Natural Heritage Reporting: Decision Workshop Results

1 Aims

The purpose of the decision workshop was to explore the use of a decision tree approach to prioritising possible indicators for Natural Heritage reporting. This approach used a hierarchical tree arrangement of possible resources, topics related to resources, issues related to topics and indicators that might address issues. A panel of stakeholders are asked to use their judgement to rank the possible options at each level in the tree. This potentially provides an audit trail for the selection of key indicators since the range of options is defined and the range of opinion is also defined. Semi–quantitative scales are used and the process is potentially repeatable with a different group of stakeholders or on another occasion. This type of decision making framework is increasingly being adopted in the public sector to provide transparency and repeatability, and to provide a framework that is flexible and capable of adaptation to changing circumstances. Willows & Connell (2003) provide an overview of some of the main approaches and software available.

Normally the decision tree to be used will have been devised and adjusted until fit for purpose. In the present case, because there was no time to create a customised tree, an existing decision tree used for identifying priority indicators for the Arctic was used to illustrate the technique and get participants responses to the approach.

2 Method

Participants were first asked to list their interests to help characterise the group, and indicate the extent to which particular sectors were under or over-represented.
All participants were then asked to rank the importance of social, economic and natural capital resources. They were then split into three groups to consider the lists of topics, issues and indicators related to the three types of resources. Each person was given a proforma listing the definitions of each of the alternatives they were being asked to rank and dealing in sequence with the subsets of alternatives to be ranked. For each subset they were instructed to identify the most important attribute and give it a score of 100, then rank the others against the best on a score of 0 (no importance to 100 (most important). In deciding on *importance* participants were asked to weigh up the likely effect of change over 20 years in the attributes being considered and to take into account both the likelihood and severity of any such change. Initially it was hoped to make separate scores for local, regional and national scale reporting but this was abandoned as too ambitious in the limited time available. Consequently scoring was only based on perceptions of national importance. The three decision trees are shown in Appendix 1, and the definitions of attributes are given in Appendix 2. After filling in the proformas the groups discussed their individual scores for each item, and could change their scores after discussion if they wished. In this way the variation in opinion both before and after discussion could be compared. A facilitator was with each group to iron out any problems. After the discussions the three groups came together again to compare present their conclusions. There were four or five participants in each group.
Scores for topics, issues were factored by the scores at previous levels in the tree to give weighted scores on a 0-100 scale that could be compared with any other attribute at the same level elsewhere in the tree (Figure 1).

