STRENGTHENING OPTIMAL FOOD CHAIN ELEMENT TRANSPORT BY MINIMIZING SOIL DEGRADATION
RECOMMENDATIONS FOR SOIL THREATS IDENTIFICATION ON DIFFERENT SCALES IN THE EUROPEAN UNION

Gergely TÓTH - Luca MONTANARELLA - György VÁRALLYAY - Tibor TÓTH - Nikola FILIPPI*

Introduction

The functional relationships between the elements of the food chain are strongly affected by the degradation of soil. It was realized by the European Commission when it launched a new policy to maintain the optimum soil functions through minimizing soil degradation. In the context of communication "Towards a Thematic Strategy for Soil Protection" by the European Commission, major threats have been identified representing the most important hazards endangering the functioning of soils (EC 2002, Várallyay 2005), including its ability to enhance plant productivity. According to current proposals, that would aim to strike the right balance between EU action and subsidiarity, Member States of the EU shall identify the location and boundaries of land areas in risk of degradation, for each major area-dependent threat to soils. Five major threats have been identified, which are soil and area specific in their appearance: (1) soil organic matter decline (2) erosion (3) compaction (4) salinisation/sodification and (5) landslides. Soil sealing and contamination as well represent major risks for soil functions, however, the probability of occurrence of these threats are mainly independent from soil and land characteristics (Birkás et al. 2005; JRC-IES 2005; Láng et al. 2004). With the collaboration of the Joint Research Centre (JRC) and the European Soil Bureau Network (ESBN), the Soil Information Working Group (SIWG) has been established to prepare a proposal with identification of common criteria to delineate risk areas on different scales (JRC-IES 2005). Present paper summarizes the main conclusions drawn by the SIWG and attempts to estimate the applicability of the approach.

Methods

Common understanding and spatial delineation of risk areas on both European and regional scales need conciliation of national/regional approaches, allowing comparability of non-harmonized procedures existing throughout Europe. Firstly, a conceptual model is proposed in which factors (e.g. climate or land use) acting on a receptor (soil) may cause harm (e.g. erosion, etc). Secondly, the spatial variation in the risk of this harm (threat) is assessed either qualitatively or quantitatively (directly or by modeling). Thirdly, risk area categories are proposed, representing different levels of acceptable threat. The 'Two Tiers' concept is developed to meet these requirements (Table 1) (JRC-IES, 2005). In this concept, 'Tiers' correspond to different work steps, each requiring different (resolution and set of) data.

Tier 1, is a step to provide tool for risk area identification based on qualitative or model-based descriptions using lower data resolution (European level).

Tier 2, is a second step, to provide tool, for risk area delineation and characterization based on higher resolution data (Member States level).

* European Commission Joint Research Centre, Institute for Environment and Sustainability, Unit of Land Management and Natural Hazards, 21020 Ispra (VA) Italy, gergely.toth@jrc.it

Table 1. Application of the two tiers approach

Tier	Target	Description
Tier 1	Broad risk zones identification (problem identification and localization)	available data at European-level Geographical scale of 1:1,000,000/1:250,000 Soil-specific qualitative approach, and/or Model-based (pedo-transfer rule) approach combined with thresholds indicators
Tier 2	Detailed risk zone delineation. Measures/implementation plans to protect and/or prevent soils within the risk zones	Data available/relevant at the Member State level (e.g. regional soil maps) Qualitative/quantitative/model approach

For each of the five major threats the following conditions have been examined in order to define common criteria of risk identification throughout Europe:
identification of factors/hazards related to the threat („external" factors)
characterization of the receptor relevant to the threat („internal" soil factors)
performance specification, model selection (with data requirements)

It is suggested that in a *first tier* to risk area identification, the general area at risk must be derived from existing information (or from data expected to be available soon). The concept can provide broadly defined zones according to the kind of the threat, its severity and risk to appear, within which specific measures have to be planned to maintain the functioning capacity of soils. Outside these zones, no measures may be taken, and no specific information about soils may needed in this context, given that no proof for the contrary occurs in the second tier assessment.
The issue of *second tier* data quality and map data resolution, political purpose and cost, has to be decided individually by each Member State. However, from a scientific point of view, changes of the state of soils can only be detected if a certain quality of data and models becomes available.

Results and discussion

The guidelines for risk area identification for each soil threat define common criteria applicable for European and Member State/ regional scales - to identify elements of degradation threats with possible presentation (visualization) options. Data availability and level of detail in the presentation are amongst the most important issues in the common criteria assessment.
Information content -- During the common criteria evaluation procedure, most important factors of risk area delineation have been identified. These factors, on the one hand represent key elements in assessing/modeling soil threats under different ecological (and management) conditions in Europe, while on the other hand are available at date, or can be produced in reasonable time and costs.
Soil typological unit (soil type), texture, soil organic carbon (concentration and stock) bulk density, structure and soil hydraulic properties are those soil parameters required for Tier 1 assessment. Climate, topography, bedrock, lands cover, land use, groundwater informatior complete the required dataset.

