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RECARE - Preventing and Remediating Degradation of Soils in Europe Through Land Care[1]

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Abstract – Much knowledge is available on soil threats in Europe, but this is fragmented and incomplete, in particular regarding the complexity and functioning of soil systems and their interaction with human activities. The main aim of the new RECARE project is to develop effective prevention, remediation and restoration (or Sustainable Land management – SLM) measures using an innovative trans-disciplinary approach in 17 case study areas across Europe, covering a range of soil threats in different bio-physical and socio-economic environments. Within these Case Study sites, i) the current state of degradation and conservation will be assessed, ii) impacts of degradation and conservation on soil functions and ecosystem services will be quantified, iii) SLM measures will be selected, implemented and evaluated in a participatory process, and iv) the applicability and impact of these measures at the European level will be assessed. Existing national and EU policies will be reviewed and compared to identify potential contradictions and synergies. A comprehensive dissemination and communication strategy will serve a variety of stakeholders to stimulate renewed care for European soils.

Keywords – *soil threats in Europe, land degradation, sustainable land management (SLM)*

1. Introduction

In Europe a number of soil threats have been identified in the European Soil Thematic Strategy (EC, 2006) and subsequent reports (EC, 2012aEC, 2012b) including soil erosion, salinization, compaction, desertification, floods and landslides, loss of organic matter, contamination, sealing and loss of soil biodiversity. A wealth of knowledge exists on most soil threats but this knowledge is spread over numerous and diverse publications, which, together with a lack of understanding of bio-physical processes and of threshold behavior under current and future climatic and land use conditions, hinders effective remediation action. Most reports or guidelines with regard to soil threats are rather qualitative or descriptive and do not allow selection of effective prevention and mitigation measures (Jeferry et al., 2010; EC, 2012a). Research on bio-physical and socio-economic aspects of soil degradation and its control is not sufficiently integrated. Field testing and adoption of SLM measures has often been proven insufficient to restore soil functions and ecosystem services (WOCAT, 2007). It has become clear that a high effectiveness of SLM measures alone is not sufficient to ensure adoption and implementation. Adoption is a complex process, in which the socio-economic and political impacts of measures also need to be duly considered. This requires a trans-disciplinary, integrated approach, as proposed by the RECARE project.

2. Project description

2.1. Main objectives

The main objectives of RECARE are to

- Identify and fill knowledge gaps in our understanding of the complex functioning of soil systems under the influence of climate and human activities;
- Develop a harmonized methodology to assess the state of degradation and conservation in relation to different soil threats;
- Develop a universally applicable methodology to assess the impacts of soil degradation and related con-

