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SID 5 Research Project Final Report

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Executive Summary

7. The executive summary must not exceed 2 sides in total of A4 and should be understandable to the intelligent non-scientist. It should cover the main objectives, methods and findings of the research, together with any other significant events and options for new work.

The overall aim of the project was to review the social and economic quantitative and qualitative evidence base for assessing the state of England's terrestrial ecosystems using an ecosystems approach. The 'evidence base' refers to data, analyses and stakeholder views and will complement and build upon the natural environment evidence base specified in Phase 1 of Defra's Natural Environment Policy research programme. The work specifically aimed to:

- Provide recommendations on which sources of social and economic 'evidence' would be most suitable for compiling an inventory of data for the natural environment
- Provide recommendations on the potential use of the evidence base for assessing the state of the natural environment and the ecosystem services it provides people
- Highlight any gaps and issues with the currently available evidence base
- Report on integration of data-sets for more effective delivery and communication of the ecosystems approach

A socio-economic data inventory was collated with guidance from expert workshops, a desk based review and stakeholder engagement. Stakeholder engagement was potentially a key role to delivering a comprehensive data inventory and generating 'buy in' and creating awareness of the ecosystems approach. Unfortunately, there was a poor reply from the stakeholders with a common response that resources were not available to complete the questionnaire. Another outcome of the stakeholder engagement process indicated that there is a low level of awareness of the ecosystems approach. Accordingly, it is clear that *understanding* amongst socio-economic stakeholders needs to be addressed in order to improve buy-in to the ecosystems approach, particularly by keeping the terminology simple. The ecosystems approach must be made relevant to the existing policies and goals of socio-economic stakeholders, otherwise it runs the risk of being seen as an overly scientific and irrelevant method.

The Millennium Ecosystem Assessment (MA) (2005) provided the scientific basis for the ecosystems approach and provides a solid foundation upon which to build a social-economic data inventory. This project did not seek to define too closely what types of data are relevant, as this carries with it the risk of ex ante exclusion of certain types of data and thus narrowing the focus of future projects. The MA is a widely recognised standard on the language around ecosystem services and was used for defining ecosystem services in this project. The MA ecosystem services are defined as regulating, provisioning, cultural and supporting services. Supporting services are problematic when used as part of the typology to develop an evidence base in that they are regarded as an underlying process towards the other ecosystem services. Thus, it was difficult to classify or collate data adhering to supporting services as it

does not disaggregate the endpoint or final qualities that we regard as being beneficial to human well-being. In addition, supporting services are environmental processes and thus provide difficulties in assessing using socio-economic data.

Using the MA defined ecosystem services and with help from an expert workshop, a list of goods (the natural products harvested or used by humans such as timber or fruit) was associated with the services in order to develop a typology for building a socio-economic evidence base that will also aided in identifying gaps. Data in the evidence base was also classified into primary and secondary data sources. In this study, primary data refers to the evidence which has been collected by the institution it is owned by and is used for the purpose it was collected for. Secondary data refers to the evidence which has been manipulated for analyses different to that which the data was collected for. An example of a dataset that can be classified as secondary is the Output Area Classification developed by the Office of National Statistics (ONS) in that this dataset is made up of data taken originally from the population census, and following some analysis of the data it shows clusters or patterns of socio-economic trends within the population. The third aspect of the data classification indicated which data can be used in valuation studies. Valuation data is data which could be used to estimate the monetary value of environmental goods and services, in other the words the benefit we derive e.g. willingness to pay for something. In addition, data which is useful in the ecosystems approach providing information which is not directly related to specific ecosystem goods or services yet can be combined with other datasets, such as population data, is defined as supplementary data.

The data catalogue is summarised below:

- The data catalogue contains over 1000 data-sets
- 13% of datasets are classified as provisioning services
- 8% of datasets are classified as regulating services
- 31% of datasets are classified as cultural services
- 11% of datasets are in classified in more than one category
- 37% of the data inventory can be used as supplementary data

Data classified under provisioning services contained the greatest number of datasets under the fibre and fuel category and is made predominantly of data pertaining to natural resources and land, yet are commonly economic measures or can equate to a market value of the resource e.g. Forestry Commission forestry data such as wood production and Defra Agricultural Commodity Prices. The sources of data classified under regulating services were wide-ranging from the Department for Communities and Local Government (DCLG) to the AEA Energy and Environment group, holders of the UK air quality archive. Climate regulation was the most frequently occurring type of data in this category and is related to an increased political interest in climate change over recent years. The climate regulation class has a broad scope in that it covers issues from renewable transport to social adaptation. An example of data classified under regulating services is Defra's Sustainable Development Indicators with information on emissions of carbon dioxide and oxides of nitrogen (as well as from particular sources such as Heavy Goods Vehicles) and information on economic performance, such as Gross Domestic Product. The social relations sub-ecosystem service was the most common type of cultural data and is mostly populated with data on demographics. The Office for National Statistics (ONS) holds a vast amount of socio-economic data pertaining to this category including household incomes, personal consumption and transport use. This type of information can also be combined with environmental data sets to provide useful analysis for the ecosystems approach. Data gaps were evident in all of the ecosystem service categories. This is almost certainly because, until now, there has been no impetus to collect and analyse data on how human well-being is influenced by ecosystem goods and services.

Whilst this project has made a broad attempt to collate existing socio-economic data to help describe and quantify the supply of ecosystem goods and services, it cannot be considered 'complete'. It was nonsensical to try to replicate equal levels of data for each category of ecosystem goods and services since one good dataset maybe all that is needed to monitor a given good or service. The locality and case study that is being monitored will drive the need for certain datasets, thus gaps can be described as being relative to the study in question. It must also be remembered that some data, such as pollination, are environmental in their nature and will always be less populated by socio-economic data. While this study's data inventory was a robust first attempt to pull together existing socio-economic data, ideally it should be iteratively updated as we learn more about the practicalities of applying an ecosystems approach. Furthermore, the amount of data available is linked to political agendas and the complexity of the issue it is monitoring, illustrated by the plethora of data related to climate regulation.

The socio-economic evidence base has limited practicality within an ecosystems approach unless it can be integrated effectively with environmental data to enable a holistic approach to sustainable development. This project detailed some recommendations and issues of data integration, firstly based on

their physical characteristics, e.g. what geographical area the data relates to and how often data is updated, and secondly on the ecosystem goods and services i.e. forging the link between biophysical habitats, for example a woodland and the benefits we derive from the habitats which are measured by the willingness to pay for woodland protection. The second point is illustrated with an example of the M6 Heysham Link Road, also a Defra Project, to assess the impact of the development of a new link road using an ecosystems approach. Future developments of the environmental and socio-economic evidence base assessing the natural environment must consider the end goal throughout its development, i.e. in conjunction with a case study project. While the data inventory for this project is large and widely applicable, it lacks the specific focus needed at a local scale or particular objective. It was beyond the scope of this project to develop an evidence base to be used for local studies as the sheer quantity of work is too vast, yet it is at the local scale where the ecosystems approach to sustainable development is most likely to be applied, thus it is here where the evidence base is best developed. As a result, recommendations on the integration of socio-economic and environmental data become limited to general issues of spatial and temporal integration and the broad conceptual framework.

The ecosystems approach is compared to an International example that utilises the 'ecological endpoints' approach, which give focus to two related scientific agendas – one in natural science, one in economics. The natural science agenda is to develop management and ecological models to predict changes in the ecological endpoints. The social science agenda is to weight or place value on those endpoints to prioritise management and protection actions. A case study is taken from Boyd and Wainger (2003), who provide an assessment of a set of ecological benefit indicators, with an emphasis on the need for easily implemented site evaluation techniques. Using GIS techniques to map the physical and social landscape can improve understanding of the ecosystem benefits arising from specific ecosystems. Maps created to display demographic patterns in the case study are relatively simple to construct and UK data is comparable and widely available. For the ecosystems approach, it shows that further analysis can be made using GIS techniques to derive more information for evaluating ecosystem services.

Finally, some recommendations are made on the issues come across in developing the evidence base to assess the natural environment. Firstly is applicability; a shortcoming in this project is a lack of ability to link the data to individual policies and targets relevant to natural resources. Future work should focus on linking both the environmental (Phase 1 – Inventory and assessment of natural resources, Defra Project NR01011) and socio-economic data inventories to relevant policies and targets. There are datasets which are environmental in nature yet can be considered for their socio-economic relevance and importance. While this report has included datasets like this, it has not gone the full way to including a comprehensive inventory of environmental data. However, the recommendations section exemplifies some of the socio-economic value we can derive from environmental data. Secondly, stakeholder involvement; with a poor response from stakeholders, future work must enable greater engagement of stakeholders.

Project Report to Defra

8. As a guide this report should be no longer than 20 sides of A4. This report is to provide Defra with details of the outputs of the research project for internal purposes; to meet the terms of the contract; and to allow Defra to publish details of the outputs to meet Environmental Information Regulation or Freedom of Information obligations. This short report to Defra does not preclude contractors from also seeking to publish a full, formal scientific report/paper in an appropriate scientific or other journal/publication. Indeed, Defra actively encourages such publications as part of the contract terms. The report to Defra should include:
- the scientific objectives as set out in the contract;
 - the extent to which the objectives set out in the contract have been met;
 - details of methods used and the results obtained, including statistical analysis (if appropriate);
 - a discussion of the results and their reliability;
 - the main implications of the findings;
 - possible future work; and
 - any action resulting from the research (e.g. IP, Knowledge Transfer).

