

Ecosystems and Land Use Stakeholders Engagement Group (ELSEG) A decision support tool to explore land use change – notes and presentation

Monday 21st January 2019, Victoria Quay, Edinburgh

A decision support tool to explore land use change options based on stakeholder's priorities for different land functions

Alessandro Gimona (presenter); Alice Hague (facilitator); Laure Kuhfuss (notetaker)

The objective of this session was to gauge stakeholders' interest in the adaptation and use of a land use planning decision support tool that was initially developed for the Lake District national park. Based on local stakeholders' inputs, the tool combines maps of land functions and suggests locations for land use change to achieve specific environmental objectives, under set constraints. It provides alternative solutions that can then be used as a support for discussions in the local land use planning arenas by mapping the trade-offs between alternative land uses. Stakeholders perceived the tool as being potentially very useful in several alternative locations in Scotland, especially as a stakeholder engagement tool providing scientific basis for discussions as well as way to illustrate the potential environmental outcomes of current trends in land use changes (reduction in sheep farming), for targeting policies or as part of the approval process of applications to current schemes (e.g. woodland scheme). Useful additions to the tool would be to include data and maps of economic (benefits and costs) of land use changes and potential employment consequences. Users are actually free to add any data they have, including their own modelling outputs, as additional input to the tool, making it flexible to users' needs.

Appendix 1 - Presentations

The following pages show support tool presentation slides

Supporting land use change decisions for sustainable land management

Alessandro Gimona Marie Castellazzi, Andera Baggio, Justin Irvine





Purpose:

- To illustrate approach to land use change decision support
 - Example project : Lake District National Park
- Provide basic knowledge of the Sustainable Land Management tool
- To discuss suggestions for application to Scotland,
 - development and
 - improvement





Sustainable Land Management Project (NT; Lake District National Park)

Study area: Lake District National Park

- Finding a more sustainable way to better mange the land and its resources for multiple purposes and benefits
- Providing objective evidence and information to support and inform landscape scale decision making about the future of the Lake District

Supporting the development of sustainable land management plans for NT's farmed estate

"LM Principles in the Lakes": Land Functions



- Water cycling sediment and nutrient retention, erosion, flood control
- Production crops, grass, timber, water
- Carbon storage sinks and emissions from peat land, soils, vegetation,
- Biodiversity habitats, species, connectivity
- Landscape and cultural history scenic beauty, historic and designed landscapes, archaeology
- Recreation and inspiration access & attractiveness

— Combine

Water Cycling



• We did not developed a water retention map (for flooding); It would have needed a separate project (check with other initiatives)





Combined Land Functions



Advice on opportunities for change

• What are the priority functions/services to improve?

• Where are areas of low function/service, and therefore opportunities to improve?

• What do different land uses/covers deliver?

What land use transitions are needed to improve function/service delivery?



Approach to land use change advice

• Which function/service should be improved?-

stakeholders weights

Which land use transitions (e.g. grassland to forest) would help?

score the transitions

Where are such transitions more advisable?

Opportunity maps



Land Functions

• For each land function in the tool: 3 components



The James

An Opportunity map

- 0 : no land use change
- 0.2 : low probability of land use change
- 0.5 : high probability of land use change



Land use transitions matrix using Scoreste

Glob.Clim.Reg.Carbon (scores)		Broadleaved, mixed	Coafferous	Arable	Imp. grassland	Rough grassland	Noutral grassland	Acid grassland	Heather, dwarf shrub	Heather grass	Bog	Montane
		1	2	3	4	5	6	8	10	11	12	13
Broadleaved, mixed	1	0	1	15	-4	-1	-1	-1	-3	.3	2	0
Coniferous	2	1	0	-6	5	2	12	12	4		1	0
Arable	3	5.	6	0	1	4	4	4	2	2	2	0
Imp. grassland	4	4	5	-1	0	3	3	.3	1	1	6	0
Rough grassland	5	1	2	-4	3	0	0	0	-7	2	з	0
Neutral grassland	6	12	2	-4	-3	0	0	0	-2	4	3	0
Acid grassland	8	1	2	-4	-3	0	0	0	-2	1	3	0
Heather, dwarf shrub	10	1	4	2	-1	2	2	2	0	0	5	0
Heather grass	11	3	4	2	-1	2	2	2	0	0	:5	0
Bog	12	2	-1	7	-6	3	1	3	5	5	0	0
Montane	13	0.	0	0	0	0	0	.0	0	0.	0	0

Weight of this function in comparison to others (spatial or non-spatial)

