, regional development, and tourism and education that have potential to impact positively on peatlands Existing cooperation amongst stakeholders	Research on peatland functions is a low priority	Support for agric extensification provides ‘time to adjust’	Perceived as a ‘plentiful’ resource in some areas
Directives: WFD/Habitats etc	Insufficient (and fragmented) funds to exploit opportunities	Peat as fuel/bio-energy crops	Cultivated peats perceived to have limited other value
	Distributing power could lead to tensions and conflicts of interest amongst stakeholders leads to inaction	Promotion of local solutions	Subsidence/Abandonment
	WFD may exclude some peatland areas (because they are heavily modified?)	Agri-environment could address resource protection issues	Bio-energy and food security

Tables 6.2 to 6.4 contain the group outcomes of breakout session 2, suggesting actions that will promote the wise use of peatlands. Most of these actions relate to policy but some are directed at stakeholders and the scientific community. This indicates that solutions for wise peatland management require input and willing from many parties and that improved policy alone is not sufficient.

Table 6.2. Breakout Session 2 Outcomes: Group 1

Strength	Action
CAP reform now promotes extensive farming/agri-environment	Continued shift in CAP payments to agri-environment and rural development and start to target peat soils in the agri-environment payments. So that peat soils are recognised for their special qualities.
Weakness	**Action**
Preservation of peatlands per se not a priority: no peatland policy	Raise targets to protect peat at national/European level
Policies (and funding) do not ‘join up’ and may actually be in conflict	Organise stakeholders, more local level control of achieving targets/objectives suited to local areas. Remove bureaucracy and carry out more research so as to understand the situation properly.
Opportunity	**Action**
GHG/Kyoto/climate change/carbon trading	Lobby to include peatlands in carbon trading
Peat as a fuel or to produce bio-energy crops	Prove advantages of peat as an energy crop where the peat farming cycle is considered better than abandonment
Threat	**Action**
Population pressure	Land use planning to protect peatlands

Of the actions suggested (Table 6.2), Group 1 considered the three most important to be continued shift in CAP payments away from production and towards environmental management, inclusion of peatlands in the carbon trading system and greater control of management at a local level, including more research. Group 2 prioritised the development of a framework for improved cooperation between stakeholders, greater efforts in communication, education and dissemination of peatland importance and the promotion of diversification of peatland farmer incomes from their agreed list of actions (Table 6.3). Group 3 struggled to reach agreement and so did not address all items on the list of strengths, weaknesses, opportunities and threats derived in the previous breakout session. Of the actions they did agree (Table 6.4) they considered obtaining funding and providing economic incentives to farmers, improving communication between scientists and policy makers and education of the general public about the significance of peatland ecosystem services, as the three most important. Group 3 also discussed types of policy mechanisms and concluded that economic incentives are an already established policy in agriculture and have been proven to be effective. Therefore it would be sensible to use these for promoting the sustainable management of peatlands. It was recognised however that as incentives tend to rely on voluntary agreement there might come a point where it is necessary to move to more compulsory and control mechanisms, including compulsory purchase.

Table 6.3. Breakout Session 2 Outcomes: Group 2

Strength	**Action**
Protection of wetland often a national priority	Policy makers make better use of existing legislation to facilitate the national priority of wetland protection
Existing cooperation amongst stakeholders	Framework for improved cooperation between stakeholders
Integration of some functions: flood management/catchment/river basin management	Integrated management plan for all functions at district scale
Weakness	**Action**
Preservation of peatlands per se not a priority: no peatland policy	Communication, education and information dissemination of information about peatlands
Policy makers unaware of linkages between various policies and potential role of peatlands	Communication between scientists and policy makers
WFD may exclude some peatland areas (because they are heavily modified)	Make an inventory of what WFD can/can not do for peatlands
Distributing power could lead to tensions and conflicts of interest amongst stakeholders that could lead to inaction	Framework for improved cooperation between stakeholders
Opportunity	**Action**
Promotion of local solutions	Adjust land use to the water table rather than the other way around
Raised awareness of water as a limited resource	Raise awareness of the importance of peatlands in controlling water quantity and quality
New Rural Development Programme: diversified rural economies	Development of environmental tourism and promote the diversification of farmer incomes
Threat	**Action**
Climate change/sea level rise	Research the meaning of climate change for peatland ecosystems
Subsidence/Abandonment	Improved water management to alleviate subsidence and introduce incentives to restore abandoned peatlands
Peat perceived as a plentiful resource in some areas	Communication and dissemination of the limit on the peat resource
Dependency on policies that could change	Improved communication, education etc to ensure the populace defend the maintenance of peatlands

Table 6.4. Breakout Session 2 Outcomes: Group 3

Threat	Action
Policy (and funding) does not 'join up' and may actually be in conflict	Improve linkages between policies, promote communication and raise awareness
Opportunity	**Action**
GHG/Kyoto/climate change/carbon trading	Lobby to ensure peatlands feature in Kyoto as a carbon sink and have the same status as forests, BUT as there is still much uncertainty about how they actually perform in this role over the long term this must be accompanied by further research
New policy directions: Habitats/WFD	Use the water framework directive to promote local solutions to problems, use the compulsory consultation within it to educate and communicate with the general public on peatland issues, and use it to flag the impact of nutrient leaching from petlands on water quality. I.e. use it as a mechanism to highlight the importance of these systems on water availability and water quality
Agri-environment could address resource protection issues	Use agri-environment schemes to target peat soils through incentives for i.e. subsurface drains, load spreading tyres and minimum tillage practices, precision farming

There were some reoccurring themes in the actions advocated by workshop participants, especially in the action considered to be a priority. Not surprisingly all three groups prioritised the support of farm incomes through means other than subsidised production. This confirmed the results of the SA, that farmers and their skills are required for the wise use of peatlands and that they respond to economic incentives. In addition better communication between stakeholders and between stakeholders and scientists was advocated, actions on which could be informed and optimised by the understanding generated in the SA regarding existing stakeholder interactions and influences. Active promotion of the importance of peatlands and their services was also considered a high priority, again this would be aided by research projects such as this, that identify, formalise and quantify the benefits functioning peatlands afford stakeholders and society. The following section summarises the key messages from the workshop, as made by the participants, with respect to actions to promote sustainable management of peatlands (SMP).

6.3 Policy Workshop Conclusions

This section reports the conclusions of the policy workshop as key points, specifically regarding policy to achieve wise peatland use and generally regarding the recommended approach to peatland management decisions. By so doing it concludes against the fourth research question.

The following key points were made by the workshop participants with respect to actions to promote wise management of peatlands (WMP) in the concluding discussion of the workshop. There was consensus that:

1. There is a need to achieve ‘joined up’ policies that work in favour of WMP. There is need and scope for better alignment of agri-environment schemes, integrated land use planning and water resource management, especially at the catchment scale which can promote WMP. Current realignment of agricultural, environmental and rural policies (e.g. Water Framework Directive/Habitats Directive/Kyoto Agreement/CAP Reform) provides an opportunity to promote WMP.

2. With respect to choice of policy instrument, the use of economic incentives to promote WMP e.g. through agri-environmental payments, appears to be most suitable approach. Reductions in agricultural support could, however, lead to abandonment of some peatlands, with uncertain consequences.

3. It is important to adopt a cooperative approach, engaging people and organisations at a local level to implement strategies for WMP.

4. Communicating the importance of peatlands and related ecosystem functions amongst policy makers and managers, and interested ‘publics’ should be encouraged. It was noted that stakeholders are interested in the services that peatlands provide, rather than peat soils themselves.

5. There is a need for increased research to generate a knowledge base to confirm the important contribution of peatland ecosystem services, especially; a) water

resource management, nutrient recycling, greenhouse gas emission control, and wildlife and landscape functions, b) issues of scale, from, for example, plot to landscape scale, c) stakeholder attitudes and behaviour regarding WMP, and d) Decision Support Tools to inform WMP practices and policy.

6. Although there is considerable variation in the characteristics of peatlands within and between research partner countries, common challenges and priorities arise. This calls for a common policy 'framework' for WMP, within which locally relevant policies can be developed and applied.

Informed by the previous research this workshop generated ideas for progress towards sustainable peatland management. The overriding message was there is currently great potential to promote improved peatland management from social and ecological perspectives through the existing policy framework, negating the need for further increasing the complexity and diversity of policy that affects peatlands, but that this will involve joining differing policy areas. It was evident that workshop participants considered peatlands to be important for many different reasons, meaning a range of policy frameworks impacts them. This is consistent with the results of the SA and MCA, which both suggest peatlands provide services that are of value to stakeholders across a range of sectors, most importantly agriculture, water management and environmental management with respect to species and habitat conservation. The workshop generated some consensus amongst the participants that any policy changes should be accompanied by a participative approach to generating solutions for peatland management amongst stakeholders and that this should help foster cooperation over conflict. The workshop confirmed a common understanding regarding the importance of peatlands across Northern Europe despite contextual differences and the need to promote this importance beyond peatland stakeholders if their future is to be secured.

The final chapter concludes against all four research questions and on the basis of these conclusions makes recommendations for action.

7. Conclusions and Recommendations

This chapter draws together the findings of this research, based on detailed case studies undertaken in two English peatland areas, supported by information from five Northern European peatland sites. It briefly reiterates the research purpose and approach before using the research findings to conclude against the research questions. It makes recommendations for actions to promote the wise use of peatlands across Northern Europe. The chapter then closes with recommendations for further research into peatlands themselves and the methodological approach.

This study proposed, designed and tested the use of a methodology that combined stakeholder analysis and multi-criteria analysis, structured by the ecosystem services framework, to elucidate the relationship between people and a natural resource, specifically peatlands. It responded to the gaps in the literature by developing a methodology that can integrate detailed knowledge of stakeholder value systems and interactions with practical decision support tools. Furthermore, the study demonstrates how this methodology could be directly useful in the policy forming/decision making process, helping decisions begin to account for both the state of the resource and the well-being of its stakeholders.

The study was carried out in the context of ecological services and stakeholder values by applying the ecosystem functions, uses and values framework. This framework was developed specifically for lowland Northern European peatlands in order to allow comment on its suitability for formulating solutions for and mechanisms to deliver the wise use of peatlands. The research adopted an inductive approach and used the qualitative data gathered in the stakeholder analysis to inform a quantitative multi-criteria analysis to determine the relative importance of factors influencing stakeholder perceptions of peatland value.

7.1 Conclusions

This section presents conclusions of the research against the research questions, demonstrating the meeting of the research aims. It discusses the issues they raise for peatland management and the methodologies employed. This section then draws conclusions against the subsidiary objective of demonstrating the combination of stakeholder and multi-criteria analysis as a useful methodology for interpreting the ecosystem services framework and therefore defining sustainable solutions to problems of resource management.

Drawing on a range of European cases, this study has confirmed that peatlands are highly complex systems that exist in a wide range of socio-economic contexts with different associated drivers and pressures, different states of peatlands and as a result different impacts on people and communities. As a consequence approaches to peatland management vary, including the ways in which government and non-governmental agencies have responded to the challenge of peatland degradation associated with anthropogenic use. The pressures relating to peatlands in densely populated England, for example, vary considerably in magnitude to those relating to peatlands in Sweden. In England lowland peatlands are highly degraded intensively managed systems that are required to meet multiple and often incompatible demands simultaneously. Sweden on the other hand is a relatively sparsely populated country with large remaining peat reserves and therefore tends not to have multi-purpose peatlands and can afford to place great importance on the landscapes of peatland areas. The stakeholders associated with a habitat restoration project such as that of the Eider valley in Germany vary in their priorities to those associated with an intensive dairy industry as of that in the Netherlands. Indeed the drivers and pressures between sites within any one country vary, as shown by the Fens and Somerset Moors cases of England. None the less, some common themes emerge and some generalisations can be made and conclusions drawn relating to the wise use of peatlands across Northern Europe.

With respect to the first and second research questions, namely: What are the ecosystem functions and associated services provided by peatlands? And: Given the current use of peatlands, how are these services distributed amongst stakeholders? A qualitative, inductive approach to stakeholder analysis combined with the ecosystem services framework was highly successful in developing an understanding of the relationship between people and peatlands. Using stakeholder analysis as a descriptive tool highlighted the peatland functions of relevance to stakeholders in the case study areas and identified how these functions are distributed among the stakeholder network given current land use. Stakeholder mapping within the stakeholder analysis also alluded to the stability of these relationships and identified areas of inequality in the current distribution of benefits and entitlement.

It is clear from the results of the stakeholder analysis that a great diversity of peatland functions are significant to human well-being because of the services they deliver. From the refuge function, that provides breeding grounds for rare species such as Snipe, through to the substrative function, that allows navigation via roads through peatland areas, peatlands are providing services of value to stakeholders and society. Even peatlands under one dominant land use perform a wide variety of functions, providing multiple services of value to peatland stakeholders. For example the Somerset Moors deliver aesthetically pleasing landscapes, recreational opportunities and cultural heritage preservation whilst at the same time delivering more direct-use flood defence and livelihood provision services. Peatland functions may be of importance for differing reasons to differing stakeholders. Primary stakeholders, those individuals who are directly impacted by peatland management, tend to draw direct benefit from the functions significant to them, for example appreciation of landscapes and recreational opportunities and deriving livelihoods. Where as secondary and tertiary stakeholders, those organisations and bodies, and boards, partnerships, panels and committees respectively, that are directly affected by peatland management, tend to be interested in functions that are failing or are vulnerable and need rehabilitation or protection, such as flood water storage and wildlife conservation. This is with a view to improve provision of these services for others, namely primary stakeholders and the general public.

Generally speaking across Northern Europe the current socio-political context of peatlands, although highly susceptible to changes in agricultural commodity markets and policy, is largely promoting extensive uses of peatlands over intensive uses. Stakeholder interest across Northern Europe is currently spread among the habitat, production, regulation and information functions predominantly, with limited interest in the carrier functions and very few stakeholders indicating a strong preference for only one peatland function, suggesting stakeholders have preferences for multi-functional land uses. Stakeholder interactions across Northern Europe identified in this research, relating to lowland and predominantly agricultural peatlands, centre on the habitat and production (including livelihood) functions as the two priorities for land use and the regulation functions as the main point of required intervention. Stakeholder influence was found to be largely dependant on ownership of property rights and entitlements (especially relating to land tenure) and organisational power (especially lobbying powers). Stakeholder interest, when refined to individual function categories revolve largely around the habitat, production and regulation functions, with local residents being distinct in their interests in information functions. Local residents are also the stakeholder group most likely to be marginalized in peatland management decisions because of their low influence but relatively high interest.

With respect to the third research question, namely: Given current stakeholder values, what is the impact of peatland use on peatland services and stakeholder well-being? MCA techniques were used, drawing heavily on existing understanding of peatlands and their stakeholders born out of the rich qualitative data of the stakeholder analysis, to capture stakeholder values in a quantitative form. Using MCA techniques as exploratory tools helped to develop an understanding of the link between peatland use, service delivery and stakeholder well-being that could, with further work, be translated into a practical policy/decision support system.

For the English cases two MCA techniques were applied, namely the Analytical Hierarchy Process (AHP) and Multi-Attribute Utility Theory (MAUT). The results showed that intensive peatland use and so peat soil degradation depletes the diversity of ecosystem services delivered by peatlands, making them vulnerable systems ecologically and less valuable socially. In terms of stakeholder well-being, livelihood provision, floodwater storage and wildlife interest were found to be the three most important aspects of peatland management. These were closely followed by archaeological preservation. In the current socio-political climate, of the options screened, more extensive peatland use options such as extensive grazing and habitat restoration maximise well-being for the majority of stakeholders despite their relatively low levels of associated livelihood. However, in stark contrast, more intensive uses such as intensive arable cropping maximise well-being for several stakeholders in the Fens region, namely: farmers, representative bodies such as the National Farmers Union and the Countryside Landowners and Business Association and water management bodies such as the Internal Drainage Boards. This difference is mainly due to a combination of very high importance placed on livelihoods and the increasing marginal utility of these stakeholders in relation to livelihoods. This implies a desire for high risk but high reward (in terms of livelihood) management of peatlands. While most of the remainder of stakeholders place relatively less importance (although still reasonably high) on livelihoods and have diminishing marginal utility in relation to livelihoods. This implies a desire for low risk management practices that deliver steady, albeit relatively low, livelihood levels. The difference is reflective of whose livelihood stakeholders were asked to express preferences for i.e. local business people, namely farmers and peat extractors.