1 Project details can be found at <http://www.Defra.gov.uk/wildlife-countryside/natres/nr0101.htm>

1. Introduction

Policy Background

Securing the Future (Defra 2005) is the UK Government strategy for achieving sustainable development and recognises natural resource protection and environmental enhancement as one of the four priority areas for Government action. Natural resources encompass biodiversity, air, land, water, soils, and access to the countryside. Through the Natural Environment Programme (NEP), Defra are working with stakeholders to develop a clear and strategic approach for the protection and enhancement of the UK's natural resources, whilst also accounting for the impact domestic policies have on the global environment.

The ecosystems approach (EA) is a framework for managing environmental systems and delivering sustainable development (Haines-Young and Potschin 2007). The concept underlying the ecosystems approach is that ecosystems and the biological diversity contained within them provide goods and services that benefit the economy, society and human well-being. The ecosystems approach represents a clear move towards a holistic approach for the management of whole ecosystems and multiple environmental pressures. Modern day pressures include increasing pollution and waste, global trade, increasing human populations, changing climate, overexploitation of natural resources, changing land use and cover and invasion by alien species (Scholes *et al.* 2006). Through accounting for environmental, social and economic factors at multiple spatial and temporal scales, the ecosystems approach can offer transparency to decision making.

Aims and Objectives

The overall aim of the project was to review the social and economic quantitative and qualitative evidence base for assessing the state and potential future changes in England's terrestrial natural environment using the ecosystems approach. 'Terrestrial' systems refer to all non-marine environments and include air, water, land, soil and biodiversity. The 'evidence base' refers to data, analyses and stakeholder views. The specific objectives of the project were to:

- I. Develop a data framework to identify a wide range of social and economic 'evidence' relevant to the natural environment in England.
- II. Compile a list of potential data-sets and methodologies, detailing their characteristics, which could be used in the ecosystem services approach.
- III. Indicate the 'usefulness' and 'robustness' of the available data for evaluating the social and economic roles of England's terrestrial environment and the ecosystem services it provides.
- IV. Compare the reviewed inventory of social and economic data in England with current and future data and methods or 'best practice' applied by other countries.
- V. Recommend how an integrated approach using the economic, social and natural environment evidence base can be used to assess the state of the natural environment and the ecosystem services it provides to people.

This project resides in Phase II of the 'Development of the Evidence Base for Natural Environment Policy'² work programme (Defra 2006c). Phase I of the research programme was completed in late 2005/early 2006, and examined a number of issues including: an inventory of environmental resources (NR0101); defining environmental limits (NR0102³); reviewing the concept of economic valuation of environmental goods and services (NR0103⁴); identification and characterisation of natural environmental pressures (NR0104⁵) and characterisation of the policy framework (NR0105⁶). This work will provide information on available social and economic evidence to the other 'core' Phase II projects namely; 'England's terrestrial ecosystem services and the rationale for an ecosystems approach' (NR0107⁷) and 'An assessment of the economic value of England's terrestrial ecosystem services' (NR0108⁸). The other case study projects will illustrate how the ecosystems approach can be applied to England's terrestrial systems (NR0109⁹, NR0110¹⁰, NR0111¹¹ and NR0112¹²). It is hoped that the data inventory will provide useful information on the evidence that will underpin all of these projects.

² <http://www.Defra.gov.uk/wildlife-countryside/natres/research.htm>

³ <http://www.Defra.gov.uk/wildlife-countryside/natres/nr0102.htm>

⁴ <http://www.Defra.gov.uk/wildlife-countryside/natres/nr0103.htm>

⁵ <http://www.Defra.gov.uk/wildlife-countryside/natres/nr0104.htm>

⁶ <http://www.Defra.gov.uk/wildlife-countryside/natres/nr0105.htm>

⁷ <http://www.Defra.gov.uk/wildlife-countryside/natres/nr0107.htm>

⁸ <http://www.Defra.gov.uk/wildlife-countryside/natres/nr0108.htm>

⁹ <http://www.Defra.gov.uk/wildlife-countryside/natres/nr0109.htm>

¹⁰ <http://www.Defra.gov.uk/wildlife-countryside/natres/nr0110.htm>

¹¹ <http://www.Defra.gov.uk/wildlife-countryside/natres/nr0111.htm>

¹² <http://www.Defra.gov.uk/wildlife-countryside/natres/nr0112.htm>

2. Concepts and Terminology

What do we mean by an Ecosystems Approach?

There is no single definition of an ecosystems approach, and this is reflected by the mix of terminology used around this agenda. The Convention on Biological Diversity (CBD) has defined a set of principles for an 'Ecosystem Approach' (CBD, 2005a) though this has not been widely taken up.

For the purposes of their Action Plan, Defra have sought to develop a set of common principles for a generic 'ecosystems approach' which can be applied in a wide range of policy areas and decision-making contexts. These are:

1. A more holistic approach to policy-making and delivery, with the focus on whole ecosystems and maintaining and enhancing ecosystem services
2. Ensuring that the value of ecosystem services is fully reflected in decision-making
3. Ensuring environmental limits are respected in the context of sustainable development, taking into account ecosystem functioning
4. Managing at an appropriate spatial scale, while recognising the cumulative impacts of local decisions
5. Adaptive management of the natural environment to respond to changing pressures, including climate change

The Benefits of an Ecosystems Approach

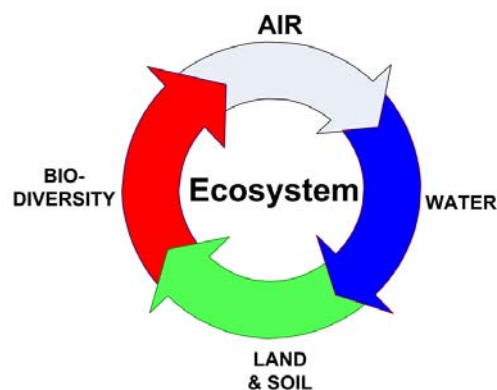
If the ecosystems approach is successfully embedded it is anticipated that this will deliver a number of important benefits:

- Better-informed decisions in the context of sustainable development – ensuring environmental costs and benefits are fully taken into account in decision-making and that environmental limits are respected
- Better prioritisation and more efficient use of resources – by focusing more on whole ecosystems rather than dealing separately with their components
- Greater awareness of the value of the natural environment across Government – by demonstrating more widely the economic and social benefits delivered by a healthy natural environment
- More effective communications with stakeholders and the public – by explaining more clearly what we are seeking to deliver and why
- Improved environmental outcomes – through a combination of all of the above

Defra's Ecosystems Approach Project

Current policy framework has evolved to deal with point sources of pollution, an approach that has been successful at addressing specific issues, but the biggest challenges now come from cumulative pressures and diffuse pollution, and cut across traditional policy 'silos'. There is therefore a need to develop a more joined-up approach to enable a better response to the complex challenges now faced. This will also help Defra to prioritise interventions more effectively and decide where limited resources should best be targeted.

An ecosystem can be defined as 'a functioning interdependent grouping of living things existing in equilibrium with their physical environment'. Everything that lives in an ecosystem is reliant on the other components – if one part is damaged or disappears, it can have an impact on everything else:



An ecosystems approach provides a framework for looking at whole ecosystems in decision making, to ensure that we can maintain a healthy and resilient natural environment now and for future generations.

The rationale for doing this is to secure and enhance the current and future supply of ecosystem services – the goods and benefits that ecosystems provide for people. The UN Millennium Ecosystem Assessment (MA, 2005) adopts four main categories of ecosystem services. These categories have been adopted as the framework for this report. In addition, it is recognised that this is not the only way of describing them. For example, they can be described in terms of providing:

- Resources for basic survival, such as clean air and water;
- A contribution to good physical and mental health, for example through access to green spaces and genetic resources for medicines;
- Natural processes, such as climate regulation and crop pollination;
- Support for a strong and healthy economy, through raw materials for industry and agriculture, or through tourism and recreation; and
- Social, cultural and educational benefits, and wellbeing and inspiration from interaction with nature.

3. Methodology

This section provides a brief overview of the methodology used in the project. The main components to the method used to collate the socio-economic data inventory are as follows:

- Data Inventory Framework;
- Data Typology;
- Data Inventory Characteristics
- Expert Group;
- Desk based review;
- Stakeholder engagement

Data Inventory Framework

The Millennium Ecosystem Assessment (2005) provided the scientific basis for the ecosystems approach in this report and was a solid foundation upon which to build the social and economic data inventory. The MA defines four main categories of ecosystem services:

- **Provisioning Services** generate resources obtained from ecosystems used directly by humans, such as food and fuel
- **Regulating Services** are those services obtained from ecosystem processes which impact indirectly on human welfare, such as regulation of air and water quality
- **Cultural Services** are the non-material benefits people obtain from ecosystems, such as recreation and spiritual inspiration
- **Supporting Services**, such as soil formation, are important for the production of all other ecosystem services. However, no further categories were identified for this category of ecosystem services since the relevant data would be covered under the other services. Please refer to Defra Project NR0101 for a review and assessment of natural resources.

At the start of the project, it was considered important to understand how the four categories of ecosystem services could be related to England's terrestrial ecosystems. An Expert Workshop was held at ADAS HQ in November 2006, where the relevant social and economic data on ecosystem goods and services for England were considered and listed. For example, under 'food', data relevant to England would include: crops, livestock, game, dairy, orchards, honey and allotments. This process was carried out for all the ecosystem services.

Where these datasets are expressed in pounds, this was indicated in the database under the column 'monetary'. These datasets included Household Consumption Expenditure by The Office for National Statistics (ONS), Capital Stocks held by the UK Data Archive and the Annual Business Inquiry by NOMIS.