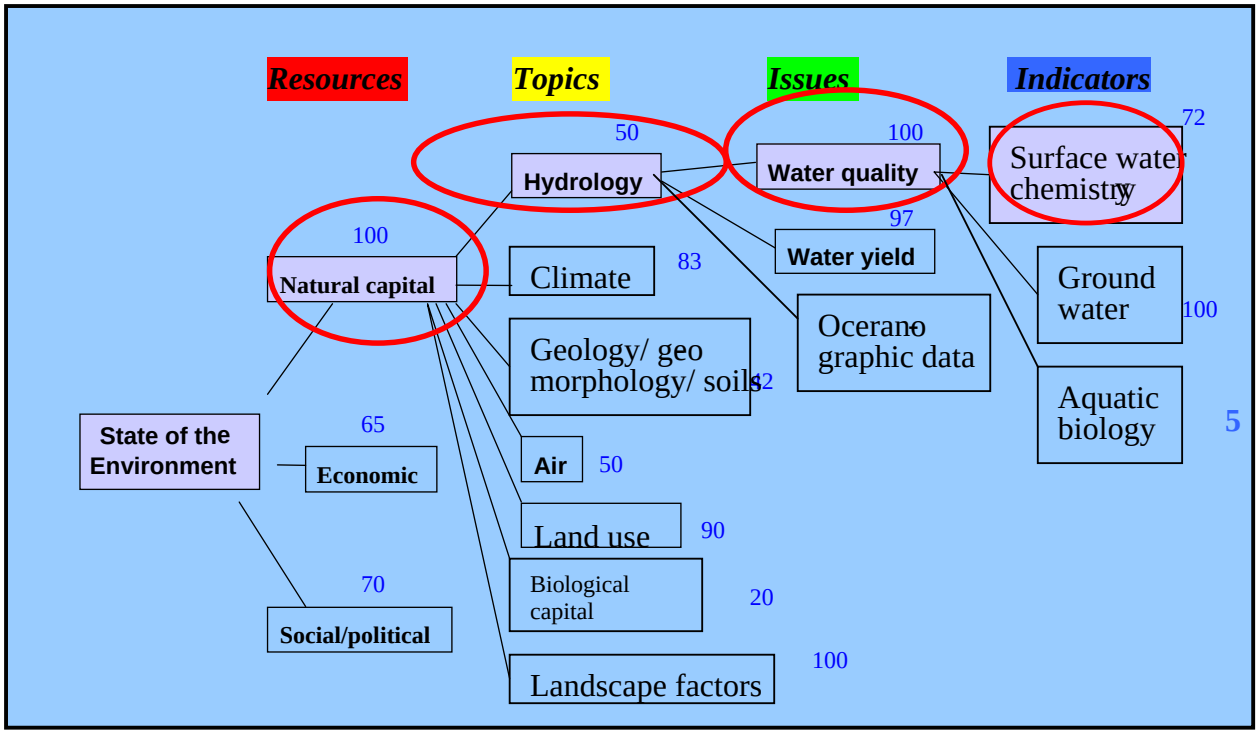


Figure 1. Example of scoring part of a decision tree. Weighted importance scores for surface chemistry taking account of scores at previous levels in the tree = indicator score x issue score/100 x topic score/100 x resource score/100 = 72 x 1.0 x 0.5 x 1.0 = 36

3 Results

3.1 Participants interests

The range of interests of the participants showed fairly good coverage of most resource sectors, although there was particularly good coverage of research, nature conservation and advice/consultancy (Table 1).

*Table 1. Sectoral interests of a sub-sample of 10 of the participants. * moderate interest, ** strong interest Each column represents one participant.*

Advice/consulting	*		**		**	**	**	*		**
Education	**			**	*	*	*		*	*
Farming				*	*	**	*		**	*
Fishing/Hunting			*		*			*	*	
Forestry				*	*				*	*
Land ownership						*	*			
Nature conservation	**	*		**	**	**	*	**	**	**
Planning					**		*		*	
Recreation		*	**	*	*		*	*		*
Research	*	**	*	**	*	**	**	**	*	*
Tourism		*					*	*		
Water resources			**	*	*	**		*		
Other			Policy			Landscape				

3.2 Importance of natural capital, social and economic resources

All participants ranked the importance of the three types of natural heritage resources (Table 2). There was quite close agreement that *natural capital* resources were the most importance in the context of natural heritage reporting, but *economic* and *social/political* resources also had quite high scores, Over all, economic resources were judged the least important.

Table 2. Mean importance values and standard deviations (n=13) for natural capital, social/political and economic resources

	Mean	S.D.
Economic resources	83	12
Social and political resources	86	22
Natural Capital resources	99	4

3.3 Importance of economic topics, issues and indicators

The economic panel gave high scores to relatively few attributes (Table 3). Highest scoring topics were *economic activity* and *gross income per capita.* Highest scoring issue was *productivity/turnover by sector* and highest indicators were *primary sector statistics,* and *planning applications. There was quite a wide range of scores for most attributes (S.D. ranged from 17-39)*

Table 3 Importance scores for economic topics, issues and indicators. Only attributes with scores of 50 or more are shown.

Topics	Mean	SD
Economic activity	75	17
Gross income	62	22
Public sector investment	52	30
Private sector investment	58	18
Issues		
Production/ turnover by sector	75	17
Income per capita	55	21
Agri-environment subsidies	52	30
Capital expenditure	56	17
Indicators		
Primary sector	63	39
Per capita income by sector	55	21
Impacts of agri-envoronment schemes	52	30
Planning applications	56	17

3.4 Importance scores for social/political topics, issues and indicators

The highest scoring topics were *population demography* and *land ownership* (Table 4)**.** Top issues were *land ownership patterns, population age structure* and *impacts on cultural heritage.* There were ten indicators with scores above 50, of which *cultural funding* and *land prices* were the highest. There was considerable variation in scoring between individuals for some attributes (SD ranged from 4-38)

Table 4. Importance scores for social/political topics, issues and indicators. Only attributes with scores of 50 or more are shown.