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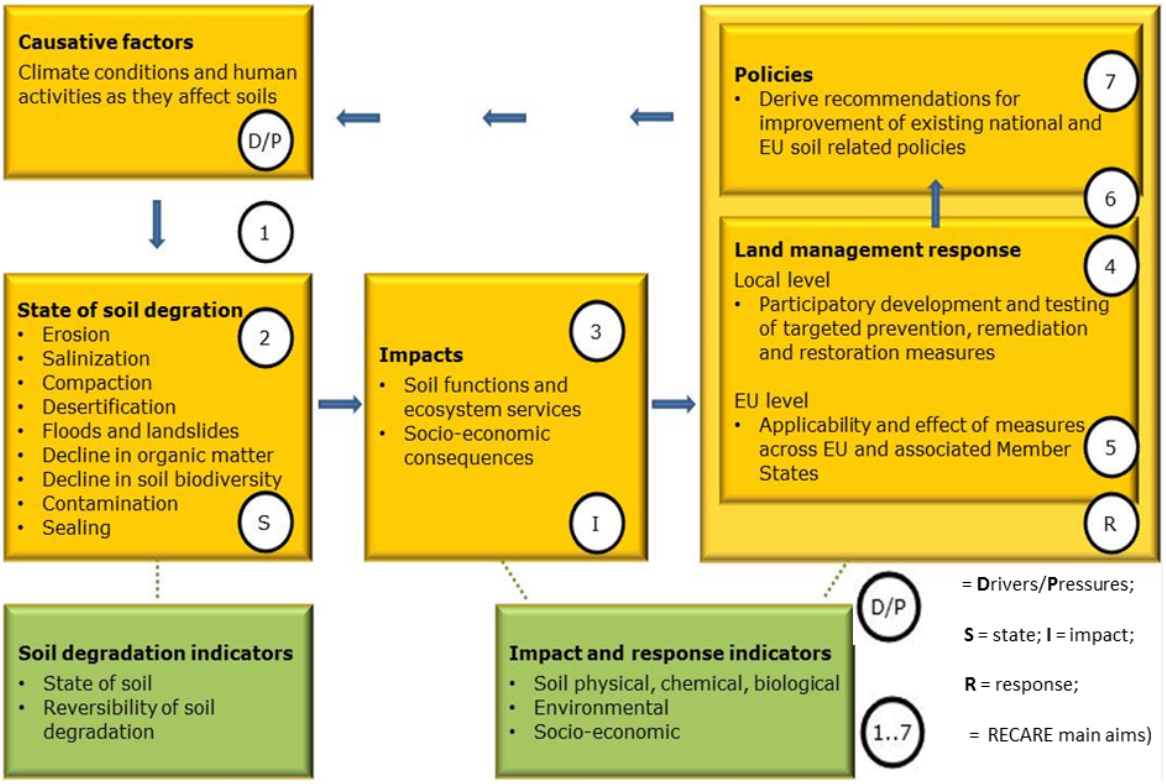

Figure 1: The RECARE conceptual framework for assessing, preventing and remediating soil degradation in Europe

servation measures upon soil functions and ecosystem services, including costs and benefits;
- Design, select, and implement in close collaboration with stakeholders, innovative prevention, remediation and restoration measures, and evaluate the efficacy of these measures regarding soil functions and ecosystem services as well as costs and benefits;
- Upscale results from the study site to the European scale using innovative simulation approaches to evaluate the applicability and effectiveness of measures across EU Member States, and associated countries;
- Evaluate constraints for, and ways to, facilitate adoption of these measures by stakeholders;
- Carry out an integrated assessment of existing soil related EU and national policies and strategies to identify their goals, impacts, synergies and potential inconsistencies, and to derive recommendations for improvement based on RECARE results;
- Disseminate project results to all relevant stakeholders, from land users to high level policy makers.

The concept of RECARE is based on the DPSIR approach (see Figure 1)

Soil plays a fundamental role in the provision of ecosystem goods and services that ensure human well-being, but this role is jeopardised by land degradation. As degradation problems are caused by the interplay between bio-physical, socio-economic and political factors, all of which vary across Europe, these problems are by definition site-specific and occur at different scales. 17 Case Studies are studied to include the various conditions in Europe (Figure 2) and to find the appropriate responses. Table 1 provides an overview of these Case Studies and demonstrates that in most Case Study areas, there are sev-

Table 1: Identified threats for each of the different Case Studies (dominant threat in bold capitals)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Erosion by water	**X**	**X**	**X**	x	x		x	x	x	x					x	x	x
Erosion by wind							x	x									
Salinization				**X**													
Compaction	x				**X**		x										
Sealing						**X**	x							x			
Desertification			x	x			**X**	**X**									
Floods and landslides	x					x			**X**	**X**				x	x		
Loss of organic matter – organic soils											**X**	**X**					
Loss of organic matter – mineral soils		x						x					**X**	**X**	x		
Contamination						x							x		**X**	**X**	x
Soil biodiversity		x					x				x						**X**

eral relevant soil threats. This also allows us to work on several soil threats in combination, which is crucial as certain soil threats are related and may enhance each other, e.g. erosion and loss of organic matter, sealing and flooding. Finally, the large number of study sites will also allow the identification of common denominators and drawing more general conclusions at a European scale, as well as presenting harmonized methodologies of soil threats assessment, and their prevention, remediation and restoration.