According to the MAUT results, in order to maximise well-being for the majority of stakeholders interviewed, efforts should be made to find land use options or landscape scale mosaics of use that provide levels of livelihood akin to an extensive grazing regime (or, as explained above, akin to an arable regime from a Fens representative body and farming perspective), adequately accommodate floodwater storage (summer and winter) and provide high levels of wildlife.

It was shown in the AHP analysis that although stakeholder preferences were at the time of interview promoting more extensive peat soil uses, given the interests of key players (those stakeholders with high influence level and a high interest, for example farmers and the Environment Agency) and the voluntary nature of much environmental action, peat soils are currently vulnerable to changes in the agricultural commodity markets and responses to climate change. Indeed, this has been exemplified recently with increases in commodity prices and anticipated intensification of agricultural use, particularly in the Fens area.

It should be remembered that this part of the research was carried out for the English case studies and results were not validated across Northern Europe, therefore conclusions drawn here may not apply across Northern Europe as a whole. However, given the similarities across Northern Europe found in the stakeholder analysis in major stakeholder groups and prime interests, and the agreement between the results of the MCA with the stakeholder analysis, it is thought there is reason to speculate the results, in terms of priorities for peatland management, bear relevance across Northern Europe. Although contextual heterogeneity may mean the detail varies from case to case.

With respect to the fourth research question, namely: What does the relationship between people and peatlands, explored by the previous research questions, mean for policy in terms of achieving the wise use of peatlands? Application of the ecosystem functions, uses and values framework to the peatland case (through SA and MCA analysis) and a stakeholder workshop allowed the identification of potential threats and opportunities for wise peatland use. This highlighted potential areas for policy intervention or improvement.

Research results suggest that given the range of interests in peatlands a multi-objective approach to peatland management may be required. It concluded that sustainable solutions must, as far as possible, reconcile differing interests. This has implications for policy regimes, notably regimes to support farm incomes, biodiversity, water resources and quality, climate regulation, flood risk management, small business support, tourism, and public access to the countryside. It has been demonstrated that all of these policy regimes, most of which call on separate funding mechanisms and engage different organisational bodies, are potentially linked to peatland management in the case study areas. Furthermore, it is evident that although there is considerable variation in the characteristics of peatlands within and between research partner countries, common challenges and priorities arise. This suggests formulation of a common policy 'framework' for the wise use of peatlands, within which locally relevant policies can be developed and applied.

The subsidiary objective of this research was to demonstrate how the combination of stakeholder and multi-criteria analysis might provide a useful methodology for interpreting the ecosystem services framework and therefore defining sustainable solutions to problems of resource management. To address this stakeholder and multi-criteria analysis were used in combination in this research. The qualitative data of the stakeholder analysis informed the construction of the multi-criteria analysis and the results of both were organised within as an ecosystems services framework. In this way, it was possible to answer the research questions, demonstrating the potential of the proposed methodology as a useful resource management aid. The study captured and formalised what was mainly pre-existing ad hoc knowledge on peatland stakeholder networks and value systems, in way suited to policy and decision makers. This thesis also provides new and useful insights, as yet limited in the literature, on how stakeholder and multi-criteria analysis were applied, offering guidance to other researchers on the practical elements of use of these techniques. It can be concluded that in combination, stakeholder and multi-criteria analysis provide a useful methodology for understanding issues of resource management where there is more than one use and user. Furthermore, they can be structured meaningfully using the ecosystem services framework and feed directly into policy formation, offering guidance on intervention areas, measures and levels. Some issues with these methods did become apparent however that should be born in mind for future studies.

Firstly, with regards to stakeholder analysis, although it is a commonly referred to technique in the field of resource management there currently exists little succinct information on what constitutes a stakeholder analysis, and even less on how to apply some of the mapping and networking techniques advocated in a systematic and consistent manner. Although this is beginning to be addressed in the work of Morris and Graves (as yet unpublished) it currently means researchers often interpret stakeholder analysis in different ways and the results can be fairly subjective. This is not conducive to it becoming a standardised methodology. The transparency in the methods sections of this thesis and availability of the differing stages of data analysis were designed in part to begin to address this issue. They provide an approach to stakeholder analysis that can be applied in a consistent manner across different resource and case study types.

Secondly, there are limitations in MCA techniques, in particular with regard to the measures selected and the type and range of criteria that can be used. Furthermore, the reliability of MCA techniques in accurately representing stakeholder preferences can be questionable, with challenges involved in capturing such concepts as character or emotional rather than 'logical' responses. However, the use in this study of two MCA techniques which largely confirmed the results of each other suggests that, used with care, these techniques *can* capture in a broad fashion the *immediate* priorities of stakeholders for resource management.

Overall this research demonstrates the ecosystem functions, uses and values framework was helpful in structuring a resource problem and elucidating the connections between social well-being and resource use. There were some challenges in applying the ecosystem services framework however, particularly with regard to separating individual functions and services from each other and in relation to specific land uses. This was partly due to the continued ambiguity of definitions of these terms, for example the difference between ecological processes and economic services at times being blurred, in spite of attempts to distinguish them. This is attributable to incomplete scientific understanding of the ecosystems in question and partly due to the complexity of interactive and dynamic natural systems. Of particular concern is the unclear distinction between biodiversity as the 'primary value' of an ecosystem (suggested by Turner and now commonly adopted) and the habitat functions, providing breeding and refuge grounds for specific species. Turner himself suggested that the habitat functions introduce double counting. It was found in this research that stakeholders find it difficult to distinguish between interest in species for their own sake (intrinsic value), for their importance to ecological systems as a whole (the primary value) or for recreational, landscape or cognitive reasons. This calls into question the validity of the 'habitat functions'. However, as found in this research, wildlife, in terms of specific species and habitats, is of high importance to stakeholders for reasons beyond being fundamental to healthy ecosystems and therefore does need to be represented in some form. Further refinement of this particular element of the ecosystem services framework is still needed.

7.2 Recommendations

Some recommendations can be made on the basis of this research. This section outlines recommendations for action to encourage wise use of peatlands across Northern Europe before making recommendations for further research avenues that may help both understand peatland systems and enhance the methodology developed in this study.

Recommendations for action towards wise use of peatlands are:

- Given that wise peatland management options have been shown to involve multi-objectives, it is recommended that existing policy regimes be joined up for this purpose in ways that suit local conditions. This would mean developing spatially defined, tailor-made peatland management strategies, for example in the English case, suited separately to the Fens and to the Somerset Moors. The management of peat soils will of course be central to this. The new agri-environment schemes in the English case, for example, provide an opportunity for this. But this approach should be strengthened to develop area specific programmes for important peatlands.
- Improved communications both between stakeholders and with the general public on the diversity of peatland services was shown to be a priority action for promoting wise peatland use amongst Northern European stakeholders. As such consideration might be given to actions that inform stakeholders about the range and value of the services that peatlands provide so that they can make informed choices about options for wise management. There is also a need to promote an understanding or the complementarities and tradeoffs amongst management options, and how these contribute to the well-being of key stakeholders, whether farmers, local residents or society at large.
- It has been shown that the wise management of peatlands (often carried out by farmers) can provide benefits to many stakeholders in the form of 'public goods', such as landscape quality, for which no direct charges are made. Furthermore, it was found that farmers feel under appreciated by the general public for the services they provide and victimised by some voluntary sector

organisations in their campaigns. It is recommended that where public goods are being provided (and science can help to confirm this), funding by the public purse continues for this purpose and that farmers are recognised for the contributions that they make, not only through financial compensation but also in enhanced reputation.

Recommendations for further work are:

- There is scope and a need for further development of an ecosystem based framework to support decisions on sustainable peatland management in ways that are responsive to stakeholder interests. This research has generated an improved understanding of the ecosystems functions and services provided by peatlands, and the usefulness and value of these to stakeholders. It is apparent that there is potential benefit from extending this understanding in relation to defining explicit guidelines on preferable peatland service provision levels and use, through a more comprehensive coverage of peatland functions, uses and values, backed up by scientific evidence.
- Policy makers would benefit from a better-developed understanding of scale in defining wise peatland use. For example, finding land uses that meet all stakeholder needs and still maintain the ecological integrity of the peatland systems is at present unlikely given the conflicting nature of some of these interests. On a landscape scale it may be possible. There are suggestions however that multiple land uses, each with their own hydrological requirements, immediately adjacent to each other is not necessarily sustainable given the number of structures and intensity of management required to keep each use from impacting on the others. This has implications for the concept of multi-functional mosaic landscapes. It is possible then the correct scale for identifying wise use is in fact national. If this is the case then understanding of local stakeholder priorities is even more imperative in order to ensure equitable distribution of costs and benefits.
- The application of the MAUT model for valuation of ecosystem services could be developed further. Work is needed to refine the livelihoods measure in particular and the extraction land use option. The technique could also be expanded to include ecosystem critical limits, as and when they are confirmed

by research, and allow the interaction of stakeholder preferences for differing attributes.

- The MCA techniques could be used for the screening of new and innovative land use options, which could be accommodated by more collaborative management or land ownership systems, therefore broadening the choices for wise peatland use.
- Guidance on the use of the methods set could be developed. This would involve streamlining the methodology, from the number of stakeholders interviewed, the treatment of interview data and the collection of stakeholder preferences for the MCA. This would help identify and recommend a minimum depth to investigation, which yields the necessary information without being overly time and resource consuming or collecting data beyond the study requirements.
- It might be useful to know if carrying out a similar methodology in a more participative manner fully involving stakeholders reduces the amount of data required and helps develop stakeholder consensus along the way.

In closing, this research has broadly achieved its purpose. It has developed and applied a research methodology that has enhanced the understanding of the social and economic value of the range of services provided by peatlands. This understanding has been demonstrated to bear relevance to the identification and implementation of solutions for the wise use of peatlands.

8. References

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APPENDIX I – REPORT OF WORKSHOP A

Sustainable management of European peat soils: Scenario Analysis

EUROPEAT

Report of a Workshop 13th July 2004

1. Background

Changing priorities in the European countryside are promoting the concept of rural land and water management as a provider of a diverse range of environmental goods and services which serve the public interest, protect natural resources and the environment and provide a basis for sustainable rural livelihoods. This process is further encouraged by a realisation that current arrangements for EU agricultural support are untenable, especially given an expanded membership (Weyerbrock 1998).

The emerging rural challenge is apparent in the case of peatlands which offer a diversity of future land management options which vary in their ability to serve the social, economic and environmental interests of major stakeholders. However mechanisms for identifying and achieving satisfactory solutions are as yet unclear.

In this context this EU funded project explores the two-way relationship between society and peatlands. Actions to preserve peat soils for environmental purposes have social and economic consequences for those communities which derive their livelihoods from use of peat lands, as well as for those who derive benefits from the range of environmental goods and services they provide. Furthermore, social and economic factors determine the practicality, effectiveness and efficiency of actions to preserve or use peat soils wisely. This project seeks to provide a framework for assessing the social and economic dimensions of the wise use of peat lands in the UK and in the partner countries.

2. Workshop Purpose

The purpose of the workshop was to engage key peatland stakeholders in the identification and interpretation of possible futures as they are likely to affect the sustainable use of peatlands in farmed areas. More specifically to:

- identify the main drivers and pressures that could shape the future 'state' of peat soils in farmed areas in the UK under alternative possible long term future scenarios, with particular reference to the impacts on the environment and livelihoods;
- identify the potential impacts on peat soils of climate change associated with these scenarios and implications for management;
- identify policy and management responses which promote the sustainable management of peatlands under different possible scenarios

3. Workshop Participants

A list of participants was drawn up by the researchers to contain representatives from key stakeholder groups with interests in the future of peatlands and agricultural use of these areas. It was also the aim that the list incorporated people with a broad knowledge of the issues at play in peatland areas. Participants identified included representatives from commercial farming and water management organisations, environmental organisations, and academics and researchers. The target number of total participants was between 8 and 14. A total of 12 people participated in the workshop, 4 of these being members of the project research team. The list of attendants is given in Appendix 1.

4. Pre-Workshop Documentation

Documentation on the background and purpose of the research project and the purpose of the workshop was sent out to participants prior to the workshop (Appendix 2)

5. Workshop Programme

The workshop consisted of an afternoon session starting at 2 pm and closing at 5.20 pm, 13th July 2004. Formal presentations were made by the researchers in the first part of the afternoon covering the following aspects:-

- Introduction to the Europeat project and the role of Cranfield University within it
- Introduction to scenario planning, agricultural and environmental futures

These presentations were followed by a brief plenary session where the key drivers for two of the foresight futures were discussed.

Participants were then divided into two equal groups to discuss one of the foresight scenarios in relation to peatland use. The groups were designed to be multi-disciplinary with interests in the Somerset Moors and The Fens also divided. The Driver-Pressure-State-Impact-Response framework was used as a structure for discussion, with themes being:-

- Social, environmental and economic consequences for peatlands and their stakeholders in terms of pressures, resultant state and the impacts of different scenarios
- Response possibilities that would help alleviate the negatives and enhance the positives identified above.

The groups reported back in plenary sessions, before rounding up and closure.

6. Plenary Discussion

Following the presentations by the research team the possible drivers for two of the future scenarios (world markets and local stewardship) were presented. In the time available these drivers were largely agreed upon by the group.

The possible drivers as presented were:-

Table 1 – Possible drivers for the world markets and local stewardship future scenarios

Drivers	World Markets	Local Stewardship
Macro economic factors	High growth, high average income, but relatively inequitable distribution	Low growth, low income, but relatively equitable distribution
Markets and prices	Consumer led, market driven, high retailer power, price competition	Local area produce, greater ‘connectivity’, farmers cooperatives
Agricultural policy	Abandonment of CAP, WTO led	Support regimes in accordance with local priorities
Agricultural production and technology	Intensive, highly technologically specialised, large scale production, GMOs promoted	Diversified, integrated, smaller scale, less intensive, GMOs rejected
Farmer motivation	Polarisation in to commercial and lifestyle farmers	Strong community and conservation ethic
Environmental policy	Limited interventions, mainly through economic incentives	Strong commitment to environmental protection supported by regulatory framework
Climate change	High emissions and climate change signal	Medium to low emissions and climate change signal

7. Breakout Sessions

Participants were divided into two multidisciplinary groups. Group 1 was asked to explore the pressures, state, impacts, and responses for the world markets scenario and group 2 was asked to explore the same for the local stewardship scenario. Both groups were asked to think about the possible difference between the Somerset Moors and The Fens.

7.1. Group 1 – World Markets

7.1.1. DPSIR

The group discussed components of the DPSIR framework in general terms for the World Market scenario. The following summarises the main points that came of this shared understanding.

Drivers here include increased world population, rising average incomes although greater income disparities between rich and poor, and dominance of market and economic factors, including power of food industry and retailers. It was confirmed that agriculture would be mainly driven by market forces, with ‘profitability’ as the key indicator of success (although land managers would also provide non-production services if there is a market demand and it is profitable to meet it).

Pressures are associated with intensification of farming in some areas of the Fens, with consequences for rapid degradation of soils, abstraction for irrigation and discharges to water environment. In other cases, abandonment may relieve environmental pressures.