Topics	Mean	S.D.
Stakeholders	63	4
Planning / regulation	69	12
Land ownership	76	22
Demography	82	8
Cultural heritage	71	20
Issues		
Stakeholders views	63	8
Planning applications	64	26
Regulation of environmental quality	63	16
Landownership patterns	76	22
Rental sector	52	21
Population density	65	17
Age structure	75	22
Impacts on heritage	71	18
Impacts on local culture	56	36
Indicators		
Surveys of stakeholders views	63	8
Approved planning applications	64	26
Regulation exceedance data	63	16
Size of land holding	56	17
Land prices	69	21
Population spatial distribution	65	17
Population structure	53	27
Damage to cultural sites	54	26
Cultural funding	71	18
Cultural activity participation	53	38

3.5 Importance of natural capital topics, issues and indicators

The natural capital panel gave the highest importance scores to the topics *climate* and *biological capital*, followed by *land use* and *hydrology*. Highest scoring issues were *biodiversity inventories*, *status/condition of resources* and *climate change* (Table 5). The most important indicators were related to these key issues, for example with *temperature* and *precipitation* (with *windiness* having a much lower score) addressing climate change. *Plant communities* and *animal populations* related to biodiversity inventories, and *habitat condition*, and *key species status* related to resource condition. As with the other panels there was considerable variation in scoring between attributes (S.D. 4-38)

Table 5. Weighted importance scores for natural capital topics, issues and indicators. Only attributes with scores of 50 or more are shown.

Topics	Mean	SD
Climate	96	5
Hydrology	79	8
Geology/geomorphology/soils	52	17
Air	76	5
Land use	81	12
Biological capital	96	5
Issues		
Snow & ice	55	23
Climate	96	5
Oceanographic data	67	14
Water quality	71	12
Water yield	53	38
Gaseous components	72	8
Precipitation characteristics	58	27
Intensive use	58	31
Extensive use	76	5
Forests	65	10
Biodiversity inventories	94	6
Status/condition	89	11

Indicators	Mean	SD
Snow cover and duration	54	25
Temperature	94	6
Precipitation	84	10
Windiness	55	21
Radiation	71	32
Tempearature	63	11
Surface water chemistry	60	21
Ground water	52	18
Aquatic biology	71	12
Hydrographic data	52	40
Abstraction rates	53	38
Greenhouse gases	53	25
Noxious gases	70	7
pH	54	32
Chemistry	53	24
Agricultural areas	55	32
Pesticides and fertilizers	55	34
Stock levels	55	32
Rangeland areas	65	12
Abandoned areas	63	14
Conservation areas	76	5
Hunting and fishing areas	52	19
Single use forest	52	10
Multi use forest	65	10
Plant communities	93	7
Animal populations	91	9
Soils	56	32
Habitats	94	6
Key species status	88	12
Habitat condition	89	11

4 Discussion

The approach was judged by participants to useful but not sufficiently focused on natural heritage reporting needs. Most participants liked the concept of working in groups in a way that both identified individual responses and permitted a dialogue that could produce some kind of consensus. There was also some enthusiasm for considering the whole spectrum of natural capital, economic and social resources, even though this was clearly quite challenging.

