The EAWG

- Promote and coordinate working partnerships
  - across the 8 themes
  - with other organisations/institutions
- Facilitate exchange of knowledge and data
- Raise awareness of EST, Ecosystem Services and the Ecosystem Approach
- Explore and develop new concepts

The EAWG

- 2/3 workshops a year
  - Topics aligned with Ecosystem Services Theme research programme
  - Based on joint discussion papers/presentations
- Attendance tailored to topics
- Spin off collaborations/projects
- Outputs

  Feedback reports, review papers, policy briefs etc

EAWG4: Why are we here today?

- Identified need to identify and build a tool-box of drivers that can be used to build scenarios for decision-making at different scales in Scotland
- Decision-making is very complex, interlinked and full of uncertainties. Therefore …….
- In order to reduce the risk of unforeseen consequences and future proof our decision making **important to look across policy areas and drivers**

EAWG 4: Managing change: the role of scenarios in decision making

The James Hutton Institute

Objectives

- Explore how scenarios can be used to aid decision-making for planning
- Explore and identify key drivers of change that different policy makers have to consider for strategic planning
- Explore and identify key common and specific drivers across different policy sectors
- Foster collaboration and KE between researchers, agencies and policy makers
- Look at the possibility of setting up an informal EAWG sub-gr (scenarios)

EAWG

EAWG 4: Managing change: the role of scenarios

	Agenda
10:00	Sign in
10:25	Welcome and Introduction
10:50	Presentation: role of scenarios; seeking synergies
11:05	Case-studies; scenarios as decision making tools
11:35	Feedback from questionnaire; exploring diversity
12:00	Lunch
12:30	A1: Exploring diversity of drivers
13:45	Coffee
14:00	A2: Identifying common and specific drivers and interactions
15:25	Next steps
15:50	Wrap up and evaluation

Housekeeping and working together

- EAWG team
- Photos
- Toilets & fire exits
- Scribing & anonymity

EAWG 4: Introductions

The James Hutton Institute

Please tell us your

- Name
- Organisation
- What you hope to get out of today's meeting

EAWG

EAWG 4: Managing change: the role of scenarios

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12:30	A1: Exploring diversity of drivers
13:45	Coffee
14:00	A2: Identifying common and specific drivers and interactions
15:25	Next steps
15:50	Wrap up and evaluation

A1: Exploring drivers in different policy areas

1) Examine objective and write any issues/ problems (5 mins)

2) Write down 5 most important drivers that have an impact on your objective. Use the list to help you or choose your own (10 mins). Write the drivers in the appropriate category.

3) Discuss the anticipated tre…core the trend (↑,↓,→) (5 mins)

A review of drivers and the scales of operation are essential to understanding the influencing mechanisms or ecosystem change.

4) Discuss the level of uncertainty associated with the trend. Score the uncertainty (Low, Medium, High) (5 mins)

5) Record the scale at which the driver operates at (5 mins)

6) In the comments box (or clearly labelled POST-IT) write any comments on t…ds, uncertainties and scales (10 mins)

55 mins

7) …there any interactions/relationships the drivers? (5 mins)

8) Write any interactions down, with comments on a clearly labelled…

use the driver codes S1/EC1) (10 mins)

Table A1 (x 5 policy areas)

Policy Area: SUSTAINABLE WATER MANAGEMENT **Facilitator:** RACHEL

Key Objective: **Team:**

Policy or Strategy relevant too:

Issues that need to be considered

Main drivers that will change the future	Trends/trajectory ↑, ↓, →	Level of uncertainty? High, Medium, Low	Scale (Global, National, Regional, Catchment, Local)	Comments? (thresholds, trends etc.)
Social				
S1				
S2				
S3				
Technological				
T1				
T2				
T3				
Environmental				
EN1				
EN2				
EN3				
Economic				
EC1				
EC2				
EC3				
Political				
P1				
P2				
P3				

5

A1: Policy objectives

Groups	Policy Area	Objective
1. Marc	Sustainable Food Production	Maintain food production while minimising impacts on ecosystem (reduce dependency on inorganics)
2. Justin	Halting Biodiversity Loss	Create a mosaic of linked and varied habitats forming more stable habitat units
3. Mike	Low Carbon Economy	To reduce GHG emissions in Scotland
4. Kirsty	Communities better Connected to the Land	Urban and rural communities better connected to the land, with more people enjoying the land and positively influencing land use.
5. Rachel	Sustainable Water Management	Protect and improve water environment

A1:Examples of drivers (or factors that cause ecosystem change)

Direct drivers (national, regional, local)

- Changes in land-use and land cover (modifications of river flow, extraction, land conversion)
- Species introductions and invasions
- Discharge of pollutants and over-use of fertilisers
- Climate variability and change

Megatrends (indirect drivers) – alter the rate or level of change in di

- Economic (globalisation, markets)
- Social (population growth
- Political (governance and regulation)
- Environmental (pollution loads

Which driver a decision maker can influence will depend at which scale they operate at. For example, a farmer decides how much fertiliser to use (DD) while a finance minister may influence global prices of commodities (ID)

A1:Examples of interactions

Water quality

Increase in rainfall (Driver EN1) +

Increase in air pollution (Driver EN2)

= Compounding negative impact on water quality

Population trends

Increasing reproductive age (Driver S1) +

Increase in diffuse pollution (EDCs)

= negative impact on human fertility

A1: Group Feedback

- Which are the 5 most important drivers?
- Which driver list did you find useful and why ?
- Which drivers are missing from the lists but are important for your specific objective?
- What are the main interactions/relationships between your drivers?

A2: Identifying common and specific drivers

1. Examine the 25 drivers and note any drivers that are the same as the yours. *Mark the same drivers with a . Number the dots to identify pairs of same drivers (10 mins)*

2. Any there any drivers that are similar to your drivers? *Mark these similar drivers with a . Number the dots to identify pairs of similar drivers.* How are the drivers similar? *(10 mins)*

3. Are there any other drivers which are relevant to your objective . *Tick the relevant box (10 mins)*

4. Are there any interactions/relationships between your drivers and the other drivers? *Use a pen to link up any interacting drivers. Write down a description of the interaction and any associated comments on a POST-IT. Write down the driver codes and your initials on the POST IT (15 mins)*

45 mins

A2:Table

Policy Area:	Integrated Land Use		Facilitator: Rachel
Page 6 (LUS)	An integrated approach to land management which enhances our capability to derive wider benefits from the land whilst also ensuring that fundamental resources are cared for and continue to provide for current and future generations		
Policy or Strategy relevant too: Land Use Strategy			
Objective	Top 5 Drivers	Sustainable Water Management	Comments
	SFP1		
	SFP2		
	SFP3		
	SFP4		
	SFP5		
	HBL1		
	HBL2		
	HBL3		
	HBL4		
	HBL5		
	LC1		
	LC2		
	LC3		
	LC4		Similar to SWM3
	LC5		
	CCL1		
	CCL2		
	CCL3		
	CCL4		
	CCL5		
	SWM1	x	
	SWM2	x	
	SWM3	x	
5	SWM4	x	
	SWM5	x	

EAWG 4: Managing change: the role of scenarios in decision making

The James Hutton Institute

Objectives

- Explore how scenarios can be used to aid decision-making for planning
- Explore and identify key drivers of change that different policy makers have to consider for strategic planning
- Explore and identify key common and specific drivers across different policy sectors
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- Look at the possibility of setting up an informal EAWG sub-gr (scenarios)

EAWG

EAWG 4: Next steps

Workshop report

- Flip chart notes and activity tables will be scribed
- The workshop will be written up and a draft circulated for comment (end of April).
  - A closer analysis of the drivers (interactions, gaps, scale etc.) for policy, research and application
  - An assessment of the approach used in the workshop to see how useful it is in evaluating the relevance of current scenarios/drivers for Scottish policy, research and decision making on the ground.
  - If a common approach to scenarios is desirable/necessary and how it could be realised?
  - Recommendations for future working

The EAWG

The Facilitation Team

- Antonia Eastwood antonia.eastwood@hutton.ac.uk
- Carol Kyle carol.kyle@hutton.ac.uk
- Kirsty Holstead kirsty.holstead@hutton.ac.uk

The Ecosystem Services Management Team

ecosystemservices@hutton.ac.uk

We are online

- How to contact us
- Info on meetings
- Download reports
- Latest news

www.hutton.ac.uk/eawg

EAWG4:
Managing Change: the role of scenarios in decision making.

(seeking synergies across research, policy and application)

Justin Irvine

The James Hutton Institute

Ecosystem Approach: Policy relevance

The James Hutton Institute

The EA* = broad objective across a range of policies: Climate Change; National Planning Framework; Scottish Biodiversity Strategy ; the Land Use Strategy.

- LUS Proposal 8 "Demonstrate how the ecosystem approach could be taken into account in relevant decisions made by public bodies to deliver wider benefits, and provide practical guidance.
- LUS Proposal 10 "Investigate the relationship between land management changes and ecosystem processes to identify adaptation priorities"

* = CBD, 2004

Applying the Ecosystem Approach:

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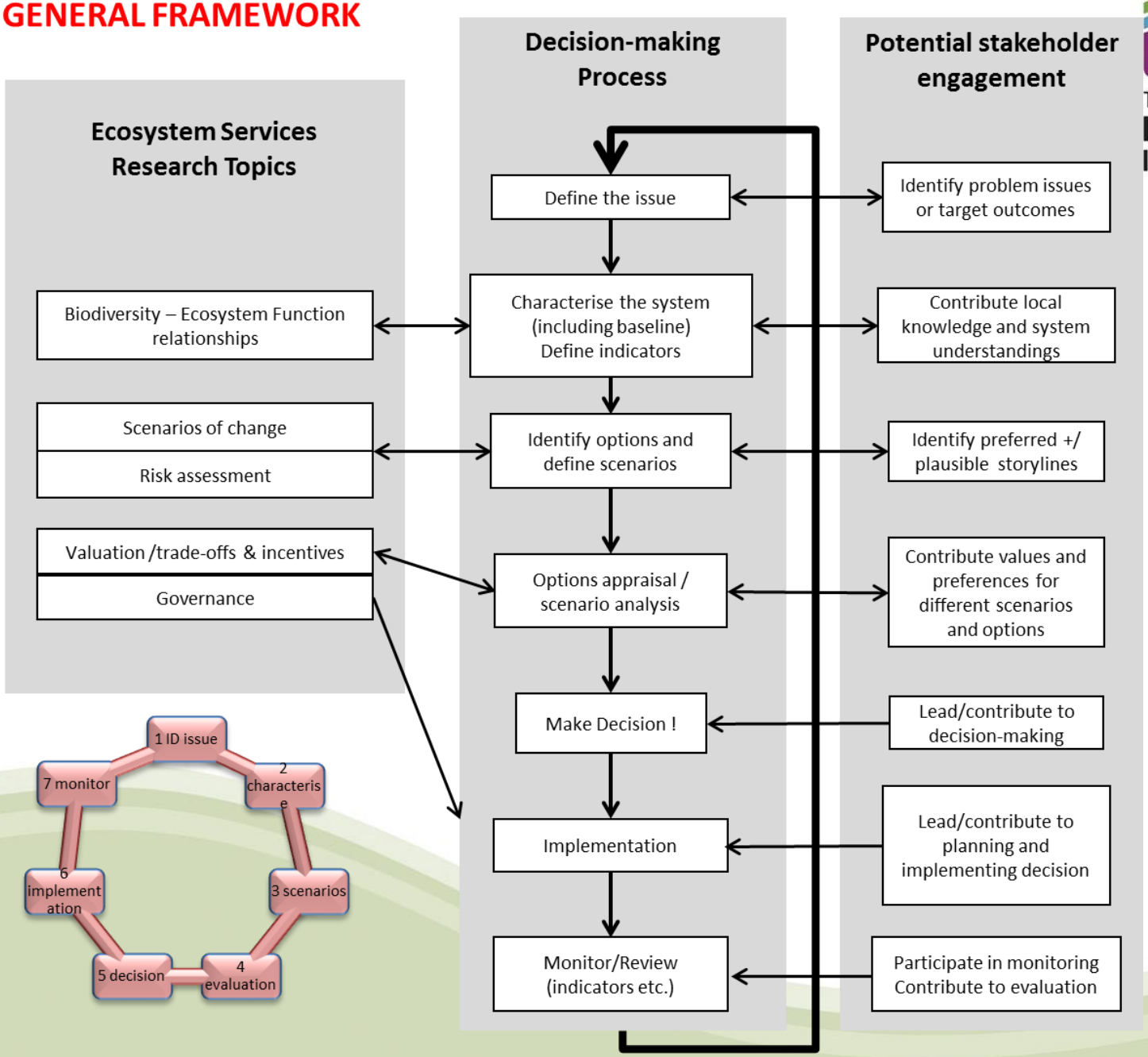
We developed an EA framework to aid decision making in relation to:

- understanding of the effects of environmental asset degradation on ecosystem service provision.
- understanding of the adaptive capacity of environmental assets to deliver final ecosystem services under a range of pressures and **drivers of change** (including changes to land use and farming systems).

We are investigating the utility of applying the Ecosystem Approach in practice to specific case studies, at a range of spatial scales

GENERAL FRAMEWORK



Scenario identification and evaluation form an important part of an ecosystem approach to decision making.

- Scenarios are a technique for medium to long-term strategic planning.
- They provide a picture of future alternative states of the environment based on a range **of indirect and direct drivers** and can therefore be used to test a range of plans and policies – '*will they be effective in foreseeable futures*?'

We need to develop land use/climate change scenarios for use in our EA framework

- To bridge between current state of ecosystem services and the management responses that might be appropriate for a range of plausible futures

This requires consideration of the range of plausible projections for the main **indirect and direct drivers of change**

- Scenarios therefore help link the drivers to ES service outputs in a transparent way

Aim: to develop consensus on using scenarios as part of an EA to delivering the policy goals in Scotland's Land Use Strategy

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This Workshop is part of a process:

How an EA can be used to help make more sustainable decisions over land-use to ensure that the ecosystem services people rely on are resilient to drivers of change?

- Scenarios are a tool for exploring the consequences of future worlds for ES delivery.
- Compare scenarios to explore how the ES delivered vary under different scenarios = the trade-offs. Next steps would be to value these in order to establish how the different scenarios affect the wellbeing of people who rely on these services.