State of peat soils (and related water and biodiversity issues) will vary according to degree of land use intensity. Where arable farming remains profitable, peat degradation is likely to increase. Abandonment could slow down the rate of degradation.

Impacts will be diverse:

- Agri-business supports rural economy through specialist cropping, and locally branded products.
- In some areas, declining farm income hastens abandonment.
- Environmental negative impacts associated with intensification in some places, and reduced farm incomes in other areas lead to neglect of managed environment.

Responses would have to put economic value on currently non-market goods and services in order to protect peat soils:

- Commoditisation of environmental services, including those of peat soils, as an alternative to farming e.g. flood storage, conservation, public access.
- Economic and market mechanisms shape land and water use according to the willingness to pay principle.

7.1.2. Uncertainties

The Fens:

- Already high level of competition for fenland growers, and increasing costs, therefore uncertainty about continued viability under growing market pressures.
- Labour supply and costs a major concern, and increased competition for water for irrigation, especially given climate change.

The Somerset Moors:

- Major uncertainties associated with viability of grassland farming in absence of farm income support, and extent to which economic market incentives will be available for ecosystems services,
- Critical question is which peatland services will be most valued?

7.1.3. Points That Arose in Discussion

7.1.3.1. Agricultural Futures

With respect to agriculture, increased international competition and declining real prices for agricultural commodities have different impacts on the two sites.

In the ***peat fens of East Anglia***, farming intensification and specialisation of production increases in some areas in an attempt to remain viable through higher yields, increased focus on tighter market specification for produce, and economies of scale and experience. In these situations peat soils offer comparative advantage for intensive high value cropping. Farmers, however, face high costs of water management (both water supply and drainage services are no longer indirectly subsidised). In some areas of the Fens there is likely to be abandonment, especially where peat soils are degraded and remaining soils do not offer comparative advantage either for intensive or conventional arable cropping. Some peat areas are purchased by conservation organisations, funded through subscription and visitor revenues.

In the Somerset Moors, grassland, dairy and livestock farming systems face declining profitability due to falling prices for commodities and rising costs. Small farms are not viable as business units. In the absence of income support, land falls out of agricultural production, with reversion to wet grassland/swamp. Conservation organisations purchase non-viable farm land for wetland reversion.

There is diversity of land use associated with conservation, recreation and tourism, as well as acquisition of property by urban-based elites. In the fens, reduced farming profitability, and relative increase value of land for conservation and/or public access expressed through market demands, encourages reversion of some peat soils to wetland. Land exchanges hands for this purpose: there is an overall decline in the proportion of the area that is farmed.

In the Somerset Moors, farming becomes unviable unless associated with some form of service provision for conservation or amenity. The latter are shaped by market forces. There is a tendency to hang on to the ownership of fragmented plots of land and 'let' them for these purposes. Farm units and buildings are purchased by rich urbanites and used for non farming purposes. In some areas, land is used for flood storage, with payments to land owners. Generally there is an increase in wetness and flooding of peat soils.

7.1.3.2. Consequences for Use of Peat Lands

In the East Anglian Fens and in the Somerset Moors, farm based operations do well if they are able to capture market advantage through 'niche marketing of locally branded products or services', whether this be fresh produce, dairy and livestock commodities, or 'countryside' services such as recreation. Peat soils and their services are thus 'commoditised' under this future and provide part of the competitive advantage, a critical aspect of this future. A number of outcomes are possible:

- abandonment, no use (but continued 'non-use'),
- 'alternative' uses for 'market based' environmental service such as conservation, public access and/or flood storage, reflected in willingness to pay for services
- continued intensive exploitation for agriculture without 'soil association', i.e. concern for soil,
- use of peat soils as part of a niche offering, whether farming or non-farming, associated with a spatial identity of which peat soil is part.

The extent to which peat soils feature in these options, and is recognised as an asset and a source of a flow of goods and services, varies. The critical issue is whether the rate of decline in the stock of peat soils is sufficient to threaten the flow of goods and services that they provide such that associated 'uses' are deemed unsustainable. The group noted that World Market relies on operation of market forces. There is a risk that services which are not traded in the market place (i.e. are not obviously 'owned' and don't appear to command a price) are unrecognised and undervalued, at least until they have disappeared.

Table 2 summarises main concerns for peatland managers associated with the World Market scenario.

Table 2. Concerns of Peatland Managers Associated with the World Market Scenario

The Fens	The Somerset Moors
Extremes of land use: in some areas further intensification of farming, in others abandonment. Peats provide comparative advantage for high value (but high cost) cropping.	**Loss of agriculture:** farming systems become non viable, land taken out of agricultural use, declining incomes in farming economy. Peat soils offer limited comparative advantage in farming unless intensively managed.
Water quality/quantities: variations according to above: increased competition for water, increased costs of water services.	**Land *management* issues:** reduced farming occupation results in reduced management of some environmental assets and decline of 'managed biodiversity' and landscapes associated with extensive grassland farming.
Peat soils: remaining deep peats continue in farming, abandonment of degraded peats so degradation therefore accelerates.	**Environment:** some environmental services such as conservation, public access and flood storage are driven by 'market forces'/willingness to pay which may undervalue them and lead to their decline.
Flood and drainage infrastructure: reduced operation and maintenance in some areas, affecting land in adjacent farmed areas.	**Flood and drainage infrastructure:** reduced flood management infrastructure and operations for agriculture, increased flood storage on farm land, affecting some adjacent areas.
Overall impact: hasten degradation of peat soils in farmed areas followed by abandonment. Transfer of degraded peats into non-farm use, including wetlands.	**Overall impact:** reduced degradation of peat soils associated with decline of farming activities. Some loss of environmental services due to reduced 'management'.

7.2. Group 2 – Local Stewardship

7.2.1. Pressures, State, Impacts

It was assumed that the entire world is operating under the same scenario and therefore there is no trade beyond national boundaries and within country trading is carried out over as small distances as possible. Under this assumption, and further assuming there are no unforeseen events such as internal political conflict or repeated crop failure which might significantly modify the scenario, the main concern of the group was that self-sufficiency in food might not be possible. The biggest question is whether there is enough land to feed the population by the methods dictated by the scenario? The consensus of the group was that the answer to this question is no. It was felt that the pressures associated with self sufficiency (intensification of production, converting land no longer in production back into agricultural land) would not be compatible with the drivers identified in table 1, which allude to high environmental awareness and protection and extensification of production. It was therefore decided that the ***drivers*** presented in the plenary discussion were in fact unlikely to support the local stewardship scenario without a decline in population.

It was decided that ***pressures*** on environmental resources would increase as the need to use land for agriculture increases. At the same time energy production and other non-agricultural activities would need to be carried out at a local level exacerbating the problem. This would be felt more in the Somerset Moors than in the Fens where production is already relatively intensive.

It was widely agreed that the Local Stewardship scenario would be detrimental to peatlands and peat stocks. It is likely the ***state*** of peat soils in terms of quantity and quality would decrease under this scenario due to continued use for agriculture and the likelihood of intensification of agricultural practice in the Somerset Moors. Opportunities for peatlands to be used for things other than agriculture would disappear and many restoration projects would be abandoned, meaning these areas would continue to be drained and cultivated or grazed. Even areas currently under legislative protection may be sacrificed as EU and central governments influence is reduced and the need for increased food supplies takes priority. Furthermore, there is a possibility peat extraction will be resorted to, to help meet energy demands.

Table 3 contains the results of the discussion with respect to the ***impacts*** arising as a result of the stewardship scenario. The scenario appears to dictate a less intensive and less mechanised farming system, perhaps reverting to traditional, more extensive farming methods. There was concern that the basic skills and knowledge required for these small scale, environmentally sound agricultural practices may not be available and therefore recruiting and training a workforce would be an important but challenging task if this scenario were to prove feasible.

Table 3 – Impacts arising from the stewardship scenario

Impacts	Commentary
Rural economy, incomes and employment	In the Fens agriculture would decrease in intensity and farms would break into smaller units. In the Somerset Moors agriculture would intensify slightly. Both areas would have to diversify production by reverting to mixed farm systems, in the Fens this would mean the introduction of livestock and in the Somerset Moors this would mean an increase in arable cropping. It is likely farm incomes would increase under this scenario as a lack of a global market, and therefore global competition, coupled with the need to feed the entire British population would increase the value of produce. Increase in rural employment due to more labour intensive farming methods and consequently an increase in rural population.
Consumption, prices and security of food and non-food commodities	The main priority would become food production resulting in less regard for *how* food is produced and more interest in *how much*. Food consumption would decrease and variety would decrease, both would become dependant on what can be provided locally. Supply consistency and certainty would decrease as it is much more sensitive to unforeseen events such as flooding or drought. Prices of both food and non-food commodities would increase for the consumer due to a decrease in competition and an increase in the value of land. Non-food commodities would become less important as meeting the basic requirement of sustenance becomes more difficult.
Use and non-use values of natural resource and ecosystem functions	Use values of peatlands would increase as the production and carrier functions of these areas become important for food production, transportation and habitation. Other use and non-use values of peatlands would decrease as environmental conservation, recreation, and cognition become relatively less valued and there is a decrease in influence from EU legislation.

7.2.1 Responses

It was decided that there were two main options available to respond to the various pressures and impacts associated with the local stewardship scenario. These were:

1. Abandon the local stewardship scenario and switch to another more production and market oriented scenario
2. Remain within the local stewardship scenario but either
    a) increase the productivity of peatland farming without negative affects on society and environment, or
    b) reduce consumption levels per head or the size of population

The Group explored option 2 by considering the responses needed to improve the overall sustainability of local stewardship option as shown in table 5.

Table 4 – Responses required under the local stewardship scenario

Responses	Examples
Modify drivers	Modify policy and market drivers towards production i.e. subsidised production, changes in demand, reduced consumption
Relieve pressures	Research into finding higher yield, higher nutritional value crop varieties without increasing environmental pressures.. Farming cooperatives to improve small farm productivity
Protect/enhance state and processes	Investment in infrastructure improvements. Funding given to sub-surface irrigation systems.
Mitigate/enhance impacts	Welfare, credit or insurance systems to mitigate crop failure. Strategic storage of crops. Controlled prices. Incentives to encourage the labour employment, i.e. welfare to work.

8. Plenary Feedback Session

The groups presented their findings in a plenary session. As well as the detail already presented it was decided that:

- In the English case, the rate of degradation of Peatlands is likely to be less under the World Markets scenario than under Local Stewardship. Under World Markets the Fens would continue to be used intensively, although degraded peatlands are likely to switch to conservation as their comparative advantage for faming is lost. Grassland farming on the Somerset Moors would be rendered commercially non-viable and peatlands would be abandoned or released for other purposes, for the most part reducing the rate of degradation.
- Given the need to achieve self sufficiency in food production, Local Stewardship, even though it aims to protect the integrity of peatlands, may result in enhanced degradation because of continued relatively high level of use for agriculture. Peatlands therefore are at relatively high risk under this scenario.
- Concerns about sustainability of World Markets and Local Stewardship scenarios led both groups to conclude a tendency towards a central position in the scenario map, taking aspects from all scenarios.
- It was noted that the discussion tended towards Global Sustainability as a ‘preferred’ scenario (and one that was perceived to be closely linked to changes in or collapse of CAP).

9 Workshop Closure

The workshop closed with an expression of thanks to the participants. Feedback suggested the afternoon had been interesting and enjoyable, however the use of scenarios in this way emphasised theoretical rather than practical issues. Furthermore, questions were raised about the state of sectors other than agriculture in the UK, especially under the Local Stewardship scenario. It was felt more time was required to fully work through and agree on the implications of each scenario before focusing specifically on agriculture and peatlands.

For future meetings efforts will be made to improve the balance of representation between the Somerset Moors and The Fens as it was felt the Somerset Moors were relatively under represented. Furthermore inclusion of representatives from policy or regulatory organisations would be beneficial.

Subsequent to the meeting, it was concluded that follow up workshops should be conducted separately on location in Somerset and the Fens to address local issues and facilitate participation.

Appendix 1 – Attendance List

Attendance List

1. Joe Morris; Cranfield University
2. Peter Leeds-Harrison; Cranfield University
3. Quentin Dawson; Cranfield University
4. Amy Rawlins; Cranfield University
5. Dick Godwin; Cranfield University
6. Chris Gerrard; The Great Fen Project
7. Harry Paget-Wilkes; Royal Society for the Protection of Birds/Internal Drainage Board
8. Martin Lester; National Trust
9. Martin Hammond; Shropshires
10. Bob Lawrence; Greens of Soham
11. David Phillips; Internal Drainage Board
12. Graham Hirons; Royal Society for the Protection of Birds

Working Groups

Group 1 -	Harry Paget-Wilkes	**Group 2**	Chris Gerrard
	Martin Lester		Graham Hirons
	Dick Godwin		David Phillips
	Bob Lawrence		Martin Hammond
	Joe Morris		Peter Leeds-Harrison
	Quentin Dawson		Amy Rawlins

Appendix 2 – Workshop Notes Sent Prior to Meeting

1. Background

Changing priorities in the European countryside are promoting the concept of rural land and water management as a provider of a diverse range of environmental goods and services which serve the public interest, protect natural resources and the environment and provide a basis for sustainable rural livelihoods. This process is further encouraged by a realisation that current arrangements for EU agricultural support are untenable, especially given an expanded membership (Weyerbrock 1998).

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In this context this EU funded project explores the two-way relationship between society and peatlands. Actions to preserve peat soils for environmental purposes have social and economic consequences for those communities which derive their livelihoods from use of peat lands, as well as for those who derive benefits from the range of environmental goods and services they provide. Furthermore, social and economic factors determine the practicality, effectiveness and efficiency of actions to preserve or use peat soils wisely. This project seeks to provide a framework for assessing the social and economic dimensions of the wise use of peat lands in UK and in the partner countries.

2. Workshop Purpose

The purpose of the workshop is to engage key peatland stakeholders in the identification and interpretation of possible futures as they are likely to affect the sustainable use of peatlands in farmed areas. More specifically to:

- identify the main drivers and pressures that could shape the future 'state' of peat soils in farmed areas in the UK under alternative possible long term future scenarios, with particular reference to the impacts on the environment and livelihoods;
- identify the potential impacts on peat soils of climate change associated with these scenarios and implications for management
- identify possible policy and management responses in order to promote the sustainable management of peatland management under possible scenarios

3. Overview of Methods Framework

For the purpose of the workshop, two analytical frameworks will be applied, namely: the DPSIR framework and the Foresight Futures Scenario framework

3.1 Driver Pressure State Impact Response (DPSIR) Framework for Sustainability Applied to Peatlands

The main **drivers** which at a high level influence use of peat soils include economic growth, international trade, consumer market demand for agricultural produce, and government policy interventions such as the EU CAP. These drivers can generate **pressures** on peatlands associated with, for example, particular types of land use and farming practice. In some cases these pressures, result in a change in the **state** (or condition) of peat soils and related natural processes.

Water regime and soil management regimes suited to conventional farming are not conducive to the conservation of peat soils and their associated ecosystems (Clarke & Joosten 2002). This is clearly evident in both East Anglia and Somerset. Subsidence and shrinkage have occurred in Somerset (Brunning 2001) where loss of peat is estimated to occur at a rate of 1-1.5cm per year even under extensive grazing regimes (Brunning 2003). In the Fens, it is estimated that agriculture will use up to 80% of the remaining peat soils in the next 20-30 years (Oates 2002).

