ENVIEVAL

Addressing challenges of evaluating impacts of RPDs on soil quality

Experiences from case studies in Hungary and Scotland

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Background to Soils Case Studies

- Soil as a new public good in CMES
- Key evaluation challenges to be addressed:
  - sample selection (soils)
  - modelling-based vs. sampling-based approaches
  - data availability
  - micro/macro linkages
  - causality
- Differences between the case study areas:
  - Soil data availability

Approaches and Indicators

- **Hungary**
  1. Sampling approach to soil organic matter
  2. Modelling approaches:
     – USLE for soil erosion (USLE: Universal Soil Loss Equation)

- **Scotland**
  1. Modelling approach:
     – InVEST for soil carbon and soil erosion
       (InVEST Integrated Valuation of Ecosystem Services and Trade-offs)

Hungary: Sampling Approach, soil organic matter

Macro level

Strengths: Samples are available at national level, taken by experts

Weaknesses: Gaps in contextual data for non-participants, lack of comprehensive statistical differentiation

All soils grouped

Soil depth	0 to 30 cm	30 to 60 cm	60 to 90 cm
Mann-Whitney U	67,119	71,171	68,846
Non-participant	866	865	853
Participant	174	173	173
P value	0.023 (Control > AE areas)	0.31	0.165

Significant difference between AE and non-AE in surface horizons

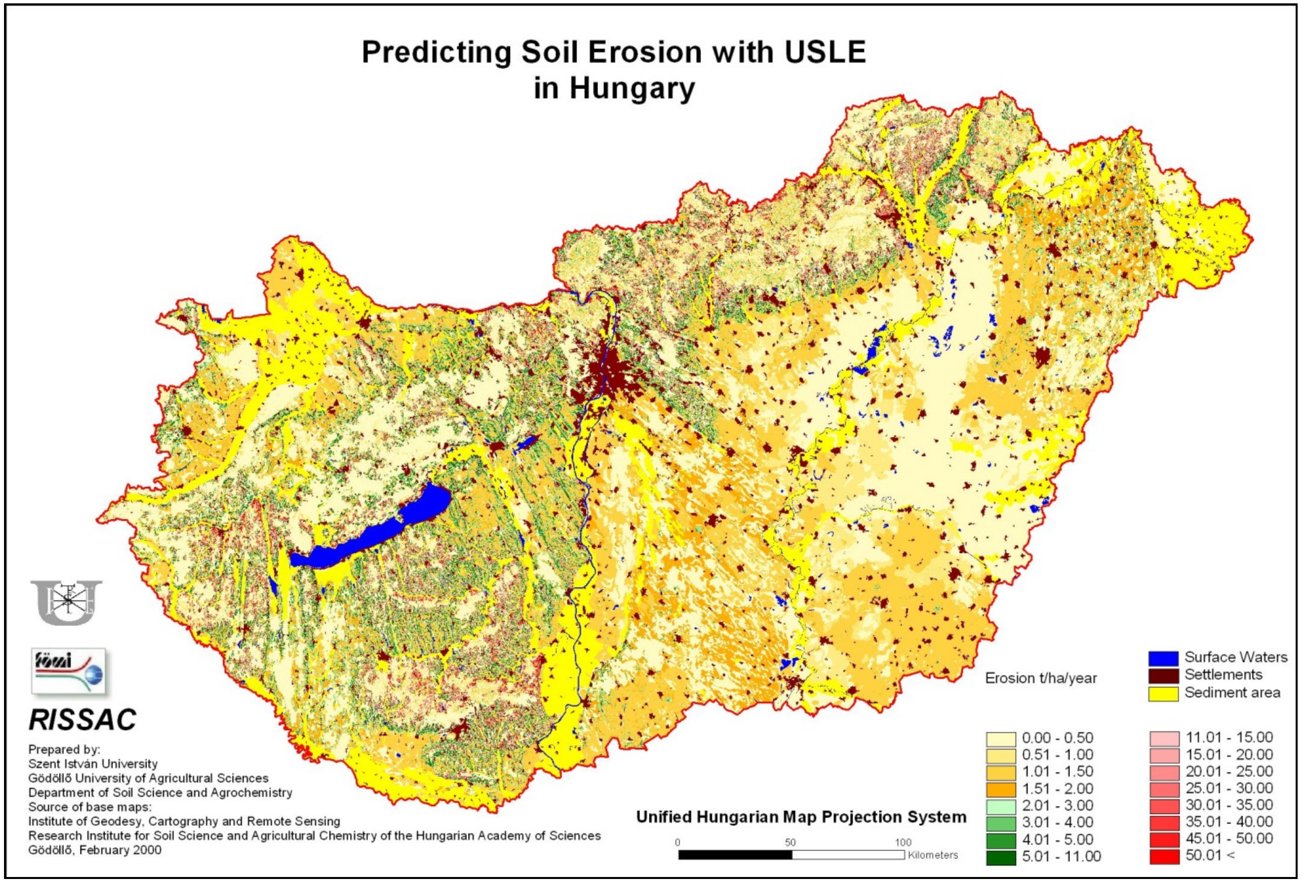
Non-sloping brown-forest soils

T-Test	0 to 30 cm	Soil depth	30 to 60 cm	60 to 90 cm
T	0.88	Mann-Whitney U	1,427.5	1,539
Df	202	Non-participant	179	170
P value	0.378	Participant	25	25
		P value	0.0034 (AE areas > Control)	0.026 (AE areas > Control)