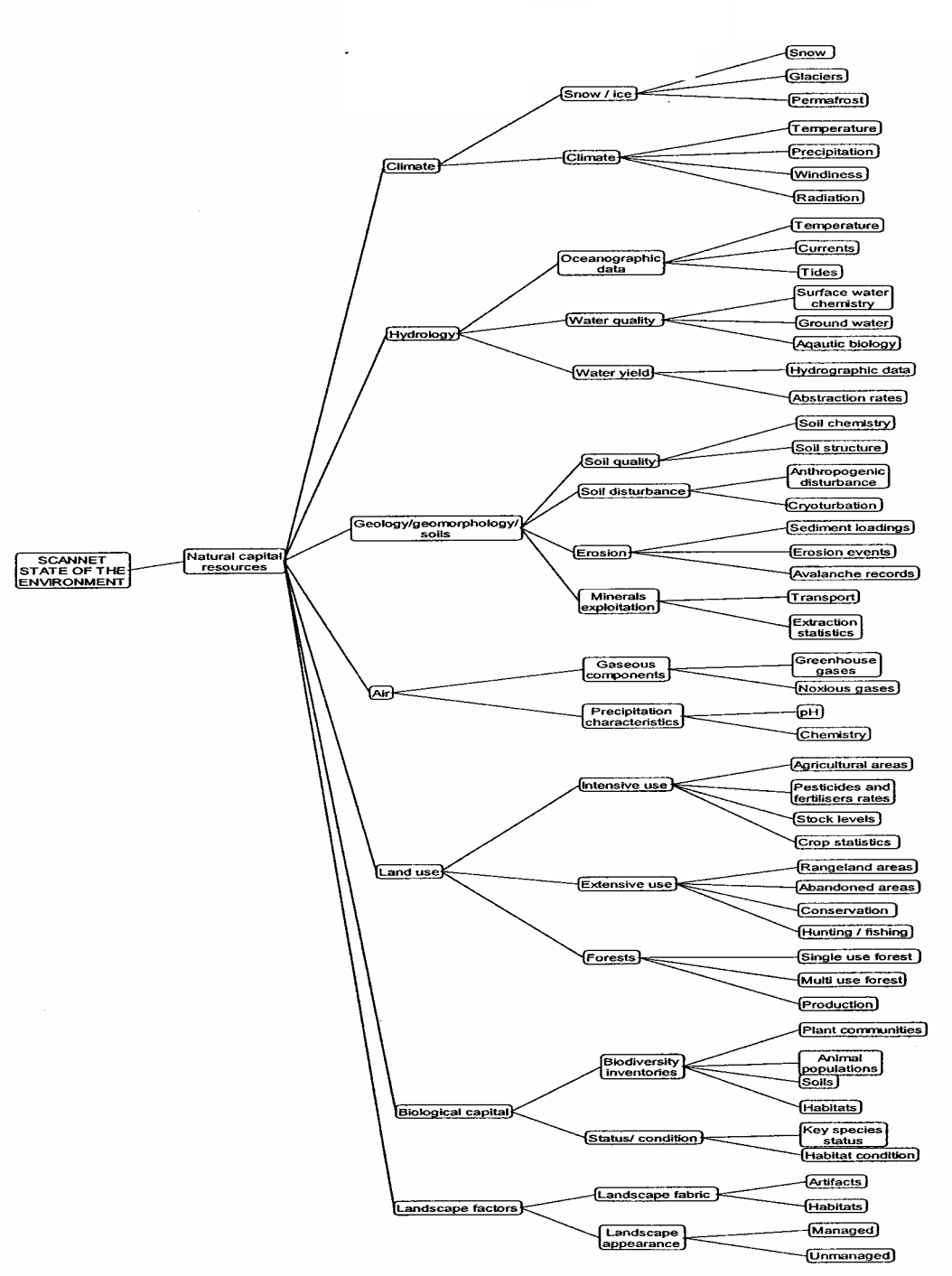
It was clear though, that the group sizes were too small and that substantially more time would be needed to complete such an exercise adequately. It would also be necessary to produce a decision framework that was more tailored for natural heritage reporting. This would require specific preliminary effort by SNH or by a stakeholder focus group. Such a group might need to consider incorporating risk assessments (likelihood and severity of possible changes), and considering how requirements might vary with the geographical scale of reporting and thematic foci of SNH.

5 Reference

Willows, R.I. & Connell, R.K. (2003). Climate adaptation: Risk, uncertainty and decision making. UKCIP Technical Report. UKCIP, Oxford.