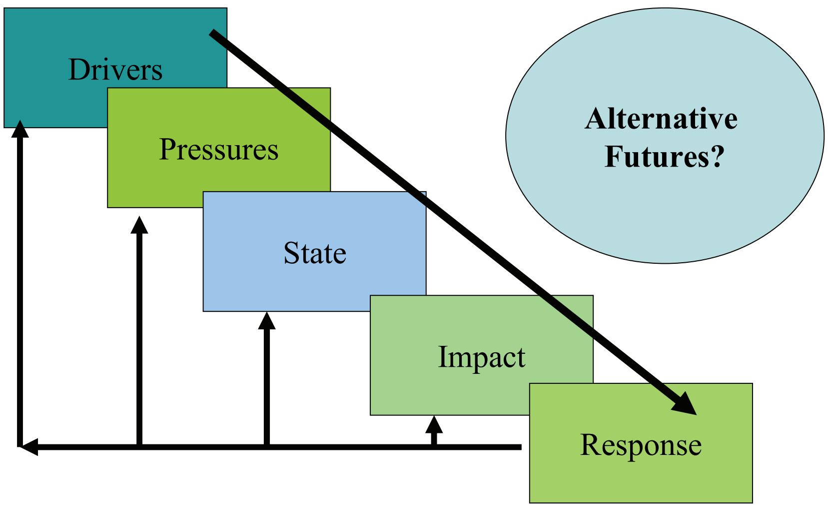

Figure 1: DPSIR Framework

A change in the state of peat soils results in **impacts** such as those associated with the decline in agricultural productivity, whereby the natural production functions of peats are substituted by external inputs. Furthermore peat shrinkage leads to further drainage investment, which in turn exacerbates the decline. Deterioration in agricultural performance is measurable in the arable systems of East Anglia (Oates 2002). Simultaneously there is loss of other, less apparent functions. For example, changes in hydrological regimes induced in Somerset, coupled with 'improvement' of grassland have negatively affected the bio-diversity of the area (Hopkins *et al*. 2001), potentially reducing tourism, recreational and conservation values to some stakeholders.

Responses are interventions undertaken by individuals, groups or organisations to achieve desirable outcomes. In the context of peat soils**,** these include actions to protect or enhance those functions which are valued by key stakeholders. Responses may address fundamental drivers, attempt to relieve pressures, protect the state of soils or mitigate impacts. Responses may include regulatory, economic or voluntary interventions, adapted to suit local circumstances.

3.2 Future Scenarios

Scenarios are not intended to predict the future. Rather, they are tools for thinking about the future, assuming that:

- the future is unlike the past, and is shaped by human choice and action.
- the future cannot be foreseen, but exploring the future can inform present decisions.
- there are many possible futures: scenarios map a ‘possibility space’.
- scenario development involves a mix of rational analysis and subjective judgement.

Thus, scenarios are statements of what is possible; of prospective rather than predictive futures; propositions of what could be. They are often made up of a qualitative story-line and a set of quantitative indicators which describe a possible future outcome. The scenarios arise as a consequence of modelling drivers of economic and social change, new trends and innovation, and of unexpected events.

The Foresight Programme (Berkhout et al., 1998; DTI, 1999; 2002) constructed four possible futures which are distinguished in terms of social values and governance (Figure 2).

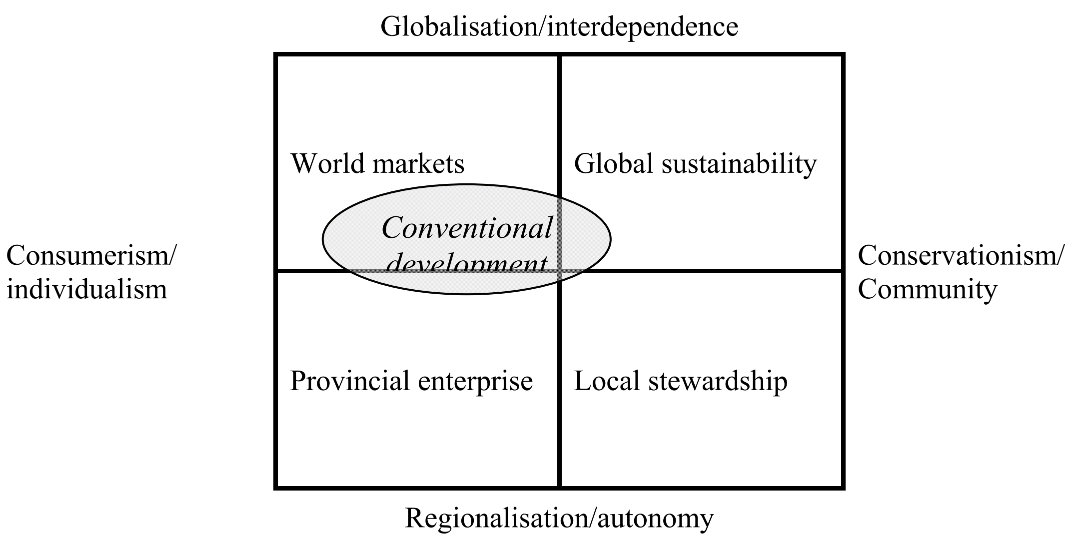

Figure 2: Possible Futures, based on Foresight (DTI, 2002)

- World Markets are characterised by an emphasis on private consumption and a highly developed and integrated world trading system.
- **Global Sustainability (also referred to as Global Responsibility) is characterised by more pronounced social and ecological values, which are evident in global institutions and trading systems. There is collective action to address social and environmental issues. Growth is slower but more equitably distributed compared with the World Markets scenario.**

- Provincial Enterprise is characterised by an emphasis on private consumption but with decisions made at national and regional level to reflect local priorities and interests. Although market values dominate, this is within national/regional boundaries.
- Local Stewardship is characterised by strong local or regional governments which emphasise social values, encouraging self-reliance, self sufficiency and conservation of natural resources and the environment.

Unforeseen events, such as international conflict or major technological advances or failures, can also shape possible futures. Some of these risks and uncertainties may be associated with particular futures.

Table 1 - Future Scenarios for UK Agriculture

	World Markets	Global Sustainability	Provincial Enterprise	Local Stewardship
Agricultural and rural policy	Abandonment of CAP. WTO led free trade in agricultural commodities. Limited interventions for social or environmental purposes. Increased global trade in agricultural commodities. Rural diversification opportunities based on market potential.	Reformed CAP. WTO promoted liberalisation. Decoupled agric support. Promotion of sustainable agriculture, including agri-environment and animal welfare regimes. Global rules seek ethical rural development. Multi-functional agriculture produces public goods.	Protectionist agricultural policies, involving input and commodity subsidies, deficiency payments and marketing/intervention regimes. Limited environmental and social concerns. Rural economy is based primarily on agriculture and food. Farming is the main agent of development.	Support regimes in accordance with local needs and priorities reflecting self reliance, social and environmental objectives as defined at local level. Development defined in terms of conservation and community: a living/working countryside.
Food markets and prices	Market led, consumer driven, but with increased domination of major food retailers. International procurement and market integration. Producer and consumer food prices fall for global products, with premiums for niche products.	Food supply chain accepts responsibility for promoting and responding to consumer concerns about safe, healthy and ethical foods. Consumer food prices rise due to quality assurance and compliance costs, providing incentives to producers.	Supply driven food chain. Food industry, especially producers and processors define product offering and criteria for food quality. Government supported supply side interventions maintain high producer prices, but cheap consumer food prices.	Greater connectivity between consumer and producer. Local area produce and market. Local 'brands' emphasise environmental and social attributes. Farmers join co-operative production and marketing schemes to add value and raise prices.
Environmental policy	Limited restrictions on chemical use, other than market imposed. Limited interest in soil and water conservation unless affecting production. Environmental risk managed through economic instruments .	Comprehensive, integrated approach to prevention/minimisation of diffuse pollution from agriculture. Policy mix includes regulation, voluntary measures and economic instruments reflecting a commitment to 'stewardship' and biodiversity.	Input intensive farming, limited controls on agro-chemicals and farming practices on environmental grounds. Regulation for controlling high risks which prejudice commercial interests.	Generally lower environmental risk but fragmented and selective regulation and control. Sustainable soil and water management embedded in farming culture, with policies, including regulation, to promote and support.
Farmer attitudes/ motivation	Polarisation into commercial and lifestyle farmers: 'real' and 'hobby' farmers. Biodiversity in farmed areas to suit commercial farming, or a commercial activity in itself.	Production oriented farmers tempered by increasing interest in conservation. Conservationists find expression in agri-environment schemes.	Commercially driven production focus, emphasis on output and production. Environmental motivations mainly commercially based and remedial.	Welfare maximising custodians, embracing commitment to sustainable livelihoods. Strong conservation and community ethic. Varied income sources, on and off-farm.
Agricultural production and farming systems	Competition leads to moderate to highly intensive, high technology, commercially driven large scale production by specialists, industrialised and global in scope, emphasis on efficiency through reduced unit costs for bulk commodity crops, with focused high quality production to gain price advantage where possible. Marginal land abandoned. GMOs widely promoted and adopted. Differentiated organic produce are an important niche market. Intensive feedlot livestock systems, but some extensive grazing on abandoned cropland.	Moderate increases in agricultural productivity and production. Agri-environment contributes to global services. Diversification/multi-functionality important. Strong 'compliance' requirements. Large scale farms, but with policy to retain family farms. Areas taken out of production used to support nature conservation. Selected adoption of GMOs, driven by environmental benefits. Limits on stocking rates, extensification incentives, strong welfare controls. High quality assurance. Some differentiated organic produce.	Broad based, relatively high input:high output farming to provide self sufficiency. Vegetables and agro-industrial raw materials are growth sectors. Mixed arable and livestock farming systems, intensive lowland dairy and cattle, with beef and sheep maintained in disadvantaged areas Moderate trend towards large farms but family farms remain viable. Patchy adoption of GMOs, given limited economic incentives and little concern about side effects. Limited by investment. Organics limited.	Decreased productivity but total agricultural area increases. Commitment to sustainable rural livelihoods reflecting community priorities. Mix of intensive and extensive and greatly diversified systems. Retention of small scale, family based farming units. Low input systems an important part of sustainable farming. Widespread adoption of Integrated Farming Systems. GMOs rejected. Relatively extensive livestock systems, part of mixed farming systems. Emphasis on environment and welfare, undifferentiated organic produce widespread.

3.3 Future Agricultural Scenarios

The Foresight framework can be applied to the agricultural sector. Drawing on the Defra funded Agricultural Futures and Implications for Environment project (IWE, 2003). Table 1 contains annotated narratives of each scenario in terms of selected themes which shape the components of D-P-S-I-R under each scenario. The issue of concern here is how these alternative future possibilities impact on peat lands and their management.

3.4 Climate Change Future Scenarios

The alternative futures are also associated with different climate change scenarios as a consequence of differences in emissions of greenhouse gases. Table 2 summarises possible climate change scenarios for the year 2050 (based on UKCIP02, Hulme et al., 2002). These are associated with the Foresight scenarios as shown.

Table 2 – Summarised Temperature and Precipitation Changes by Scenario

Climate Change and Foresight Scenario	Temperature C degrees		Precipitation %change	
	Somerset	East Anglia	Somerset	East Anglia
Low Emissions (Global Sustainability)	1-1.5 annually with increases of 2 possible in the summer and autumn	1-2 annually	-10-0 annually with increases of 10 possible in the winter and -30 possible in the summer	-10-0 annually with increases of 15 possible in the winter and -20 possible in the summer
Medium-Low Emission (Local Stewardship)	1.5-2 annually with increases of 2.5 possible in the summer	1.5-2 annually with increases of 2.5 possible in the summer and autumn	-10-0 annually with increases of 15 possible in the winter and -30 possible in the summer	-10-0 annually with increases of 15 possible in the winter and -20 possible in the summer
Medium-High Emissions (Provincial Enterprise)	1.5-2 annually with increases of up to 3 possible in the summer and autumn	1.5-2.5 annually with increases of up to 3 possible in the summer	-10-0 annually with increases of 15 possible in the winter and -30 possible in the summer	-10-0 annually with increases of 20 possible in the winter and -30 possible in the summer
High Emissions (World Markets)	2-2.5 annually with increases of up to 3.5 possible in the summer and autumn	2-2.5 annually with increases of up to 3.5 possible in the summer and autumn	-10-0 annually with increases of 20 possible in the winter and -40 possible in the summer	-10-0 annually with increases of 20 possible in the winter and -40 possible in the summer

Climate change trends appear to be:-

Temperatures will increase

- The degree of increase is dependant on the emissions scenario, with higher emissions yielding higher temperatures
- The increase is most pronounced during the summer months
- There is no profound difference between the changes in temperature in the two regions but it does appear that East Anglia may on average become warmer than Somerset.

Overall precipitation will decrease

- The degree of precipitation change is dependant on the emissions scenario, with higher emissions yielding greater changes in precipitation
- Precipitation during the winter months will increase
- Precipitation during the summer months will decrease
- It appears that East Anglia will have less rainfall in the summer and more rainfall in the winter compared with Somerset.

4. Workshop Programme

Appendix 1 contains a draft programme for the workshop

Following a brief introduction of the analytical frameworks, participants will break into two groups to explore, for selected scenarios:

- the implications for peat land management of a selected Foresight scenario
- appropriate management responses in order to promote the sustainable management of peat soils under the selected scenario

Groups will reconvene for plenary discussion

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APPENDIX II – REPORT OF WORKSHOP B

Sustainable management of
European peat soils:
Pressures, State and Responses

EUROPEAT

Work Package 8 –
Social and Economic Analysis
of the
Management of Peat Soils
in Northern Europe

Report on a Workshop with
National Representatives of Stakeholder Interests
28th Sept , 2004

1. Context and Purpose

As part of the EU funded Europeat project, a 2 hour workshop was held in Kiel on 28th September 2004. The workshop was attended by representatives of the national stakeholder panels of partner countries. The purpose of the workshop was to identify the main issues and challenges for the sustainable management of peat soils.

Workshop notes were distributed to participants before the workshop, together with key questions to be addressed (see Appendix 1). In addition to these questions, the workshop was charged with defining possible scenarios which could be used to guide the modelling process and outputs of the Europeat research project in line with the needs of stakeholders. The workshop used the Drivers-Pressures-State-Impact-Response framework to steer the discussion.

2. Workshop Outputs

The following notes summarise the outputs of the workshop.

States
Workshop Participants (WP) argued that it was difficult to generalise the state of peat soils as this varied considerably between and within countries according to a mix of geo-physical, hydraulic and anthropogenic factors. The state of peatlands, and the rate of change in the state, varied particularly according to the intensity of land management. Land management reflects dominant purposes, whether arable, grassland, nature conservation or forestry, and the relative importance given to objectives such as farm incomes, water management and biodiversity. After peat extraction for fuel or horticultural purposes, the biggest deterioration was associated with intensive agriculture.

Classification by dominant land use was therefore an important basis for profiling peatlands.

Drivers
WP identified a mix of high level drivers affecting peatland use and management. These included macro economic conditions and rates of economic growth and incomes, agricultural policy, and environmental policy. It was thought that exposure of agriculture to increased international competition associated with CAP reform would increase the pressure on farm incomes in intensively farmed areas in the face of declining commodity prices. In grassland areas, reduction in income support to livestock farming could reduce viability of peatland farms, unless other sources of income are found. In the Polish case however, increased access to EU markets had increased incentives to intensive farming, at least in the short to medium term, with implications for peatlands.

For the most part it was perceived that peatland farmers did not enjoy comparative advantage in agricultural production, compared to non peat farmers, especially as land and water management costs appear to be higher. In the UK however, the perception is that peatlands offer comparative advantage for intensive vegetable production (although this benefits from indirect subsidies to land drainage and flood defence). This raises the point whether peatland farmers were relatively sensitive to changes in high level drivers, such as incentives to agricultural production, or environmental regulation. It was generally felt that they were more sensitive to changes in drivers, and those who depend on peatlands for their livelihoods may be particularly vulnerable. However, a change in policy priority towards environmental protection and enhancement, combined with willingness to pay by society for environmental goods and services (eg associated with enhanced water quality) could favour sustainable management of peat soils, including income support to those responsible for their management.

