Introduction

In 2006 the EU launched the Thematic Strategy for Soil Protection in response to assessment reports showing that soil degradation may be a serious problem in Europe. The Strategy recognizes that certain soil threats, such as erosion, soil organic matter decline, compaction, salinization, erosion and landslides, occur in specific risk areas, which remain to be identified. The identification of such risk areas occurs on the basis of Risk Assessment Methodologies (RAMs).

The following soil threats were assessed (short definition):

Compaction: changing the nature of the soil such that there is a decrease in the volume of voids between soil particles or aggregates.

Landslides: movement of a mass of rock, earth (e.g. soil) or debris down a slope due to gravity.

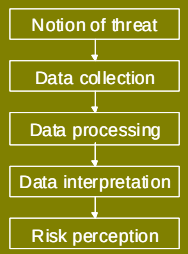
Erosion: The wearing away of the land surface by water, wind, ice, gravity or other natural or anthropogenic agents.

Salinization: The condition in which the salt content of soil accumulates over time to above normal levels.

Soil organic matter decline: Reduction in soil organic matter content as measured over a period of time.

Risk assessment deals with the probability of occurrence of a soil degradation process relative to a critical threshold value. While the soil degradation process itself and the probability of occurrence may be quantified via objective means, the threshold values and the acceptability of the risks are value-laden, and must be defined at the policy level. Basically, the threshold values and acceptability of the risks should be related to the resilience capacity of the soil. The risk assessment involves a series of activities, as shown in the box below.

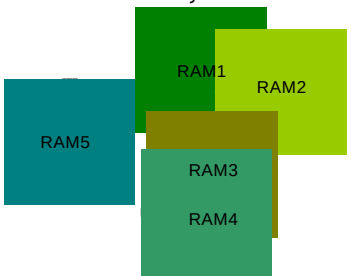
The risk assessment chain for soil threats



For instance: a RAM for erosion consists of data on climate, land use, relief and soil texture (*data collection*), which is used in a process model (*data processing*). The model provides an erosion rate which is compared with a threshold value (data interpretation). The extent of exceeding the threshold value is expressed in the sense of urgency (*risk perception*), which can be reflected in color scaling on maps.

RAMs in EU member states

Various EU member states have RAMs to identify areas at risk for soil degradation. Some RAMs are already implemented in legislation, whereas others are still in development. However, most Member States do not have a complete set of RAMs for all soil threats. At present about half of the EU member states report to use one or more soil RAMs, but these RAMs can be very different, because:



Different RAMs may have large overlaps or be very different.

- RAMs have been developed independently of each other.
- The definition of the soil threats differ.
- Environmental conditions differ.
- Driving forces of the threat differ.
- Objectives of the RAMs differ.

Harmonization of soil RAMs

The use of different RAMs for one specific soil threat may result in different levels of soil protection in EU Member States. Such unevenness can be nullified when RAMs are harmonized. Reasons to harmonize RAMs include:

- The transboundary character of soil threats and their effects;
- The need to establish a minimum level of protection;
- The ability to exchange information easily and compare results;
- To establish equal production facilities and market access.

Most RAMs currently in practice are incomplete and cover only the first two steps of the risk assessment chain. These RAMs are rather process quantifications and do not assess the perception of risks. The common use of incomplete RAMs is caused by the complexity to derive adequate threshold values and risk perceptions.

Harmonization is making results comparable and compatible hence consistent throughout every process of risk assessment. Harmonization is different from standardization, where standardization aims at making procedures exactly similar.

The need and options for harmonization

The need for harmonization appeared highest for RAMs on erosion and compaction. It was not possible to assess the need for harmonization for soil organic matter decline, because for this soil threat many developments are still ongoing.

Needs versus options for harmonization
The need for harmonization indicates the necessity to harmonize RAMs, i.e. it indicates the discrepancies between different RAMs for the same soil threat. The options for harmonization indicate the difficulties occurring during the process of harmonization and are related to the efforts needed for harmonization.

The best options for harmonization were found for soil organic matter decline and landslides, but the reasons were very different: the landslides scientific community is already in a process towards harmonization as a result of, amongst others, the real impact the landlside threat has on livelihood, economy in some egions, as well as pressure from external parties. For soil organic matter decline the development of RAMs is still in its infancy and the best time to harmonize RAMs is when they are being developed. The other soil threats have intermediate positions and are relatively hard to harmonize.