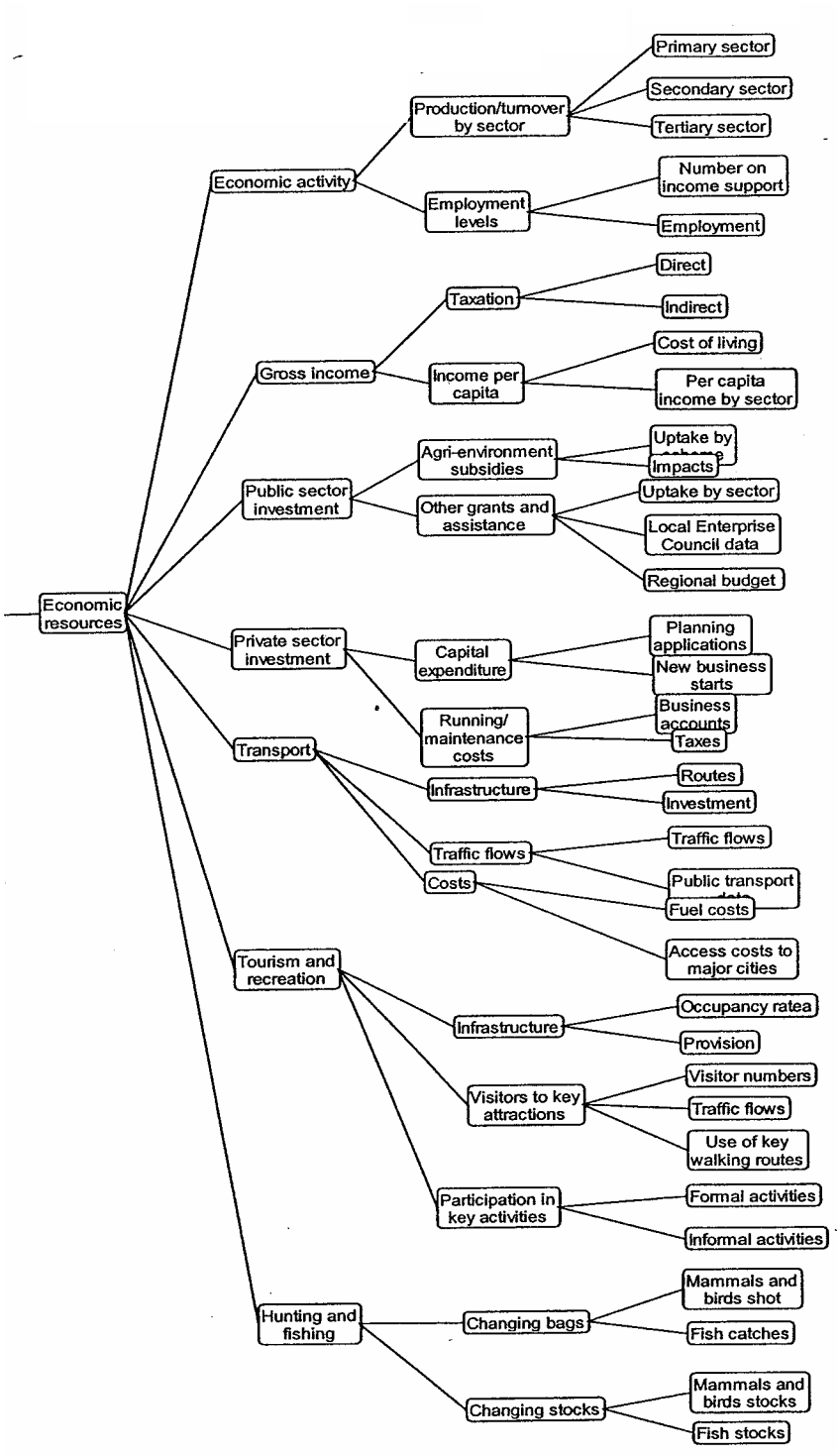
Appendix IA: Decision tree for the Workshop: Natural capital resources