Data Typology

Data were classified to make effective use of the data inventory and to aid in the identification of data gaps. The first aspect of the classification arranged the data according to ecosystem goods and services, as defined by the MA (2005). The second aspect of the classification split the data into primary and secondary data sources. In this study, primary data refers to the evidence which was collected by the institution holding the data and is used for the purpose for which it was collected. Secondary data refers to the evidence that has been spatially or temporally manipulated, or aggregated/ merged with other datasets for the purpose of analyses different to those for which the data was collected. This part of the classification is important because it allows data inventory users

access to the original or primary source of the data should the data format or summaries provided in the secondary data not be fit for purpose.

The third aspect to the data classification defines whether the data can be used in valuation studies, and is important for understanding the applicability of the data. Valuation data is data which could be used to estimate the monetary value of (which is itself a measure of *preferences* for) environmental goods and services and is likely to comprise of:

- Market prices (e.g. of agricultural produce)
- Results of stated preference studies (where people are asked whether they would be willing to pay for environmental goods/services)
- Studies which show how many visitors are attracted to recreational sites (and what they pay)
- House prices (which could be analysed to see if they are higher in areas of higher environmental amenity)

In addition, the data classification defines whether the data is ‘monetised’, or is simply a measure of economic variables, and is important for understanding the applicability of the data.

Data Inventory Characteristics

In addition to the collation of the socio-economic data inventory, the characteristics of the data catalogue were developed and detailed, including what data was required for the inventory, the units of data that are commonly used in the UK and accessibility and barriers to using data in the UK.

The data inventory captured a number of data characteristics which are highlighted in **Error! Reference source not found.** A supplementary information data field was created in the data inventory and is classified under supplementary. This evidence, which cannot be related directly to ecosystem goods and services, may be important to inform policy interventions.

Table 1: Summary of the Data Fields in the Data Catalogue

Data Characteristic	Entry	Description
Primary	Contact Name	Details of the main contact for the data at the institution that holds the data.
	Contact Details	Email/ Tel of the main contact
	Institution	Name of institution which holds or disseminates the data/ analysis
	Name of Data	Name of the dataset/analysis
	Synopsis of Data	Short description of data/analysis.
	Reference	Reference for further information on the data-set or web address where data can be downloaded.
Secondary	Details	Detailed description on how the data is created, and what data is used as input. How the data is collected or sourced, etc.
	Accessibility	Information on whether a license is required
	Temporal Coverage	Years or months the data-set has been created e.g. every year between 1995-2000
	Frequency of Updates	How often is the data updated e.g. annually, monthly
	Spatial Coverage	What geographic area does the data cover? e.g. national or specific county or locality
	Spatial Resolution	What is the spatial resolution of the data e.g. 1km ²
	Format	Is the data in spreadsheet, database or GIS format?
Stakeholder	Data Quality	What quality assurance takes place?
	Known Issues	What are the known errors and key assumptions?
	Main Uses of Data	What is the data mostly used for?
Classification	Future Developments of Data	How could this data be improved? What format would be more useful?
	Additional Comments	Other comments
	Ecosystem Service	MA ecosystem service (provisioning, cultural, regulating, supporting)
	Sub Ecosystem Service	Sub ecosystem service as defined in Tables 1 to 3
	Data Type	Primary or secondary data
	Monetary	Datasets expressed in pounds

Expert Group

The expert group comprised of a multi-disciplinary team combining expertise from environmental, economic, social and cultural fields. The main outcomes from the Expert Workshop were identification of key ecosystem goods services that can be obtained from England's terrestrial systems, and how these could be represented by qualitative or quantitative data (for e.g. area, price, yield, visitor numbers or simply its occurrence). In addition, the Expert Workshop enabled a comprehensive list of key economic, social and cultural data sources and stakeholders to be identified.

Desk Study

Key sources of social and economic data were identified through a preliminary desk based study, which was guided by the expert group opinions and knowledge. In addition to searching websites for information, this project consulted a number of social and economic data reviews to ensure a comprehensive data inventory (Huby *et al.* 2005, Defra 2006c and Communities and Local Government, 2006). Many government and commercial companies' websites were searched for relevant data in addition to using data hubs and portals.

Stakeholder Engagement

This part of the project involved contacting data custodians and data users. This aspect of the work provided a valuable opportunity to generate 'buy-in' amongst key stakeholders and awareness of the ecosystems approach system amongst stakeholders at the local level that will be essential for the implementation of the ecosystems approach in the future.

- A total of 151 individual stakeholders from 73 institutions were identified
- 58% of stakeholders were government organisations
- 13% were commercial organisations
- 12% were non-governmental organisations
- 12% from research
- 5% from academia

A questionnaire, taking the form of the preliminary draft database, was sent out to the stakeholders. The primary aim of sending out the questionnaire was to generate, as far as possible, a complete database. While thirty people agreed to participate in the study, only eight of these replied to the questionnaire. Due to the poor response from stakeholders, details required for the inventory were collated wherever possible from publicly available sources. Several issues were raised during the stakeholder communication phase, notably the poor response rate.

4. Summary of the Data Catalogue

A total of 1,104 datasets were identified in the ecosystems approach database, shown in Figure 1. The total number of data sets grouped by ecosystem service appears higher at 1,225, due to some of the data sets being classified under multiple ecosystem services. For example, *The State of the Countryside Report* is classified under both Cultural Services and Provisioning Services.

The catalogue can be summarised as follows:

- The number of data-sets relating to cultural services only is 345 (31%)
- Provisioning services only is 141 (13%)
- Regulating services only is 92 (8%)
- Supplementary services only is 411 (37%)
- Data-sets that are in more than one category number 118 (11%)
- Primary data represents 20% of the data
- Secondary data represents 50% of the data
- Hubs/web represents 6% of the data
- Supplementary data represents 24% of the data

The remaining datasets are accounted for in the supplementary data category. Whether the data involves monetisation provides an added descriptor; i.e. if the data is in the format of an economic variable. There are a total of 135 datasets which are classified as monetary data.

4.1 Provisioning Services

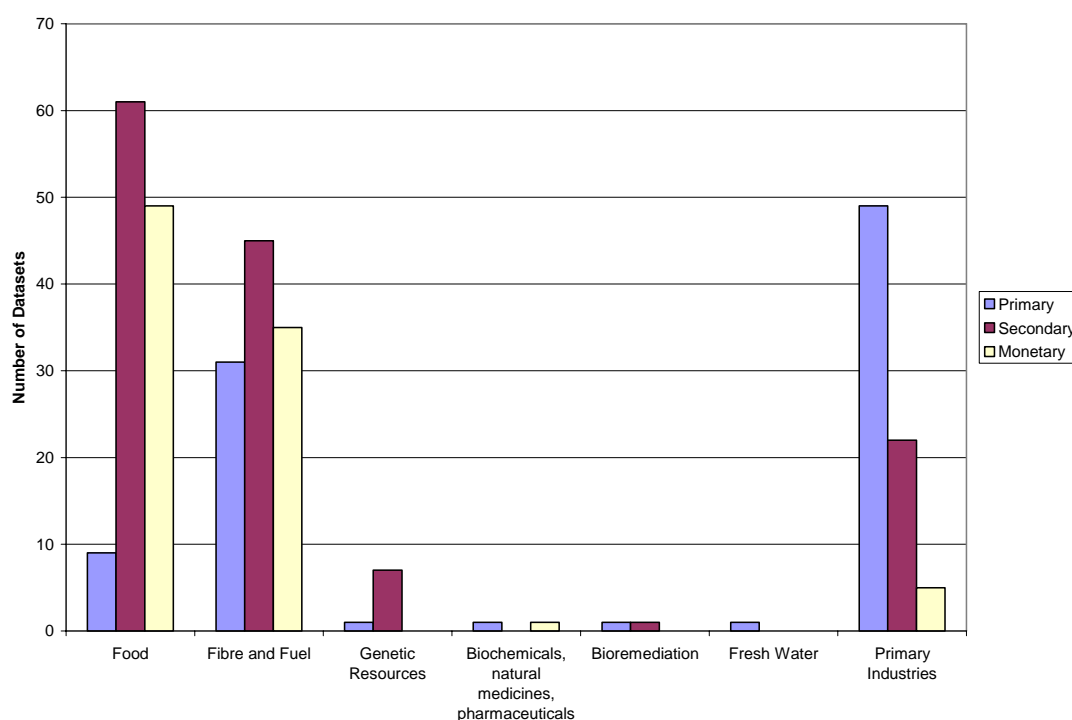


Figure 1: Distribution of data sets by sub-category related to provisioning ecosystem goods and services, delineated into primary and secondary data, as well as the number of these data sets that have 'monetary' value

- Data classified under provisioning services in the inventory amount to 216 datasets.
- The fibre and fuel category contains the most number of datasets in provisioning services.
- Mostly comprises data on natural resources and land, indicating the market value of the resource e.g. Forestry Commission forestry data such as wood production and Defra Agricultural Commodity Prices.
- A lot of the data (e.g. Defra agricultural statistics) cover both the food and fibre and fuel categories.
- There is less socio-economic data for pharmaceuticals, fresh water and bioremediation ecosystem services.
- Provisioning services category contains a high number of data-sets classed as monetary data - food and fibre and fuel datasets amount to almost 80%.