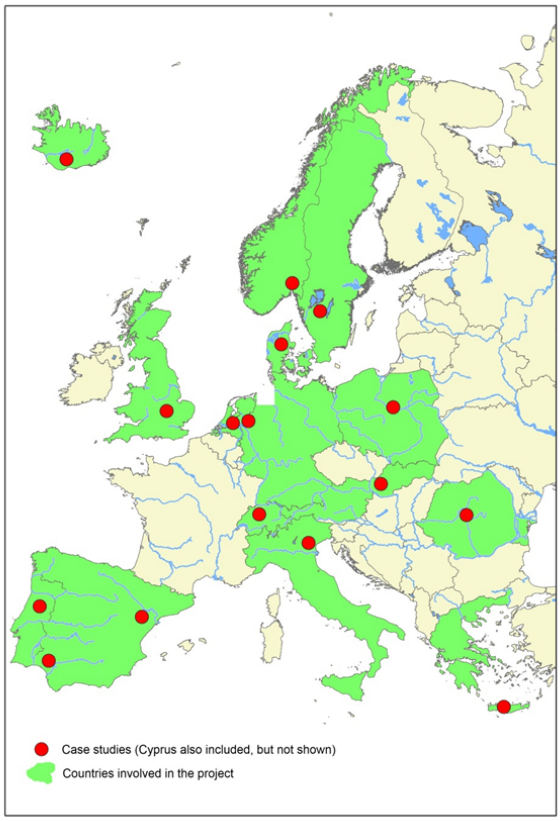

Figure 2: Location of RECARE Case Study sites in Europe

Various studies have assessed the extent and degree of soil degradation across Europe. The recent report 'The implementation of the Soil Thematic Strategy and on-going activities' (EC, 2012a) stated that 20% of Europe's land surface is subject to erosion rates above 10 t/ha/yr, while soil sealing leads to the loss of more than 1000 km2 of productive land each year. The EC (2012b) noted that soil degradation processes are accelerating in many parts of Europe, confirming earlier findings by EEA (2005). Van Beek and Tóth (2012) provide suggestions for harmonization of methods to assess soil threats in Europe. Furthermore there is a multitude of publications that deal with individual soil threats highlighting concerns about soil degradation in Europe that need to be taken very seriously and with measures urgently needed to avoid further loss of soil functions, or to restore these where necessary.

As noted by the EC (2006), soil degradation is often driven by human activity, such as inadequate agricultural and forestry practices, industrial activities, tourism, urban sprawl and construction works. The identification of soils at risk should be based on soil knowledge in combination with the impacts of management (OECD, 2003). Soil degradation, in turn, might impact climate change and carbon sequestration, the provision of water, biodiversity and can also impair the health of citizens and threaten food security (EC, 2006).

Our understanding of how humans and soils interact is still incomplete. For agricultural soils there is a large body of work examining socio-economic factors that affect the adoption of SLM practices. With the recent shift in emphasis towards facilitation of learning, there has been more recognition of a need for soil scientists to operate in a more collaborative way with all stakeholders, including land-users, developers, professionals, regulators and policy makers. It has also become clear that SLM measures should not only address bio-physical aspects, but also socio-economic and political ones (FAO, 2011). Economically profitable measures are not always widely adopted e.g. due to financial motives (e.g. lack of money to meet initial investments in measures) or due to less tangible cultural, religious or political factors. More trans-disciplinary approaches, which emphasise the integrated concept of humans in nature, are being applied.