RESOURCES TOPICS ISSUES INDICATORS



Appendix IB: ***Decision tree for the Workshop: Economic resources***

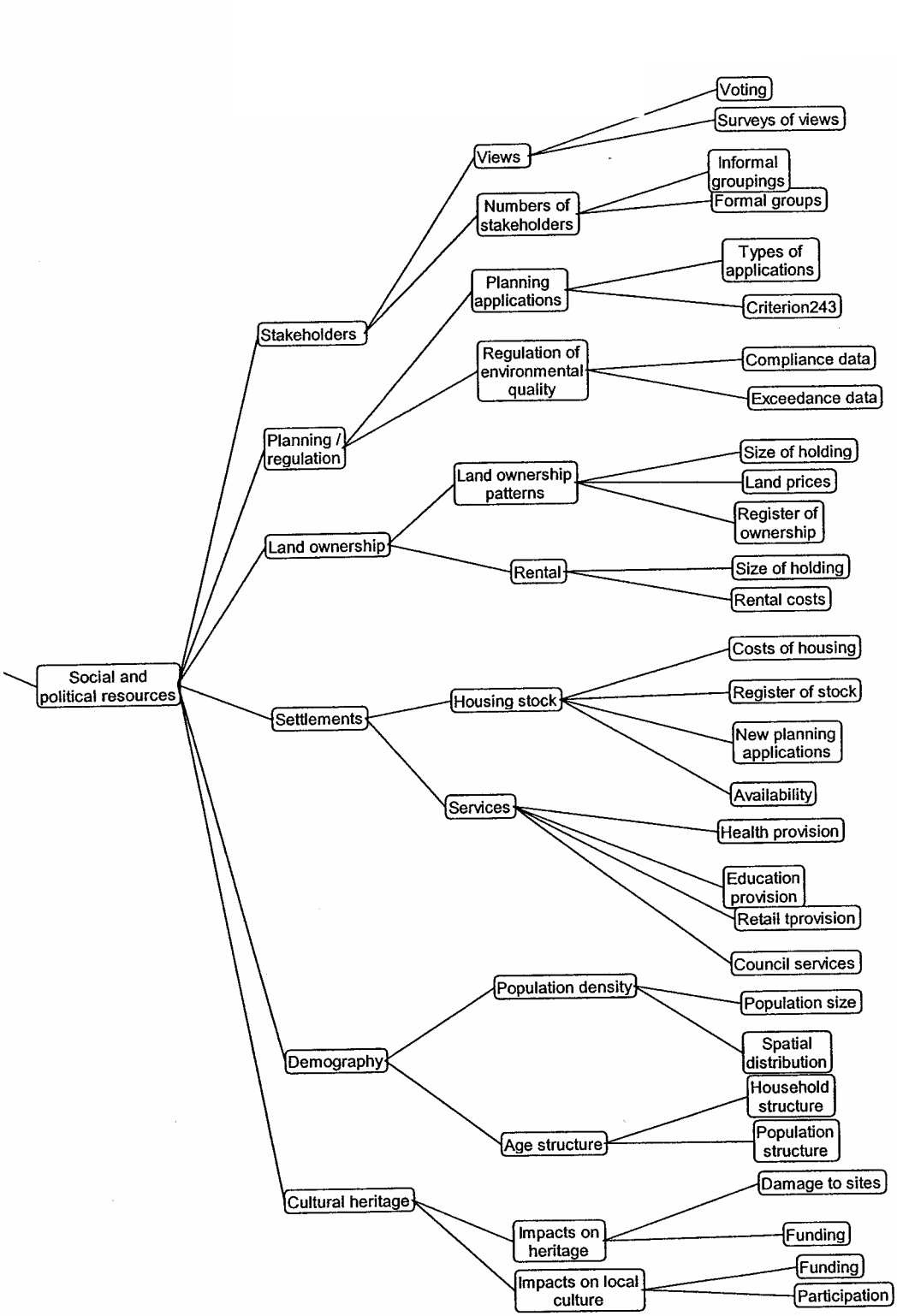
RESOURCES TOPICS ISSUES INDICATORS



Appendix IC

Decision tree for the Workshop: Social and political resources

RESOURCES TOPICS ISSUES INDICATORS



APPENDIX II

Parameter definitions

Resource Definitions

Natural Capital resources: Biological and physical aspects of the environment
Economic resources: The condition of a region, community or individual with regard to material prosperity
Social and political resources: The structure, welfare (health and housing) and beliefs and culture of communities, and the regulatory framework within they exist

Topic definitions

Natural capital

Climate: Meteorological characteristics
Hydrology: Covers water quality, yield abstraction and water chemical and biological quality (fresh and sea water)
Geology/geomorphology: Includes soils, underlying geology and sub-soil (or drift) geomorphological features , minerals and oil
Air: Air and precipitation quality (including polluting gases and acid rain)
Land use: Covers all types of land use, but mainly agriculture, forestry and non-intensive (extensive) use
Biological capital: Includes plant, animal and soil communities and species
Landscape factors: Covers both the physical structure (fabric) of the landscape and its appearance (views)

Economic

Economic activity: Production and turnover by economic sectors
(**primary**: related to harvesting of resources such as forests or fishing
secondary: processing and manufacturing,
tertiary: services)
Gross income: Taxation and per capita income by sector
Public sector investment: Local, regional or EU government subsidies and investment
Private sector investment: All non-government investment
Transport: Infrastructure, traffic flows of walkers, road vehicles, and public transport and costs
Tourism and recreation: Infrastructure and use of areas for tourist visits and participation in recreational activities
Hunting and fishing: Hunting birds and mammals, and fishing

Social/political

Stakeholders: Views and numbers of persons, organizations or groups with an interest in the area
Planning/ regulation: Planning and statutory regulation of developments and of environmental protection
Land ownership: The pattern of land ownership

Settlements: Housing, commercial infrastructure and social and local council services in the area
Demography: The structure of the population, age, sex, family units etc.
Cultural heritage: The intellectual and cultural status (ideas, beliefs, values and knowledge) of a community

Issue definitions

Natural capital

Snow/ ice: includes snow cover, depth and persistance,
Climate: Meteorological characteristics and the changes over time in key features such as temperature, wind speed and precipitation
Soil quality: Defined through chemistry and structure
Soil disturbance: Includes anthropogenic and natural disturbance
Erosion: Removal of soil or subsoil materials by wind, water, trampling or other means
Minerals exploitation: Includes oil and gas, sand and gravel, stone and ore extraction
Gaseous components: Means the air composition (including greenhouse and noxious gases)
Precipitation characteristics: Information about pH and major cations and anions in rain
Intensive (enclosed) use: Arable land and pasture (grazing and fodding)
Extensive use: Include rangeland areas, abandoned areas, areas for hunting and fishing and areas designated for landscape or nature conservation
Forests: Forests used for multiple use including commercial , recreational conservation, hunting and landscape uses
Biodiversity inventories: The variety and extent of biological organisms communities, populations and habitats
Status/ condition: quality or fitness of communities species or habitats (such as the extent to which a community has been damaged by grazing**)**
Landscape fabric: Distribution and proportions of structural elements of the landscape (woods, slopes, skylines, water, linear features, habitats, artifacts etc.)
Landscape appearance: views of the landscape from key observation points