Whereas in Germany, UK and Netherlands agri-environment and landscape, biodiversity, and amenity were perceived to be key drivers, in Poland agricultural production retains a high level of priority given the importance given to maintaining rural incomes and employment. In the Swedish case, where only a relatively small proportion of peatlands are farmed, high level environmental drivers appear important, especially relating to the control of greenhouse gas emissions and climate change.

Pressures
WP confirmed that pressures on peatlands reflected dominant land uses, as referred to above, and the incentives to land managers provided by drivers such as markets and policy regimes. Pressures were perceived to be positively correlated with intensity of use, being greatest for intensive arable farming and least for nature conservation.

In the Polish case, the main pressures were associated with the intensification of agriculture in response to production incentives, including for example strengthening livestock and milk prices as they affect the intensity of grassland management.

In the Netherlands, there is concern that rising costs to farmers of land and water management on peatlands is placing pressure on farm incomes and the comparative advantage of peatland farms, questioning the continued viability of farming systems. In the UK, there are similar concerns about further increased intensification, scale, specialisation and mechanisation (and irrigation) of farming in order to maintain farm incomes in the face of declining real commodity prices and rising costs.

While it was thought that peatlands were subject to the same type of generic pressures associated with agricultural land use, peatland soil, water and environmental characteristics and processes (the state of peatlands) are relatively more sensitive compared to other soil categories.

Impacts
The WP discussed the impacts of changes in the state of peat soils, confirming the important human dimension of the impacts. There was discussion about whether impacts were a major concern of society: were they high on the political agenda. There was mixed feelings about this. It was thought that concern about the state of peatlands reflected a general concern about rural environmental management and particular environmental qualities and processes, i.e. water quality or biodiversity. In Germany and Netherlands, peatland management concerns were mainly driven by these focused interests.

WP identified a number of main impacts, namely:

- Landscape/habitats/biodiversity

- Amenity/public access and enjoyment
- Water management (quantity and quality issues, flood management)
- Emissions (and related nutrient cycles)
- Farm incomes and livelihoods (and related rural economy impacts)

The relative importance of these impacts varies according to context. In Poland, for example, farm incomes were thought to take priority, whereas in Netherlands and Germany, a mix of rural environment and water resource impacts were considered more important. Greenhouse gas emissions associated with peatlands were of greater concern in Sweden. In the UK, the concern about impacts of deteriorating peatlands finds expression as part of a general concern about the impact of intensive farming on the environment, concern that conventional farming systems are not commercially sustainable in the longer term. It was recognised that the identification of and importance attributed to particular impacts reflects dominant stakeholder interests and influences. These vary between and within countries.

Responses

WP discussed possible responses in the context of the DPSIR framework. It was agreed that the focus should be on relieving the pressures associated with the use of peatlands as they determine state and impacts. The responses thus need to relate to dominant uses, modified to suit local circumstances.

The point was strongly made that particular guidance was needed to help stakeholders formulate appropriate responses or intervention measures. These included:

- Sustainable agricultural practices which conserve peatlands while they are being used and support farm incomes and livelihoods;
- Ways of managing the transition from one use to another, for example from intensive arable to grassland, or intensive to extensive grassland;
- Methods for managing peatland nature conservation sites;
- Ways of capturing citizen willingness to pay for sustainable peatland management;
- Ways of promoting adoption of sustainable practices amongst farmers.

Unknowns and uncertainties

WP, making references to DPSIR, identified the following gaps in knowledge which the project should aim to address (or confirm that further research is needed):

How to identify appropriate management options to enhance sustainability of peatland management for a given geo-physical/land use situation;
How to achieve restoration in practice for given situations, i.e. what options are available? What is their relative effectiveness in terms of outcomes? What is their relative efficiency in terms of value for money? What is their relative equity in terms of the distribution of benefits and costs?
How to identify and value the environmental benefits and costs of peatland environmental goods and services

Scenarios

WP discussed a framework for building scenarios which will guide the modelling process in accordance with the needs of key stakeholders.

It was agreed that scenarios should focus on pressures and responses to relieve these pressures, and that these are best classified by major land use types as discussed earlier. The following classification was generated reflecting the degree of human intervention and the intensity of land use.

Scenario Framework

Human Intervention:

High					Low
Dominant land Uses:					
Extraction	Arable	Grassland	Forestry	Nat Con	Abandonment

Criteria for appraisal:

- Soils
- Water
- Emissions
- Landscape
- Biodiversity
- Farm incomes

WP recommended that Scenarios are created to capture major land use categories, and within these the intensity of management (eg arable distinguished into intensive eg vegetables, extensive eg cereals; grassland into intensive eg silage cutting, extensive eg grazing only at low stocking rates). Similarly nature conservation can involve different degree of management intensity, and may be more intensive in terms of management inputs than some types of extensive grassland.

WP thought that the scenarios can be assessed, through the modelling process, in terms of their performance against selected criteria that reflect 'state' and related processes, with consequences for impacts. Where existing land uses generate pressures which result in unacceptable impacts (eg water, biodiversity or farm income impacts), then appropriate responses, suited to local conditions, can be identified and implemented. Where there are opportunities to achieve enhancement (as opposed to avoiding further deterioration), it is also appropriate to identify suitable locally relevant interventions.

WP thought that such a framework could help, through appropriate intervention measures and management prescriptions, the sustainability of peatland management (judged against locally relevant criteria) to be maintained or enhanced:

- Within a given land use category (eg reduced deterioration of peat in arable farming)
- By switching from one land use category to another (eg from arable to grassland, or grassland to nature conservation).

A key message from WP was that the project should provide guidance on best management practices in accordance with local objectives and conditions. They thought that the modelling processes should test the relevance of alternative measures under specific site conditions. It might be possible to identify a list or menu of possible actions, and provide guidance on what determines their suitability/fitness for purpose and how to determine the best programme of measures.

3. Conclusions and Recommendations

WP recommended that scenario analysis, and within this the design of programmes of measures to maintain or enhance the sustainable management of peat soils, should focus on dominant land uses, recognising particular country and site specific conditions.

WP emphasised that project outputs should provide guidance on peatland management that meets user needs and can be interpreted for local conditions.

WP recommended that the national advisory panels should apply the DPSIR framework to dominant types of peatland use, eg arable, grassland, forestry, nature conservation, abandonment, with a view to confirming key pressures and impacts (and hence concerns). The panels could also identify types of intervention measures that are being or could be used to maintain or enhance sustainability for given peatland use types within their countries.

WP requested that guidance should be provided by the project to the national panels to obtain this information from national panel members, perhaps through a questionnaire or workshop notes depending on the preferred method.

Appendix 1 WORKSHOP BRIEF

A. UNDERSTANDING THE CHALLENGE OF SUSTAINABLE PEATLAND MANAGEMENT: CAUSES AND EFFECTS.

1. What is the current state or condition of peatlands in partner countries, how is this measured and what is the direction, magnitude and rate of change?

2. What are the main causes of the changes in the state of peatlands? Can these be grouped into:
   high level drivers that influence land use and management;
   local pressures associated with particular land use and activities?

3. What are the main effects (impacts) of the changes in the state of peatlands on environment, society and the economy.

4. How are these drivers, pressures, state and impacts likely to change in the next 10 years/20 years assuming a Business as Usual case?

Plenary Feed back on identification and prioritisation of key challenges to be addressed

B. FORMULATING RESPONSES

5. Drawing on part A, for each of the key challenges to be addressed, what are the most appropriate actions (responses) that can be taken, by whom, how and when?

6. What are the main uncertainties and gaps in knowledge which need to be addressed in order to formulate sustainable strategies for peatland management?

Plenary feedback on strategies for sustainable peatland management

APPENDIX III – LIST OF POTENTIAL STAKEHOLDERS

Table 1. Inventory of Potential Stakeholders Identified and the Contact Made

The Fens			**The Somerset Moors**		
Group Identified	**Interviewed?**	**If not found to be a stakeholder, why not?**	**Stakeholder Identified**	**Interviewed?**	**If not found to be a stakeholder, why not?**
Cambridgeshire Wildlife Trust (WT)	**Yes**		Royal Society for the Protection of Birds (RSPB)	**Yes**	
Farmers/Farm Business (F)	**Yes (multiple)**		Environment Agency (EA))	**Yes**	
Internal Drainage Boards (IDBs)	**Yes**		Internal Drainage Boards (IDBs)	**Yes**	
National Trust (NT)	**Yes**		Levels and Moors Partnership (LAMP)	**Yes**	
English Nature (EN)	**Yes**		English Nature (EN)	**Yes**	
Rural Development Service (RDS)	**Yes**		Rural Development Service (RDS)	**Yes**	
Royal Society for the Protection of Birds (RSPB)	**Yes**		Somerset Wildlife Trust (WT)	**Yes**	
Environment Agency (EA)	**Yes**		Flood Defence Committee (FDC)	**Yes**	
Department for environment, food and rural affairs (Defra)	**No**	Does not meet classification criteria (not case specific)	Department for the environment, food and rural affairs (Defra)	**No**	Does not meet classification criteria (not case specific)
Local Residents ®	**Yes (multiple)**		Farmers (F)	**Yes (multiple)**	
National Farmers Union (NFU)	**Yes**		Local residents ®	**Yes (multiple)**	
Country Land and Business Association (CLA)	**Yes**		Withy Growers (WG)	**Yes**	WG interest in peatlands specifically found to be limited
Farming and Wildlife Advisory Group (FWAG)	**No**	Only mentioned once by one other stakeholder and after investigation role not considered significant	Peat Extractors (PE)	**Yes**	
East of England Development Agency (DA)	**No**	Only mentioned once by one other stakeholder and after investigation role not considered significant	Other landowners (LO)	**No**	LO interest in peatlands specifically found to be limited
Anglian Water (AW)	**Yes**	Role of AW found to be limited in peatlands and land management	Parish Council (PC)	**No**	Role of PC found to be limited in interest in peatlands and land management
Water Research Centre (WRC)	**No**	Only mentioned once by one	Member of Parliament (MP)	**No**	Does not meet basic

		other stakeholder and after investigation role not considered significant			classification criteria (no explicit/direct link)
Parish Council (PC)	**No**	Role of PC found to be limited in interest in peatlands and land management	Association of Drainage Authorities (ADA)	**No**	Only mentioned once by one other stakeholder after investigation role not considered significant
District Council (DC)	**Not directly – secondary documents: Fenland Community Strategy**		District Council (DC)	**Not directly – secondary documents: Sedgemoor Community Strategy**	
County Council (CC)	**Conversation – no peat extraction, secondary documents: Rights of Way Improvement Plan**		National Farmers Union (NFU)	**Yes**	
English Heritage (EH)	**Yes**		Country Land and Business Association (CLA)	**Yes**	
Suffolk County Farms (SCF)	**No**	Only mentioned by one other stakeholder and after investigation role not considered significant	Central Government (CG)	**No**	Does not meet classification criteria (not case specific)
Wildfowl and Wetlands Trust (WWT)	**Yes**		Parrett Catchment Project (PCP)	**Not directly – secondary documents: website**	
Sustrans (ST)	**No**	Only mentioned once by one other stakeholder and after investigation role not considered significant	County Council (CC)	**Yes – and secondary documents: Rights of Way Improvement Plan and Somerset Minerals Plan**	
Wet Fens Partnership (WFP)	**Not directly – secondary documents: Wet Fens Partnership Document**		Wessex Water (WW)	**No**	Only mentioned once by one other stakeholder and after investigation role not considered significant

Association of Drainage Authorities (ADA)	**No**	Only mentioned once by one other stakeholder and after investigation role not considered significant	Plantlife International (PL)	**Yes – and secondary documents: website**	Interest found to be limited in terms of the specific area
Central Government (CG)	**No**	Does not meet classification criteria (not case specific)	Game Conservancy Council (GCC)	**No**	Only mentioned once by one other stakeholder and after investigation role not considered significant
NFU Fenland Flood Defence Group (NFU-fld)	**No**	NFU taken as representative	English Heritage (EH)	**No**	Only mentioned once by one other stakeholder and after investigation role not considered significant
Other landowners (LO)	**No**	Only mentioned once by one other stakeholder and after investigation role not considered significant	Somerset Food Links (SFL)	**Yes**	
Lincolnshire Wildlife Trust (WT)	**No**	Only mentioned once by one other stakeholder and after investigation role not considered significant	Farming and Wildlife Advisory group (FAWG)	**Yes**	
			Member of European Parliament (MEP)	**No**	Does not meet classification criteria (not case specific)
			Land Agents (LA)	**No**	Only mentioned once by one other stakeholder and after investigation role not considered significant
			Rural Environmental Facilitation Service (REFS)	**Conversation**	REFS disbanded
			Rising Damp (RD)	**No**	Only mentioned once by one other stakeholder and after investigation role not considered significant
			Somerset and Exmoor Local Access Forums (AF)	**No**	Only mentioned once by one other stakeholder and after investigation role not considered significant
			Lifestyle Buyers (LB)	**No**	Fall under 'other landowners' previously found to have limited interest specifically in

		the peatlands
Somerset Peat Producers Association (SPPA)	**Not directly – peat extractors sought SPPAs response to correspondence**	Difficult to contact and so views taken to be captured in peat extractors views.
Minerals Planning Authority (MPA)	**Yes**	MPA in Somerset is the CC.
Peatlands Campaign Consortium	**No**	Does not meet classification criteria (not case specific)

NB: Stakeholder interviews were carried out before the merger of EN, RDS and the Countryside Agency to Natural England in 2006/07.

Highlighted boxes indicate those finally considered a stakeholder given the classification and some investigation.

APPENDIX IV – SEMI-STRUCTURED INTERVIEW QUESTION SET

Questions

Organisation job title of respondent

1. What is the nature of your involvement with peatlands?
2. Roughly how long have you held this job? (years)
3. What is your organisations interest in the area? Why?
4. What changes, if any, have there been in the area over roughly the last 10 years?
5. Does your organisation directly use the area for any purpose?
6. What issues are of concern to your organisation for this area?
7. If you have any concerns do you voice them? If so in what form? And who to? If not why not?
8. Do you feel your views are listened to and taken account of by others? Why?
9. What are your organisations views on:
    a. Flooding in the area?
    b. Agriculture in the area?
    c. Nature conservation in the area?
    d. Archaeology/heritage in the area?
    e. Recreation in the area?
10. Does your organisation like the landscape? Why?
11. What changes, if any, have there been in the landscape over roughly the last 10 years? Does your organisation consider the changes mentioned to be good or bad? Why?
12. What changes, if any, have there been in the land use over roughly the last 10 years? Does your organisation consider the changes mentioned to be good or bad? Why?
13. What changes, if any, would your organisation like to see in the landscape?
14. What changes, if any, would your organisation like to see in the land use?
15. Is it important to your organisation that the land use in the area is profitable? Why?
16. What does the term peatland mean to your organisation?

Would you be happy for me to contact you again in the future with regards to this research if needs be?

If yes what is your name and contact number?

APPENDIX V – SEMI-STRUCTURED QUESTIONNAIRE 2

Stakeholder Analysis – Questionnaire 2

Instructions

1. Selection of case study area

Each partner should choose *one area* which they will, from now on, respond to questionnaires on the basis of. The area does NOT have to be the same site the physical data collection is occurring on although the better it is known, by both the academic partner and their advisory panel, the easier the questionnaires will be to complete.

In order to minimise the need to repeat questions from questionnaire to questionnaire it is important that the area chosen at this juncture be used for the rest of this work. It is therefore important that site selection is thoughtfully done at this stage.