Using Scenarios in decision making

The James Hutton Institute

UKNEA scenarios framework was well conceived and appropriate but need *validating against Scottish policy context*

Need to agree on “focal questions” or a common purpose for scenarios research across the Research Community in order to integrate effort and engage meaningfully with practitioners

- How would woodland expansion as a tool for achieving low carbon economy goals (Climate change policy area) affect the delivery of other LUS goals (water management, biodiversity enhancement, recreation opportunities and food security)? Or,
- How would achieving good ecological status of freshwater systems to comply with WFD policy goals affect other LUS goals (low carbon economy, biodiversity enhancement, recreation opportunities and food security)

Today we want to identify a common set of drivers that will affect how land can deliver a range of ecosystem services

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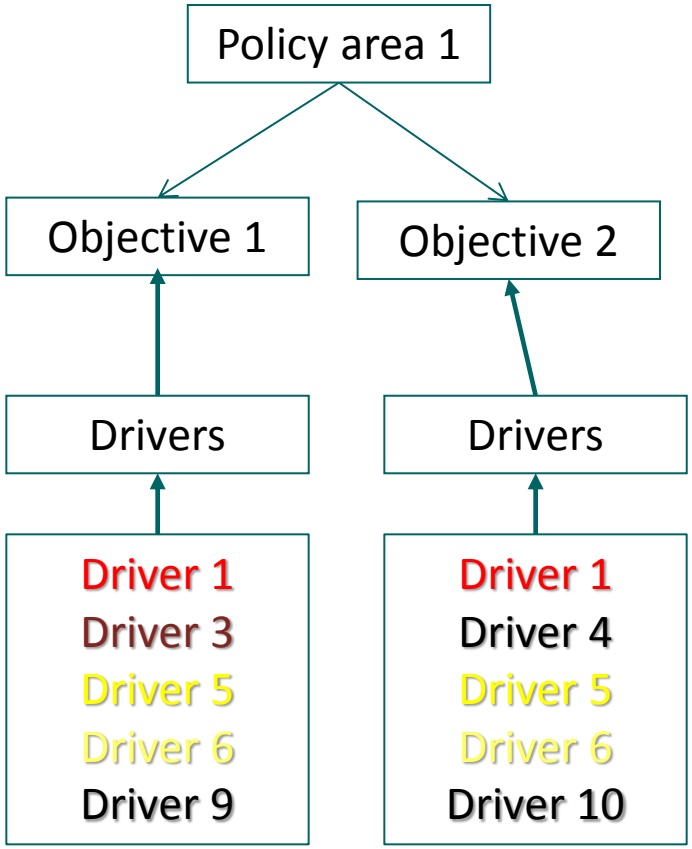
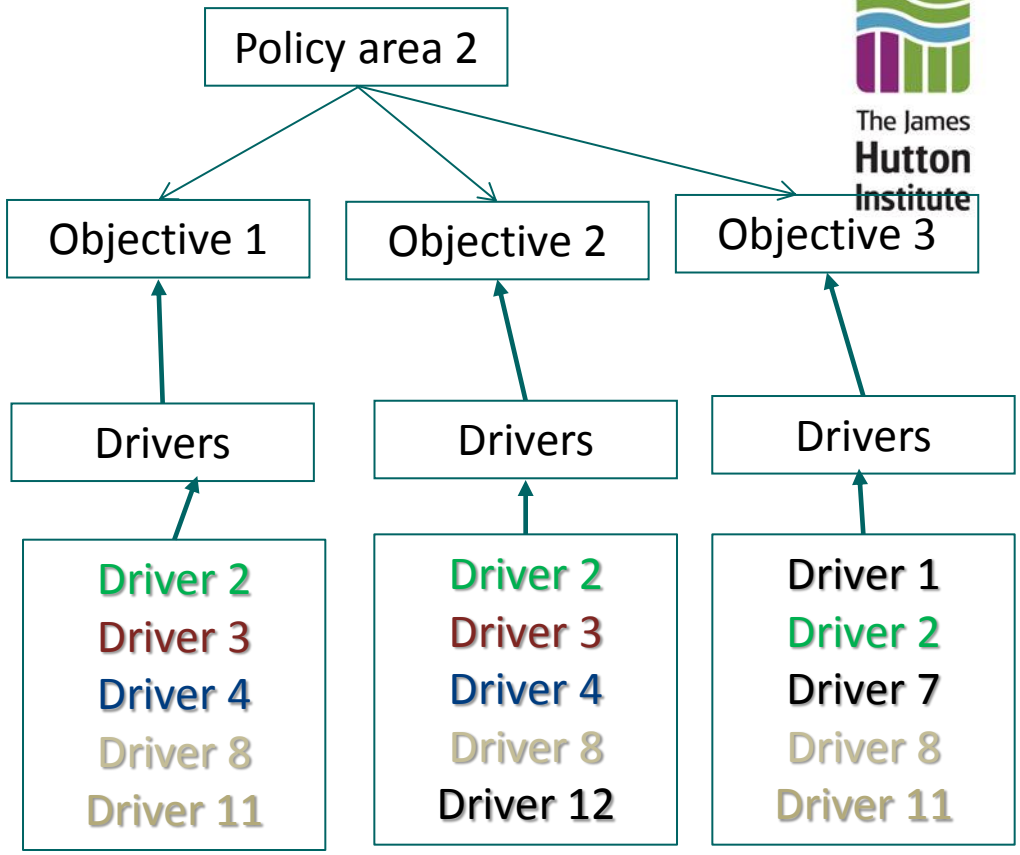
- foster interaction between policy sectors to explore interaction between drivers of change and how they might affect policy delivery
- collate the range of policy objectives and issues that each policy area is trying to deal with
- identify some of the targets that the policies are trying to achieve.
- identify the drivers of change that are relevant to or impact upon your policy area.





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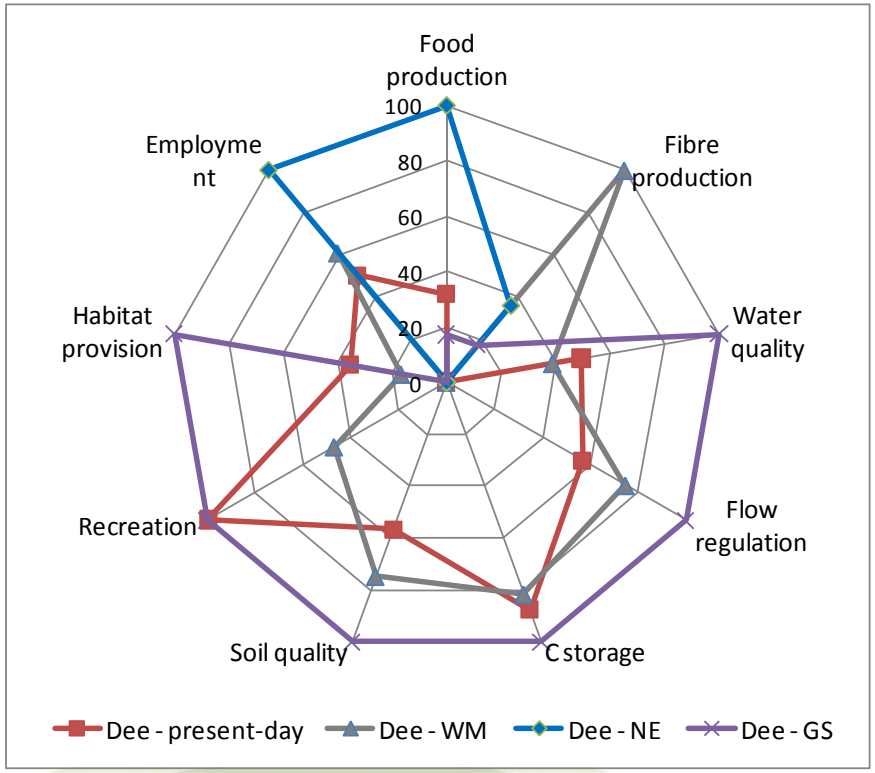
- A policy are has multiple objectives
- Each objective is affected by different drivers.
- Some of these drivers are common to different objectives (shown in same colour) and may therefore cause conflict or synergy if the driver is dealt with in a particular direction

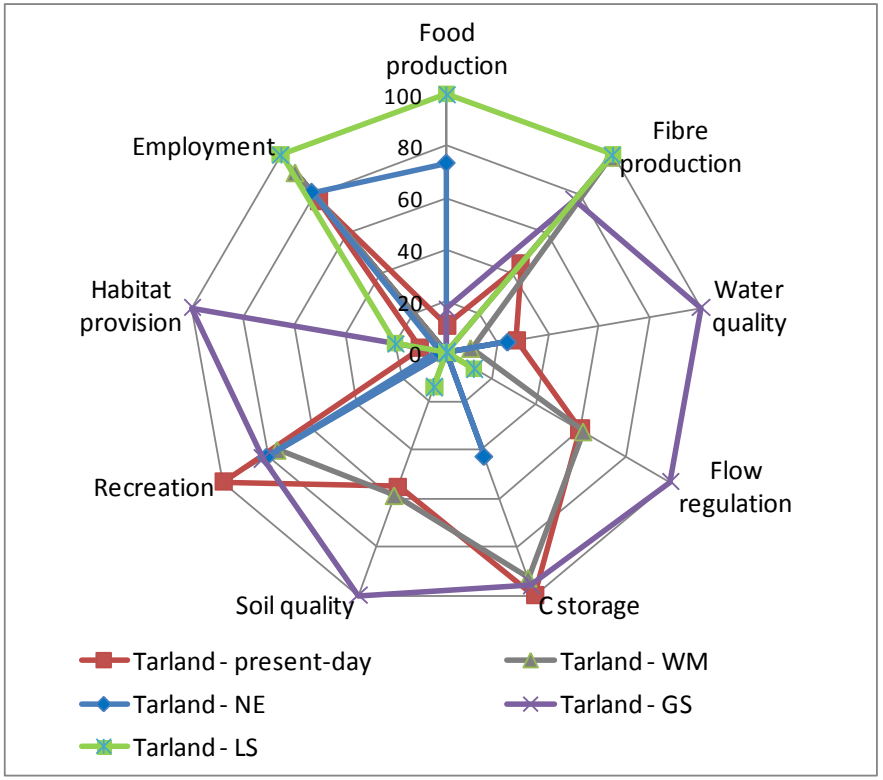
Once the drivers are established we can *identify issues that relate to the idea that achieving one goal can have repercussions in other policy areas*.

Need to agree on "focal questions" or a common purpose for scenarios research across the Research Community in order to integrate effort and engage meaningfully with practitioners

- How would woodland expansion as a tool for achieving low carbon economy goals (Climate change policy area) affect the delivery of other LUS goals (water management, biodiversity enhancement, recreation opportunities and food security)? Or,
- How would achieving good ecological status of freshwater systems to comply with WFD policy goals affect other LUS goals (low carbon economy, biodiversity enhancement, recreation opportunities and food security)

Trade-offs among policy objectives





JHI: EA for Decision making

Drivers

Climate Change (e.g. SRES)

Policies (Land Use Strategy goals)

Land Managers

2a. Develop scenarios of in response to drivers

3. Explore how policy affect decision making

Land cover, technology, preferences, etc

2b. Explore Land configuration under different scenarios

Land Use Configuration

Carbon storage

Drinking water

Food

Recreation and culture

2c. Explore ES trade-offs for different scenarios

Ecosystem Services

1. Characterise the system

OPERAs Ecosystem Services Scenarios Toolbox

- OPERAs – a 12 million Euro 5 year EU project coordinated by Edinburgh University
- Operationalising ES concepts for policy and practice
- Testing in Scotland (in collaboration with CEH, JHI, FR)
- One deliverable: an ES Scenario Toolbox :
  - Versatile and user friendly
  - Aid decision-making
  - Draw on existing scenario studies (e.g., UK NEA)

Using an Ecosystem Approach to Manage Change (Present & Future)

Iain Brown (JHI)

The Challenge

- Change is happening now
- Some change is beyond our control ('drivers' of change)
- Responses in one 'sector' can affect another ('trade-offs')
- Natural and human systems are complex (often increasing …)
- Need for a common approach
  - systems-based
  - understand risks AND opportunities
  - robustness and resilience

EVIDENCE BASE

- Current trends in Ecosystem Services

- Change is happening
- Likely to further accelerate in future
  - Socio-economic
  - Pests & Diseases
  - Climate change
  - Etc.
- Some of this is unpredictable

Source: NEA Phase 1

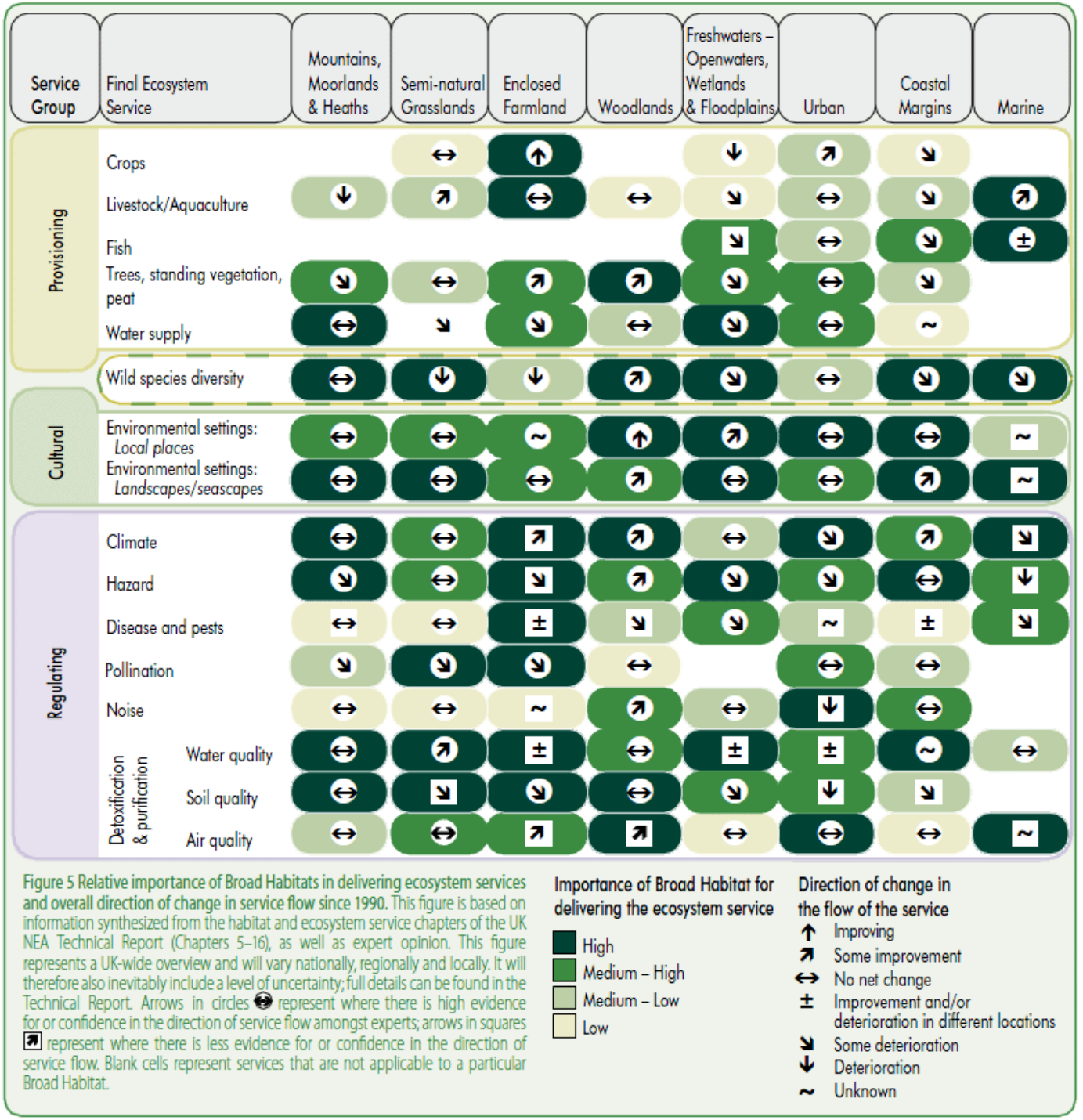


Figure 5 Relative importance of Broad Habitats in delivering ecosystem services and overall direction of change in service flow since 1990. This figure is based on information synthesized from the habitat and ecosystem service chapters of the UK NEA Technical Report (Chapters 5–16), as well as expert opinion. This figure represents a UK-wide overview and will vary nationally, regionally and locally. It will therefore also inevitably include a level of uncertainty; full details can be found in the Technical Report. Arrows in circles represent where there is high evidence for or confidence in the direction of service flow amongst experts; arrows in squares represent where there is less evidence for or confidence in the direction of service flow. Blank cells represent services that are not applicable to a particular Broad Habitat.