Significant difference between AE and non-AE in lower horizons

Hungary: Modelling Approach, soil erosion

Macro level



- **Indicator values can be derived from the spatial data**
- **Model can be run using updated data on RDP uptake**
- **Changes in indicator values over time can be reported**

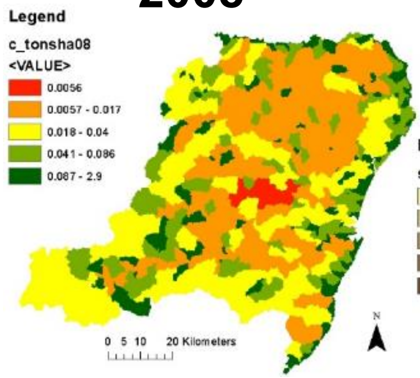
- USLE model **(Wischmeier and Smith 1978)** used for the assessment of average annual soil loss per hectare

Scotland: Modelling Approach, soil carbon & erosion

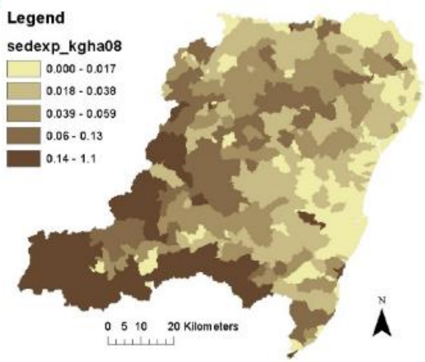
Macro level

- InVEST*, a tool for exploring changes in ecosystem services that lead to changes in benefits that flow to people [by the *Natural Capital Project***]
- *Carbon Storage and Sequestration model,* enabling soil carbon assessment
- *Sediment Delivery Ratio model**** based on Revised USLE calculating the amount of sediment transported out or retained (cell by cell). The total export is calculated at a sub-catchment level
- Land use and uptake using IACS records