Criteria for case study area selection

1. Does not have to be large but it is required to be representative of national use of peatlands and the issues which surround them;
2. Areas owned by a research institute may not be appropriate because:
    a. It is likely their historical use will be different to that of surrounding peatlands;
    b. And the stakeholder interests in a research site are likely to be very different for those of a conventional site.
3. If the partner can demonstrate that a research site will be representative or is the best option for other reasons then this will be satisfactory;
4. The area maybe a mosaic of land uses or a network of one land use, as long as partners feel it has the potential to incorporate the broad issues surrounding peatlands (especially agricultural peatlands) in the Country;
5. The area must be contiguous.

Expecting *one* area to be *nationally* representative may appear to be a contradiction. However, it is thought that if the area is chosen carefully then the issues surrounding it, irregardless of what the specific management system is at this point in time, should give incite to the agendas and interests of the key stakeholders, these interests will invariably be consistent across the country.

If you have any doubts or queries about the site selection, please do not hesitate to contact me directly so we can discuss it.

2. Completing the questionnaire

Partners may wish to continue referring to the site for which they completed the previous questionnaire as it conforms to the criteria given above. If this is the case they need not complete questions 1, 2 and 6 (parts a & b) of this questionnaire if they are confident information provided will be consistent with what was provided last time. However, all other questions MUST be completed even if it appears information is being repeated. This is so the data all arrives in the same format but more importantly because flaws in the previous questionnaire design meant that it was not possible to unravel the required information. I apologise for this repetition but I hope as the questions will be familiar it will not be to time consuming.

Questions 3 onwards should be completed with the aid of the advisory panel. It may be useful to present these questions to the panel and then work through them in a workshop style. If this is done and points are raised in discussion that do not relate directly to the questions but are still relevant and important to peatland use then please attach this information and its context to the questionnaire.

3. Return of questionnaire

As areas need to be chosen and ideally a panel meeting arranged the results of this questionnaire will not be expected until the end of April 2005. In future it is thought a maximum of 4 months will be needed between sending of questionnaires and collecting the results.

Questions

1. Overview of Area: (need not be completed if site remains the same as for previous questionnaire)

The purpose of this section is to gain an understanding of your site and its management.

a) Size: *In hectares, please provide small-scale maps if available.*

b) Location: *Some general indication of the surroundings as well as the geographical location is required here, i.e. in a flood plain, between two conservation areas.*

c) Ownership/Occupancy: *Who owns the land? Do they manage it? If not who does? And what is the nature of the tenancy?*

2. Details of Area Management: (need not be completed if site remains the same as for previous questionnaire)

a) Present land use: *please be explicit about this i.e. explain what is meant by the terms used if they are ambiguous i.e. grazing, is this intensive or extensive, rough or improved, beef or dairy?*

b) Previous land use if different:

c) Water level management: *please be explicit with water levels if possible*

d) Flooding: *flooding here implies at least half of the area covered in enough water, from* ***any*** *source, to cause splashing i.e. covers the foot. Please complete even if* *flooding does not occur at the site. Details of surrounding land and flooding is also relevant i.e. is there investment in actively preventing the area flooding?*

ALL FOLLOWING QUESTIONS TO BE COMPLETED WITH THE AID OF THE ADVISORY PANEL IF REQUIRED OR POSSIBLE

3. What is the economic profile of the current land use? *I.e. is the land use profitable and if so, for whom? Is there a market for the produce and/or is it subsidised? If there is a market, where is it sold and for how much? If the land use is not profitable in monetary terms, what are the benefits of it and who pays for it? Etc.*

4. Please list ALL stakeholders and their primary interest in the area: *Please think broadly i.e. local people will have an opinion on the land use of the area in general, as will visitors, non-users, conservation bodies, government departments etc. Please list these stakeholders in order of perceived importance.*

Please insert or delete lines as necessary to the table on the following page

No.	Stakeholder	Interest
1		
2		
3		
4		
5		
6		
7		

5. Functions, Uses and Associated Stakeholders: *Please choose the area functions and uses from the table in APPENDIX 1. For the uses please extract the information which is relevant rather than simply copying the entire statement. Make a new line for EACH FUNCTION so the stakeholders connected to that specific function/use are clear. Please give an indication of the importance to stakeholders of each function/use by way of a HIGH, MEDIUM or LOW.*

Function: The action for which a person or thing is specifically fitted or used or for which a thing exists: PURPOSE

a) ***Production functions*** – the capacity to provide resources i.e. water, food, raw materials, energy

b) ***Regulation functions*** – the capacity to regulate essential ecological processes and life support systems i.e. regulating climatic, water, soil, ecological and genetic conditions

c) ***Carrier functions*** – the capacity to provide space and a suitable subsoil for i.e. habitation, cultivation, energy generation, conservation, recreation

d) ***Information functions*** – All those functions which contribute to human well-being through e.g. spiritual experiences, aesthetic pleasure, cognition and recreation

Please insert or delete lines as necessary

Type of function	Function	Use	Import-ance H/M/L	Associated Stakeholders
Production				
Carrier				
Regulation				
Information				

6. Stakeholder Interactions (parts a and b need not be completed if site remains the same as for previous questionnaire)

a) Areas of conflict between stakeholders

b) Areas of consensus between stakeholders *This may be agreement between stakeholders on ideas or principles but this agreement has not necessarily been translated into action.*

c) Areas of cooperation between stakeholders *This is where stakeholders are actively working together towards a common goal. This may involve compromise on both sides or be an amalgamation of funds and human resources from stakeholders already in agreement. Please explain the nature of the cooperation i.e. which stakeholder does what? What is the goal? How does each party benefit? What are the compromises made?*

WHEN ANSWERING THE NEXT SET OF QUESTIONS PLEASE MAKE IT CLEAR WHEN YOU ARE TALKING ABOUT YOUR CASE STUDY AREA AND WHEN YOU ARE TALKING ABOUT PEATLANDS MORE GENERALLY. *IT IS LIKELY TO BE USEFUL TO DISCUSS THESE QUESTIONS AT BOTH SCALES – CASE STUDY AREA AND THEN NATIONALLY*

7. Key legislation which exerts an influence in the area: *Please give a brief explanation of the nature of the influence and the nature of the legislation especially if it is national or local rather than European.*

8. Likely futures for the area considering present policy and social values: *Broad statements of trends or direction will suffice here i.e.*

'agriculture is likely to continue at the same intensity for the foreseeable future as it is profitable, policy is not deterring it and the area is not of interest for other reasons'

Or;

'the area is likely to trend towards extensive agriculture with a greater focus on non-production functions and non-use values; eventually it will be of very little value in terms of agricultural production. Agri-environment policy is encouraging this trend through economic incentives'.

One specific future direction does not need to be chosen, several possibilities could be presented with a clear explanation as to the reasoning behind the different futures and justification for any assumptions made.

9. What are the pressures these futures may exert on stakeholders and are they equitably distributed? *I.e. agriculture is likely to continue and get more intensive, therefore conservation bodies will have to find other means of achieving their objectives for peatland areas or find ways to increase the compatibility of their objectives with the agricultural system. This future does however ensure continued livelihoods for farmers and continued food supply for the general public, however the longevity of this is uncertain as peat loss may increase. So, conservation bodies are marginalised by this future and farmers favoured.*

10. What are the likely impacts of the possible futures on the state of peat soils and peatlands in general? *I.e. peat loss will increase/decrease, the value of peatlands in terms of agriculture will increase/decrease, the value of peatlands in terms of conservation will increase/decrease, the value of peatlands in terms of water storage in flood prevention will increase/decrease, and any more detail that can be confidently offered.*

11. What are the underlying social values which are driving these futures? *Define broadly what is causing the current direction of change in your area. Although the question asks for social values it may be that commercial interests or some other factor have a greater role, if this is the case please specify.*

Appendix 1 to Questionaire 2

Table 8.1: Table of Possible Functions

Type of Function	Function	Uses
Production	Food production through the conversion of solar energy into edible plants and animals and their products.	Agriculture – arable, dairy, extensive cattle grazing, wild animal grazing.
	Conversion of solar energy into biomass for human construction and other uses.	Horticultural fertiliser. Timber production.
Regulation	Filtering, retention and storage of fresh water.	Drinking water, irrigation water, flood water storage.
	Role of biota in storage and recycling of nutrients.	Maintenance of healthy soils and productive ecosystems.
	Influence of land cover and biologically mediated processes on climate.	Maintenance of a favourable climate for human habitation.
	Role of land and cover in regulating run off and river discharge.	Regulation of catchment hydrology.
	Role of vegetation and root matrix and soil biota in soil retention.	Maintenance of agricultural land.
Information	Aesthetic information through attractive landscape features.	Enjoyment of scenery – please elaborate.
	Variety in nature with scientific and educational value.	Research, education
	Variety in landscapes with potential recreational uses.	Recreation – please elaborate.
	Variety in natural features with cultural and artistic value.	Use of nature as a motive in books, film, painting, folklore, national symbols etc.
	Variety in natural features with spiritual and historic value.	Use of nature for religious or historic purposes – preserved historic information in the form of the peat itself and structures or beings preserved within it.
Carrier	Suitable living and reproduction habitat for wild plants and animals.	Conservation/rehabilitation of species, habitats and ecosystems – please elaborate.
	Suitable space and subsoil for human habitation/construction.	Development for housing or other buildings – please elaborate.
	Suitable space and conditions for terrestrial and non terrestrial transport.	Navigation via roads or waterways.

This table has been complied from the functions cited by partners in the previous questionnaire. Theoretically therefore it should contain the functions most likely to be required. However, if it is found that the table does not cover something that is regarded as important then the list can be added to.

APPENDIX VI – SUPPORTING TABLES FOR INFLUENCE/INTEREST MAPS

Table 1: Explanation of the Fens influence/interest matrix

S	Influence	Interest	Dialogue	Example of Interview or Secondary Document Evidence
R	3 (property)	5 (information)	Very low desire to influence, few mechanisms available; Interest is place of residence and therefore land management change in their direct vicinity *could* have great impact. Do not seem to recognise this however and display little interest and at present there is no perceived problem.	Fen People 4: *No, don't voice concerns. He doesn't feel it would make any difference anyway* Fen People 5: *History, the landscape and it is his home*
F	8 (property)	9 (livelihood)	Own large tracks of land, their management decisions shape the area, but are bound by policy and they can not influence other stakeholders or policy to any degree; Interest is livelihood, they loose a job and income if forced out of business	Fens Farmer 1: *tries to interact with all stakeholders but is limited…i.e. have to make a profit at the end of the day so they have to balance farming and wildlife and it is difficult for them to produce what looks like bad farm land when they have been trained for production;* Fens Farmer 2: *Livelihood.*
EN	6 (organisation)	6 (habitat)	Own land and have legislative power over designated sites but these are limited in the area; Main interest is rare habitats that are minimal in area, fragmented and isolated and therefore vulnerable, funding implications to organisation if fail to meet PSA targets for designated sites and therefore potential job loses	Fens EN: *EN has ownership over some of the nature reserves and statutory involvement with SSSIs;* *EN interest is the statutory sites (achieving favourable condition – PSAs).*
EA	8 (organisation)	8 (regulation)	Broader sphere of influence than EN given responsibilities for water management and	Fens EA: *He stated that there was a consensus from other stakeholders that the EA could be more*

			abstraction permissions. Still have responsibilities for achieving favourable condition; As above.	*strategic and provide leadership;* *PSA targets for favourable condition for some areas whilst trying to balance agricultural and wildlife needs in terms of water management.*
RDS	5 (organisation)	5 (livelihood)	Sphere of influence potentially very large, but scheme is voluntary so ability to influence is not guaranteed; Interest is the running of agri-environment schemes so supporting livelihoods. If policy changes they change what they deliver.	Fens RDS: *consulted with people on making the scheme. Other than that are just focused on delivering the scheme, which is supposed to alleviate the concerns of others.*
EH	3 (organisation)	6 (information)	EH respond to requests from landowners/project developers for advise and surveys rather than decide when to intervene. Interest in the Fens is largely the record in the peat.	Fens EH: *we raise issues as comments on specific projects at Scoping & Consultation Report stages during project planning;* *Palaeoenvironmental archives (principally vegetation & proxy climatic indicators) of archaeological interest*
NT	3 (property)	7 (habitat)	Do not own huge amounts of land, although plan to acquire more, have no legislative powers, not a large lobbying section to organisation; Own extremely rare habitat which is vulnerable, and put considerable funds and efforts into their 100 year vision project for Wicken Fen	Wicken Fen NT: *Managing reserve, which is peat and converting some arable back to some sort of wetland.*
WT	4 (property)	7 (habitat)	Partnership approach, Great Fen project is gaining momentum; As above (but for Great Fen project)	Great Fen WT: *Is a partnership project so they have liased with all levels of stakeholder. They talk with farmers a lot and update them on the project.*
RSPB	6 (organisation)	7 (habitat)	Massive lobbying capacity; Own important habitat in the area, have invested lots of money in recreation and safeguarding projects	Fens RSPB: *Lobbying at local and national levels and influencing land use change through the planning system. Keeping an eye on things to ensure legal processes are followed properly. Proactive*

				approach.
WWT	3 (property)	7 (habitat)	Own a high profile visitor reserve with designations on it but not active outside of this area; Invested in a large visitor centre and habitat management for specific birds	Welney WWT: *Protecting a site that has national, European and international designations on it. Is an SPA and Ramsar wetland and is also an SAC, which is an EU designation.*
CC	3 (organisation)	5 (carrier)	Has authority over Rights of Way and development; Serving community needs and interests so can affect the socio-economic status of Fens communities	Secondary documents e.g. Cambridgeshire Rights of Way Improvement Plan: *The council should be more proactive and less reactive to rights of ways opportunities*
DC	4 (organisation)	6 (mixed, information / carrier dominant)	The planning authority; As above only on a more localised level	Secondary documents e.g. Fenlands Sustainable Community Strategy: *Most future growth will be directed to the towns but some villages are facing intense development pressures;* *Fenland is a place created out of watery peat marshes by past generations, from the Romans, through land-owning religious orders, the Adventurers who drained the Fens and the Fen Tigers who resisted.*
NFU	6 (organisation)	6 (production)	Large organisation that represents farming perspective to policy makers, scheme designers and the general public as well as analysing markets in order to advise farmers; Maintain the farming communities livelihood	Fens NFU: *The NFU will launch a study in September which aims to collate the economic data on the fenland area which we will use to demonstrate the economic importance of the area;* *The NFU strongly believes that the fens area should be recognised as the countries most productive area in terms of food productivity, contributing greatly to the economy through production and food processing businesses.*
CLA	5 (organisation)	6 (livelihood)	Organisation that represents land owners perspective to policy makers and offers advise and services to	Fens CLA: *We regularly lobby and work with European, national, regional and local government*

			members; Maintaining land owners interests, largely livelihoods based on production	*departments and appropriate NGOs;* *The CLA represents land owners, farmers and rural businesses (mostly food/farm/tourism based). Our membership owns a significant proportion of rural land.*
IDB	4 (organisation)	4 (regulation)	Generally serve other peoples needs but do have powers to refuse or alter water level management requirements and in some areas of the Fens have flood protection responsibilities; If water level requirements change, they adapt.	Q1 Fens IDB: *There isn't a lot of developed land in parts of the Fens so flood defence for people and properties is an issue but only in a much smaller way than in some districts or the role that the agency play;* *We manage water levels for peat areas.*
WFP	3 (organisation)	5 (habitat)	Partnership of all organisations with habitat restoration projects, giving and one voice but has recently been inactive; Promote the projects and the value they will add to the area.	Secondary documents e.g. The Restoration of Fenland for People and Wildlife (WFP promotion document): *There is more wetland restoration potential in the Fens than anywhere else in the UK. The sites contained within this document represent the large-scale projects currently being undertaken by various organisations and partnerships;* *These projects will make a major contribution to current and future Biodiversity Action Plan targets and will help sustain the precious fenland wildlife.*