4.2 Regulating Services

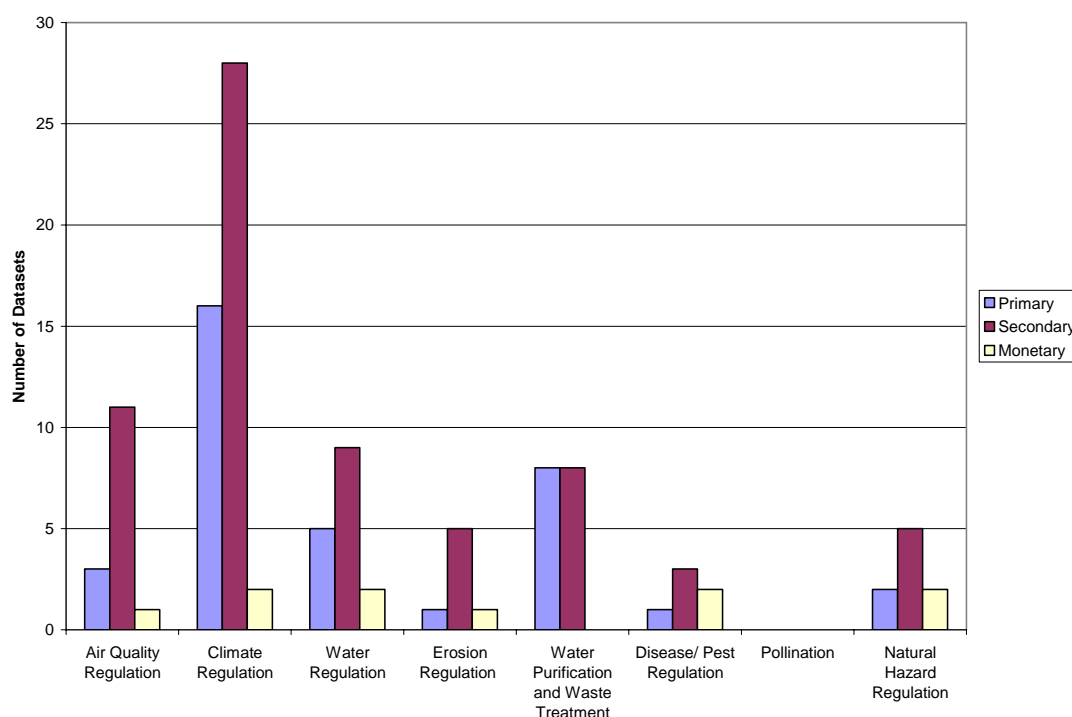


Figure 2: Distribution of data sets by sub-category of regulating ecosystem services, delineated into primary and secondary data and the number of these data sets that have 'monetary' value

- Data classified in the regulating services category amounts to 159 datasets (Figure 2), of which 66% of the data is secondary, for example Defra's UK Environmental Protection Expenditure Survey.
- An example of primary data in this category is household waste produced, provided by the ONS, and falls under the water purification and waste treatment sub-ecosystem service category.
- Data is wide-ranging - from the Department for Communities and Local Government (DCLG) to NETCEN, the UK air quality archive.
- 'Climate regulation' is the most frequently occurring type of data in this category and is related to an increased political interest in climate change over recent years.
- The 'climate regulation' class has a broad scope - covers issues from renewable transport to social adaptation.
- Much of the data belonging to climate regulation is populated by transport data e.g. Defra's sustainable development indicators, which quantify the distance travelled per person.
- Much of the data classified under 'climate regulation' is also classified under 'air quality regulation'.
- 'Air Quality regulation', 'water regulation' and 'water purification and waste treatment' all have similar data representation, ranging between 14 and 21 datasets.
- The services where data is lacking include 'erosion regulation', 'disease/pest regulation' and 'pollination'.

4.3 Cultural Services

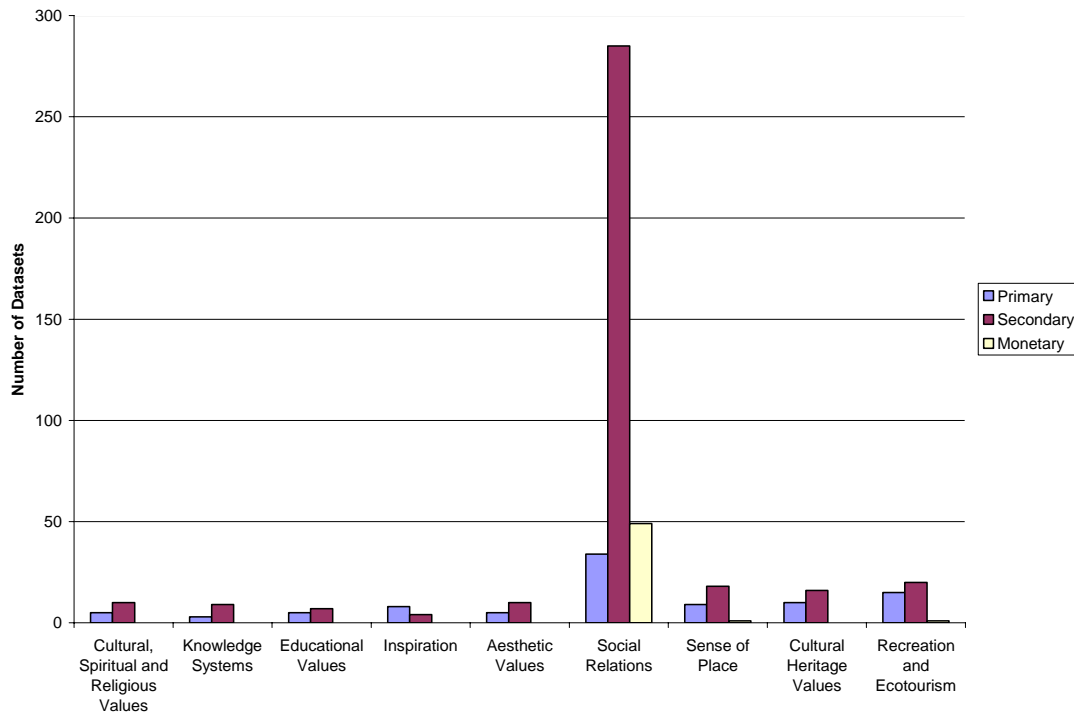


Figure 3: Distribution of data sets by sub-category of cultural ecosystem services, delineated into primary and secondary data and the number of these data sets that have 'monetary' value

- There are 473 datasets in the cultural services category (Figure 3)
- Secondary data accounts for 72%
- Primary data accounts for 18%
- 10% of data comprises monetary data
- One of the key hubs of 'cultural services' information is Defra's Rural Evidence Hub
- The 'social relations' group is the most common type of cultural data with 324 datasets (68%), and is mostly populated with data on demographics
- The ONS hold a vast amount of socio-economic data, such as household incomes, personal consumption and transport use, which are all free to use
- The remaining sub-categories in cultural ecosystem services have considerably fewer datasets - between 10 and 30 datasets
- 'Cultural heritage values', 'cultural, spiritual and religious values', 'inspiration', 'aesthetic values', 'sense of place' and 'recreation and tourism' are commonly associated with data held by English Heritage and Natural England, such as Buildings at Risk, Millennium Greens, and World Heritage Sites

4.4 Valuation Data

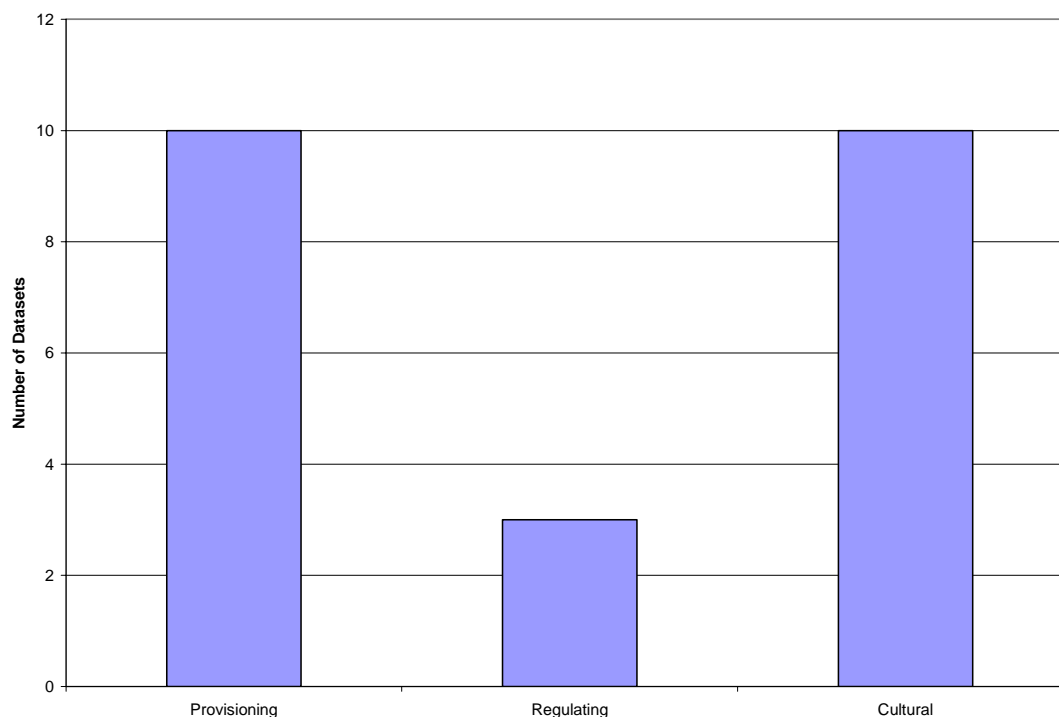


Figure 4: Number of data-sets that can be used for valuation studies in each of the ecosystem service categories

There are only 23 data-sets in the data inventory that can be used as valuation data. Whilst this is a low number, data was sourced to fit into the MA Classification (2005) rather than explicitly sourced as valuation data. Valuation data within provisioning services are mainly comprised of data based on market prices, such as Commodity Price Movements or Agricultural Prices by Defra. Valuation data in the cultural services category comes from the results of stated preference studies, such as the National Travel Survey by the Department for Transport and the UK Day Visit Survey.