Principles of the Ecosystem Approach

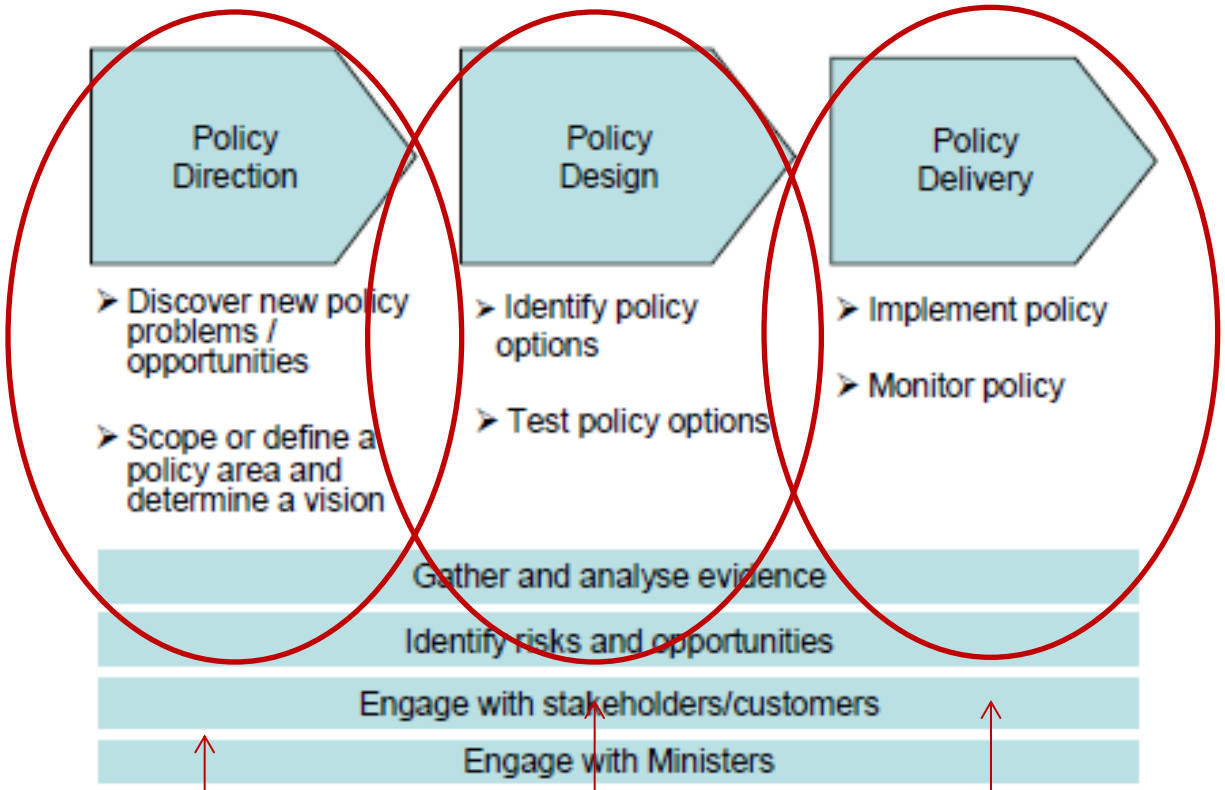
Conference of Parties to the Convention on Biological Diversity, 2004

1	The objectives of management of land, water and living resources are a matter of societal choice
2	Management should be decentralized to the lowest appropriate level
3	Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems
4	Recognizing potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem-management programme should: a) Reduce those market distortions that adversely affect biological diversity; b) Align incentives to promote biodiversity conservation and sustainable use; c) Internalize costs and benefits in the given ecosystem to the extent feasible.
5	Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach
6	Ecosystems must be managed within the limits of their functioning.
7	The ecosystem approach should be undertaken at the appropriate spatial and temporal scales
8	Recognizing the varying temporal scales and lag-effects that characterize ecosystem processes, objectives for ecosystem management should be set for the long term
9	Management must recognize that change is inevitable
10	The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity
11	The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices
12	The ecosystem approach should involve all relevant sectors of society and scientific disciplines

Example Policies requiring 'Future-proofing'

- Planting new or replacement woodland consistent with the principles of 'the right trees in the right place' ***(Woodland Expansion Strategy)***
- Planning new infrastructure, including new sites for renewable energy or Green Infrastructure ***(National Planning Framework; Renewables Routemap***)
- Water resources – identifying key risks to meeting water quality objectives ***(Water Framework Directive SWMI etc.)***
- Water resources – balancing changing supply and demand to maintain a healthy resource base ***(Water Framework Directive)***
- Developing appropriate measures to protect against pests, diseases and invasive species ***(Wildlife & Natural Environment Act)***
- Flood defence – designing schemes to deliver minimum standards of service (***Flood Management Act)***
- Planning ecological networks ***(Biodiversity Strategy)***
- Developing realistic conservation objectives for priority species/ habitats ***(Biodiversity Strategy)***
- Identifying the best transition pathways to deliver greenhouse gas emissions reductions and a low carbon economy ***(Climate Change Act)***

Future-proofing: Link with the Policy Process

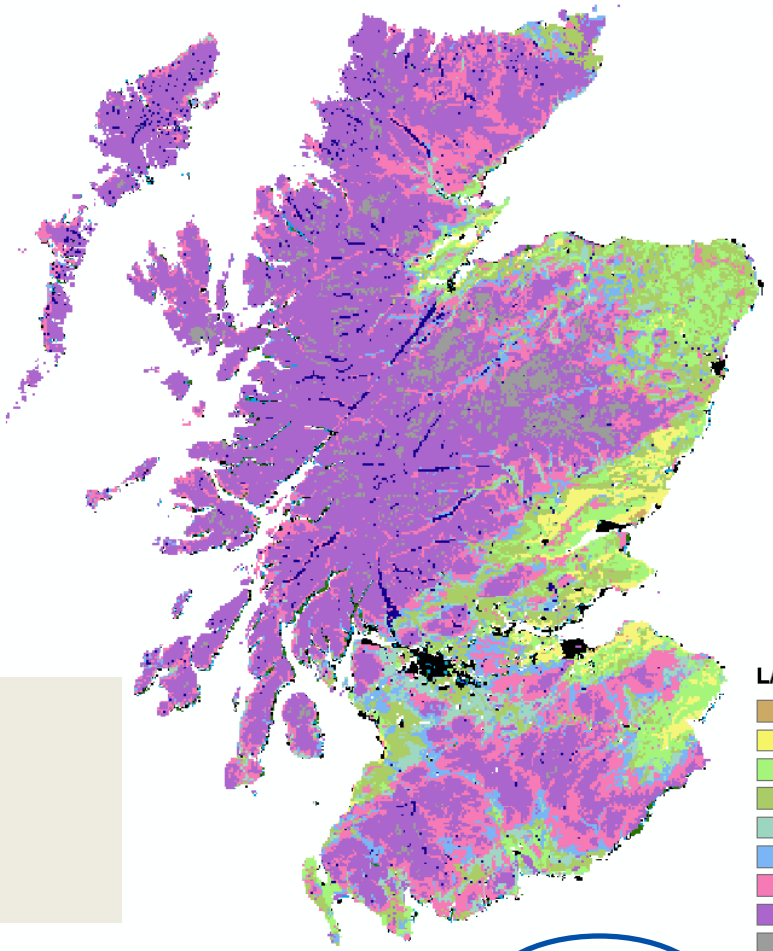


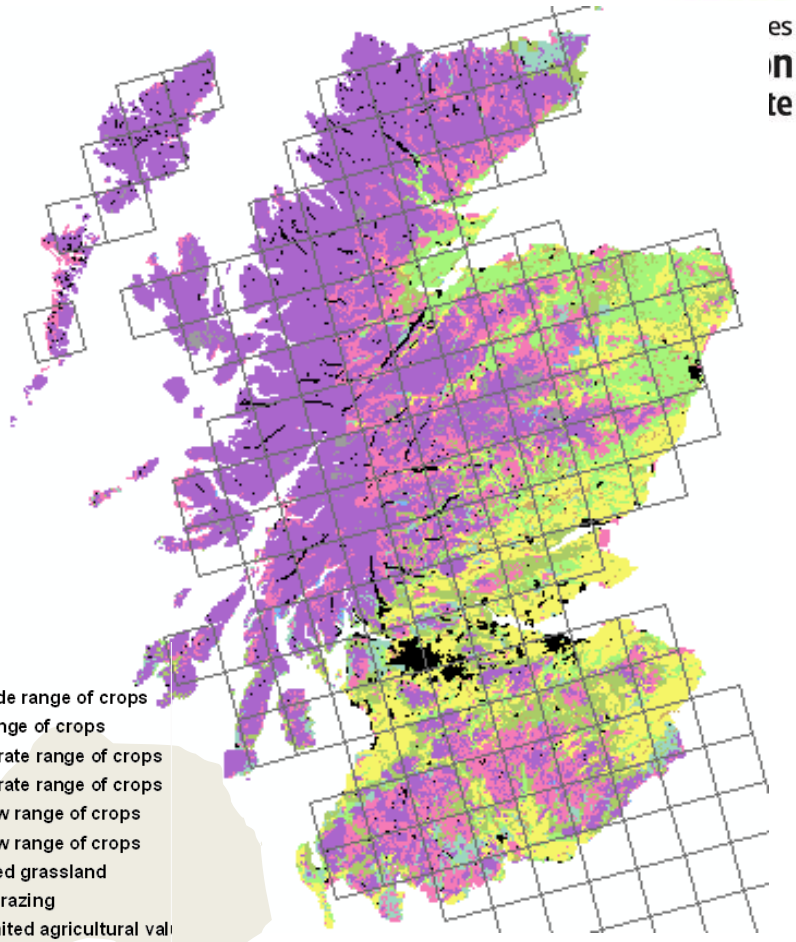
Scenarios and other tools can help here

Options Appraisal

'Ex-post' analysis Monitoring & Evaluation

Climate Change as a Driver - Land Capability





LAND CAPABILITY
- Class 1 - very wide range of crops
- Class 2 - wide range of crops
- Class 3.1 - moderate range of crops
- Class 3.2 - moderate range of crops
- Class 4.1 - narrow range of crops
- Class 4.2 - narrow range of crops
- Class 5 - improved grassland
- Class 6 - rough grazing
- Class 7 - very limited agricultural val

Published version [1982]

2050s projection [UKCP09 q3]

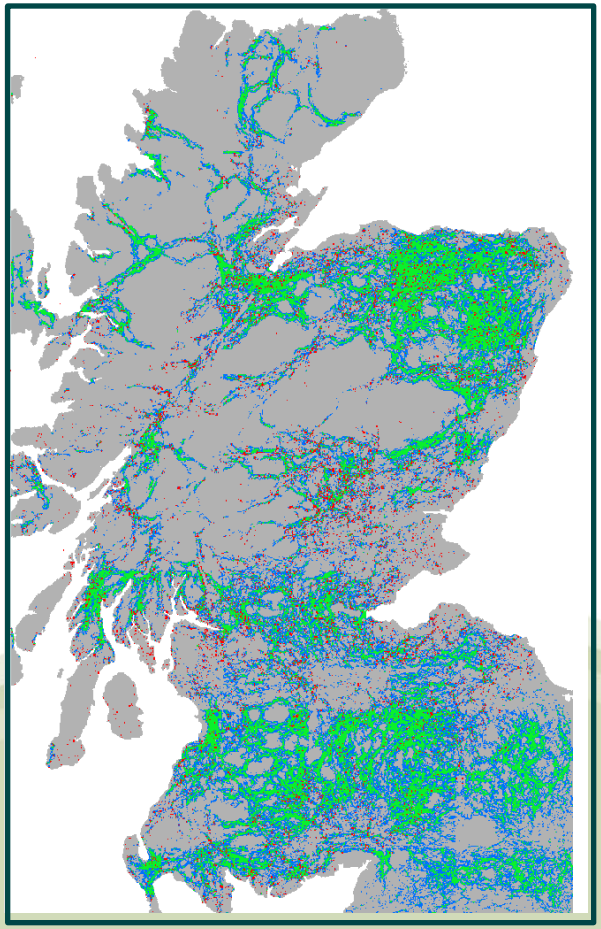
Source: Brown et al. (2008, 2011)

- Potential expansion of Prime Agricultural Land with necessary adaptation measures – good for Food Security ??

Climate Change and Land Use Change as an indirect driver

- National Planning Framework objective:
  '….to develop a national ecological network'