Table 2: Explanation of the Somerset Moors influence/interest matrix

S	Influence	Interest	Dialogue	Example of Evidence
R	3 (property)	8 (information)	Limited mechanism through which to exert an influence, ones they have they feel are ineffective; Interest is place of residence and therefore land management change in their direct vicinity *could* have great impact.	Somerset people 1: *Parish councils despite the will, have trouble making any difference as they don't have any influence so takes them along time to get anything done.*
F	6 (property)	10 (livelihood)	Smaller land owners than in the Fens, greater restrictions on what can and can not do with their land because of amount of designations for nature conservation in the area; Livelihoods and homes, livelihood for children.	Somerset Farmer: *Just wants to see his farm continue as a viable unit and provide for his son should he choose to take it on.*
PE	5 (property)	9 (livelihood)	Their impact is substantial in the areas they are allowed to work in, but their sphere of influence is very restricted and they have obligations for after use; Livelihood, business	Somerset Peat Producer: *At the moment MPG13 is allowing continued extraction and currently at a rate whereby 50% of the end product is Somerset peat, in the future he sees Somerset peat being about 30-40% of the product.*
EN	7 (organisation)	7 (habitat)	Legislative power over designated sites, high number of designated sites in the area, and influence planning policy towards extraction; PSA targets for favourable condition, and would change whole nature of area if lost grazing	Somerset EN: *There are some 18 SSSIs across the levels and moors which come under my area of control, so there we are leasing with land owners, making sure people comply with the Wildlife and Countryside Act and the CRoW Act, but we also do planning and such issues as that, so if there is development on or adjacent to SSSIs ENs views will be taken into account.*
EA	8 (organisation)	8 (regulation)	Responsibilities for PSA targets and drawing up of water management plans for area;	Somerset EA: *RDS, EN and EA working very closely together at the moment, developing future*

			Job security	*plans for water level management that is more whole moor based, fewer structures, board ideas that will help meet PSA targets.*
RDS	7 (organisation)	6 (livelihood)	High conservation interest in area means agri-environment schemes widely taken up and their nature can shape a large area; High profile area, high profile scheme, need it to work	Somerset RDS: *Scheme been put together with lots of consultation with all key stakeholders, confident farmers will take it up and will end up being competitive to enter.*
WT	5 (property)	6 (habitat)	Own last fragment of raised bog in the area and have lobbying potential, protect their interests; Own very rare habitat in area, loss of which would be bad for the organisation	Somerset WT: *Written objections. Make arguments clear. Make clear will maintain objections and take further if necessary. Work together with other conservation bodies to back each other up;* *Own the last remnants of the raised bog.*
RSPB	7 (organisation)	7 (habitat)	Lobbying potential, protect their interests; As an organisation have invested a lot of money in the area on reserves and management	Somerset RSPB: *we are the largest NGO active in the area, our activities are really on a par with EN, EA, and the IDBs, and we need to build some confidence and improve our communication so we know where everybody is coming from, and from our point of view find out how we can support the process, both guide and support the process.*
CC	4 (organisation)	6 (mixed, information / carrier dominant)	Responsible for county minerals plan, have an active archaeologist in area and responsibilities on Rights of Way; Serving community needs and interests so can affect the socio-economic status of Somerset Moors communities	Somerset CC archaeologist: *What they can tell you about the past. Paleoenvironmental information in the peat such as plant remains and beetles and what they can tell you about the landscape and sea levels in the past.* Secondary documents e.g. Somerset Minerals Plan: *identify, in development plans, Mineral Consultation Areas and safeguard mineral resources to ensure that there are sufficient*

				environmentally acceptable sources to maintain an appropriate level of supplies for current and future needs; Secondary documents e.g. Somerset Rights of Way Improvement Plan: *The public rights of way network is key to enabling residents and visitors alike to enjoy the beauty of Somerset's diverse natural and built environment.*
DC	6 (organisation)	7 (no fit)	Are the Mineral Planning Authority as well as the conventional planning authority; As above only on a more localised level.	Secondary documents e.g. Sedgemoor Community Strategy: *A strong sense of community is an important feature of life in Sedgemoor. The area has a rich tradition of activity involving whole communities such as Carnivals, Harvest Home Suppers and Arts Festivals. However, there are concerns that the pressures of modern life have weakened community life.*
NFU	6 (organisation)	6 (production)	Large organisation that represents farming perspective to policy makers, scheme designers and the general public as well as analysing markets in order to advise farmers; Maintain the farming communities livelihood.	Somerset NFU: *To represent the best wishes of our members there. Act as a champion for the role of productive agriculture and farming in harmony with the environment.*
CLA	5 (organisation)	6 (livelihood)	Organisation that represents land owners perspective to policy makers and offers advise and services to members; Maintaining landowners interests, largely livelihoods based on production.	Somerset CLA: *We offer advice and support to members and lobby on things like environmental issues, flooding and culling. Access is also an issue. We try to remove the red tape for small rural business and land owners.*
FWAG	6 (organisation)	6 (habitat)	Advise and help farmers with agri-environment scheme applications, carry out research for other organisations, act as an interface between	Somerset FWAG: *Primarily SSSIs and maintaining their condition for wildlife but FWAG looking from a farming perspective as well, i.e. so farmers can*

			conservation and farming communities; Lots of members from the Somerset Moors, high potential for environmentally sensitive farming.	*make a profit;* *Becoming more and more involved with farmers who have in the past not been exactly environmentally sensitive, thinks the water level management plans are partly driving this, the schemes on offer in the plans are a good incentive.*
SFL	3 (organisation)	5 (livelihood)	Work with only a small number of farms to create a brand on a local scale; Concerned with supporting livelihoods and character of the area through the celebration of traditional produce.	SFL: *The overall purpose of "Selling the Levels" is regeneration for farming and food specifically for the Somerset Levels and Moors. Since June 2003 the project has supported farmers, growers and food producers.*
IDB	6 (organisation)	5 (regulation)	Generally serve other people's needs but do have powers to refuse or alter water level management requirements and becoming proactive in terms of new water level management plans to help improve the condition of designated sites; If water level requirements change, they adapt.	Somerset IDB: *Many of the peatland areas are of particular nature conservation interest and often designated, IDB has a duty to maintain and enhance the management of those interests, especially with regard to achieving favourable conditions.*
FDC	7 (organisation)	4 (regulation)	Is a board made up of representatives from many different interests so can be good discussion forum, influence opinion and responsibilities for flood risk budget spending; Is a committee trying to meet others needs.	Wessex Regional FDC: *FDC made up of representatives from lots of bodies, so issues get raised/discussed at their meetings;* *Responsibilities to organise flood risk management to land and property whilst conserving and enhancing nature interest.*
LAMP	4 (organisation)	5 (no fit)	Partnership building organisation, has potential and drive to influence but is only successful if people sign up to it; Voice to local people, job security if unsuccessful.	LAMP: *80-90% of the work done is in support of the Levels and Moors partnership, which was designed to get local people more involved in the Moors and get their views listened to… Focuses on environment, economic, and cultural/social development. Only cross cutting organisation and*

				try to get other bodies to recognise the need to have a broader awareness at least as well.
PCP	6 (organisation)	5 (regulation)	Generated funding for the area due to concerns over flooding and the partnership approach it took; Catchment does not include all of the peatlands of the Somerset Moors.	Secondary documents e.g. PCP website: *This diversity means that efforts to address flooding have to consider a variety of concerns, be they from individuals, communities, farmers, businesses or other organizations. The PCP is a partnership of 27 organizations, which reflect the diversity of issues and shape the work of the project to ensure the activities of every single organization are coordinated and contribute to the objectives of the whole. There is no single organisation that can tackle the problem of flooding alone, so there is no single solution.*

APPENDIX VII – AHP QUESTIONNAIRE

Preference ranking questionnaire

Peatland Land-Use Scenario Questionnaire

AHP requires you to state how important each criterion is relative to each other, when the criteria are compared two at a time (pairwise) by using the comparison scale below:

Verbal Judgment	Numerical Rating
Extremely more important	9
Very strongly to Extremely more important	8
Very strongly more important	7
Strongly to Very strongly more important	6
Strongly more important	5
Moderately to Strongly more important	4
Moderately more important	3
Equally to Moderately more important	2
Equally important	1
Equally to Moderately less important	1/2
Moderately less important	1/3
Moderately to Strongly less important	1/4
Strongly less important	1/5
Strongly to Very strongly less important	1/6
Very strongly less important	1/7
Very strongly to Extremely less important	1/8
Extremely less important	1/9

The criteria to be compared:

- Livelihoods
- Hydrological management
- Public access
- Cultural interest
- Ecological integrity

Table 1 gives a brief description of these criteria which can be discussed to confirm understanding and agreement.

Table 1. Criteria to be compared and their meaning

Criteria	Description
Livelihoods	Maintenance of livelihoods judged on profit *and* sustainability, i.e. the provision of incomes, both now and into the future. When answering the second set of questions remember to account for the sustainability of the land use, especially given that we are talking about peat soils.
Hydrological management	Regulation of catchment hydrology, in particular the ability to contribute to flood water management through water storage. When answering the second set of questions bear in mind the compatibility of the land use with both natural hydrology and flood water storage.
Public access	Provision of recreation and tourism opportunities, including; walking, cycling, horse riding, dog walking, bird watching, fishing and shooting. When answering the second set of questions bear in mind such things as the practical/health and safety requirements of public access, the interest provided by the land use, and the potential disturbance caused by public access.
Cultural interest	Connection of the landscape with cultural heritage including the preservation of the archaeological record. For the second set of questions bear in mind both the water table and the historical significance of the land use, when the two are not compatible i.e. maybe arable is historically important but the water table is not ideal for archaeological preservation, then please focus on which ever of these factors is most important to you or your organisation.
Ecological integrity	System resilience and stability and support of rare species and habitats.

Please answer all questions with your locality in mind and with awareness that your consistency will be measured.

<u>Ranking the criteria</u>

By using the table on page 1, answer the set of pairwise questions underneath:

Pairwise QUESTIONS	**SCORE**
1. How **'Livelihoods'** performs in comparison with **'Hydrological management'**?	
<u>Example:</u> **'Livelihoods'** is Moderately more important than **'Hydrological management'**. OR the reciprocal: **'Hydrological management'** is Moderately more important than **'Livelihoods'**.	3 OR 1/3
2. How **'Livelihoods'** performs in comparison with **'Public access'**?	
3. How **'Livelihoods'** performs in comparison with **'Cultural interest'**?	
4. How **'Livelihoods'** performs in comparison with **'Ecological integrity'**?	
5. How **'Hydrological management'** performs in comparison with **'Public access'**?	
6. How **'Hydrological management'** performs in comparison with **'Cultural interest'**?	
7. How **'Hydrological management'** performs in comparison with **'Ecological integrity'**?	
8. How **'Public access'** performs in comparison with **'Cultural interest'**?	
9. How **'Public access'** performs in comparison with **'Ecological integrity'**?	
10. How **'Cultural interest'** performs in comparison with **'Ecological integrity'**?	

<u>Performance of land-use scenarios related to each criterion</u>

The second part of the AHP requires you to express pairwise comparison preferences for the six land use scenarios using each criterion one at a time by using the previous comparison scale.

The six land use scenarios to be compared are:

- Arable
- Intensive grazing
- Extensive grazing
- Withies
- Fen/mire habitat restoration

- Abandonment

Table 2 gives a brief description of each land use.

Table 2. Land-use scenarios

Scenario	Description
Arable	Deep drainage, rotation likely to include maize, potatoes and possibly salad crops.
Withies	Medium drainage, willow crop for charcoal or energy production.
Intensive grazing	Medium drainage, improved grassland for grazing of predominantly dairy cattle.
Extensive grazing	Shallow drainage, unimproved rough grazing of predominantly beef cattle.
Habitat restoration	No drainage, fen/mire habitat/ecosystem actively restored.
Abandonment	Drainage structures abandoned, land abandoned. Outcome would be dependant on surrounding land use and species present.

In terms of Livelihoods:

Pairwise QUESTIONS	SCORE
How **'Arable'** performs in comparison with **'Intensive grazing'**?	
How **'Arable'** performs in comparison with **'Extensive grazing'**?	
How **'Arable'** performs in comparison with **'Withies'**?	
How '**Arable**' performs in comparison with **'Fen/mire habitat restoration'**?	
How '**Arable'** performs in comparison with **'Abandonment'**?	
How **'Intensive grazing'** performs in comparison with **'Extensive grazing'**?	
How **'Intensive grazing'** performs in comparison with **'Withies'**?	
How **'Intensive grazing'** performs in comparison with **'Fen/mire habitat restoration'**?	
How **'Intensive grazing'** performs in comparison with **'Abandonment'**?	
How **'Extensive grazing'** performs in comparison with **'Withies'**?	
How **'Extensive grazing'** performs in comparison with **'Fen/mire habitat restoration'**?	
How **'Extensive grazing'** performs in comparison with **'Abandonment'**?	
How **'Withies'** performs in comparison with **'Fen/mire habitat restoration'**?	
How **'Withies'** performs in comparison with **'Abandonment'**?	
How **'Fen/mire habitat restoration'** performs in comparison with **'Abandonment'**?	

Example: In terms of Livelihoods, ‘**Arable**’ is Moderately more important than ‘**Intensive grazing**’. OR the reciprocal In terms of Livelihoods, ‘**Intensive grazing**’ is Moderately more important than ‘**Arable**’.	3 OR 1/3
In terms of Livelihoods, ‘**Intensive grazing**’ is Strongly more important than ‘**Extensive grazing**’. OR the reciprocal In terms of Livelihoods, ‘**Extensive grazing**’ is Strongly more important than ‘**Intensive grazing**’.	5 OR 1/5

In terms of Hydrological Management on-site:

Pairwise QUESTIONS	SCORE
How **'Arable'** performs in comparison with **'Intensive grazing'**?	
How **'Arable'** performs in comparison with **'Extensive grazing'**?	
How **'Arable'** performs in comparison with **'Withies'**?	
How '**Arable**' performs in comparison with **'Fen/mire habitat restoration'**?	
How '**Arable'** performs in comparison with **'Abandonment'**?	
How **'Intensive grazing'** performs in comparison with **'Extensive grazing'**?	
How **'Intensive grazing'** performs in comparison with **'Withies'**?	
How **'Intensive grazing'** performs in comparison with **'Fen/mire habitat restoration'**?	
How **'Intensive grazing'** performs in comparison with **'Abandonment'**?	
How **'Extensive grazing'** performs in comparison with **'Withies'**?	
How **'Extensive grazing'** performs in comparison with **'Fen/mire habitat restoration'**?	
How **'Extensive grazing'** performs in comparison with **'Abandonment'**?	
How **'Withies'** performs in comparison with **'Fen/mire habitat restoration'**?	
How **'Withies'** performs in comparison with **'Abandonment'**?	
How **'Fen/mire habitat restoration'** performs in comparison with **'Abandonment'**?	

In terms of Public Access:

Pairwise QUESTIONS	SCORE
How **'Arable'** performs in comparison with **'Intensive grazing'**?	
How **'Arable'** performs in comparison with **'Extensive grazing'**?	
How **'Arable'** performs in comparison with **'Withies'**?	
How '**Arable**' performs in comparison with **'Fen/mire habitat restoration'**?	
How '**Arable'** performs in comparison with **'Abandonment'**?	
How **'Intensive grazing'** performs in comparison with **'Extensive grazing'**?	
How **'Intensive grazing'** performs in comparison with **'Withies'**?	
How **'Intensive grazing'** performs in comparison with **'Fen/mire habitat restoration'**?	
How **'Intensive grazing'** performs in comparison with **'Abandonment'**?	
How **'Extensive grazing'** performs in comparison with **'Withies'**?	
How **'Extensive grazing'** performs in comparison with **'Fen/mire habitat restoration'**?	
How **'Extensive grazing'** performs in comparison with **'Abandonment'**?	
How **'Withies'** performs in comparison with **'Fen/mire habitat restoration'**?	
How **'Withies'** performs in comparison with **'Abandonment'**?	
How **'Fen/mire habitat restoration'** performs in comparison with **'Abandonment'**?	