5. Data Gaps

Data gaps were apparent for every kind of ecosystem service throughout the data catalogue because, until now, there has been no impetus to collect and analyse data on how human well-being is influenced by ecosystem goods and services. This study's data inventory is a first attempt to pull together existing socio-economic data to help describe and quantify the supply of ecosystem goods and services and as such it cannot be considered 'complete'.

- There were few datasets associated with genetic resources, biochemical, natural medicines, pharmaceuticals, bioremediation and fresh water – these have high potential for developing the linkages between ecosystem goods and services with direct benefits to human well-being.
- Erosion regulation represents only 0.9% of the regulating goods and services data
- Disease and pest regulation represents only 4%
- There were no datasets for pollination - regulating services are more associated with environmental datasets

6. Recommendations on Data Use

Previous sections have identified a framework for identifying a range of socio-economic data, and compiled a summary of the data and its characteristics. This data, however, holds little value without some recommendations as to its use. Adhering to objective III, this section indicates the usefulness of the data using a scoring system based on the typology and classification method described in section 3.

This section of the report highlights which data-sets we considered most useful for the ecosystems approach, whether used alone or combined with other socio-economic and environmental data sets. The tables suggest widely available, general usability data-sets with an ability to monitor changes (temporal resolution) at a good spatial scale.

The tables of recommended data-sets (Tables 2, 3, 4, 5 and 6) list the source, name, whether it is primary or secondary data and whether it is valuation data. The change detection column is based on its temporal resolution (the frequency the data is updated). A single tick means the data is less capable of detecting change as the data is either a one-off or is only updated every 10 years or more. Two ticks are used to identify data that are updated every 5 years and three ticks represent data capable of monitoring rapid change at annual intervals or less. The ecosystem service column and sub-ecosystem service column detail which ecosystem service the data relates to and the sub-ecosystem parameter within each ecosystem service.

Change Detection	Indicator
Updated every 10 years or more	✓
Updated every 5 years	✓ ✓
Updated annually or less	✓ ✓ ✓

The spatial resolution column stipulates what scale the dataset is collected at. This helps to place the dataset into the context that it can be used, and therefore be more practical in its implementation.

Table 2: List of recommended data-sets for targeting future monitoring related to provisioning services

Resource	Data-set	Primary or Secondary	Monetary	Change Detection	Spatial Resolution	Ecosystem Service	Sub-Ecosystem Service	
DEFRA	E-digest of Environmental Statistics Economic and Supplementary Information	Primary/Secondary	✓	✓ ✓ ✓	National	Provisioning	Food	✓
							Fibre and Fuel	✓
							Genetic Resources	✓
							Biochemicals, natural medicines, pharmaceuticals	✓
							Bioremediation	✓
							Fresh Water	✓
ADAS	ADAS Land Cover	Primary		✓	1km ² Grid	Provisioning	Food	✓
							Fibre and Fuel	
							Genetic Resources	
							Biochemicals, natural medicines, pharmaceuticals	
							Bioremediation	
							Fresh Water	
DEFRA	Agricultural and Horticultural Census (June)	Primary		✓ ✓ ✓	Parish	Provisioning	Food	✓
							Fibre and Fuel	✓
							Genetic Resources	✓
							Biochemicals, natural medicines, pharmaceuticals	✓
							Bioremediation	✓
							Fresh Water	✓
Environment Agency	Water Statistics (Usage and demand)	Primary		✓ ✓ ✓	National	Provisioning	Food	
							Fibre and Fuel	
							Genetic Resources	
							Biochemicals, natural medicines, pharmaceuticals	
							Bioremediation	
							Fresh Water	✓
Forestry Commission	Range of forestry data (e.g. wood production)	Primary	✓	✓ ✓ ✓	Regional	Provisioning	Food	
							Fibre and Fuel	✓

Resource	Data-set	Primary or Secondary	Monetary	Change Detection	Spatial Resolution	Ecosystem Service	Sub-Ecosystem Service	
							Genetic Resources	
							Biochemicals, natural medicines, pharmaceuticals	
							Bioremediation	
							Fresh Water	
							Primary Industries	
Countryside Quality Counts	National indicator of how the countryside is changing	Secondary	✓	✓ ✓ ✓	Joint Character Area	Provisioning	Food	✓
							Fibre and Fuel	✓
							Genetic Resources	
							Biochemicals, natural medicines, pharmaceuticals	✓
							Bioremediation	✓
							Fresh Water	✓
Primary Industries	✓							
DEFRA	Agricultural Commodity Prices	Secondary	✓	✓ ✓ ✓	Government office Region	Provisioning	Food	✓
							Fibre and Fuel	✓
							Genetic Resources	
							Biochemicals, natural medicines, pharmaceuticals	✓
							Bioremediation	
							Fresh Water	
Primary Industries								

Table 3: List of recommended data-sets for targeting future monitoring related to regulating services

Resource	Data-set	Primary or Secondary	Monetary	Change Detection	Spatial Resolution	Ecosystem Service	Sub-Ecosystem Service	
DEFRA	E-digest of Environmental Statistics - Environmental Protection Expenditure by Industry	Primary	✓	✓ ✓ ✓	National	Regulating	Air Quality Regulation	✓
							Climate Regulation	✓
							Water Regulation	✓
							Erosion Regulation	✓
							Water Purification and Waste Treatment	✓
							Disease/ Pest Regulation	✓
							Pollination	✓
							Natural Hazard Regulation	✓
Department of Trade and Industry	Regional Energy Consumption Statistics	Secondary		✓ ✓ ✓	Local Authority (NUTS4)	Regulating	Air Quality Regulation	
							Climate Regulation	✓
							Water Regulation	
							Erosion Regulation	
							Water Purification and Waste Treatment	
							Disease/ Pest Regulation	
							Pollination	
							Natural Hazard Regulation	
DEFRA	E-digest of Environmental Statistics - Waste Data	Primary		✓ ✓	Government office Region	Regulating	Air Quality Regulation	
							Climate Regulation	
							Water Regulation	

Resource	Data-set	Primary or Secondary	Monetary	Change Detection	Spatial Resolution	Ecosystem Service	Sub-Ecosystem Service	
							Erosion Regulation	
							Water Purification and Waste Treatment	✓
							Disease/ Pest Regulation	
							Pollination	
							Natural Hazard Regulation	
RELU	Range of Rural Data	Secondary		✓	Super Output Area	Regulating	Air Quality Regulation	✓
							Climate Regulation	✓
							Water Regulation	✓
							Erosion Regulation	✓
							Water Purification and Waste Treatment	✓
							Disease/ Pest Regulation	✓
							Pollination	✓
							Natural Hazard Regulation	✓
Countryside Quality Counts	National indicator of how the countryside is changing	Secondary	✓	✓ ✓ ✓	Joint Character Area	Regulating	Air Quality Regulation	✓
							Climate Regulation	✓
							Water Regulation	✓
							Erosion Regulation	✓
							Water Purification and Waste Treatment	✓
							Disease/ Pest Regulation	✓
							Pollination	✓
							Natural Hazard Regulation	✓
National Statistics Online	United Kingdom Environmental Accounts	Secondary	✓	✓ ✓	Regional	Regulating	Air Quality Regulation	✓
							Climate Regulation	✓
							Water Regulation	✓
							Erosion Regulation	✓
							Water Purification and Waste Treatment	✓
							Disease/ Pest Regulation	✓
							Pollination	✓
							Natural Hazard Regulation	✓

Table 4: List of recommended data-sets for targeting future monitoring related to cultural services

Resource	Data-set	Primary or Secondary	Monetary	Change Detection	Spatial Resolution	Ecosystem Service	Sub-Ecosystem Service	
Campaign to Protect Rural England (CPRE)	Tranquillity Mapping	Secondary		✓	500m * 500m grid	Cultural	Cultural, Spiritual and Religious Values	
							Knowledge Systems	
							Educational Values	
							Inspiration	✓
							Aesthetic Values	✓
							Social Relations	
							Sense of Place	✓
							Cultural Heritage Values	✓
Recreation and Ecotourism	✓							

Resource	Data-set	Primary or Secondary	Monetary	Change Detection	Spatial Resolution	Ecosystem Service	Sub-Ecosystem Service	
Department for Communities and Local Government (DCLG)	Index of Multiple Deprivation	Secondary		✓ ✓	Super Output Area	Cultural	Cultural, Spiritual and Religious Values	✓
							Knowledge Systems	✓
							Educational Values	✓
							Inspiration	✓
							Aesthetic Values	✓
							Social Relations	✓
							Sense of Place	✓
							Cultural Heritage Values	✓
Recreation and Ecotourism	✓							
Commission for Rural Communities (CRC)	State of The Countryside Reports	Secondary	✓	✓ ✓ ✓	Regional	Cultural	Cultural, Spiritual and Religious Values	✓
							Knowledge Systems	✓
							Educational Values	✓
							Inspiration	✓
							Aesthetic Values	✓
							Social Relations	✓
							Sense of Place	✓
							Cultural Heritage Values	✓
Recreation and Ecotourism	✓							
Department of Geography and Geosciences, University of St Andrews, the South East Public Health Observatory (SEPHO), the University of Oxford, and Oxford Consultants for Social Inclusion (OCSI)	Health Poverty Index	Secondary		✓	Local Authority	Cultural	Cultural, Spiritual and Religious Values	
							Knowledge Systems	
							Educational Values	
							Inspiration	
							Aesthetic Values	
							Social Relations	✓
							Sense of Place	
							Cultural Heritage Values	
Recreation and Ecotourism								
MAGIC	Range of Cultural Data-sets	Primary		✓	Various	Cultural	Cultural, Spiritual and Religious Values	✓
							Knowledge Systems	✓
							Educational Values	✓
							Inspiration	✓
							Aesthetic Values	✓
							Social Relations	✓
							Sense of Place	✓
							Cultural Heritage Values	✓
Recreation and Ecotourism	✓							
NOMIS Neighbourhood Statistics	Range of Cultural Data-	Primary/Secondary	✓	✓ ✓ ✓	Local Authority	Cultural	Cultural, Spiritual and Religious Values	