Testing Habitat Networks – Broadleaved woodlands

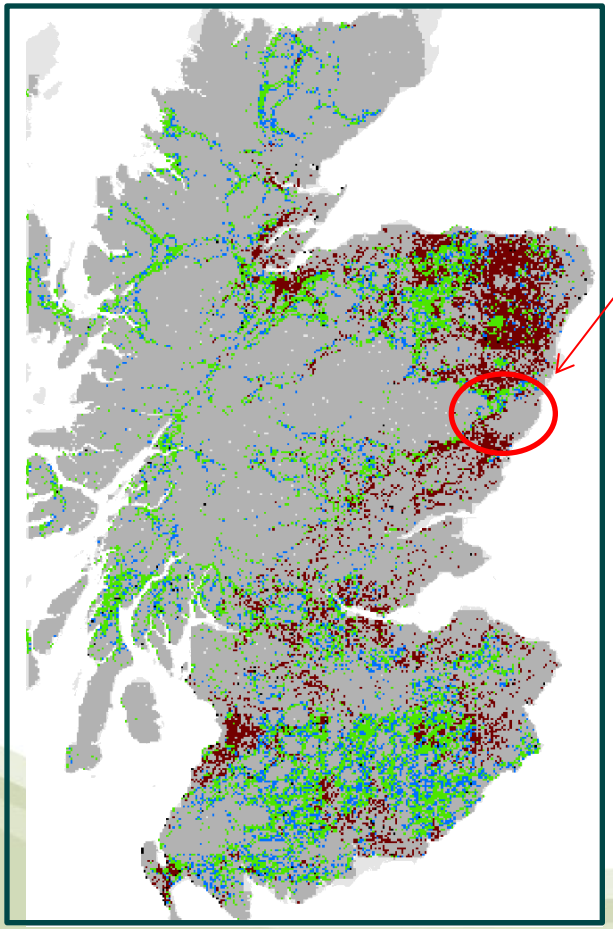


90th percentile

75th percentile

Current Broadleaved Woodland

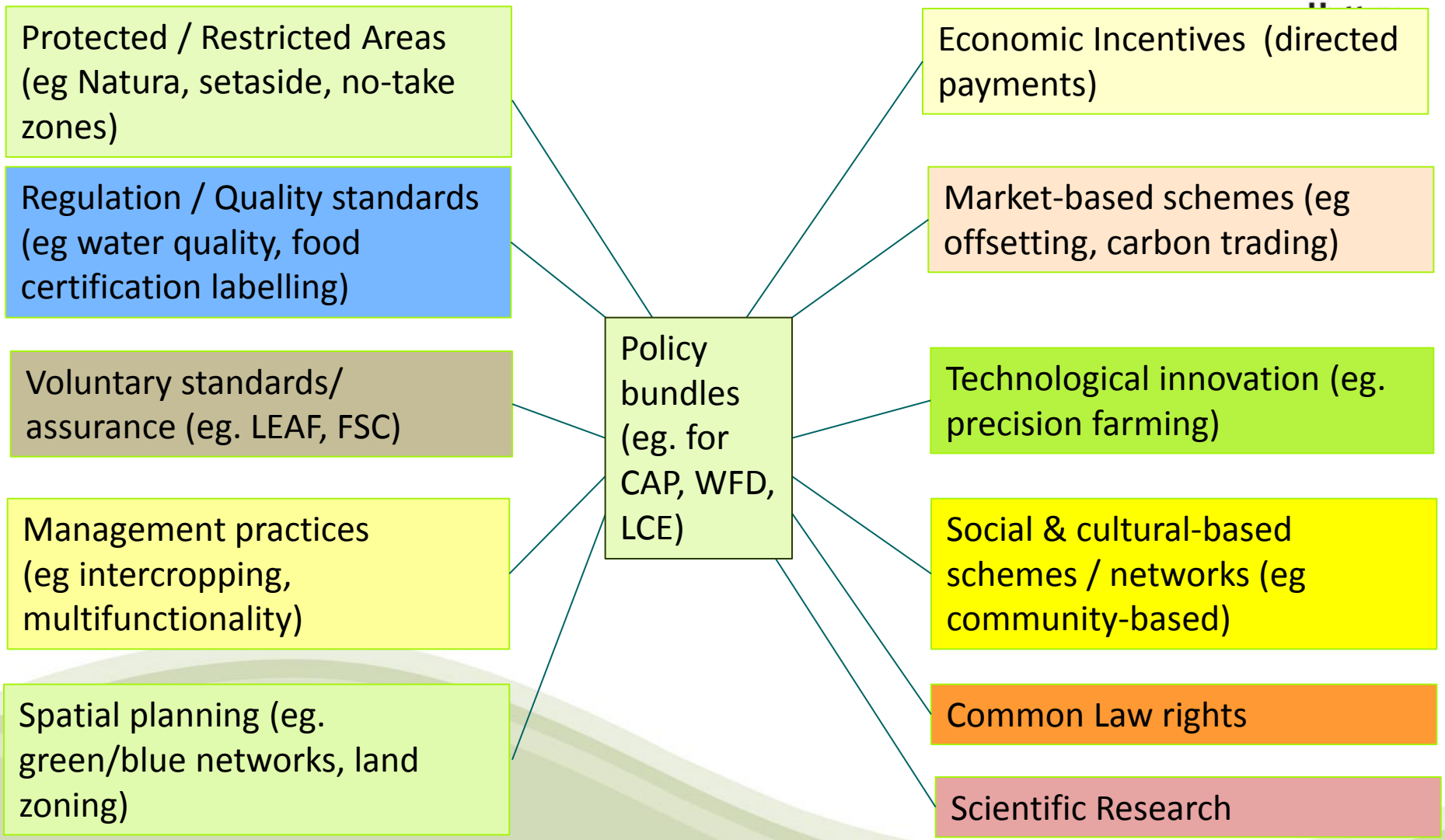
Present-day connectivity potential



2050s projection – Climate & Land Use Change

Source: Gimona et al (2011)

Generic Types of Response Option



All have requirements (eg. funding), key actors, spatial & temporal dimensions, attitudes to risk

Using Scenarios to test robustness of options & bundles - 1 Narrative Scenarios ('Storylines')

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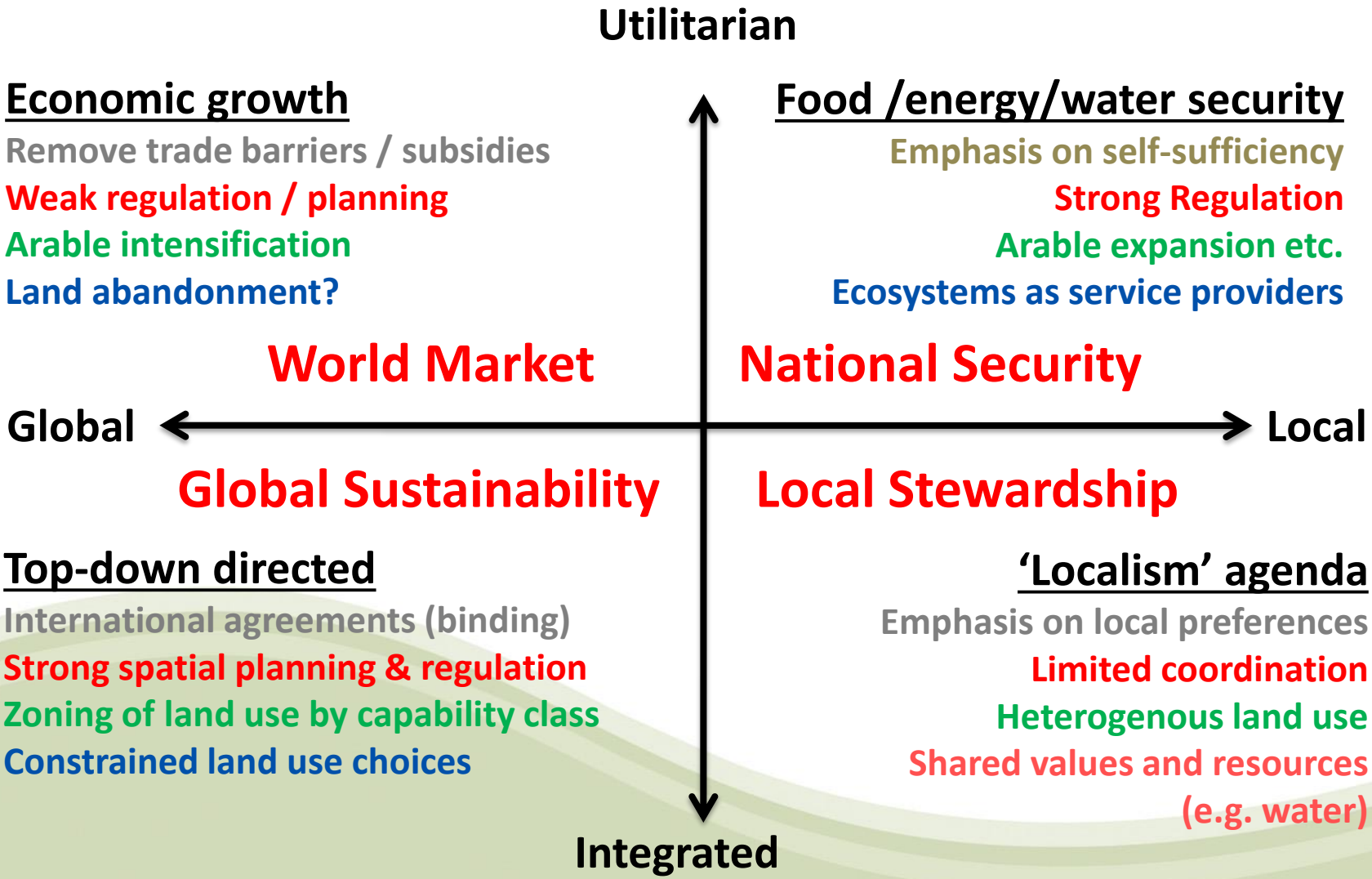
What does these linked drivers or factors mean for our decision and location?



Scenarios were derived from those of IPCC and linked to land use drivers

Climate change

Socio-economic change

Using Scenarios 2 – Quantitative Land Use Scenarios (multiple scales)

WM

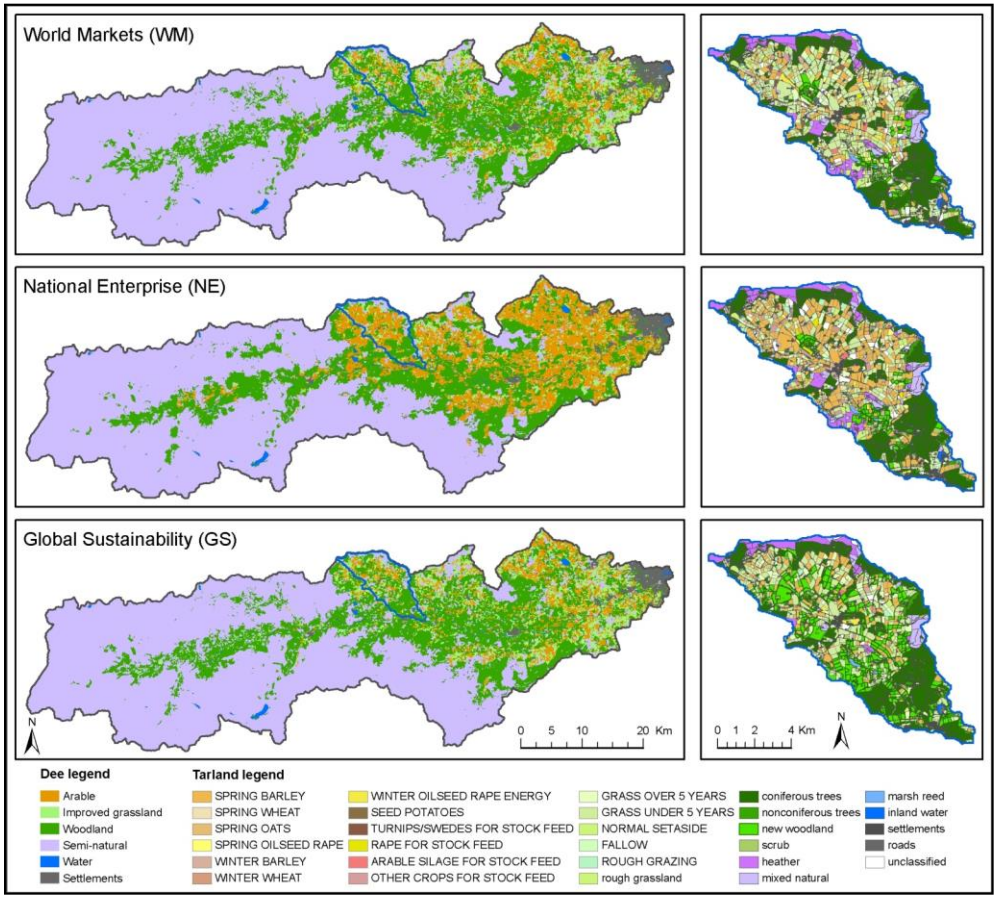
NE

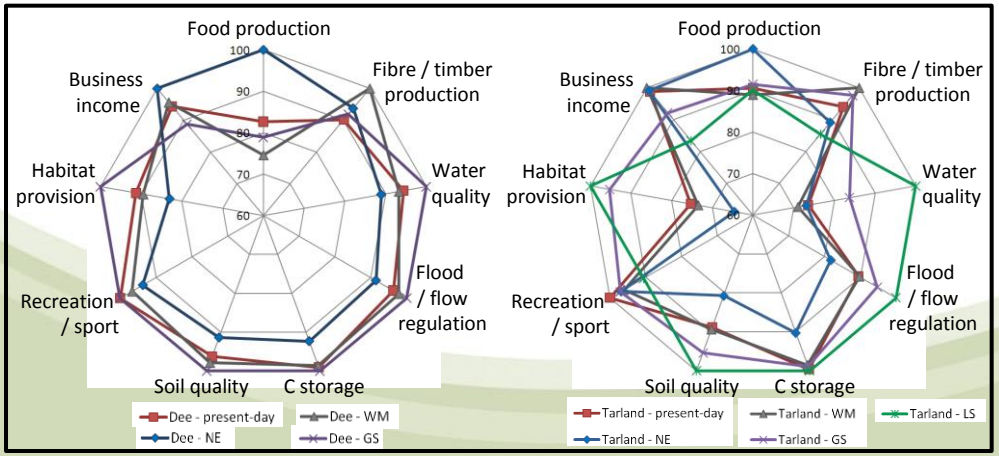
GS

Trade-offs for Ecosystem Services

DEE CATCHMENT

TARLAND





Scenarios in Visioning Exercises

"The objectives of management of land, water and living resources are a matter of societal choice" [EA Principle 1]

"The ecosystem approach should involve all relevant sectors of society and scientific disciplines" [EA Principle 12]

Ballater Primary School

- Understand future change, choices and decision strategies
- Improving interaction - Who has a say? - Social learning

Using land use and climate scenarios to explore impacts on future water quality

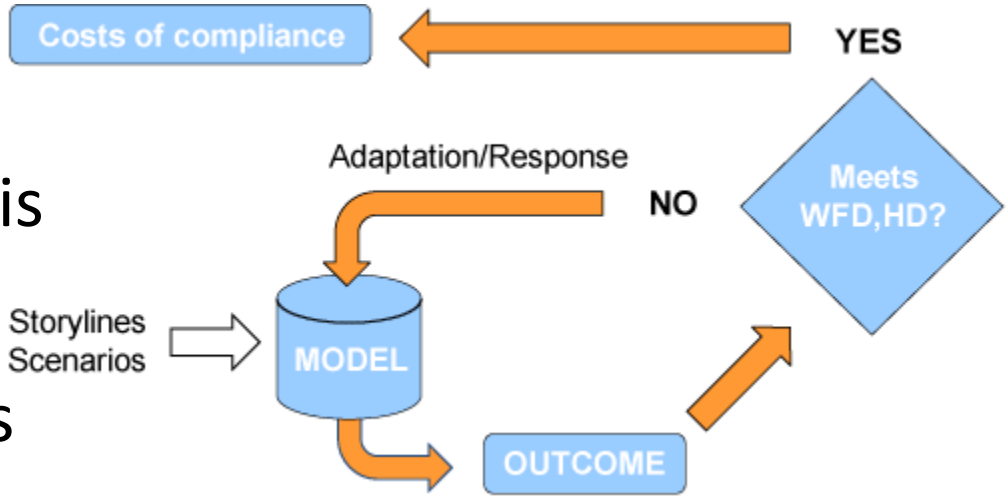
Sarah Dunn

James Hutton Institute, Aberdeen, Scotland

Willie Towers, James Sample, Julian Dawson, Leah Jackson-Blake, Iain Brown, Marie Castellazzi, Rachel Helliwell

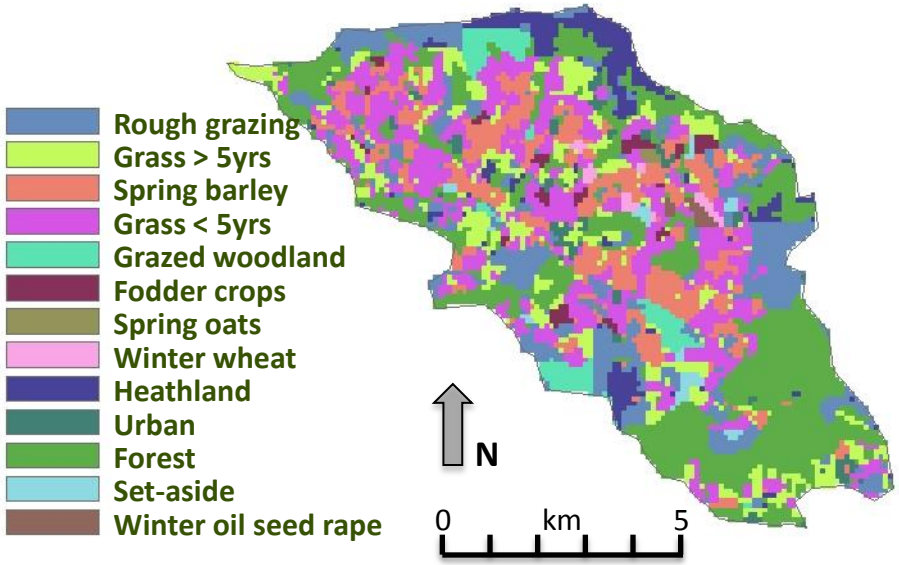
REFRESH - Adaptive strategies to mitigate the impacts of climate change on European Freshwater Ecosystems