Towards harmonization of soil RAMs

Harmonization of RAMs is possible when consensus is reached about i) the understanding of the soil threat, ii) the scale and iii) the objective of the RAM. Then, harmonization on data collection, data processing, data interpretation and risk perception can be achieved, but the options for harmonization may differ per step in the risk assessment chain for each soil threat. For example, for compaction harmonization is hampered by the use of different indicators, whereas for erosion harmonization is hampered by differences in, and discussions about, proper threshold values.

From the RAMSOIL project four main conclusions can be drawn:

- Many soil RAMs are still incomplete, i.e. are process quantifications rather than risk assessments.
- Many different RAMs are used but often the basic concepts (i.e. assumptions or process understanding) are comparable.
- Highest needs for harmonization are expected for erosion and salinization.
- Best options for harmonization are expected for landslides and soil organic matter decline.

Harmonization of soil RAMs demands for completion of soil RAMs and for harmonizing every step in the risk assessment chain. These two activities can be merged as the best time to harmonize RAMs is when they are being developed.

Case-study on harmonization of soil RAMs

In a case-study the erosion RAMs 'SIDASS-WEPP' and 'PESERA' were compared. Both RAMs can be considered as 'process based modeling', but the SIDASS-WEPP approach is more complex compared to the PESERA approach. A comparison of the two models at European scale showed that SIDASS-WEPP predicted higher soil loss rates and higher spatial variability compared to PESERA (Figure 1).

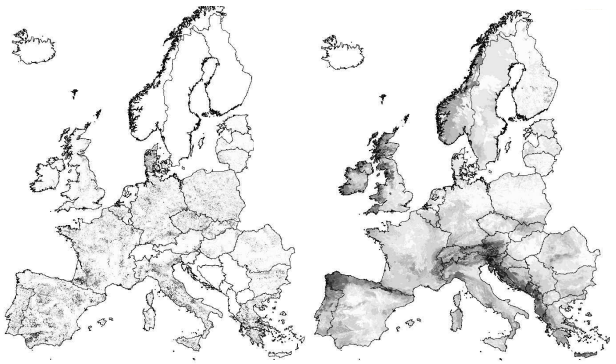


Figure 1. Soil loss evaluated using PESERA model (left) and SIDASS-WEPP model (right). The scale of the original soil map of Europe was 1:1,000,000; Climate data came from ATEAM interpolation for 1960-1990 time series. The rate of predicted soil erosion increases from light to dark tones.

The use of different RAMs resulted in different acreages of areas at risk at national level (Figure 2) and thus has consequence for possible legislation on soil erosion. Due to complex calculation algorithms in both approaches of data processing, harmonizing the PESERA and SIDASS-WEPP would require large efforts and would probably result in a 'compromise model'. Therefore, for this set of RAMs we suggest to reach scientific consensus on data processing and to harmonize data collection, threshold values and risk perception.

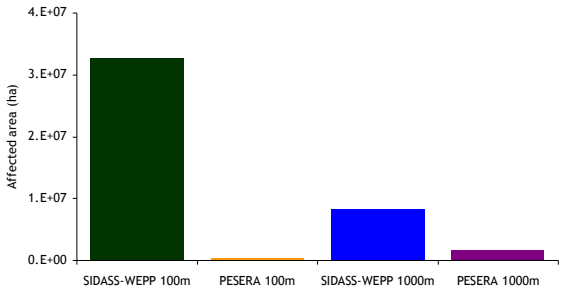


Figure 2. Affected areas (ha) using a threshold value of 1 tonnes ha^{-1} for soil erosion in Romania using different methods (PESERA and SIDASS-WEPP) and using different grid sizes (100m and 1000m).

More information

For more information please visit the project's website: www.ramsoil.eu or send a message to info@ramsoil.eu. Reports, presentations and scientific papers from the RAMSOIL project can also be downloaded from the project website.

This study was part of the RAMSOIL project on harmonization of risk assessment methodologies for soil threats. The RAMSOIL project was co-funded by the European Commission, DG Research, within the 6th Framework Programme of RTD, (Priority 8 - Specific Support to Policies, contract n° 44240). The views and opinions expressed in this publication are purely those of the writers and may not in any circumstances be regarded as stating an official position of the European Commission. The RAMSOIL project was jointly performed by ICPA (Romania), CNRS (France), CIDE (Spain), RISSAC-MTA TAKI (Hungary), JRC-IES (Italy), Wageningen University (The Netherlands) and Alterra (The Netherlands, coordinator).

The photos is this flyer show examples of salinization (p. 2), erosion (p. 4), soil organic matter decline (p. 4), presentation of the RAMSOIL results at the EUROSOIL conference (p. 3) and the project team (p. 6).

RAMSOIL
Risk Assessment Methodologies for Soil Threats

Towards harmonization of risk assessment methodologies of soil threats in the EU