Resource	Data-set	Primary or Secondary	Monetary	Change Detection	Spatial Resolution	Ecosystem Service	Sub-Ecosystem Service	
	sets						Knowledge Systems	
							Educational Values	
							Inspiration	
							Aesthetic Values	
							Social Relations	✓
							Sense of Place	
							Cultural Heritage Values	
							Recreation and Ecotourism	
Countryside Quality Counts	National indicator of how the countryside is changing	Secondary	✓	✓ ✓ ✓	Joint Character Area	Cultural	Cultural, Spiritual and Religious Values	✓
							Knowledge Systems	✓
							Educational Values	✓
							Inspiration	✓
							Aesthetic Values	✓
							Social Relations	✓
							Sense of Place	✓
							Cultural Heritage Values	✓
Recreation and Ecotourism	✓							
English Heritage and MAGIC	World Heritage Sites	Primary		✓	Varies	Cultural	Cultural, Spiritual and Religious Values	✓
							Knowledge Systems	✓
							Educational Values	✓
							Inspiration	✓
							Aesthetic Values	✓
							Social Relations	✓
							Sense of Place	✓
							Cultural Heritage Values	✓
Recreation and Ecotourism	✓							
Visit Britain	UK Tourism Survey	Primary	✓	✓ ✓ ✓	Regional	Cultural	Cultural, Spiritual and Religious Values	✓
							Knowledge Systems	
							Educational Values	✓
							Inspiration	✓
							Aesthetic Values	✓
							Social Relations	
							Sense of Place	✓
							Cultural Heritage Values	✓
Recreation and Ecotourism	✓							
Forestry Commission	Visits to Woodlands	Primary		✓ ✓ ✓	Woodland Size	Cultural	Cultural, Spiritual and Religious Values	✓
							Knowledge Systems	✓
							Educational Values	✓
							Inspiration	✓
							Aesthetic Values	✓

Resource	Data-set	Primary or Secondary	Monetary	Change Detection	Spatial Resolution	Ecosystem Service	Sub-Ecosystem Service	
							Social Relations	✓
							Sense of Place	✓
							Cultural Heritage Values	✓
							Recreation and Ecotourism	✓

Table 5: List of useful supplementary data-sets

Resource	Data-set	Primary or Secondary	Monetary	Change Detection	Spatial Resolution
Department for Transport	Regional Transport Statistics	Primary	✓	✓ ✓ ✓	Regional
Experian	Mosaic	Secondary	✓	✓ ✓ ✓	Household Level
Online National Statistics	Population Census	Primary	✓	✓ ✓ ✓	Unitary Authority
Department for Communities and Local Government (DCLG)	Housing in England	Secondary	✓	✓ ✓ ✓	Regional

Table 6: List of data-sets that can be used for valuation studies

Resource	Data-set	Primary or Secondary	Change Detection	Spatial Resolution	Ecosystem Service	Sub-Ecosystem Service	
DEFRA	Rural Economic Reports - various economic reports on England's rural economy	Secondary	✓ ✓	Regional	All	All	
Countryside Agency	UK day visit survey - info on all leisure day trips from home in GB - 7000 interviews face-to-face. Latest survey 2005	Primary	✓ ✓ ✓	Regional	Cultural	Cultural, Spiritual and Religious Values	✓
						Knowledge Systems	✓
						Educational Values	✓
						Inspiration	✓
						Aesthetic Values	✓
						Social Relations	✓
						Sense of Place	✓
						Cultural Heritage Values	✓
Department for Transport	Personal Travel - The survey collects information on where, how and why people travel as well as factors which affect personal travel such as car availability, driving licence holding and access to key services.	Primary	✓ ✓ ✓	Dependent on response	Cultural	Cultural, Spiritual and Religious Values	✓
						Knowledge Systems	✓
						Educational Values	✓
						Inspiration	✓
						Aesthetic Values	✓
						Social Relations	✓
						Sense of Place	✓
						Cultural Heritage Values	✓
Department for Transport, Local Authority and Regions/ONS	National Travel Survey - Relates to journeys made and distances travelled every year. Information is broken down by participants' personal characteristics - age,	Primary	✓ ✓ ✓	Dependent on response	Cultural	Cultural, Spiritual and Religious Values	✓
						Knowledge Systems	✓
						Educational Values	✓

Resource	Data-set	Primary or Secondary	Change Detection	Spatial Resolution	Ecosystem Service	Sub-Ecosystem Service	
	working status, whether they held a driver's licence and general household details (such as income and car availability).					Inspiration	✓
						Aesthetic Values	✓
						Social Relations	✓
						Sense of Place	✓
						Cultural Heritage Values	✓
						Recreation and Ecotourism	✓
Forestry Commission	Visits to Woodlands	Primary	✓ ✓	Woodland Size	Cultural	Cultural, Spiritual and Religious Values	✓
						Knowledge Systems	✓
						Educational Values	✓
						Inspiration	✓
						Aesthetic Values	✓
						Social Relations	✓
						Sense of Place	✓
						Cultural Heritage Values	✓
Recreation and Ecotourism	✓						
National Statistics Online	British Social Attitudes Survey - Environment, conservation and landuse	Secondary	✓	National	Cultural	Cultural, Spiritual and Religious Values	✓
						Knowledge Systems	✓
						Educational Values	✓
						Inspiration	✓
						Aesthetic Values	✓
						Social Relations	✓
						Sense of Place	✓
						Cultural Heritage Values	✓
Recreation and Ecotourism	✓						
DEFRA	Agricultural Market Prices/ Reports - time series data for prices and quantities for the categories and sub categories of bananas, cereals, eggs and poultry, feeding stuffs, finished stocks, fruit, vegetables, flowers, pot plants, hay and straw, livestock potatoes	Primary	✓ ✓ ✓	National	Provisioning	Food	✓
						Fibre and Fuel	✓
						Genetic Resources	✓
						Biochemicals, natural medicines, pharmaceuticals	✓
						Bioremediation	✓
						Fresh Water	
						Primary Industries	✓
Department for Communities and Local Government (DCLG)	House Price Index - monthly statistical release provides mix-adjusted house prices at Government Office Region level and a chain linked index and measures of annual inflation	Primary	✓ ✓ ✓	Postcode	Cultural/Provisioning		✓
Experian	Average price of houses, aggregated to geographic bricks - Derived from Land Registry of actual house sale transactions	Secondary	✓ ✓ ✓	Household	Cultural/Provisioning/Regulating		✓
Land Registry	House Prices	Primary	✓ ✓ ✓	Postcode	Cultural	Cultural, Spiritual and Religious Values	✓
						Knowledge Systems	✓
						Educational Values	✓
						Inspiration	✓
						Aesthetic Values	✓
						Social Relations	✓
						Sense of Place	✓
						Cultural Heritage Values	✓
Recreation and	✓						

Resource	Data-set	Primary or Secondary	Change Detection	Spatial Resolution	Ecosystem Service	Sub-Ecosystem Service	
						Ecotourism	
DEFRA	Horticultural Statistics - Publication is designed to provide comprehensive statistics on the production and value of horticultural crops grown in the United Kingdom.	Primary	✓ ✓ ✓	National	Provisioning	Food	✓
						Fibre and Fuel	✓
						Genetic Resources	✓
						Biochemicals, natural medicines, pharmaceuticals	✓
						Bioremediation	✓
						Fresh Water	
Primary Industries	✓						
DEFRA	Agricultural Price Indices - Indices of the prices received by producers for agricultural products and of the prices paid by producers for inputs used in agricultural production. Both a monthly and annual series are produced	Primary	✓ ✓ ✓	National	Provisioning	Food	✓
						Fibre and Fuel	✓
						Genetic Resources	✓
						Biochemicals, natural medicines, pharmaceuticals	✓
						Bioremediation	✓
						Fresh Water	
Primary Industries	✓						
DEFRA	Commodity Price Movements - Made up of four excel spreadsheets and graphs split into commodity groups. Cereals, Livestock, Cattle and Other. Tables are updated weekly, some commodities such as eggs are updated quarterly.	Primary	✓ ✓ ✓	National	Provisioning	Food	✓
						Fibre and Fuel	✓
						Genetic Resources	✓
						Biochemicals, natural medicines, pharmaceuticals	✓
						Bioremediation	✓
						Fresh Water	
Primary Industries	✓						
DEFRA	Agricultural Commodity Prices - weekly price series for various agricultural produce	Primary	✓ ✓ ✓	National	Provisioning	Food	✓
						Fibre and Fuel	✓
						Genetic Resources	✓
						Biochemicals, natural medicines, pharmaceuticals	✓
						Bioremediation	✓
						Fresh Water	
Primary Industries	✓						
Forestry Commission	Financial Return from Forestry - Returns to the forest owner are made up of sales of timber (standing or felled), sales of other goods and services, increases in the value of the woodland (from annual increment or market factors), and the net income from subsidies (e.g. planting grants) less taxes	Primary	✓ ✓ ✓	National	Provisioning	Food	✓
						Fibre and Fuel	✓
						Genetic Resources	✓
						Biochemicals, natural medicines, pharmaceuticals	✓
						Bioremediation	✓
						Fresh Water	
Primary Industries	✓						
Forestry Commission	Prices of wood and wood products - Timber Price Indices gives values for overlapping 12 month periods and is available from the Forestry Commission website	Primary	✓ ✓ ✓	National	Provisioning	Food	✓
						Fibre and Fuel	✓
						Genetic Resources	
						Biochemicals, natural medicines, pharmaceuticals	✓
						Bioremediation	✓
						Fresh Water	
Primary Industries	✓						
Home Grown Cereals Association (HGCA)	Physical Prices - EU Delivered Prices, EU Feed Ingredients Prices, UK corn returns, UK Corn Returns Volumes, UK Daily Ex Farm Prices,	Primary	✓ ✓ ✓	National	Provisioning	Food	✓
						Fibre and Fuel	✓
						Genetic Resources	