- EU FP7 Project 2010-2014
- Future status of freshwater ecosystems is dependent on land-use and pollution loading as well as climate-change



- Assess how systems will respond to climate and land use change and identify suitable adaptation measures

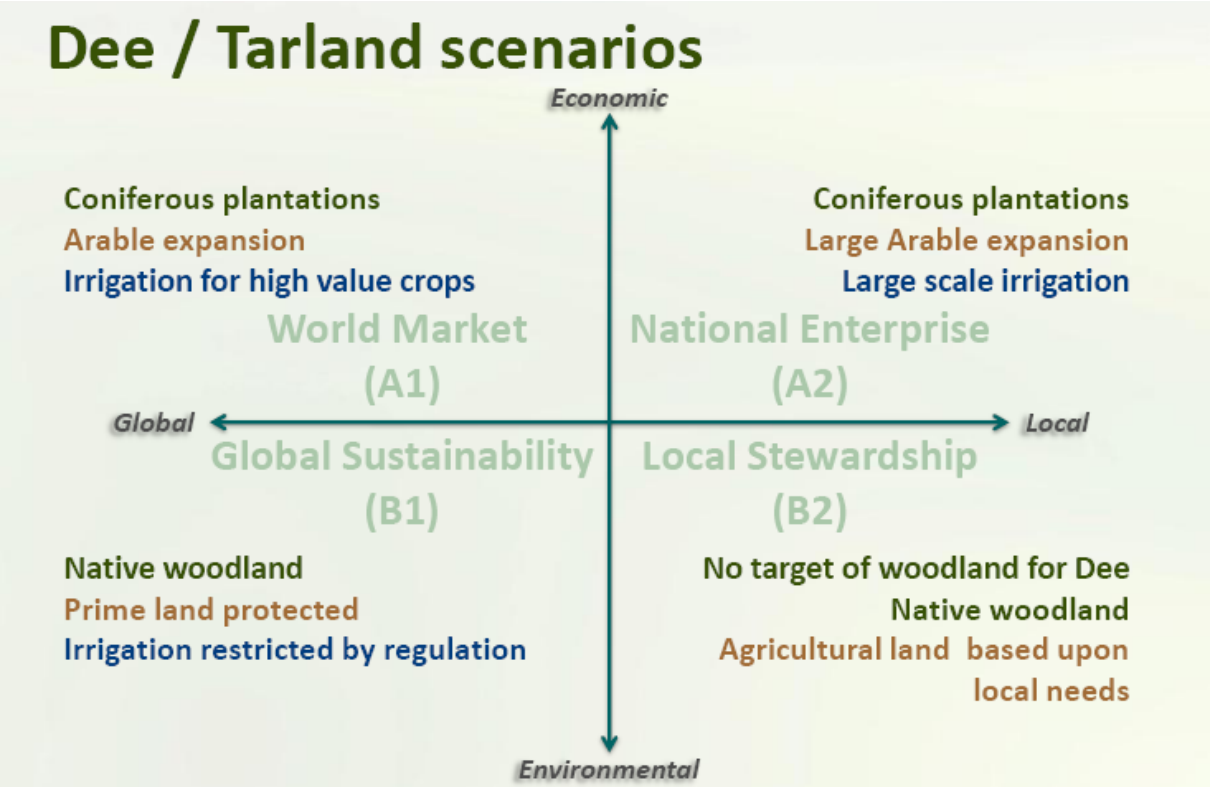
Tarland Burn case study



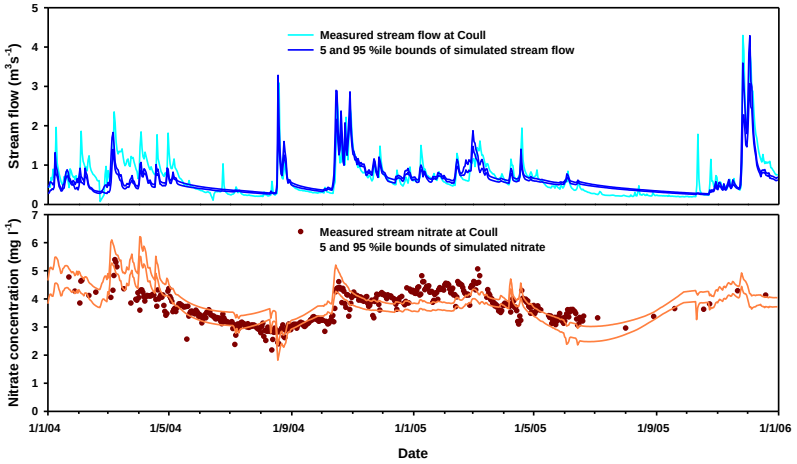
- Transitional agricultural catchment – vulnerable to land use change under climate change?
- Evaluate 3 different climate change models for the same SRES A1B scenario
- Develop land use change scenarios linked to climate and economic drivers

Land use scenario development

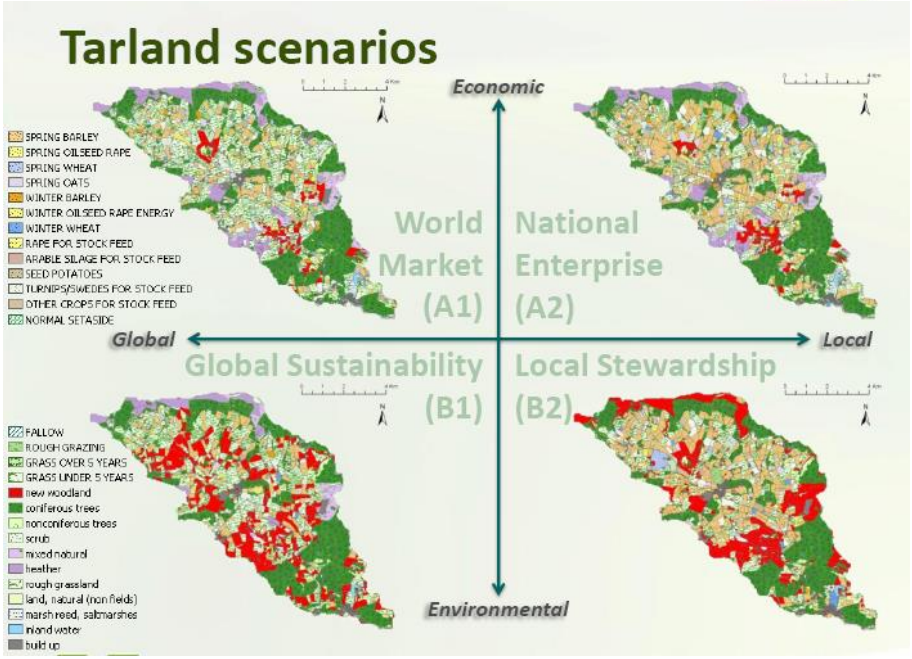
- Changes in land use may be linked to climate change and other socio-economic drivers
- Evaluate future land capability
- Consistency with Land Use Strategy for Scotland
- Stakeholder evaluation

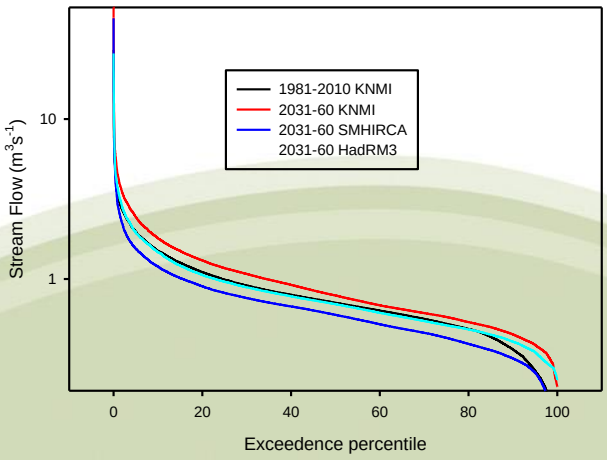


Nitrate modelling – future scenarios

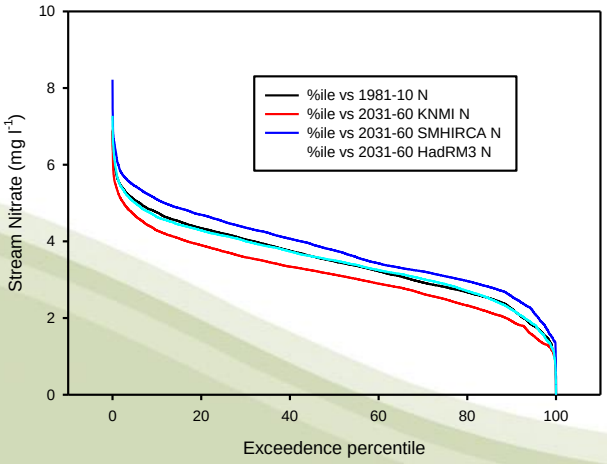


Baseline model validation: 2004-06

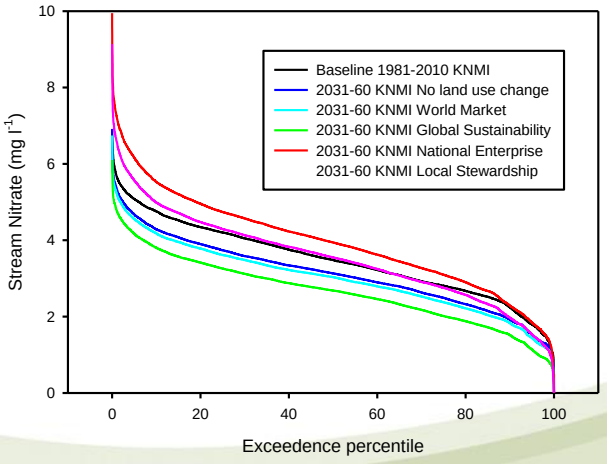




Climate scenarios and flow



Climate scenarios and nitrate



Land use scenarios and nitrate

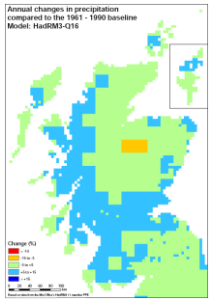
CREW - potential risks to water quality from diffuse pollution driven by future land use and climate change

The James Hutton Institute

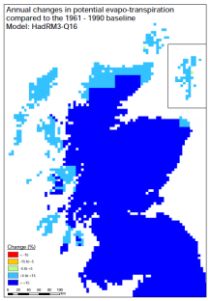
- National scale screening of multi-pollutants
- SEPA WFD Significant Water Management report – horizon scanning
- Qualitative assessment due to complexity
- Aimed at identifying key risk areas
- Simple scenario integration using matrices to describe changes in key drivers

“Key Driver” matrix methodology

The James Hutton Institute

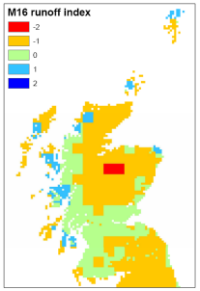


CC
Rain + PET



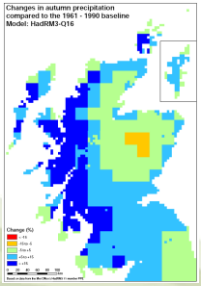
Runoff

	Precipitation Change class				
PET class	<-15 ("-2")	- -5 ("-1")	-5 - 5 ("0")	5 - 15 ("1")	>15 ("2")
<-15 ("-2")	-1	0	1	2	2
-15 - -5 ("-1")	-1	-1	1	2	2
-5 - 5 ("0")	-2	-1	0	1	2
5 - 15 ("1")	-2	-2	-1	1	1
>15 ("2")	-2	-2	-1	0	1

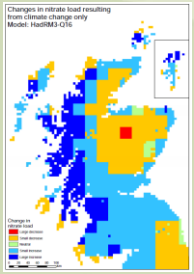


Autumn precip

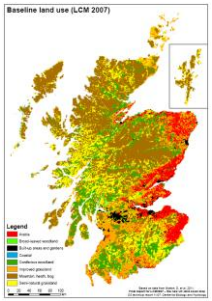
	Runoff Change class				
Autumn precip class	-2	-1	0	1	2
<-15 ("-2")	-2	-2	-2	-1	-1
-15 - -5 ("-1")	-2	-1	-1	0	0
-5 - 5 ("0")	-1	-1	0	1	1
5 - 15 ("1")	0	1	1	2	2
>15 ("2")	1	1	2	2	2



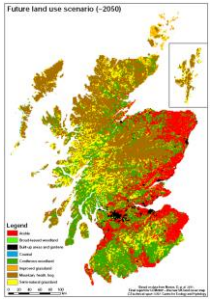
Dissolved pollutant risk from CC



CC



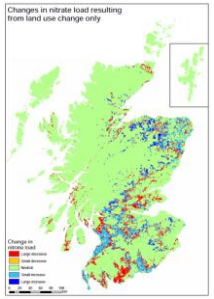
LUC
Scenario



Dissolved pollutant risk from LUC

N, SRP, Hydrophilic Pesticide

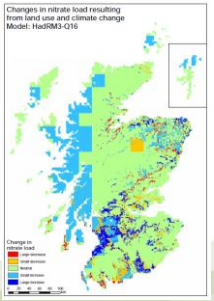
	Land use change					
Baseline land use	Arable	Imp grass	Conif forest	B-leaf forest	Semi-nat	Urban
Arable	0	-1	-2	-2	-2	-1
Imp grass	1	0	-2	-2	-2	-1
Conif forest	2	2	0	0	0	1
B-leaf forest	2	2	0	0	0	1
Semi-nat	2	2	0	0	0	1
Urban	1	1	-1	-1	-1	0



LUC

N, P, FIO, pesticides - land use dominant

	Climate Response Class				
Land use response class	-2	-1	0	1	2
-2	-2	-2	-2	-1	-1
-1	-2	-2	-1	-1	0
0	-1	0	0	0	1
1	0	1	1	2	2
2	1	1	2	2	2