Within the RECARE project, a structured methodology is foreseen to advance the current state of knowledge along a number of priority themes. The methodology is largely based upon the successful recent EU-FP6 project DESIRE (Desertification mitigation and remediation of land, http://www.desire-project.eu/). DESIRE developed and implemented a universal approach to implementing land degradation mitigation technologies (Hessel et al., forthcoming). Incorporated in the project was a strong intention to ensure that research was "user-inspired, user-friendly and user-useful". The DESIRE process followed a number of steps coinciding with the planning phases of SLM. A structured stakeholder consultation process was designed (Schwilch et al., 2012a, b) to select promising SLM measures for implementation. Field experiments were subsequently performed to assess and document the effectiveness of these measures. Modelling approaches were developed for scaling up feasibility field to regional level (Fleskens et al, forthcoming).

Although the basic approach of RECARE is inspired by the DESIRE project, it differs substantially in a number of ways and will lead to significant new insights. The main differences and progress beyond the state-of-the-art developed in DESIRE are:

- *Focus on a multitude of soil threats*; whereas DESIRE was explicitly focusing on combating desertification, RECARE will consider soil threats more comprehensively. The degradation processes that will be studied include soil erosion, salinization, compaction, desertification, floods and landslides, decline in organic matter, contamination and sealing. State-of-the-art knowledge on each of these processes will be thoroughly reviewed to identify knowledge gaps. This approach will allow a stronger focus on innovation for SLM. Moreover, as these processes occur at different

scales and interact, their study in an integrated way is expected to lead to significant new insights.

- *Thorough study of soil functions and ecosystem services*; the DESIRE approach focused on study of different SLM methodologies in dryland contexts. With a broader range of environmental conditions, land uses, stakeholders and scales of study, RECARE will develop a more sophisticated field research programme able to capture this diversity of biophysical conditions and socio-economic perspectives. Significant advances in understanding the links between ecosystem functioning and service provision to stakeholders will be aimed at. The SLM methodologies to be tested will include a much enhanced potential, through involvement of various SMEs developing innovative SLM approaches for a variety of soil threats.
- *Modelling of the effects of sustainable land management methods at multiple scales*; In DESIRE, the PESERA model (Kirkby et al., 2008) was coupled to the newly developed DESMICE model to evaluate costs and benefits of desertification mitigation measures in a spatially explicit way (Fleskens et al., 2012). The focus of the PESERA-DESMICE model has been the field-scale, which is adequate for assessing effects of land degradation and productivity effects at that scale but which does not cover aggregation effects at larger scales. Such aggregation is needed to cover the European scale. There is also a need to adapt PESERA to a larger number of soil threats and for the increasing spatial (100m) and temporal (daily) resolution of datasets. The (observed and potential) interaction between a series of soil threats and drivers which intensify (or actions that mitigate) the individual soil threats has not been studied before. In RECARE we will integrate the PESERA-DESMICE model codes with the state-of-the-art METRONAMICA land use model (`www.metronamica.nl`) to account for land use dynamics, including sealing (Van Delden et al, 2010), and develop a model code to translate the effects of soil degradation measures with regard to ecosystem services, applicable at the European scale. The latter integrated spatial simulation tool will allow a significant step forwards in supporting EU soil policies.
- *Multi-level stakeholder involvement and policy analysis*; While DESIRE focused on the local effects of remediating desertification, a much wider and complex stakeholder involvement process is required for soil threats such as flood risk with up- and downstream populations. Moreover, policy drivers and variations across the continent will receive much more thorough attention in RECARE. This means that scenario analyses with integrated models will bear a direct relation to the policy challenges faced at the European level.

3. Added value to the One Health approach

Various soil functions directly or indirectly affect human health and wellbeing. Soil functions and services relate amongst others to critical societal challenges like food production, water provision, carbon sequestration, pest and disease regulation, biodiversity conservation and civil protection against extreme events.

4. Conclusion

The RECARE project will offer an innovative and integrative approach to the assessment of soil threats in Europe and their prevention, remediation or restoration. The project will largely build on experiences in the DESIRE project, and lessons learnt during that project will be incorporated and improvements made to the approach, while keeping in mind the specific needs and requirements in the European context.

References

EEA. (2005). The European Environment – state and outlook 2005. European Environment Agency, Copenhagen.