Resource	Data-set	Primary or Secondary	Change Detection	Spatial Resolution	Ecosystem Service	Sub-Ecosystem Service	
	UK Delivered Prices, UK Feed Ingredients Prices, UK FOB Prices, UK Imported Prices, UK Intervention Prices					Biochemicals, natural medicines, pharmaceuticals	
						Bioremediation	✓
						Fresh Water	
						Primary Industries	✓
ADAS	Cost Diffuse Pollution - Estimates cost of various mitigation measures for diffuse water pollution to achieve targets	Secondary	✓ ✓ ✓	1km ² Grid	Regulating	Air Quality Regulation	✓
						Climate Regulation	✓
						Water Regulation	✓
						Erosion Regulation	✓
						Water Purification and Waste Treatment	✓
						Disease/ Pest Regulation	✓
						Pollination	✓
						Natural Hazard Regulation	✓

7. Socio-economic and Environmental Data Integration

This section recommends how an integrated approach, bringing together socio-economic and natural environment data, can be used to assess the state of the natural environment and the ecosystem services it provides people (Objective V).

Recommendations on Integrating Environmental and Socio-Economic Data

Haines-Young and Potschin (2007) discuss how identifying England's major terrestrial ecosystems and their associated goods and services determines the 'operational units' for the analytical framework, namely *the 'habitats-focus'* or the *'ecosystem services perspective'*. A 'habitats-focus' approach uses the major habitats found across the English landscape as the defining operational unit, whereby a defined habitat could be representative of the goods and services associated. Alternatively, an 'ecosystem services perspective' identifies the actual goods and services, as opposed to the habitat units. This perspective looks at the functional units required that provide us with a particular good or service. While these two approaches to implementing the ecosystems approach differ slightly, they are not mutually exclusive and can both be considered in applying the ecosystems approach. In combination with the MA (2005) guidelines on ecosystem services classifications, (provisioning, regulating, cultural and supporting) we can associate the ecosystem goods and services with the biophysical structure or habitats and therefore begin to integrate the data in a meaningful way.

Case Study Heysham M6 Link

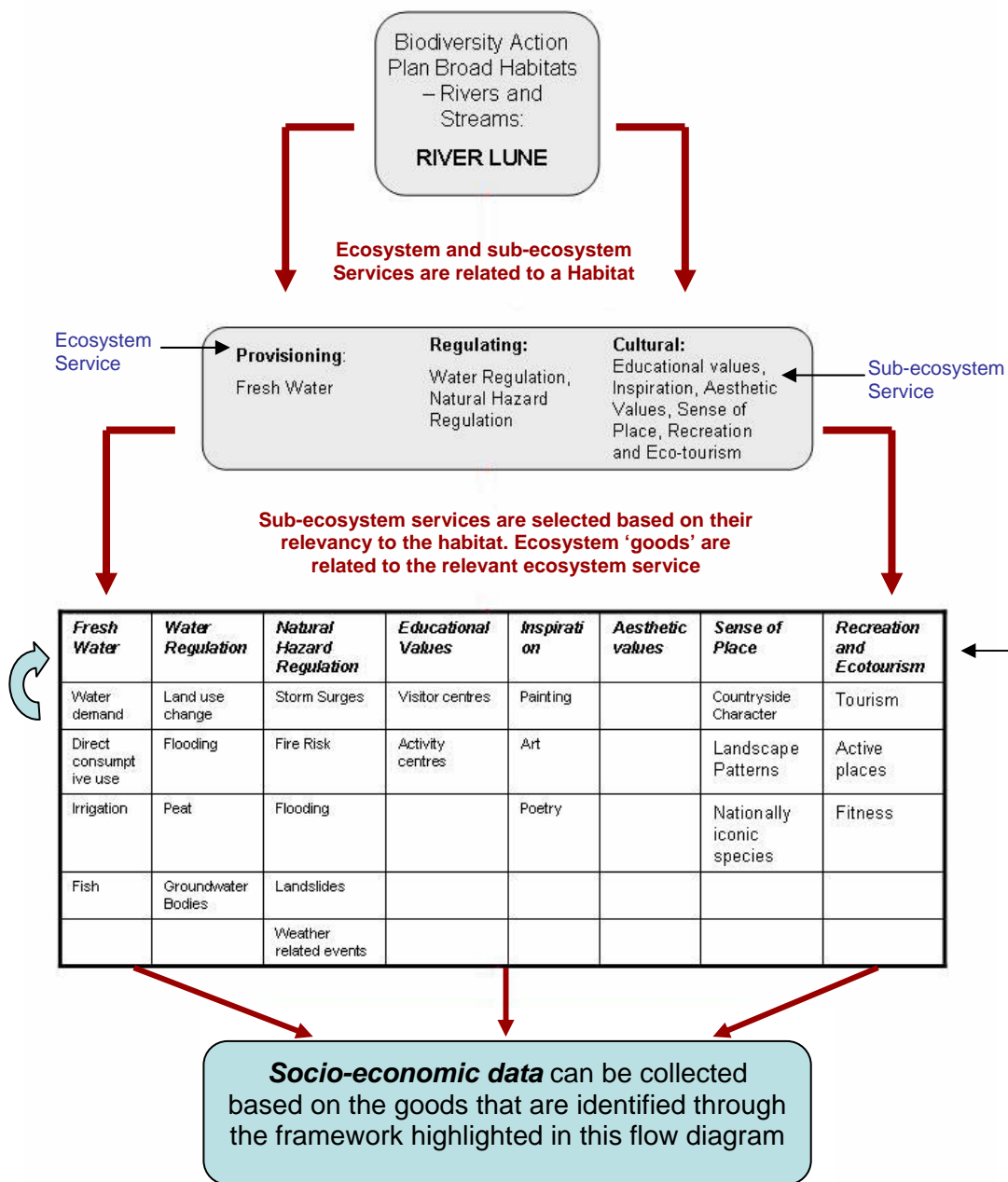
Defra Project NR0110 looks retrospectively at a regionally important infrastructure development – the Heysham M6 link in Lancashire for which a planning application has recently been made. The two options for the M6 link road will impact upon the local environment. The case study seeks to look at how well the procedure that has been followed for the proposed Heysham M6 link delivers the ecosystems approach and to what extent can the information collected to assess the impact of the Heysham M6 link, together with other information already available, be used to successfully apply the ecosystems approach. Using this project as a practical example highlights the process by which environmental and socio-economic data can be integrated to assess the natural environment.

Using a habitats focus emphasises the broad and priority habitats of the case study area, and more importantly the extent to which we can identify the services associated with them (Haines-Young and Potschin 2007). Figure 5 is a flow diagram highlighting, in simple terms, the route to assess and identify goods and services through a habitats-focus. Using the Biodiversity Action Plan broad habitat types, the River Lune has been identified as one of the habitats that would be affected by the proposed M6 Link. The river has rich biodiversity and is also one of the best Salmon Rivers in the country.

The red arrow in Figure 5 leads down to a box containing the ecosystem services that are associated with the River Lune Habitat. The sub-ecosystem services associated with the main services are chosen based on their relevance to the chosen habitat. For example, fresh water is identified under provisioning services, water and

natural hazard regulation under regulating services and educational values, inspiration, aesthetic values, sense of place, recreation and eco-tourism under cultural services. From the expert workshop, a list of goods were recognised and associated with the sub-ecosystems. Following the flow diagram down to 'Goods' is a table relating the possible goods found within the ecosystem services. Using this process we have identified what goods and services are found in the Heysham area that will be affected by the M6 link road. Using the MA ecosystem services framework, it is possible to relate the services and sub-ecosystem services associated with each habitat, thus forming the basis to search for socio-economic data. For example, under the sub-ecosystem service fresh water, goods that will reflect the value we derive from this service could include water demand, direct consumptive use and irrigation. Collecting data pertaining to these will be indicative of the value we derive from those ecosystem services. As a framework, this process endeavours to provide a full and systematic scoping of the data pertaining to the ecosystem services related to the area of study. This method does not imply that a definitive list of goods and services are related to a given habitat, rather that such an assessment will aid in defining what goods and services are relevant to the locality.

Figure 5: Flow diagram explaining a potential method for creating the link to integrate socio-economic and environmental data



8. Stakeholder Communication

Suitable procedures and potential channels through which to disseminate

Stakeholders are an integral part of the data collection and dissemination process, thus having strong communication procedures with stakeholders is vital. There are two elements to this process: identification of suitable procedures and potential channels through which to disseminate the final report to key natural stakeholders, and the identification of potential mechanisms through which various stakeholders can access social and economic datasets. Distribution of the data catalogue could be enhanced by providing bespoke information for stakeholders that shows them how the socio-economic data may be of use to them.

Potential mechanisms through which various stakeholders can access social and economic datasets

There are a number of existing Government initiatives for data unification and sharing. Organisations such as the Environmental Statistics Section of the Royal Statistical Society (RSS), the Association for Geographic Information (AGI), and the Intra-Governmental Group on Geographical Information (IGGI) all coordinate databases. Interactive GIS-based visual tools are a powerful way to demonstrate the potential to use socio-economic data in tandem with natural environmental data to solve area-based problems. Similar means of data distribution are the Rural Evidence Hub by Defra, Neighbourhood Statistics by ONS and MAGIC, a web-based interactive map portal to bring together information on key environmental schemes and designations in one place.