Combined CC / LUC pollutant risk

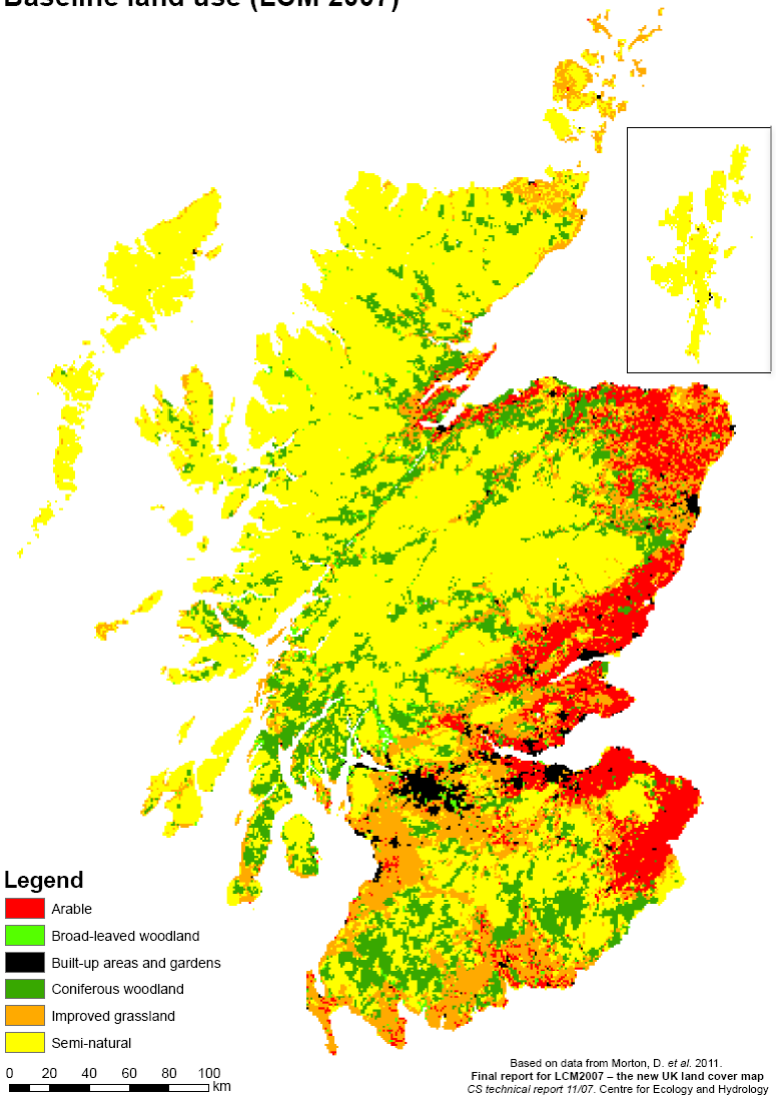
Land Use Change Scenario

- Land Use Strategy for Scotland
  - Woodland expansion
  - Agricultural expansion
    - Set in a context of changes in land capability
- Rules for allocation
  - LCA 2050 to identify areas suitable for agriculture
    - All prime land will become arable
  - WEAG phase 3 forestry combined with LCF
    - Use most favourable land to least until target reached
- Produces a fairly extreme scenario illustrating maximum extent of arable and forestry

Land Use Change Scenario

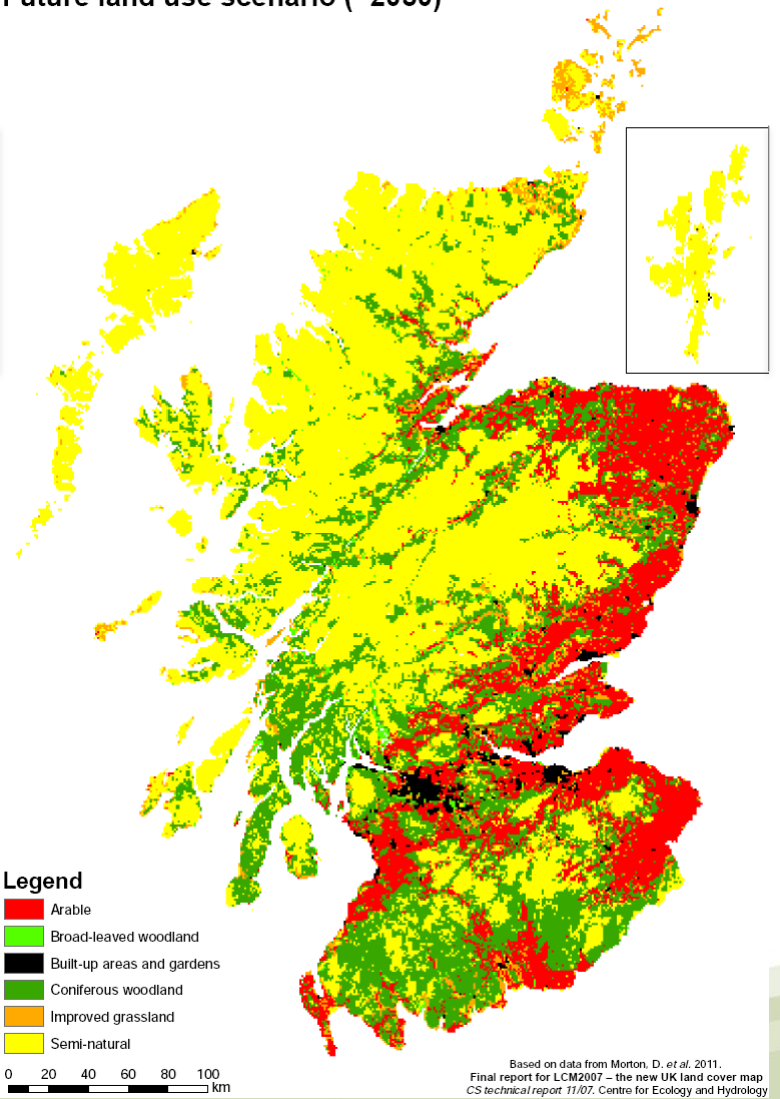
The James Hutton Institute

Baseline land use (LCM 2007)



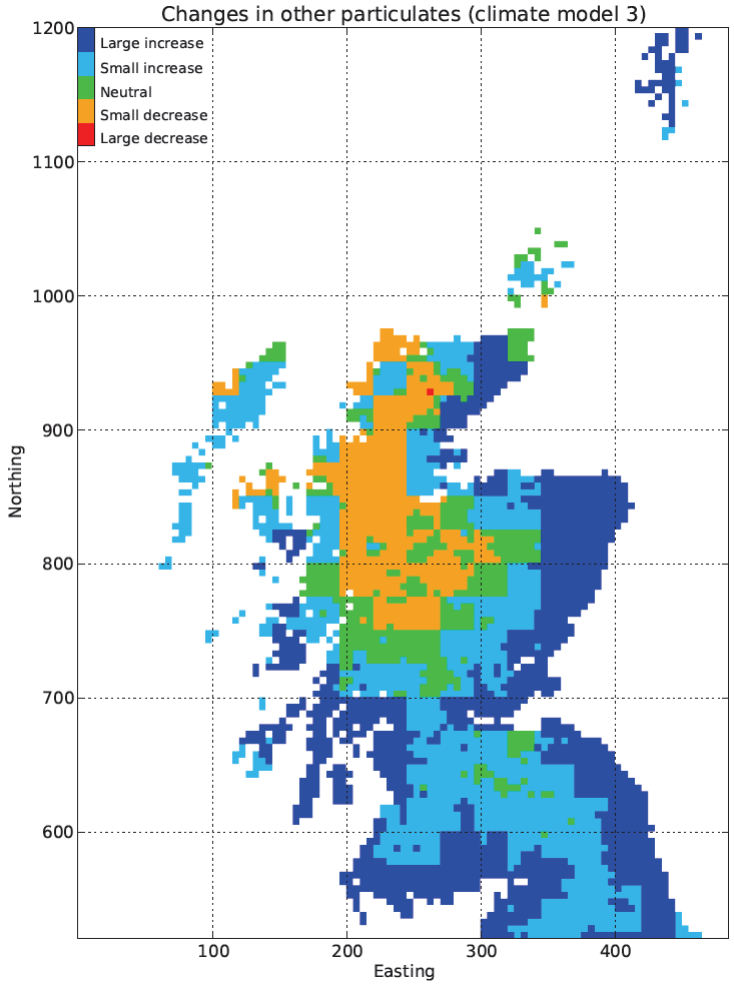
Based on data from Morton, D. *et al.* 2011.
Final report for LCM2007 – the new UK land cover map
CS technical report 11/07. Centre for Ecology and Hydrology

Future land use scenario (~2050)

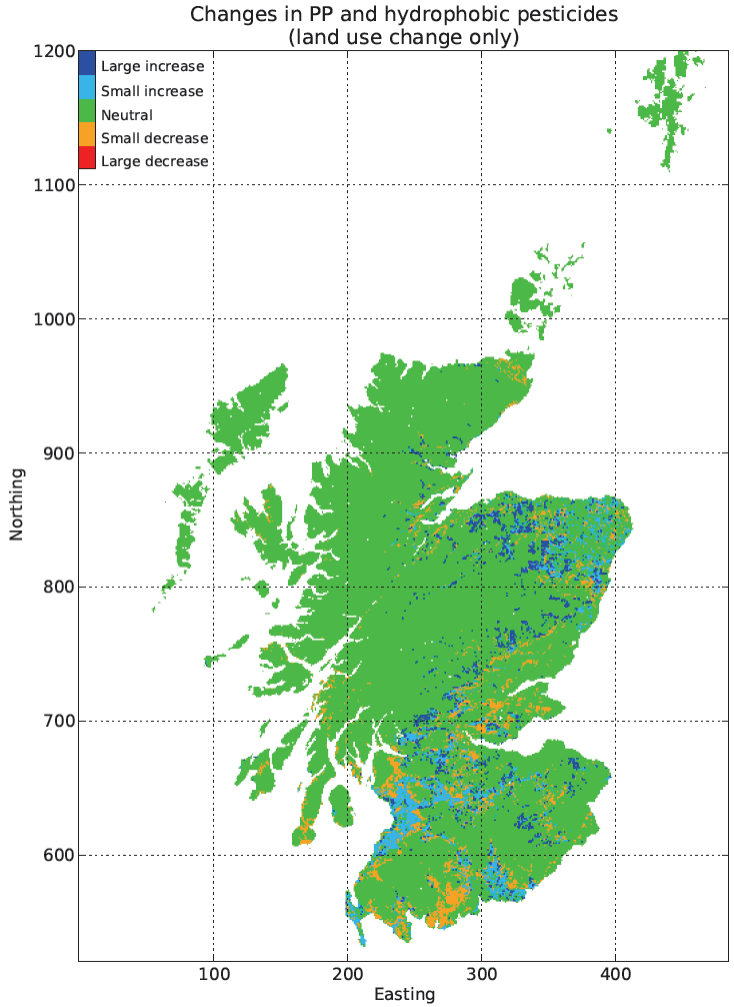


Based on data from Morton, D. *et al.* 2011.
Final report for LCM2007 – the new UK land cover map
CS technical report 11/07. Centre for Ecology and Hydrology

Qualitative change in particulate P

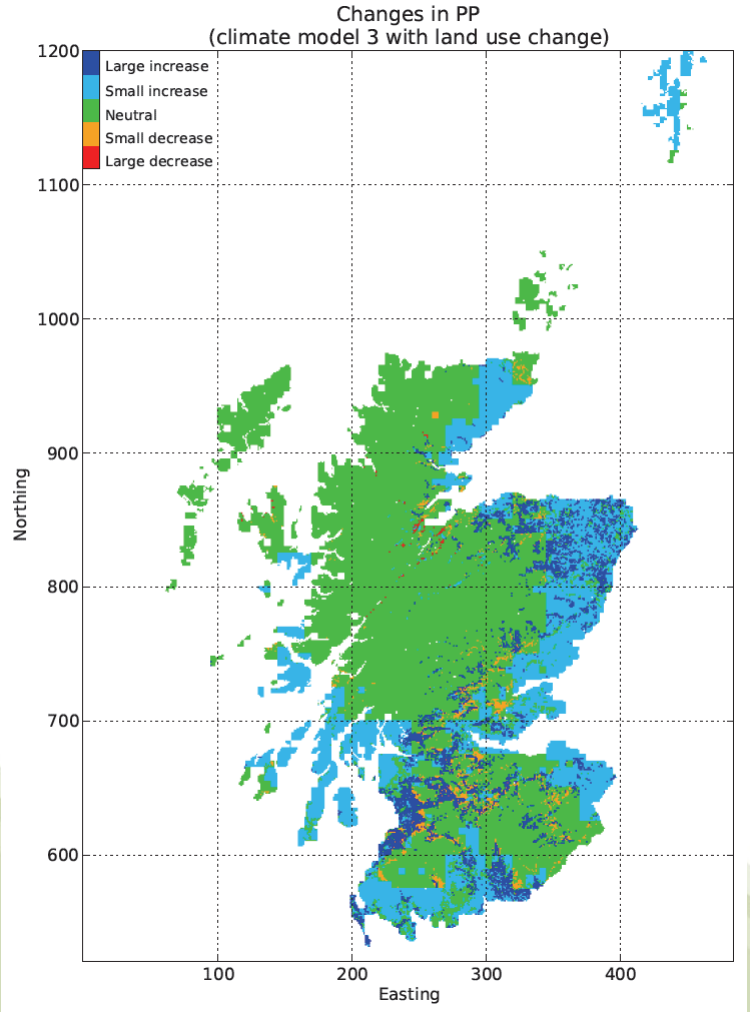


Climate change only



Land use change only

Qualitative change in particulate P – combined climate and land use change



- Combined maps highlight areas where climate and land use change risks might be additive or counteractive.

Summary

- Water quality is closely linked to both climate and land use
- Scenarios are useful for exploring the extent to which water quality might be expected to change
- This allows evaluation of robustness of resources to future changes
- Highest risk areas in national assessments can be prioritised for more detailed evaluation

Acknowledgements: This work was co-funded by the EU FP7 REFRESH project, the Rural and Environment Science and Analytical Services of the Scottish Government and the Centre of Expertise for Water (CREW)

Exploring the diversity of policy objectives, issues and drivers:

An review of the questionnaires

Rachel Helliwell

The James Hutton Institute

Aims of the questionnaire:

- To collate the range of policy objectives and issues from each policy sector.
- To identify the main drivers of change that are relevant to, or impact up, different policy areas.

This is part of the process by which policy makers can engage with the Scottish Government's Strategic Research Programme and others with an interest in the Ecosystem Approach in Scotland.

Organisations represented today

- Centre for Ecology and Hydrology
- Edinburgh University
- Forestry Research
- James Hutton Institute
- RESAS - Head of Rural Analytical Unit
- Scotland's Rural University College
- Scottish Environment LINK
- Scottish Water
- Scottish Environmental Protection Agency
- Scottish Government
- Scottish Natural Heritage
- Scottish Wildlife Trust
- University of Dundee
- University of Strathclyde

Questionnaires returned = 20

What you had to say……..

What is your policy sector?

The James Hutton Institute

Policy Sector	No. of responses
Environment	14
Farming forestry & rural issues	7
Nature conservation	7
Research	4
Planning	2
Health & social care	1
Food	1
Business, industry & energy	0
Economy	0
Marine & fisheries	0

Specific topic or policy area in your sector?

- Ecosystem Services/Ecosystems Approach
- Biodiversity conservation (Integrated policies with land use)
- Climate change(mitigation/adaptation) and green infrastructure
- Land use and land use planning
  - Agri-environment and natural heritage impacts of CAP
- Sustainable food, nutrition and diet
- Water (resources/quality), flood risk, land policy, air quality, radioactive substances

Main policy objectives

- Halt the loss of biodiversity
- Raising awareness of biodiversity/conservation
- Increase the proportion of designated sites in favourable or recovering condition
- Achieving sustainable development
- Reduce GHG emissions in Scotland
- Integrated sustainable land use
- Woodland expansion
- Water Framework Directive –achieve good ecological and chemical status by 2015
- Protect and improve the water environment & manage flood risk sustainably
- Reduce the incidence of obesity and/or improve the health status of overweight and obese people in Scotland

Associated targets relating to policy objectives

- By 2020 people are aware of the values of biodiversity and the steps they can take to conserve it
- By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded
- Strengthening the Land Use Strategy
- An Adaptation Programme for Scotland
- Reducing Scotland's greenhouse gas emissions by 80%
- 97% of water bodies to achieve good ecological status by 2027

What is the time frame to achieve this target or the time horizon you are working towards?