Land functions in the tool	Weights
Glob.Clim.Reg.Carbon	0.1
Water cycling - Purification	0.1
Water cycling - Nutrient	0.1
Erosion Regulation	0.1
Woodland Connectivity	0.1
Production - Crops	0.1
Production - Fodder	0.1
Production - Timber	0.1
visual amenity and recreation	0.1
Landscape cultural heritage	0.1



visual amenity and recreation Ð Purification heritag Water cycling - Nutrient Woodland Connectivity Glob.Clim.Reg.Carbon Provisioning services - Fodde Regulating services Production - Timbe Erosion Regulation andscape cultural Production - Crops Cultural services Water cycling Production CID CiDname Broadleaved, mixed Coniferous Arable Imp. grassland Rough grassland Neutral grassland б Acid grassland Heather, dwarf shrub Heather grass Bog Montane Inland rock Salt water n Freshwater Supra-littoral sediment Littoral rock Littoral sediment Saltmarsh Urban Suburban

Land functions – FUNCTION (SERVICE) scores

Exemplary ecosystem service potential matrix, after Burkhard et al. 2009 and 2012.



Example Opportunity Map Carbon=>Climate Regulation



Lower C = higher opportunity to improve

(3 intervals: 0-0.25;0.25-0.75;0.75-1)



Glob.Clim.Reg.Carbon {scores}		Broadleaved, mixed	Coniferous	Acable	Imp. grassland	Rough grassland	Neutral grassland	Acid grassland	Heather, dwarf shrub	Heather grass	Bog	Montane	Inland rock	Salt water	
		1	2	3	4	5	6	8	10	11	12	13	14	15	
Broadleaved, mixed	1	0	1	-5	-4	-1	-1	-1	-3	3	2	0	0	0	
Coniferous	2	-1	0	-6	5	-2	-2	-2	-4	-4	1	0	0	0	
Arable	3	5	6	0	1	-4	4	4	2	2	7	0	0	0	
imp. grassland	4	4	5	-1	0	3	3	3.	1	1	6	0	0	0	
Rough grassland	5	1	2.	.4	-3	0	0	0	-2	-2	E	0	0	0	
Neutral grassland		1	2	-4	3	0	0	0	-2	2	3	0	0	0	
Acid grassland	8	1	2.	-4	3	0	0	0	2	2	3	0	0	0	
Heather, dwarf shrub	10	3	.4	2	-1	2	2	2	0	0	5	0	0	0	
Heather grass	11	3	-4	2	-1	2	2	2	0	0	5	0	0	0	
Bog	12	-2	-1	-3	-6	-3	-3	-3	-5	-5	Ð.	0	0	0	
Montane	13	0	0	0	0	0	0	0	0	0	0	0	0	0	
Inland rock	14	0	0	0	0	0	0	0	0	0	0	0	0	0	
Salt water	15	0	0	0	0	0	0	0	0	0.	0	0	0	0	
Freshwater	16	0	0	0	0	0	0	0	0	0.	0	0	0	0	
Supra-littoral sediment	18	0	0	0	D	0	0	0	0	Ū	0	0	0	0	
Littoral rock	19	0	0	.0	0	0	0	0	0	0.	0	0	0	0	
Littoral sediment	20	0	0	0	0	0	0	0	0	0	0	0	0	0	
Saltmarsh	21	0	0	0	0	0	0	0	0	0	D	0	0	0	
Urban	22	0	0	0	0	0	0	0	0	0	0	0	0	0	
Suburban	23	0	0	0	0	.0	Û	0	0	0	0	0	0	0	

How land use transitions improve function/service delivery?

Where are opportunities to improve?



10 opportunity maps





How to improve multiple functions?

Software needed to handle the complexity and *suggest* options:

Sustainable Land Management OptionsTool:

Software to aid decision making about natural capital and ecosystem services







Marie Castellazzi, Alessandro Gimona



National Trust

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Sustainable Land Management - OptionsTool

- **Overview:** project & tool
- SLM-OptionsTool components:
 - LandSFACTS model & developments
 - ArcGIS interface
- Example of scenarios





- Designed for the National Trust in the Lake District National Park
- Main project focus was on mapping land functions
- Exploratory work: tool to help using those land functions maps for informed land use change







- Suggests potential land use changes meeting userdefined land management objectives
- Considers:
 - multiple land functions
 - other land management constraints
 - for specific areas (e.g. protected areas)
 - land uses (e.g. no arable decrease)