9. International examples of the ecosystems approach

This section of the report complements the Inventory Study on Natural Environment Data II project by discussing alternative ecosystem assessment methods in use or being developed outside the UK to provide a comparison of the social and economic data being utilised. We use the 'ecological endpoints' approach to highlight data requirements, thus providing some comparison to data inventories used in alternative approaches to an ecosystem services assessment.

Ecological Endpoints

Defra's challenge, and opportunity, is to measure, manage, and communicate the value of non-market ecological resources for the benefit of the British people. Management requires measurement. The question is what to measure and how to coordinate and aggregate that measurement in a way that is scientifically sound, practical, and intuitive to the public. This section of the report describes and advocates a particular strategy to provide an insight into the types and availability of data used, specifically in the use of Ecosystem Benefit Indicators (EBIs). The strategy is to develop *ecological endpoints* and build an accounting system around them. Ecological endpoints are biophysical characteristics; they are concrete, tangible, and measurable; and they are directly connected to human wellbeing. These endpoints give focus to two related scientific agendas – one in natural science, one in economics. The natural science agenda is to develop management and ecological models to predict changes in the ecological endpoints. The social science agenda is to weight or place value on those endpoints to prioritise management and protection actions. The ecological endpoints can be thought of as a conceptual and quantifiable bridge between the natural and social science agendas central to the evaluation of environmental benefits.

Ecological endpoints employ specific air and water quality, land cover, habitat and species data from existing ecological measurement systems. These endpoints differ from existing ecological measurements in that they are defined in terms of utilitarian, human needs and desires and in the context of accounting economics.

Ecological Benefit Indicators

Ecosystem benefit indicators (EBIs) are countable features of the physical and social landscape. They are environmental and social features that influence ecosystem services' contributions to human wellbeing. EBIs convey information about the production of benefits involving ecological inputs. However, they tell us nothing about the underlying preferences for goods and services. Thus, they provide some information relating to welfare, but by themselves do not allow for monetary valuation. EBIs combine ecological endpoints with data on the endpoint's scarcity, substitutes, and complements, with rough measures of the populations and economic activities they support. We can draw welfare-significant conclusions even without knowledge of underlying preferences. Even alone, EBIs intuitively convey economic principles and the dependence of human wellbeing on

natural assets. They can be expected to improve the understanding of decision-makers and stakeholders and thereby lead to better decisions.

Comparing Data

Spatial analysis can be an essential component to ecosystem service valuation because the production of biophysical functions and the social determinants of service benefits depend upon the landscape in context in which those functions and services arise. Boyd and Wainger (2003) provide an assessment of a set of ecological benefit indicators, with an emphasis on the need for easily implemented site evaluation techniques. Using GIS techniques to map the physical and social landscape can improve understanding of the ecosystem benefits arising from specific ecosystems.

A wetland mitigation bank used to compensate for wetland losses in Lee County, Florida, provides the case study to illustrate how GIS techniques can be used as an indicator approach, and therefore highlight the data used in such a study. The case study addresses the question; are the social benefits of the lost wetland impact sites adequately replaced by the wetland mitigation bank? Boyd and Wainger (2003) constructed 40 maps that can be used for ecosystem benefit indicators. Some maps were created directly from the original data and some were created by constructing new types of data from underlying data and performing calculations or basic spatial analysis. The maps are categorised by types into demographics, biophysical, land use and land cover, infrastructure, public sites and planning (Table 7).

Table 7. Map categories used to build ecosystem benefit indicators

DEMOGRAPHIC	Total Population	BIO-PHYSICAL	Watersheds	
	Population Density		Wetlands	
	Households		Floodplains	
	Children		Elevation	
	Income		Sea grass	
	Educational Attainment		Invasive Species	
	Race		Rare Species	
LAND USE AND LAND COVER	Crop & Pastureland		Wetland ability to de-nitrify	
	Livestock Operations		Wetland risk from Phosphorus	
	Developed Land Cover		Wetland risk from Nitrogen	
	Non-Ag Natural Land Cover		PUBLIC SITES	Recreational Areas
	Natural and Pasture			Schools
	Upland Forest			Culturally Important Sites
	Aquatic Preserves		PLANNING	Future Citrus Plantations
	Protected Land	Future developed land		
INFRASTRUCTURE	Major Roads	REAL ESTATE	Housing Units	
	Trails		Median Housing Value	
	Permitted Wells		Median Rent	
	Private Drinking Wells		Commercial Units	
	Density of Private Wells		Value of Commercial Units	

Maps created to display demographic patterns in the wetland case study are relatively simple to construct and UK data is comparable and widely available. In summary, data used by Boyd and Wainger (2003) to relate to the social value of biophysical processes (the endpoints) highlight the generic characteristic of the datasets. The data collated for this project is akin to Boyd and Wainger's (2003) work and can be analysed in a similar fashion. For the ecosystems approach, it shows that further analysis can be made using GIS techniques to derive more information for evaluating ecosystem services.

10. Recommendations and Further Work

Data Management

Through the identification of over 1000 relevant socio-economic datasets and the potential linkages to environmental data, it is clear there is a need for cataloguing and managing the information. The Data Inventory presented in this project goes some way to addressing this issue by capturing relevant information relating to the typology, the ownership, the access rights and the ecosystem services that it can be used to represent. This information represents the key facts required to simplistically assess whether or not a dataset may be of use for a particular need.

Should the metadata information for each data be complete, one potential avenue for storing a definitive, formalised catalogue would be to utilise a system such as SPIRE (Shared Spatial Information Services). As its name suggest, the system provides a portal to spatial data, including the associated metadata, allowing the user to make quick decisions about its use. Uploading the data collated in the Data Inventory to SPIRE and attributing it with the appropriate fields such as the ecosystem services it can be used to represent, or its data typology would allow open access to the datasets that can be used to represent a given good or service.

Biophysical Datasets

Since the aim of this project was to review the social and economic 'evidence' relevant to the natural environment in England, a decision was made to leave biophysical data to the domain of an environmental review and the social and economic data to the socio-economic review. This begs the question of which, if any, of the data reviews consider the socio-economic relevance associated with biophysical data?

This report makes some headway into discussing environmental data with socio-economic relevance, for example, the Environment Agency Flood Risk Maps. Reviewing all biophysical data to extract the socio-economic relevance is beyond the scope of this report. Indeed, a bridge may be needed that requires a specifically biophysical review to consider the socio-economic importance implicit to biophysical data.

Environmental and Socio-Economic Data Integration

The aim of this project was not to meet the needs of a case study, but rather to broadly assess the evidence base using the MA classifications as a guide to building the data inventory. Therefore, providing recommendations on data use, recommending sources of data and highlighting gaps in the data inventory become more problematic when the data inventory is applied to a specific case study. Future developments of the environmental and socio-economic evidence base for assessing the natural environment must consider the end goal throughout its development i.e. in conjunction with a case study project. While the data inventory for this project is large and widely applicable, it lacks the specific focus needed i.e. at a local scale or particular objective. It is beyond the scope of this project to develop an evidence base to be used for local studies as the sheer quantity of work is too vast, yet it is at the local scale where the ecosystems approach to sustainable development is most likely to be applied, thus it is here where the evidence base is best developed. Otherwise recommendations on the integration of socio-economic and environmental data become limited to general issues of spatial and temporal integration and the broad conceptual framework.

Stakeholder Involvement

A key outcome of this project was to highlight the low level of awareness of the ecosystems approach amongst socio-economic stakeholders. Accordingly, it is clear that *understanding* amongst socio-economic stakeholders needs to be addressed in order to improve buy-in to the ecosystems approach. The ecosystems approach must be made relevant to the existing policies and goals of socio-economic stakeholders, otherwise it runs the risk of being seen as an overly scientific and irrelevant method (Evans, 2006). This aspect of the work may have been underestimated because previous projects have dealt with natural environment organisations that understand the concepts and language of the ecosystems approach, rather than socio-economic stakeholders. If stakeholders understand ecosystem services then they will be able to appreciate the benefits of engaging with this kind of exercise.

Managing Lack of Stakeholder Involvement

Outlined below is a series of recommendations for stakeholder engagement, including strategic recommendations concerning the best way to engage diverse socio-economic stakeholders, and a set of actions that could be taken.

Generate Case Studies - Case studies would be a very effective means of demonstrating the potential and actual benefits of the ecosystems approach to various socio-economic stakeholders. It is at the local scale that the ecosystems approach to sustainable development is most likely to be applied, and it is at this level that socio-economic stakeholders can best be engaged.

Identification of key data custodians and organisations - The most efficient use of resource would be to identify a group of individuals within core organisations on whom to focus attention. This group could be identified

in a number of ways: by the number of datasets contributed to the database; in terms of the goals of a specific study; or on the basis of strategic political importance.

Identification of different classes of socio-economic stakeholders - Effective stakeholder engagement needs to be tailored to the needs of different groups of stakeholders. The level of explanation that may be suitable for Natural England will be vastly different to that which would be suitable to the Church Tourism Association. For example, comments from the JNCC show that they have already fully bought into the approach, whereas the ecosystems approach will be totally foreign to others. The identification of different classes of socio-economic stakeholders would improve the effectiveness of engagement.

Ultimately, increased participation of stakeholders and the wider public in the benefits of an ecosystems approach relies heavily upon educating people as to the importance the environment has on their lives. Developing simpler terminology, providing examples of the interrelationship between people and the environment and embedding a sense of responsibility towards the environment is a must to generate a more positive response from stakeholders and the wider public.

References to published material

9. This section should be used to record links (hypertext links where possible) or references to other published material generated by, or relating to this project.

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