The James Hutton Institute

Time Interval	No. of responses
Annual	0
1-3years	0
3-5 years	1
5-10 years	2
10-30 years	0
30-50 years	1
Target year	
by 2015	3
By 2020	5
By 2030	2
By 2050	3
By 2100	0

Number of responses for the driver themes at different spatial scales

Driver Themes	*International*	*UK*	*Scotland*	*Regional*	*Catchment/ local*	*Total*
Social	19	23	37	26	22	127
Technological	23	26	29	21	16	115
Environmental	39	41	53	46	45	224
Economic	31	32	37	25	21	146
Political	21	22	28	20	19	110
Total	133	144	184	138	123	

Theme: Social Drivers

Demographics

Attitudes

Health

Farming and land management

Water-related

Clean, safe water environment for people

Social impacts of flooding – tangible and intangible

Increasing insurance take up

Better amenity value of water

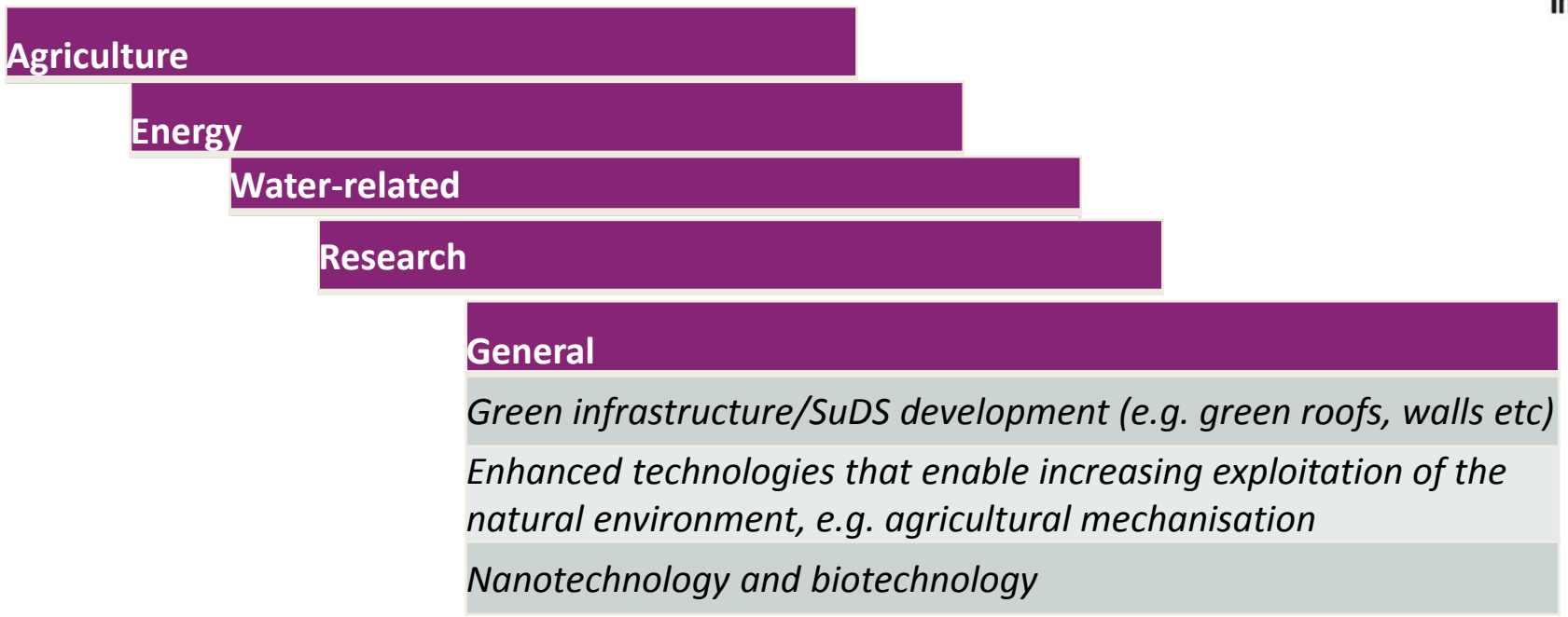
Driver Themes	*International*	*UK*	*Scotland*	*Regional*	*Catchment/ local*	*Total*
Social	19	23	37	26	22	127

The James Hutton Institute

Common drivers identified by the EEC and the workshop questionnaires

Theme	Megatrend	Drivers	Response from questionnaire
Social	Increasing global divergence in population trends	Continued population growth, but slower & with regional differences. Fertility, mortality, migration, economic development, poverty and governance are the main drivers of population growth	*Population growth*
		Ageing societies	*Ageing societies*
		Migration	*Migration*
	Living in an urban world	Increasing productivity (& consumption)	*Expanding per capita demand for resources*
		Greater access to goods, health etc	***x***
		Migration for economic opportunity	*Migration and increasing movements of workforce*
	Disease burdens and the risk of new pandemics	Climate change	***x***
		Increasing mobility increases risk to exposure to new emerging and re-emerging diseases, to accidents and new pandemics	***x***

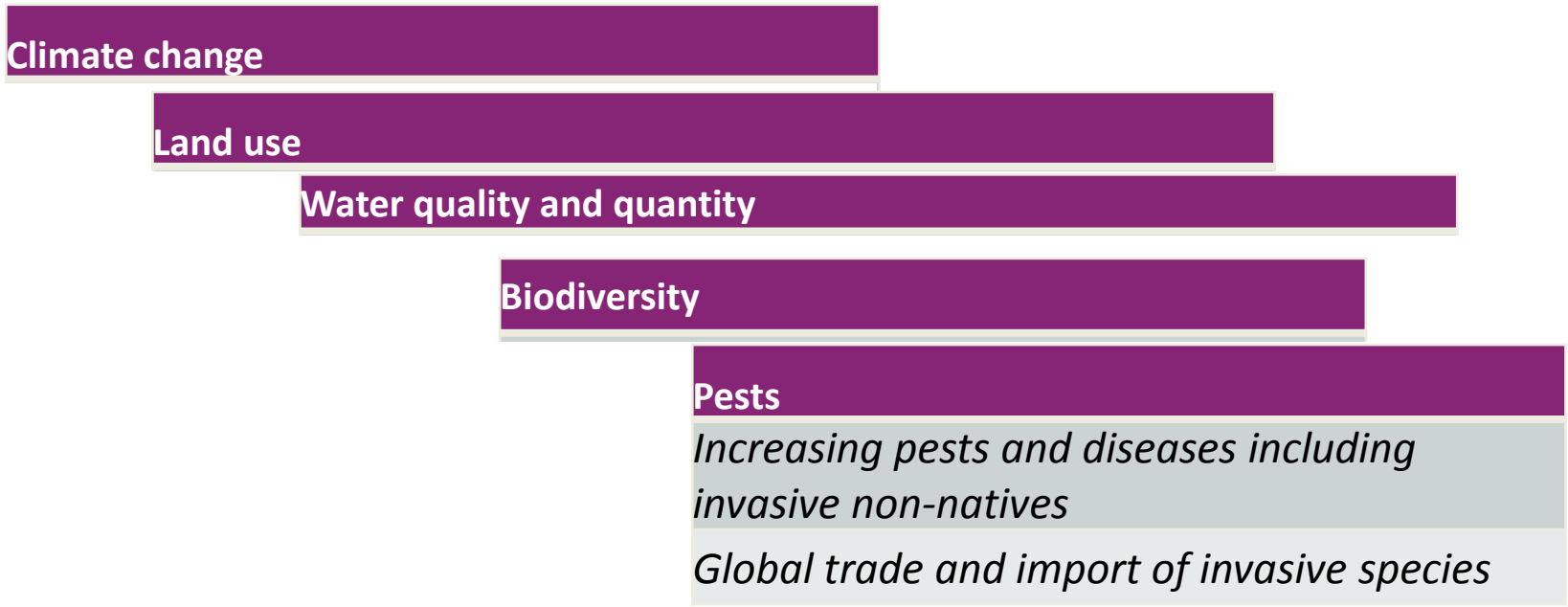
Theme: Technological Drivers



Theme	Megatrend	Drivers	Response from questionnaire
Technological	Accelerating technological change: racing into the unknown	Nanotechnology and Biotechnology	*Nanotechnology and biotechnology*
		Information & communication technology	*Social media and information technologies*

Driver Themes	*International*	*UK*	*Scotland*	*Regional*	*Catchment/ local*	*Total*
Technological	23	26	29	21	16	115

Theme: Environmental Drivers



Driver Themes	*International*	*UK*	*Scotland*	*Regional*	*Catchment/ local*	*Total*
Environmental	39	41	53	46	45	224

Theme	Megatrend	Drivers	Response from questionnaire
Environmental	Decreasing stocks of natural resources	Expansion of agricultural land (and energy/water) to meet needs of growing affluent society	*Expansion of Agricultural land to meet food demands* `
	Increasingly severe consequences of climate change	Greenhouse gas (GHG) emissions from fossil fuel use for energy (from global population growth, increases in demand for food, water)	*Climate change – GHG emissions reduction*
		Deforestation (as above)	***x***
		Unsustainable agricultural practice	*Agricultural intensification*
	Increasing pollution load	Climate change and land use changes may influence the emissions from natural sources.	*Diffuse pollution mitigation*
		Increased demand for energy, transport, food and non-food crops may further increase emissions arising from human activity and changes in consumption and production patterns are likely to affect the distribution of pollutants.	*Pressures on soil quality from agricultural practices, increasing built development & climate change*
		Economic and population growth cause increasing emissions of reactive nitrogen, ozone precursors and chemical waste.	*Intervention through EC Directives (WFD)*

Theme: Economic Drivers

Agriculture

Water/Biodiversity

Health and wellbeing

General
Economic recession
Low carbon economy
Current drive for economic growth – whether sustainable or not
Tourism
Commodity prices
Business development

Driver Themes	*International*	*UK*	*Scotland*	*Regional*	*Catchment/ local*	*Total*
Economic	31	32	37	25	21	146

Theme	Megatrend	Drivers	Response from questionnaire
Economic	Continued economic growth?	Population growth	*Population growth*
		Further Market globalisation	*Business development*
		Technological innovation	*New renewable energy/agricultural technologies*
	From a unipolar to a multipolar world	Increase in trade (globalisation)	*Increasing wealth in developing countries fuelling demand for consumer goods/higher protein diets, leading to increasing demands for provisioning*
		Global shift in economic power	***x***
		Higher rates of productivity in emerging economies	*Increasing wealth in developing countries fuelling demand for consumer goods/higher protein diets, leading to increasing demands for provisioning*
		Also, population growth, continuing technological innovation and diffusion of technologies, favourable economic policies and integration at regional and global level	***x***
	Intensified global competition for resources	Continuing economic growth	*Business development*
		Technological innovation	*New renewable energy/agricultural technologies*
		Depleting resources (see below)	***x***

Theme: Political Drivers

Methods/practices

Policies/Directives/Legislation

Scotland's future

Political processes/timelines
Lack of political will to prioritise environmental conservation over the immediate supply of resources to the electorate: effectively political short-termism
Political (with small 'p') pressure to push through development that doesn't adequately incorporate sustainable design criteria (i.e. in favour of economic development/job creation)
Time horizons for decision making in democratic societies – working against decisions for the long term

Driver Themes	*International*	*UK*	*Scotland*	*Regional*	*Catchment/ Local*	*Total*
Political	21	22	28	20	19	110

Theme	Megatrend	Drivers	Response from questionnaire
Political	Environmental regulation and governance: increasing fragmentation and convergence	Economic globalisation and rapid economic growth in emerging economies	*x*
		Climate change	*x*
		Changing resource scarcity patterns	*x*
		Trade barriers and different standards	*x*
EEA, 2011. The European Environment - state and outlook 2010: assessment of global megatrends. European Environment Agency, Copenhagen.			

What are the unforeseen events which you consider in your policy area?

Unforeseen Events	No. of responses
Global recession	7
Leaving EU/independence	7
Pandemic disease	4
Extreme climate change/weather events	4
Volcanic eruption	1
Climate tipping points	1
Plant or animal disease	1
Leap in technology	1

3b Please note an associated target related to this policy objective

- Halting the loss of biodiversity by 2020
- By 2020, at the latest, biodiversity values have been integrated into decision making at national and local levels
- Implement environmental legislation robustly
- To cut emissions by 42%
- Scottish Biodiversity Strategy currently under review. New target is likely to relate to halting the loss of biodiversity by 2020. This is also reflected in a national indicator in the National Performance Framework to increase the abundance of terrestrial breeding birds, as a wider indicator of biodiversity.
- We have not included targets as its difficult to develop them alone, realistic options that are achievable are not easy to identify
- Increase woodland cover to 25% (by 10,000 – 15,000 woodland planting ha per annum)
- Various
- Take 10% of affected homes out of flood risk (please note: this has been included for example only and is not currently one of Glasgow City Council's targets)
- To prepare first flood plans for December 2015
- 71% of water bodies to achieve good ecological status by 2015
- To cut emission by 80%; To match the growth rate of small independent countries; Increase exports
- Improve human wellbeing

4c What is your time frame to achieve this target or the time horizon you are planning for?