In terms of Cultural Interest:

Pairwise QUESTIONS	SCORE
How **'Arable'** performs in comparison with **'Intensive grazing'**?	
How **'Arable'** performs in comparison with **'Extensive grazing'**?	
How **'Arable'** performs in comparison with **'Withies'**?	
How '**Arable**' performs in comparison with **'Fen/mire habitat restoration'**?	
How '**Arable'** performs in comparison with **'Abandonment'**?	
How **'Intensive grazing'** performs in comparison with **'Extensive grazing'**?	
How **'Intensive grazing'** performs in comparison with **'Withies'**?	
How **'Intensive grazing'** performs in comparison with **'Fen/mire habitat restoration'**?	
How **'Intensive grazing'** performs in comparison with **'Abandonment'**?	
How **'Extensive grazing'** performs in comparison with **'Withies'**?	
How **'Extensive grazing'** performs in comparison with **'Fen/mire habitat restoration'**?	
How **'Extensive grazing'** performs in comparison with **'Abandonment'**?	
How **'Withies'** performs in comparison with **'Fen/mire habitat restoration'**?	
How **'Withies'** performs in comparison with **'Abandonment'**?	
How **'Fen/mire habitat restoration'** performs in comparison with **'Abandonment'**?	

In terms of Ecological Integrity:

Pairwise QUESTIONS	SCORE
How **‘Arable’** performs in comparison with **‘Intensive grazing’**?	
How **‘Arable’** performs in comparison with **‘Extensive grazing’**?	
How **‘Arable’** performs in comparison with **‘Withies’**?	
How ‘**Arable**’ performs in comparison with **‘Fen/mire habitat restoration’**?	
How ‘**Arable’** performs in comparison with **‘Abandonment’**?	
How **‘Intensive grazing’** performs in comparison with **‘Extensive grazing’**?	
How **‘Intensive grazing’** performs in comparison with **‘Withies’**?	
How **‘Intensive grazing’** performs in comparison with **‘Fen/mire habitat restoration’**?	
How **‘Intensive grazing’** performs in comparison with **‘Abandonment’**?	
How **‘Extensive grazing’** performs in comparison with **‘Withies’**?	
How **‘Extensive grazing’** performs in comparison with **‘Fen/mire habitat restoration’**?	
How **‘Extensive grazing’** performs in comparison with **‘Abandonment’**?	
How **‘Withies’** performs in comparison with **‘Fen/mire habitat restoration’**?	
How **‘Withies’** performs in comparison with **‘Abandonment’**?	
How **‘Fen/mire habitat restoration’** performs in comparison with **‘Abandonment’**?	

NB: The completed questionnaires will permit me to fill different matrices and check their consistency; if they are not consistent, I will contact you.

Risk Analysis

- What potential threats are there to the preferences you have given and what is their nature? i.e. global, national, local? Institutional, legislative, social?

- If realised, how would the threats affect your preferences? i.e. climate change would increase the value placed on flood storage over all else.

- Is preserving peat in itself a priority for you?

APPENDIX VIII – MAUT ATTRIBUTE MEASURE CALCULATIONS AND SURVEY METHODS

MAUT Attribute Measure Levels

The following information details how the measure levels used for the MAUT analysis were arrived at. In the cases of floodwater storage compatibility and below ground archaeology no data is presented here because no calculations or surveys were carried out. Floodwater storage compatibility levels were a simple assessment of the land uses compatibility with flooding; be that negative, neutral or positive. This was based on the effect of a standard flood event at different times on the particular land use, in terms of its performance against its purpose. Below ground archaeology is based explicitly on an understanding of rates of peat loss under different land uses according to Ramsar literature.

Landscape Quality Survey

A questionnaire was carried out with 80 local residents on the streets of Taunton and Ely, two towns large enough to have sizable numbers of the general public out shopping on a Saturday. All respondents were local residents, ranging from students, professionals, unemployed and the elderly. The survey presented respondents with pictures of the differing land uses. It was used to confirm the recreational interest of differing land uses (when this was a possible MCA criteria), to confirm the features of landscape quality and define measures of landscape quality for the MAUT MCA. The results of the final question, regarding overall landscape attractiveness, were averaged (arithmetic mean), rounded to the nearest whole number and used as the landscape quality measure levels in the MAUT analysis.

Wildlife Interest Measures

Land Use	Biodiversity %	Rare Species	Habitat Importance Factor	Result	Final %
Extraction	30	3	0.1	3.3	3
Intensive Arable	40	11	0.5	25.5	20
Intensive Grazing	85	15	0.4	40	30
Extensive Grazing	90	20	1.2	132	100
Habitat Restoration	50	8	2	116	88

Biodiversity % and Rare Species were summed and then multiplied by the Habitat Importance factor to give the Result. The result was converted to a percentage, giving the percentage of wildlife interest.

Biodiversity percentages are estimates inferred from literature reports of vascular plant diversity in the Somerset Levels and Moors under differing grazing intensities.

Rare species are estimates of rare bird species (defined by being priority Biodiversity Action Plan priority species) that are likely to frequent peatlands under the conditions created by the land uses.

Habitat importance factor is based on the rarity and quality of habitat likely to result from the differing land uses, assuming no habitat is totally devoid of wildlife.

Livelihood Interest Measures

All measures displayed in the main document are per ha per year, all assume a 3m depth of peat, 30 year business plan and a discount rate of 6%. The information below is the raw data from which the measures were determined. It is based on published farm data, data from the industry provided by extractors and farmers and on Ramsar data regarding peat soil loss.

Extraction: *Extraction rate = 0.3 m/yr, gross margin = 6400 ha/yr. 3 m peat will last 10 years after which gross margin is 0 ha/yr.*

Intensive Arable: *Soil loss = 0.025 m/yr, gross margin for average yields on an average farm with a rotation of crops including winter wheat, lettuce, potatoes and* *fallow = 1775 ha/yr. 25% of the 3m of peat will be used in 30 yrs so same margin maintained for 30 years.*

Intensive Grazing: *Soil loss = 0.0079 m/yr, gross margin on dairy cattle at average stocking rates and average yield = 1420 ha/yr. Same margin maintained for 30 years.*

Extensive Grazing: *Soil loss =0.0044 m/yr, gross margin on lowland beef cattle, spring calving and average yield = 382 forage ha/yr. Same margin maintained for 30 years.*

Habitat Restoration: *Soil loss = 0 m/yr, gross margin = 0 ha/yr.*

Access Practicability Measures

Scores were assigned, from 1-3, for each of the features of access displayed in the following table. The scores were assigned based on existing and expert knowledge. The scores were combined to give a score from 3-9 for each land use. 1 = poor, 2 = medium, 3 = good.

Land Use	Health and Safety	Route Contiguity	Range of Access Types
Extraction	1	1	1
Intensive Arable	1	1	2
Intensive Grazing	2	2	2
Extensive Grazing	2	2	2
Habitat Restoration	3	2	3

Above Ground Archaeology Measures

Scores were assigned, from 1-5, for each of the features of above ground archaeology displayed in the following table. The scores were assigned based on existing knowledge and expert knowledge. The scores were combined to give a score from 3-15 for each land use. 1 = very low, 2 = low, 3 = medium, 4 = high, 5 = very high.

Land Use	**Abundance**	**Prominence**	**Cohesiveness**
Extraction	2	2	1
Intensive Arable	3	3	2
Intensive Grazing	4	3	3
Extensive Grazing	5	4	5
Habitat Restoration	4	3	4

APPENDIX IX – MAUT SENSITIVITY ANLAYSIS TABLES

Sensitivity Analysis –Weights

Table 1. Changes to Land Use Preference Rankings with Changes in Stakeholder Weights in The Fens

Criteria		EA – weights roughly even	WT – wildlife weight mildly dominant	DC – livelihood weight mildly dominant	NFU – livelihood weight strongly dominant	IDB – livelihood weight mildly dominant
Livelihood Provision	+10%	-	Extensive grazing becomes preferable to Habitat restoration (top 2)	Extensive grazing moves from the second to fourth most preferred option	-	-
	-10%	-	-	Extensive grazing becomes preferable to Intensive grazing (top 2) and Habitat restoration becomes preferable to Extraction (bottom 2)	Intensive grazing becomes preferable to Intensive arable	-
Wildlife Interest	+10%	-	-	Extensive grazing becomes preferable to Intensive grazing (top 2) and Habitat restoration becomes preferable to Extraction (bottom 2)	Extraction becomes less preferable to Intensive arable and Intensive grazing	-
	-10%	-	Extensive grazing becomes preferable to Habitat restoration (top 2)	Intensive arable becomes preferable to Extensive grazing	Intensive grazing becomes preferable to Intensive arable	-
Flood Storage (autumn/winter)	+10%	-	Extensive grazing becomes preferable to Habitat restoration (top 2)	Extensive grazing becomes preferable to Intensive grazing (top 2)	-	-
	-10%	Intensive arable becomes preferable to extraction (bottom 2)	-	Intensive arable becomes preferable to Extensive grazing and Extraction becomes preferably to Intensive arable	-	-
Flood Storage (spring/summer)	+10%	-	-	-	-	Habitat restoration becomes preferable to Extensive grazing (bottom 2)
	-10%	-	Extensive grazing becomes preferable to Habitat restoration (top 2)	Habitat restoration becomes preferable to Extraction (bottom 2)	-	-

- = no significant change to the preference ranking

Table 2. Changes to Land Use Preference Rankings with Changes in Stakeholder Weights in The Somerset Moors

Criteria		EA –weights roughly even	WT – weights roughly even	DC – wildlife and livelihood weights mildly dominant	NFU – livelihood weight strongly dominant	FWAG – weights roughly even	IDB – livelihood weight mildly dominant
Livelihood Provision	+10%	-	Extensive grazing becomes preferable to Habitat restoration (top 2)	Habitat restoration becomes less preferable to Intensive grazing and Extraction	Intensive arable becomes preferable to Extensive grazing	Habitat restoration becomes less preferable to Intensive grazing and Extraction	Top four land uses (Extensive grazing, Intensive grazing, Intensive arable and Extraction) reverse in preference
	-10%	-	-	Habitat restoration becomes preferable to Intensive grazing	Extensive grazing becomes preferable to Intensive grazing (top 2) and Habitat restoration becomes preferable to Extraction (bottom 2)	Habitat restoration becomes preferable to Extensive grazing (top 2)	-
Wildlife Interest	+10%	-	-	Habitat restoration becomes preferable to Intensive grazing	-	-	-
	-10%	Extraction becomes preferable to Intensive arable (bottom 2)	-	Habitat restoration becomes less preferable to Intensive grazing and Extraction	-	-	Top four land uses (Extensive grazing, Intensive grazing, Intensive arable and Extraction) reverse in preference
Flood Storage (autumn/winter)	+10%	Extraction becomes preferable to Intensive arable (bottom 2)	Extensive grazing becomes preferable to Habitat restoration (top 2)	-	Extensive grazing becomes preferable to Intensive grazing (top 2)	-	-
	-10%	-	-	-	-	Habitat restoration becomes preferable to Extensive grazing (top 2)	Extensive grazing becomes less preferable to Intensive grazing, Intensive arable and Extraction
Flood Storage (spring/summer)	+10%	Habitat restoration becomes preferable to Extensive grazing (top 2)	-	Habitat restoration becomes preferable to Intensive grazing	-	Habitat restoration becomes preferable to Extensive grazing (top 2)	-
	-10%	-	Extensive grazing becomes preferable to Habitat restoration (top 2)	Habitat restoration becomes less preferable to Intensive grazing and Extraction	-	-	-

- = no significant change to the preference ranking

Sensitivity Analysis – Land Use Performance

Table 3. Changes in Preference Rankings Induced by Changes in Livelihood Provision for The Fens

Land Use		EA	WT	DC	NFU	IDB
Habitat Restoration	+10%					
	-10%					
Extensive Grazing	+10%		Increased preference ranking by 1			
	-10%			Decreased preference ranking by 1		
Intensive Grazing	+10%					
	-10%					
Intensive Arable	+10%			Increased preference ranking by 1		Increased preference ranking by 1
	-10%					
Extraction	+10%					
	-10%					Decreased preference ranking by 1

Table 4. Changes in Preference Rankings Induced by Changes in Livelihood Provision for The Somerset Moors

Land Use		EA	WT	DC	NFU	FWAG	IDB
Habitat Restoration	+10%				Increased preference ranking by 1		
	-10%						
Extensive Grazing	+10%				Increased preference ranking by 1		
	-10%				Decreased preference ranking by 1	Decreased preference ranking by 1	Decreased preference ranking by 3
Intensive Grazing	+10%						Increased preference ranking by 1
	-10%					Decreased preference ranking by 2	
Intensive Arable	+10%						Increased preference ranking by 2
	-10%						Decreased preference ranking by 1
Extraction	+10%						
	-10%						

Table 5. Changes in Preference Rankings Induced by Changes in Wildlife Interest for The Fens

Land Use		EA	WT	DC	NFU	IDB
Habitat Restoration	+10%		Decreased preference ranking by 1			
	-10%		Decreased preference ranking by 1			
Extensive Grazing	+10%					
	-10%		Increased preference ranking by 1			
Intensive Grazing	+10%					
	-10%					
Intensive Arable	+10%					
	-10%					
Extraction	+10%					
	-10%					

Table 6. Changes in Preference Rankings Induced by Changes in Wildlife Interest for The Somerset Moors

Land Use		EA	WT	DC	NFU	FWAG	IDB
Habitat Restoration	+10%			Increased preference ranking by 1			
	-10%		Decreased preference ranking by 1	Decreased preference ranking by 2			
Extensive Grazing	+10%						
	-10%						Decreased preference ranking by 3
Intensive Grazing	+10%			Increased preference ranking by 1			
	-10%						Decreased preference ranking by 2
Intensive Arable	+10%			Increased preference ranking by 1			Increased preference ranking by 1
	-10%	Decreased preference ranking by 1					Decreased preference ranking by 1
Extraction	+10%	Increased preference ranking by 1					Increased preference ranking by 2
	-10%						

Table 7. Changes in Preference Rankings Induced by Changes in Flood Storage Compatibility for The Fens

Land Use		EA	WT	DC	NFU	IDB
Habitat Restoration	+10%					
	-10%		Decreased preference ranking by 1			
Extensive Grazing	+10%			Decreased preference ranking by 1		
	-10%					
Intensive Grazing	+10%					
	-10%	Decreased preference ranking by 1				
Intensive Arable	+10%					
	-10%			Increased preference ranking by 1		
Extraction	+10%					
	-10%	Decreased preference ranking by 1				

Table 8. Changes in Preference Rankings Induced by Changes in Flood Storage Compatibility for The Somerset Moors

Land Use		EA	WT	DC	NFU	FWAG	IDB
Habitat Restoration	+10%					Increased preference ranking by 1	
	-10%						
Extensive Grazing	+10%						
	-10%						Decreased ranking by 3
Intensive Grazing	+10%						Increased preference ranking by 1
	-10%					Decreased preference ranking by 1	Decreased preference ranking by 1
Intensive Arable	+10%						
	-10%						Decreased preference ranking by 1
Extraction	+10%	Increased preference ranking by 1				Increased preference ranking by 1	Increased preference ranking by 2
	-10%					Decreased preference ranking by 1	