EC. (2006). Thematic Strategy for Soil Protection. `http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2006:0231:FIN:EN:PDF`

EC. (2012a). Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: The implementation of the Soil Thematic Strategy and ongoing activities. Brussels, COM(2012) 46 final. `http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2012:0046:FIN:EN:PDF`,15 pp.

EC. (2012b). The State of Soil in Europe. JRC Reference Report. JRC. Ispra. Italy `http://ec.europa.eu/dgs/jrc/downloads/jrc_reference_report_2012_02_soil.pdf`, 80 pp

FAO. (2011). The state of the world's land and water resources for food and agriculture (SOLAW) – managing systems at risk. Rome: Food and Agriculture Organisation of the United Nations.

Fleskens L, B. Irvine, M. Kirkby, and D. Nainggolan. (2012). Model outputs for each hotspot site to identify the likely environmental, environmental and social effects of proposed remediation strategies. DESIRE report 100

Fleskens, L., D. Nainggolan, and L.C. Stringer. (2013). An exploration of scenarios to support sustainable land management using the PESERA-DESMICE integrated environmental socio-economic models. Environmental Management, submitted.

Hessel, R., M.S. Reed, N. Geeson, C.J. Ritsema, G.W.J. van Lynden, C.A. Karavitis, G. Schwilch, V. Jetten, P. Burger, M.J. van der Werff ten Bosch, S. Verzandvoort, E. van den Elsen, and K. Witsenburg. (2013). From Framework to Action: The DESIRE approach to combat desertification. Environmental Management, submitted.

Jeffery S., C. Gardi, A. Jones, L. Montanarella, L. Marmo, L. Miko, K. Ritz, G. Peres, J. Römbke and W. H. van der Putten (Eds.). (2010). European Atlas of Soil Biodiversity. European Commission, Publications Office of the European Union, Luxembourg.

Kirkby, M.J., Irvine, B.J., Jones, R.J.A., Govers, G. and the PE-

SERA team, (2008). The PESERA coarse scale erosion model for Europe. I-Model rationale and implementation. European Journal of Soil Science 59, 1293-1306

OECD (2003). Descriptions of selected key generic terms used in chemical hazard/risk assessment. OECD Environment, Health and Safety Publications, Series on Testing and Assessment, No. 44.FAO. 2011. The state of the world's land and water resources for food and agriculture (SOLAW) – managing systems at risk. Rome: Food and Agriculture Organisation of the United Nations.

Schwilch G., F. Bachmann, and J. de Graaff. (2012a). Decision support for selecting SLM technologies with stakeholders. Applied Geography 34: 86-98. Doi 10.1016/j.apgeog.2011.11.002.

Schwilch, G., R. Hessel, and S. Verzandvoort. (Eds). (2012b). Desire for Greener Land. Options for Sustainable Land Management in Drylands. Bern, Switzerland, and Wageningen, The Netherlands: University of Bern - CDE, Alterra - Wageningen UR, ISRIC - World Soil Information and CTA - Technical Centre for Agriculture and Rural Cooperation.

Van Beek, C.L. and G. Tóth. (2012). Risk assessment methodologies of soil threats in Europe (RAMSOIL). Status and options for harmonisation for risks by erosion, compaction, salinization, organic matter decline and landslides. JRC Scientific and Policy report. Report EUR 24097 EN.

Van Delden, H., T. Stuczynski, P. Ciaian, M.L. Paracchini, J. Hurkens, A. Lopatka, Y. Shi, O.G. Prieto, S. Calvo, J. Van Vliet, and R. Vanhout. (2010). Integrated assessment of agricultural policies with dynamic land use change modelling. Ecological Modelling 221, 18: 2153-2166.

WOCAT (2007). Where the land is greener: Case studies and analysis of soil and water conservation initiatives worldwide. Edited by Liniger, H.P. and W. Critchley. World Overview of Conservation Approaches and Technologies (WOCAT), Berne, Switzerland.

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