Time Interval	No. of responses
Time Interval	
Annual	1
1-3years	1
3-5 years	2
5-10 years	3
10-30 years	0
30-50 years	1
Target year	
by 2015	4
By 2020	8
By 2030	3
By 2050	5
By 2100	0

The James Hutton Institute

"The voyage of discovery is not in seeking new landscapes, but in having new eyes"

Marcel Proust

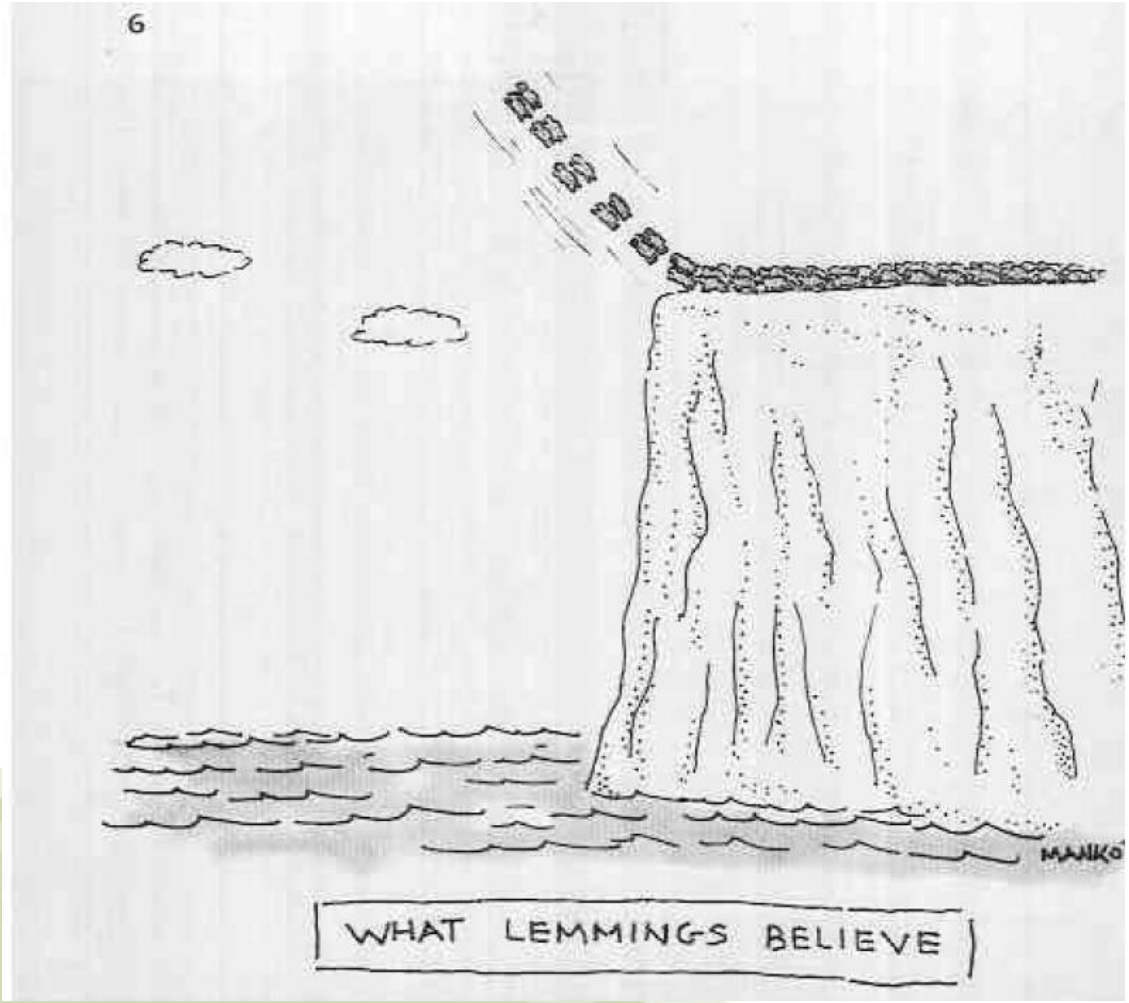
Next steps…

Marc Metzger
The University of Edinburgh

The James Hutton Institute

Plan for the future to avoid unpleasant outcomes

Conventional wisdom …?



We need imagination!

Scenarios - images

My painting is visible images which conceal nothing; they evoke mystery and, indeed, when one sees one of my pictures, one asks oneself this simple question ***'What does that mean'?***
René Magritte, 1947

Scenarios

- form a tool to address uncertainty
- are presented through stories or narratives
- describe drivers of change - social, economic, policy, technology, governance.
- may be both qualitative (narratives) and quantitative (models)
- are not predictions!

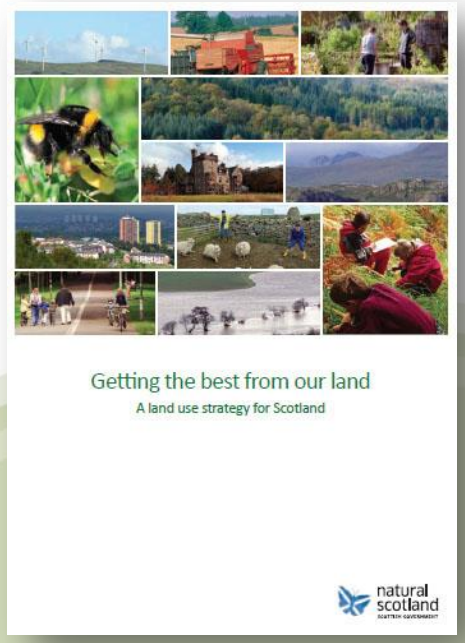
Great interest / A lot happening

The James Hutton Institute

Policy questions	Policies
Where to plan more trees?	Woodland Expansion Strategy
Where to plan new infrastructure?	National Planning Framework
Where to locate renewables?	Renewables Routemap
How to anticipate changing water supply and demand?	Water Framework Directive
How to plan against pest, diseases and invasive species?	Wildlife & Natural Environment Act
How to plan flood defense?	Flood Management Act
How to plan Ecological Networks ?	Biodiversity Strategy
How to deliver realistic conservation?	Biodiversity Strategy
Which pathways lead to a low carbon economy?	Climate Change Act
How to integrate these objectives across sectors?	Land Use Strategy

Great interest / A lot happening

The James Hutton Institute



EA for Decision making e.g. Dee/Aberdeenshire LUS pilot

Drivers

Climate Change (e.g. SRES)

Policies (Land Use Strategy goals)

2a. Develop scenarios of in response to drivers

Land Managers

3. Explore how policy affect decision making

Filter: Land cover, technology, preferences, etc

2b. Explore Land configuration under different scenarios

Land Use Configuration

Carbon storage

Drinking water

Food

Recreation and culture

2c. Explore ES trade-offs for different scenarios

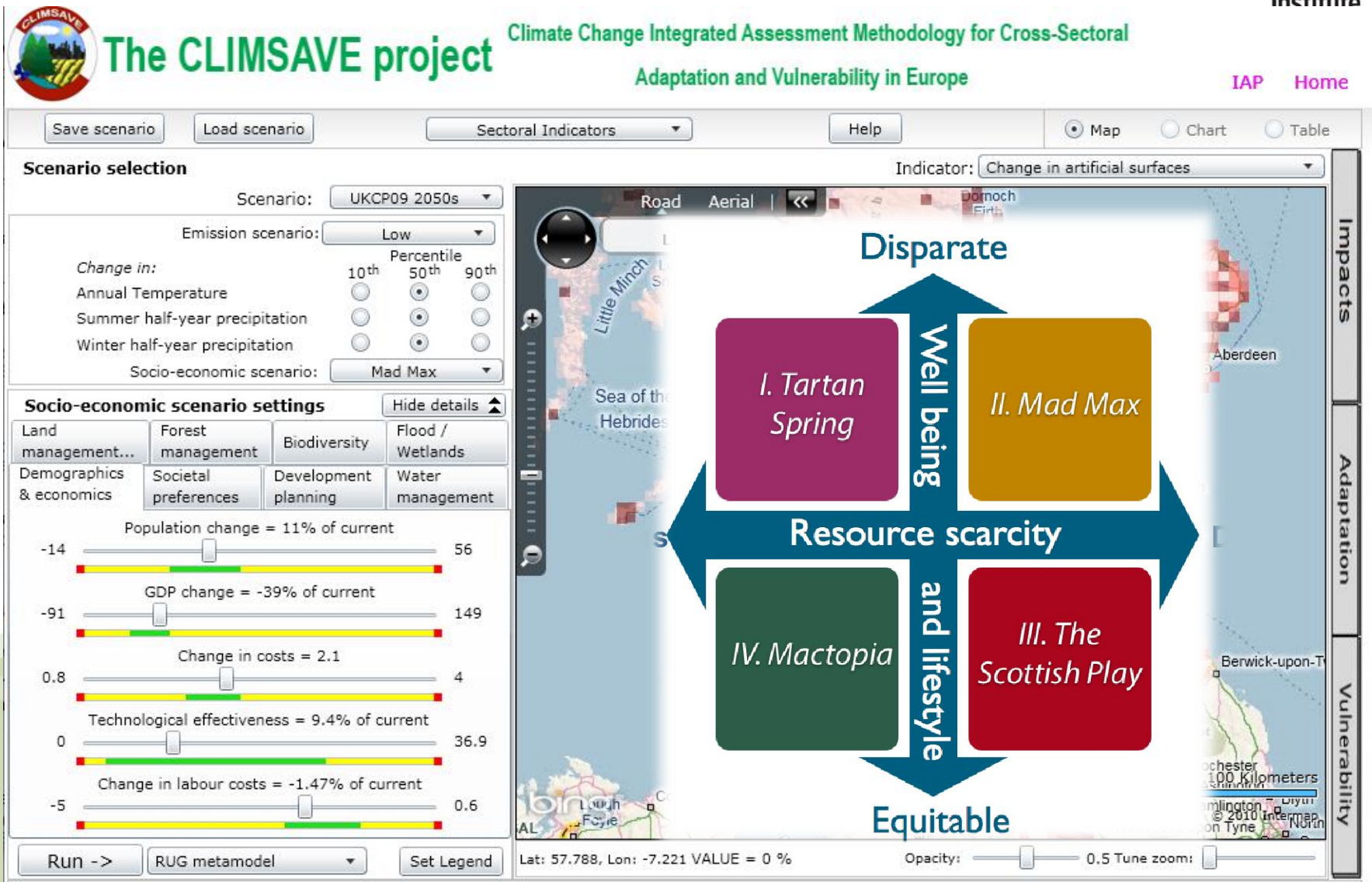
Ecosystem Services

1. Characterise the system

3

Great interest / A lot happening

The James Hutton Institute

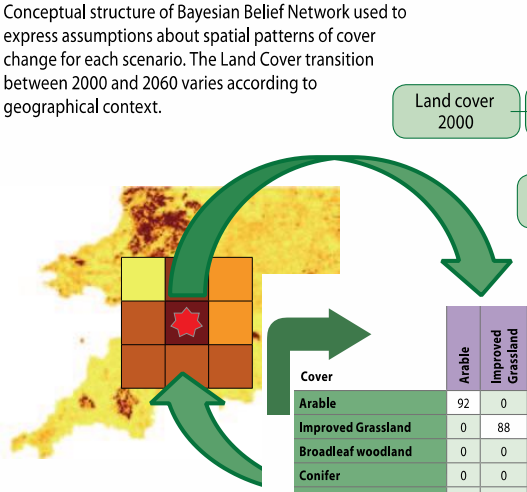


Great interest / A lot happening

The James Hutton Institute

Box 25.2 Structure of the Bayesian Belief Network used to make land cover projections under different scenarios.

Conceptual structure of Bayesian Belief Network used to express assumptions about spatial patterns of cover change for each scenario. The Land Cover transition between 2000 and 2060 varies according to geographical context.

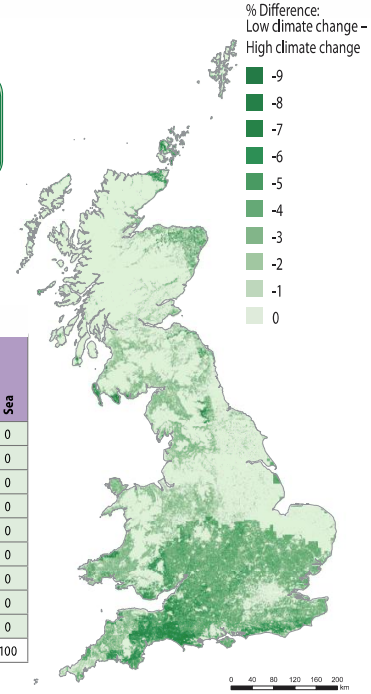


To (2060)

From (2010)

Cover	Arable	Improved Grassland	Broadleaf woodland	Conifer	Urban	Semi-natural Grassland	Upland	Water	Coast	Sea
Arable	92	0	4	0	0	3	1	0	0	0
Improved Grassland	0	88	5	0	0	2	5	0	0	0
Broadleaf woodland	0	0	100	0	0	0	0	0	0	0
Conifer	0	0	10	90	0	0	0	0	0	0
Urban	0	0	0	0	100	0	0	0	0	0
Semi-natural Grassland	0	0	0	0	0	100	0	0	0	0
Upland	0	0	0	0	0	0	100	0	0	0
Water	0	0	0	0	0	0	0	100	0	0
Coast	0	0	0	0	0	0	0	0	100	0
Sea	0	0	0	0	0	0	0	0	0	100

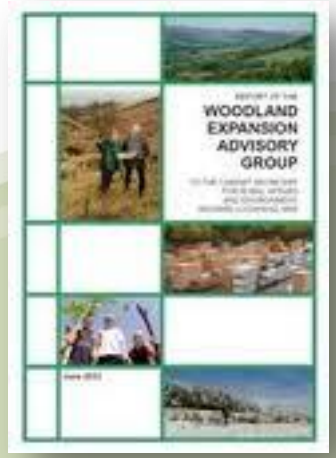
Bayesian Belief Network applied to each 1 km x 1 km cell, transforms mix of land cover from 2010 state to that projected for 2060; transition probabilities were initially defined for aggregate types defined in Land Cover Map 2000 and then the output was modified to be consistent with the habitats defined by the UK NEA.



Example output for projections of arable areas under the *World Markets* scenario for high and low climate change versions of the storyline. Map shows % difference in arable area between them for 2060; the differences between scenario outcomes are greatest in south where climate impacts are projected to be greatest.

Great interest / A lot happening

- Future forest change in forests and wooded landscapes
  - Cover
  - Ecosystem Services
- Review of drivers and scenarios
- Downscaling and customisation, e.g. Lochaber Forest District



Great interest / A lot happening

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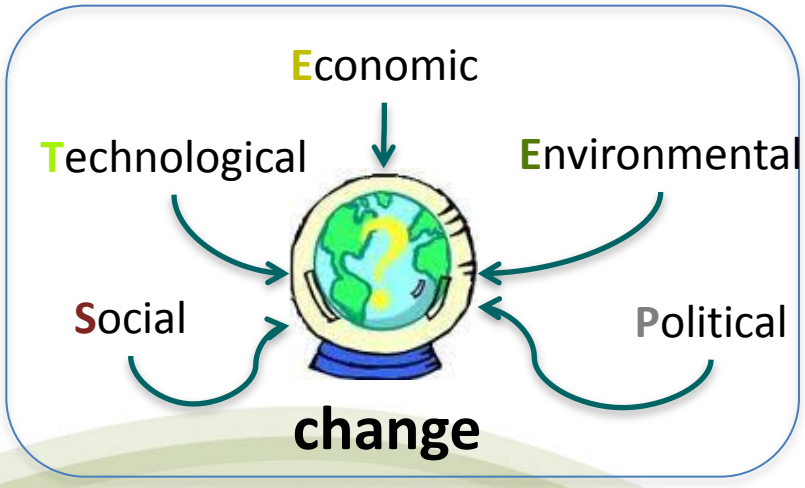
ES Scenario Toolbox

- Versatile and user friendly
- Aid decision-making
- Draw on existing scenario studies (e.g., UK NEA)

OPERAs – new EU project

Scottish Scenario Working Group

- Standardised list of drivers
  - follow-up from today's activities



	Main drivers for Scotland	Recent trends
S	Population growth	…
	Urbanisation	…
	Societal equitability	…
	…	…
T	…	…
E	…	…
E	…	…
P	…	…

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- Identify the relation to existing scenario studies
- Develop guidelines for future scenario studies

	Main drivers for Scotland	LUC	NEA	Clims ave
S	Population growth	X	X	X
	Urbanisation	X	X	
	Societal equitability			X
	...			

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- Develop response tables that identify robust management alternatives within the scenario context

Land class	Management	Green and Pleasant land	Nature@work	Local Stewardship
Mountains, moorland and heaths	Conservation	Very important, focus on conserving native species and habitats.	Important in targeted sites maintained. New areas created as corridors.	Less important on a national scale

Scottish Scenario Working Group

- We welcome any suggestions
- We hope you will want to stay involved

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