Economic

Production/turnover by sector:
Primary, secondary and tertiary sectors
(**primary**: related to harvesting of resources such as forests,
secondary: processing and manufacturing,
tertiary: services)
Employment levels: Employment and unemployment statistics by sector including financial cost of creating a new job

Taxation: Direct and indirect taxation including national insurance and income tax, council tax, VAT…
Income per capita: Income per capita by economic sectors (gross and net income)
Agri-environment subsidies: Investment in agri-environment schemes to encourage prescribed types of management. Includes farm woodland schemes, ESA schemes etc.
Other grants and assistance: All other grants and assistance from local, regional, NGO (non- governmental organisation) or EU sources
Capital expenditure: it reflects the level of development activity taking place
Running/ maintenance costs: recurrent/continuing investment in business activities
Infrastructure: Includes number and type of routes as well as new investment in the route network
Traffic flows: Traffic types and flow rates (road, rail, air, water)
Costs: Fuel, fares and vehicles
Infrastructure (tourist): Provision and use statistics for tourist accomodation and facilites such as car parks, information centres, nature trails, toilets
Visitors to key attractions: Numbers going to paid or free tourist attractions
Participants in key activities: Numbers participating in recreational activities such as canoeing, skiing, walking, horse riding, paragliding
Changing bags: Changes in the numbers of birds, mammals and fish killed
Changing stocks: Stocks of game birds, mammals and fish

Social/political
Stakeholders views: Opinions and voting patterns of stakeholders
Numbers of stakeholders: The numbers of stakeholders in various interest groups
Planning applications: Types of applications (commercial, domestic, tourism, etc.) and those applications given planning permission
Regulation of environmental quality: Effectiveness of statutory controls on environmental quality
Land ownership patterns: The pattern and size of land holdings (which might influence management practices and land prices)
Rental sector: Pattern and size of properties and rental income
Housing stock: Types and proportions of different categories of housing including costs and availability of housing
Services: Provided services such as health care, schools, retail outlets, council services such as water, sewage, refuse collection, etc.
Population density: Distribution and density of populations (can be linked to provision of services, living costs etc. in remote areas)
Age structure: Population age and range (can be linked to provision of schools, services for elderly people)
Impacts on heritage: Effects of development and other pressures on ancient monuments, buildings, routes etc
Impacts on local culture: Effects of development and other pressures on local culture

Indicator definitions

Natural capital

Snow: Snow cover and persistence
Air temperature
Precipitation: Amount and frequency of rainfall
Windiness
Radiation: Solar radiation
Ocean temperature: Water temperature
Currents: Flows and direction
Tides: Tidal range
Surface water chemistry: Major cations, anions and pollutants in streams and rivers
Ground water: Ground water quality (chemistry, pollutants etc)
Aquatic biology: Vertebrate and invertebrate fauna of streams and rivers (indicators of biological quality
Hydrographic data: Flow rates
Abstraction rates: The rates and proportions of water abstracted for domestic, agricultural or industrial use
Soil chemistry: Major anions, cations and pollutants
Soil structure: Physical composition, compaction, aeration
Anthropogenic disturbance: Ploughing, vehicular and other forms of human impact
Cryoturbation: Frost and solifluction features both active and historic
Sediment loadings : Quantities of transported sediments
Erosion events: Numbers and severity of erosion events
Avalanche records: Numbers and severity of avalanches and mudslides
Transport movements: Numbers of vehicle movements
Mineral extraction statistics: Quantities of minerals extracted
Greenhouse gases: O_3, CO_2, CH_4 (methane)
Noxious gases: Ammonia, NO_x (oxides of nitrogen), SO_2 (sulphur dioxide)
pH: A number used to express degrees of acidity or alkalinity in solutions
Chemistry: Major anions and cations in rain
Agricultural areas: Areas of arable, grazing, meadows etc
Pesticides and fertilizer rates: Frequencies and types of fertilizer application
Stock levels: Numbers and types of grazing animals
Crop statistics: Types of crops
Rangeland areas: Condition and size of areas used for extensive grazing by domestic or wild stock
Abandoned areas: Condition and size of areas with no formal management regime
Conservation areas: Condition and size of areas managed for landscape or nature conservation
Hunting /fishing: Condition and size of areas managed for bird or mammal hunting or for rod fishing
Single use forest areas: Areas and types of forest used mainly or exclusively for timber production
Multi use forest areas: Areas of forests with recreation, hunting or other uses in addition to timber production
Timber production: Timber production by species