• Accessible through ArcGIS 10.1





Overview

SLM-OptionsTool – Components

The James

ArcGIS toolbox



ArcGIS toolbox Running the model – Output map 1 The James New land use map The | Hutton istitute SLM Option/Tool_Dvenil_160318_b.mxd - AvcMap te File Edit View Bookmarks Invert Selection Geoprocessing Customize Windows Help CE24 1 28 1 0 0 0 + 1350.745 Table-Of Coments Circelog. 1004 11 😑 🐖 Layers Lacation: \$ 6_Ron LandSFACTS model Internet All-Internet work 100 Home - LakeDistrict Broadleaved, mixed E SUPPORT E Coniferous E SIM-OptionsTool package Arable # ES Projects III Imp. grassland SLM-OptionsTool IE im templatestakeDistrict Rough grassland 10 in toolpackage Neutral grassland E SIM-OptionsTool.pyt Acid grassland \$ 0 Choose Project Heather, dwarf shrub 🐇 La_LandF - General Heather grass. 1b LandF - Transition Matrice Bog. 3 1c LandF - Add Spatial Data Montane \$ 2_Land use change 3_Non-changeable areas Inland rock 4 Target land use proportion Salt water \$ 5. Simulation parameters Freshwater 6 Run LandSFACTS model Supra-littoral sediment 5 7a_Outputs Statistics Eittotal rock 7b_Outputs to Shapefiles Internet sedment \$ tool Raster to Polygons III Saltmarih evention_e055fb6.txt README.txt III Urban SI.M-OptionsTool_package_template III Suburban III LO Projects ⊟ Backgrounds III SLM-OptionsTool version ∃ C LCM07_22-23_Sub-Urban-Urban ListofFilesToAdd.on ∃ 12 LCM07_16_Freshwater HI BE GIS III □ LCM07_1-2_Broadleaved-Confernus 🗄 🛄 Projects E SLM-OptionsTool III CLCM07_1-2_Broadleaved-Conifernus iii 🛅 Burkhard_table_170316c.xisa III BE LakeDistrictNPBoundary SLM-OptionsTool_Overall_160318.mxd III CI NT_subw_Wastwater_Area SLM-OptionsTool_Overall_160318_4.mxd ⊞ □ NT_subw_prediction SLM-OptionsTool Overall 160318 b.m. E & LDNP_NTmanagt_1kmBuffer SLM-OptionsTool Overall 160318 Washing SLM-OptionsTool_Overall_1603181_bckp. ii C others SLM-OptionsTool_Overall_1603181_bckp. E Solder Connections I □ OpportunityMaps IE CO D'ALakeDistrict ∃ □ Non-CharigeableAreasMap III @_D5LakeDistrict/GIS I GIT SLM-OptionsTool The state of the second second state of the state of the second s 0 0 H 4 356268.848 485711.292 Meters



ArcGIS toolbox

Viewing the results - Statistics

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2 scenarios based on woodland expansion:

a) Enhancing water cycling

- 3 land functions:
 - water cycling purification

Scenarios

- water cycling nutrient
- erosion regulation
- 2 sub-scenarios

b) Enhancing all 10 land functions

 Highlight complexity & output variability







Expand woodiands to children water quanty

- LCM2007 (vector)
- Woodland expansion (10,000ha)
- No arable decrease
- 3 land functions with equal weights
 - water cycling purification
 - water cycling nutrient
 - erosion regulation



Expand woodlands to enhance water quality

- LCM2007 (vector)
- Woodland expansion (10,000ha)
- No arable decrease
- 3 land functions with equal weights
 - water cycling purification
 - water cycling nutrient
 - erosion regulation

• Priority areas for LU change

Enforce constraint: Protected Habitats with no LU change



a) Enhancing water cycling – land functions



Weight of these functions in comparison to others (non-spatial)

Land functions in the tool	Weights
Glob.Clim.Reg.Carbon	0
Water cycling - Purification	0.34
Water cycling - Nutrient	0.33
Erosion Regulation	0.33
Woodland Connectivity	0
Production - Crops	0
Production - Fodder	0
Production - Timber	0
Visual amenity and recreation	0
Landscape cultural heritage	0



water, priorities of T protected nan. - option I

Scenario





b) Enhancing all 10 land functions scenario

- LCM07 (vector)
- Woodland expansion (10,000ha)
- No arable decrease
- Considers 10 land functions (opportunity & matrices), equal weight all functions



- Priority areas for LU change:
 - 10 land functions
 - values above 3rd quartile only
 - excludes priority habitats



Woodl.

b) 10 land functions scenario, priority areas





- 10 land function opportunity maps
- + only above 3rd quartile

+ 'Protected Habitats' with no LU change



10 land functions scenario, 1 example option

Woodl. Expans.





Equally weighted functions



• for ArcGIS front-end tool



- Interface enhancements beyond NT project
 Implementation in Scotland for scenario development and analyses
 - allow new area of analysis and base maps (i.e. outside of Lake District)
 - allow **new land use classes** (e.g. to include land

management)

- multi-years scenario
- Training sessions

Potential developments



- further output interpretation tools
 - if multiple runs: **summary map over** all new landscapes
 - Spider diagrams
 - export for GoogleEarth



Sustainable Land Management – OptionsTool

Many Thanks for your Attention !



Contact: alessandro.gimona@hutton.ac.uk marie.castellazzi@hutton.ac.uk