2008

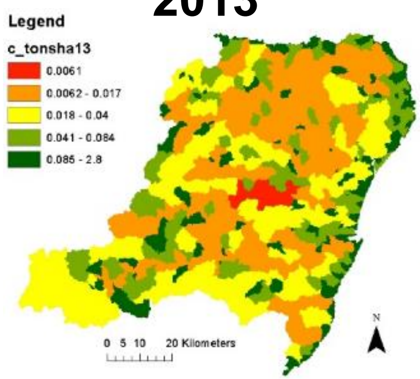


2008



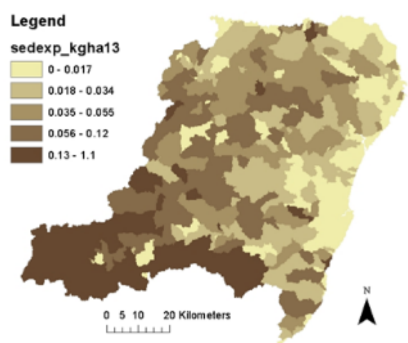
Soil carbon

2013



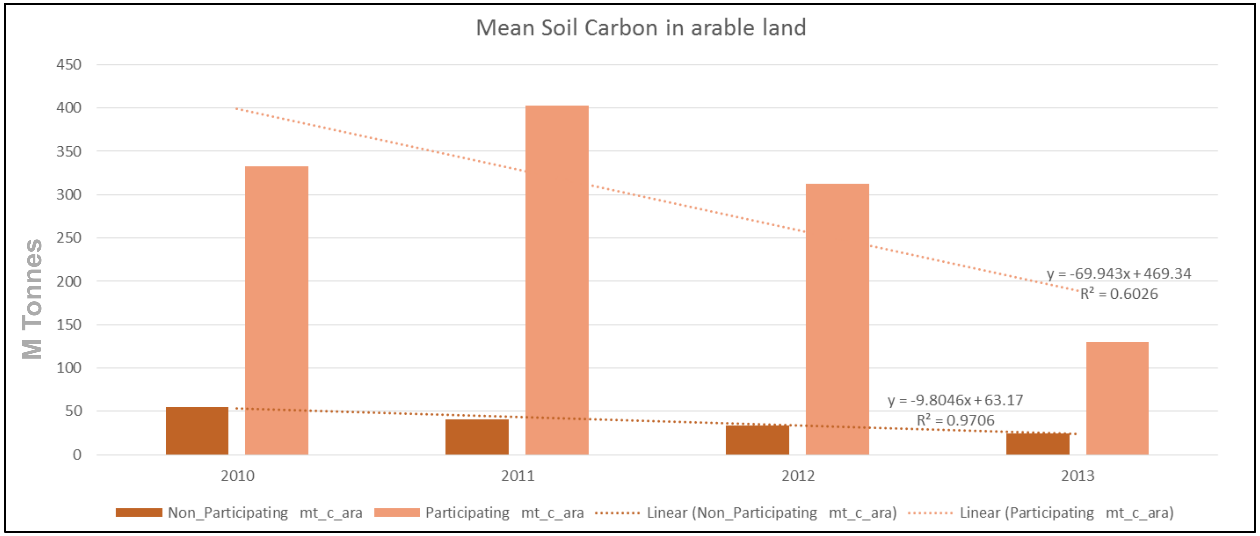
Soil erosion

2013



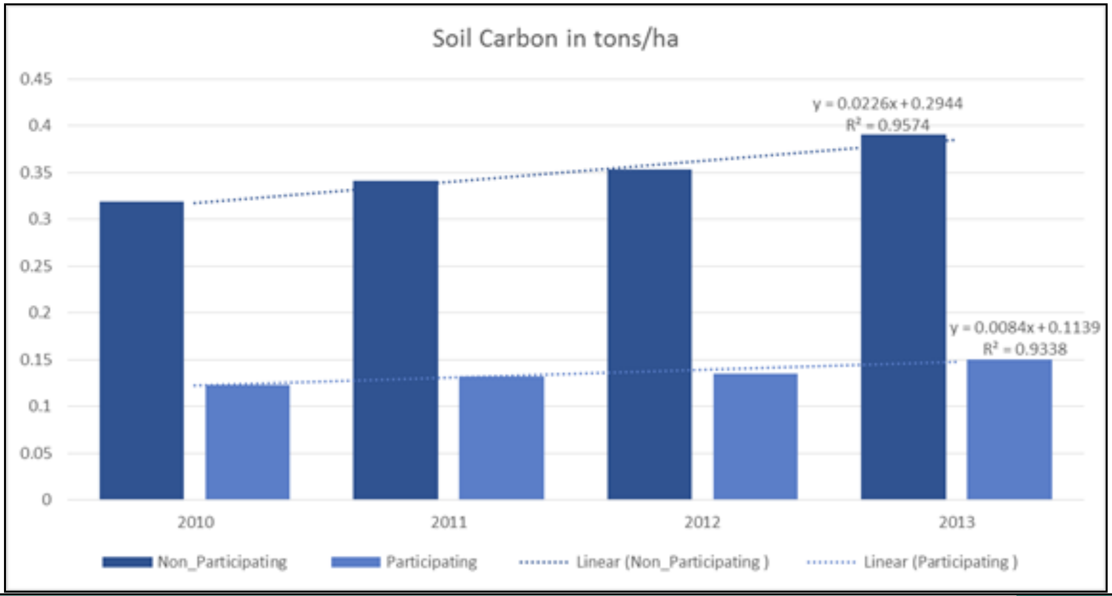
* http://data.naturalcapitalproject.org/nightly-build/invest-users-guide/html
** http://www.naturalcapitalproject.org/invest/
*** Borselli et al. (2008); Cavalli et al. (2013); López-vicente et al. (2013); Sougnez et al. (2011)

Scotland: Results for soil carbon



- Measures considered: 214, 223 and 225

- Results presented at sub-catchment level
- Comparison groups based on sub-catchments with or without uptake of measures



Advantages of selected approaches

- **USLE Hungary:**
  - Very good resolution digital soil and other data relevant for the modelling is available
- **Sampling Hungary:**
  - A large number of samples are collected and analysed in designated laboratories
- **InVEST Scotland:**
  - Model is based on established relationship of land use and land use change and the soil quality indicators
  - Model uses a spatially explicit movement and retention of sediment based on the Revised USLE

Disadvantages of selected approaches

- **USLE Hungary:**
  - USLE does not calculate sediments
  - Model not usable for temporal resolution less than a year
- **Sampling Hungary:**
  - Sampling strategy did not account for creation of participating and non-participating comparison groups
- **InVEST Scotland:**
  - Carbon storage model is based on an oversimplified carbon cycle, and assumption of linear change
  - Limitations of (R)USLE for modelling soil erosion include effect of slope **combined** with vegetation cover on erosion, and the **interaction** of effects of soil type on effects of slope