Plant communities: Cover and species composition of plant communities
Animal populations: Distribution and species of animals
Soils: Types and distribution of soils
Habitats: Numbers and distribution of habitats
Key species status: Status (favourable or otherwise) of key species (numbers or extent of key species of local, regional or EU importance such as rare raptors)
Habitat condition: The status (favourable or otherwise) of key habitats
Artifacts: Human constructions or facilities including walls, buildings, fields, pylons ditches, etc.
Habitat features: areas or proportions of woodland, grassland, wetlands, rivers etc.
Managed landscapes: Proportions of views featuring obvious signs of human management such as fields, plantation forests, domestic animals, buildings, roads etc
Unmanaged landscapes: Proportions of views with with a "natural" appearance and largely lack artifacts

Economic

Primary sector: Related to harvesting of resources such as forests
Secondary sector: Processing and manufacturing
Tertiary sector: Services
Number on income support: Numbers of persons receiving income support
Employment: Numbers employed by sector
Direct taxation: Such as national insurance, income tax, local taxes
Indirect taxation: VAT and any other indirect taxes
Cost of living: The amount of income or money needed to acquire a given quantity of goods and services or to achieve a given living standard
Per capita income by sector: Income per person (gross and net income)
Uptake by scheme: Numbers of participants in individual agri-environment schemes
Agri-environment scheme Impacts: Effects of the schemes on the environment (social, economic and environmental)
Planning applications: investment proposed by planning applications
New business starts: investment committed by new business starts
Development investment: expenditure on product or other business expansion
Running cost subsidies: investment to cover business losses
Routes network: System of transport routes
Transport Investment: Levels of investment on new or existing routes, vehicles, other infrastructure such as stations, bus stops, garages, etc.
Traffic flows: Traffic by vehicle type, route and region
Public transport data: Numbers of people transported by transport type (bus, train etc.), region and route
Fuel costs: Price of fuel etc**.**
Access costs to major cities: Cost of transport to centres of population
Tourism occupancy rate: Numbers and proportion of tourist beds occupied by location and time of year
Tourist bed provision: Numbers of tourist beds available

Visitor numbers: Numbers of visitors to key attractions (including car parks, visitor centres etc.)
Traffic flows: Tourist flows by type of vehicle
Use of key walking routes: Numbers of visitors using key walking routes
Formal activities: Numbers participating in organised activities for which there is usually a charge such as skiing, horse riding
Informal activities: Numbers participating in free activities such as walking
Mammals & birds shot : Numbers of animals killed (grouse, deer, etc.) by area
Fish catches: Numbers of fish caught by area or river
Mammals & birds stocks: Stocks of mammals or birds used for hunting by area
Fish stocks: Stocks of fish caught by area or river

Social/political
Voting statistics: Results of local, regional or national elections
Surveys of views: Results of surveys of views of stakeholder groups
Informal groupings: Numbers of stakeholders with a common interest in an issue
Formal groups: Numbers of stakeholders belonging to organised clubs, societies or action groups
Types of planning application: Types and numbers of applications that were submitted
Approved planning applications: Types and numbers of applications that were approved
Environmental regulation compliance data: Numbers and types of samples within statutory limits
Environmental regulation exceedance data: Numbers and types of samples within exceeding statutory limits
Size of property holding: Size and location of property
Land prices: Price of land in various categories (agricultural, forestry, building, commercial etc.)
Register of ownership: List of ownership of property
Size of holding: Numbers and sizes of land holdings
Rental costs: Costs of renting various types of property (agricultural, domestic, commercial etc)
Costs of housing: House prices by area
Register of stock: Lists of all housing by area
New planning applications: Numbers and types of applications for new housing (affordable, executive, second homes, etc.)
Health provision: Expenditure or other indicators of health provision such as hospital beds available by area
Education provision: Expenditure or other indicators of education provision such as distance to school or class sizes
Retail provision: Numbers of shops and other commercial outlets by area or location
Council services: Expenditure on other indicators of levels of service (refuse collection, water, sewage, lighting etc.) provided by local councils
Population size: population size by region
Spatial distribution: density of population by area and locality

Household structure: Composition of households by sex age and number
Population structure: Population structure by age class and area
Damage to heritage sites: numbers and severity of damaged sites
Heritage funding: expenditure on heritage by area and type
Culture funding: expenditure by area and type
Culture participation: numbers participating in cultural activities