During Tier 2. assessment national/regional approaches developed in Member States may apply more detailed information, that consist of a wider datasets.
Geographical scale of analysis and data quality -- Soil information at 1:1,000,000 scales is the basic requirement for Tier 1 delineation of risk areas. (Except for landslides, where a specific concept has been developed.) Based on existing continental datasets a first outline of areas for specific assessment can be approached. However, the level of uncertainty of results provided on the basis of the 1:1.000.000 map and possible mismatching with knowledge available in Member States would require the development of the available datasets. A 1:250,000 scaled thematic soil map may provide sufficient background for the Tier 1 identification of risk areas. National databases (with spatial details at 1:250.000 scale or finer) may provide bases for reporting on risk areas in Tier 2 descriptions. Similar to Tier 1 situation, the confidence of assessments (and reports) will largely depend on the detail of the available dataset.

Conclusions

A proposal for common criteria for delineation of areas in risk of soil degradation has been prepared (JRC-IES 2005). It should be achievable in the further development of the soil thematic strategy to develop a common framework, which attempts to keep the linkage of soil information in EU Member States with pan-European data, and thus provides comparable data, which can be interpreted in a meaningful way not only for the member states, but also for continental-wide Europe. Much effort still have to be conducted to establish an efficient workflow for updating and maintaining thematic layers with highly detailed information, more particularly in a participatory approach, involving bottom-up transfer of spatial information from local to global level. The new "Multiscale European Soil Information System" (Panagos et al. 2006) should be integrated into more comprehensive/multi-layer monitoring and reporting programmes, for example the Commission's Infrastructure for Spatial Information in Europe initiative. In this manner the infrastructure and access to soil information transfer can be developed to assist the protection of the multifunctionality of soils (Van-Camp et al. 2004, Várallyay 2003) and contribute to optimal food chain element transport.

References

Birkás, M., Bencsik, K., Stingli, A., Percze, A. 2005: Correlation between moisture and organic matter conservation in soil tillage. Cereal Research Communications, 33 (1) 25-28.

EC (Commission of the European Communities) 2002. Communication of 16 April from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions: Towards a Thematic Strategy for Soil Protection {COM (2002) 179 final} Brussels

JRC-IES (Joint Research Center- Institute for Environment and Sustainability) 2005. Common Criteria for Risk Area Identification according to Soil Threats. Technical Report based on the manuscript of Eckelmann, W., et al. 2005 ESBN/JRC. Manuscript

Láng, I., Jolánkai, M., Kőmíves, T. (Eds) 2004: Pollution processes in agri-environment. A new approach. Akaprint Publishers, Budapest, 277 pp.

Panagos, P., Van Liedekerke, M., Filippi, N. and Dusart, J. 2006. Multiscale EUropean Soil Information System (MEUSIS) at: http://eusoils.jrc.it/projects/Meusis/main.html. Last accessed on 9 January 2006

Van-Camp. L., Bujarrabal, B., Gentile, A-R., Jones, R.J.A., Montanarella, L., Olazabal, C. and Selvaradjou, S-K. 2004. Reports of the Technical Working Groups Established under the Thematic Strategy for Soil Protection. EUR 21319 EN/5, 872 pp. Official Publications of the European Communities, Luxembourg.

Várallyay, Gy. 2003. Role of soil multifunctionality in future sustainable agricultural development. Acta Agronomica. 51. (1) 109-124.

Várallyay, Gy. 2005: Talajvédelmi stratégia az EU-ban és Magyarországon [Soil conserevation strategy in EU and in Hungary]. Agrokémia és Talajtan, 54. (1-2) 203-216.

Kádár, I. (2004): Szennyvíziszap-adagok hatása a növény (*Triticum vulgare* L.)-talaj rendszer néhány mikrobiológiai és biokémiai tulajdonságára (Impact of sludge treatments on some microbiological and biochemical properties of plant (*Triticum vulgare* L.)-soil system. – *in Hungarian*). Agrokémia és Talajtan. 53. 3-4. 331-342 pp

Svetková, K.; Henselová, M.; Morvová, M. (2005): Effects of a carbonization product as additive on the germination, growth and yield parameters of agricultural crops. Acta Agron. Hun. 53. (3). 241-250 pp

Tanács, L., Matuz, J., Gerő, L., Petróczi, I.M. (2005): Effect of NPK Fertilizers and Fungicides on the Quality of Bread Wheat in Different Years. Cereal Res. Commun. 33 (2-3): 627-634 pp