Lessons learnt: modelling and sampling

Modelled solutions, issues of :
- **Scale / level**
- **Technical approach**

Cost of sampling vs modelling
- **Reliability of sampling v modelled output**

Macro/micro
Problems / solutions

Method

	SQ-HU macro Problems encountered	SQ-HU macro Solutions applied	SQ-HU micro Problems encountered	SQ-HU micro Solutions applied
Sampling method	Lack of data on non-participant farms' other, related activities that effects the performance of the indicator.	The big amount of data for the statistical analyses was expected to reveal real differences between the participant and the non-participant groups.	There were lack of national monitoring data for Agri-environmental payments at the macro level testing area.	Former measurements of soil thickness was used for the analyses of the tested indicator (thickness of layers with soil organic matter)
Modelling USLE	Cannot be used for a higher than one year resolution (theoretically).	In the present case there is no need for more detailed analyses as the programs are compared at a yearly base.	Cannot be used for a higher than one year resolution (theoretically).	In the present case there is no need for more detailed analyses as the programs are compared at a yearly base.
Modelling SENSOR	The SENSOR model was chosen for comparison of countries, e.g. Scotland and Hungary. So its weaknesses applies only at national level.	NA	NA	NA

- **What is required?**
  - **Support pairwise comparisons of participant / non-participant**
  - **Reflect heterogeneity of soils (polygons as mapped, and within polygon variation)**
- **E.g. Stratify by:**
  - **mapped soil types**
  - **land use (e.g. Netherlands)**

Lessons learned, for Authorities: Data and Indicators

- **Strength**
  - Established relationships between land use and land management with the soil quality indicators
- **Weakness**
  - True impact of measures on soil indicators may take decades, beyond scope of RDP evaluation
  - Change within the indicator during RDP limited
- **Recommendation**
  - Development of strategy for RDP specific soil monitoring
  - Consider alternative indicators for soil carbon

Lessons learned, for Evaluators: Value of modelling approaches for assessing impacts of soil quality

- **Strength**
  - Modelling approaches used for ex-ante can be of value for ex-post assessment
  - Indicate impacts of RDP measures when limited data on soils
- **Weakness**
  - Improvements needed for consistency of application between micro and macro level evaluations
  - Building models requires time and effort
- **Recommendation**
  - Choose methods which take account of links between land use and management and soil quality
  - Training for use and interpretation of models and outputs

Claude

Proper name: Noncalcareous Gley Soil

What: Very old, prone to dampness and has become very blotchy over the years. Average height but often rather overweight because of all the water he retains

Where: Covers 10% of Scotland mainly in the western part of Central Scotland

Occupations:

- He is very heavy and hard to turn over so his preferred occupation is as a livestock farmer
- He grows a good crop of grass
- If he is used for growing other crops like barley he needs to lose weight. The easiest way of doing this removing water by cutting drains into him
- He does like some types of trees

Pete

Proper name: Organic Soil

What: Can be between 0.5 and 10 metres high but he is about 90% water so he shrinks a lot if he ever dries out!

Where: Covers 20% of Scotland mainly in the north and the islands

Occupations:

- Stores about 50% of the whole of the UK's surface carbon
- Major supplier of pure water to local people and particularly to the whisky industry
- He has lots of damp surfaces and pools and many bird and insect species love him, including midges! This is a rich *biodiversity*

Sandy

Proper name: Regosol/Brown Calcareous Soil

What: Younger than most Scottish soils. Sandy is light, soft and shallow and prone to breakdown!

Where: Covers 1% of Scotland and is almost always found at the coast

Occupations:

- Very popular character
- Crofters on the west coast use him for grazing sheep and cattle and growing some crops
- In many places he has been used for golf courses
- Plants love him and he has a fantastic variety of plants growing on him, especially in the Machair of the Western Isles
- Rabbits are very fond of him because he is easy to burrow into but too many burrows can cause him to breakdown

Ally

Proper name: Alluvial Soil

What: Often quite tall but with feet permanently in water. Sometimes can be totally under water!

Where: Covers 2% of Scotland mainly beside rivers

Occupations:

- Very adaptable
- Used for arable farming in East Scotland and she loves all sorts of crops
- Loves trees and if left alone she would grow lots of them
- Valuable sponge in some valleys, by flooding she protects places downstream

Rusty

Proper name: Brown Earth

What: Weight increases with depth. Height depends on his parents, but usually over a metre. Appearance has changed over the years due to frequent ploughing

Where: Covers 10% of Scotland mainly in Eastern Scotland

Occupations:

- Loved by Scottish farmers because he is suitable for growing a wide range of crops
- He originally developed under trees so is very happy with trees on him. If it was left to him this is what he would prefer!
- He is very stable so is ideally suited for being built on
- Wildlife and plants love the places that Rusty provides but there is not much space left because we use so much of it

Look after our soils!

Thank you!

2015 International Year of Soils