



Are existing soils data meeting the needs of stakeholders in Europe? An analysis of practical use from policy to field



G.A Campbell^{a,b,*}, A Lilly^a, R. Corstanje^b, T.R. Mayr^b, H.I.J Black^a

^a The James Hutton Institute, Craigiebuckler, Aberdeen, AB15 8QH, United Kingdom

^b Cranfield University, College Road, Cranfield, Bedford, MK43 0AL, United Kingdom

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ABSTRACT

Soils form a major component of the natural system and their functions underpin many key ecosystem goods and services. The fundamental importance of soils in the environment means that many different organisations and stakeholders make extensive use of soils data and information in their everyday working practices. For many reasons, stakeholders are not always aware that they are reliant upon soil data and information to support their activities. Various reviews of stakeholder needs and how soil information could be improved have been carried out in recent years. However, to date, there has been little consideration of user needs from a non-expert perspective. The aim of this study was to explore the use of explicit and hidden soil information in different organisations across Europe and gain a better understanding of improvements needed in soil data and information to assist in practical use by non-expert stakeholders. An on-line questionnaire was used to investigate different uses of soils data and information with 310 responses obtained from 77 organisations across Europe. Results illustrate the widespread use of soil data and information across diverse organisations within Europe, particularly spatial products and soil functional assessments and tools. A wide range of improvements were expressed with a prevalence for finer scale resolution, trends over time, future scenarios, improved accuracy, non-technical supporting information and better capacity to use GIS. An underlying message is that existing legacy soils data need to be supplemented by new up-to-date data to meet stakeholder needs and information gaps.

1. Introduction

Soils form a major component of our natural environment on Earth, performing an array of essential functions that underpin key ecosystem goods and services which we rely on (Costanza et al., 1997; Smith et al., 2015). The significance of soils within the environment has meant that stakeholders have to use a wide variety of soils data and information in their decision making.

The concept of soil functions was first conceived during the early 1950s and has since been widely adopted in national and regional policy (Blum, 2005). From the mid-1900s onwards, soils functional aspects have been incorporated into assessment tools such as maps and models that assist decision makers across a wide range of soil-related issues from land use, cropping practises, protection of water bodies, and restoration of habitats to climate regulation. For instance, many early assessments around agricultural productivity, such as the Land Capability for Scotland (Bibby et al., 1982) and laterally, the CAPRI model (Britz and Witzke, 2014), are based on soil maps. However, functional assessments have since extended across many other issues such as

groundwater vulnerability (Environment Agency, 2013; Harter and Walker, 2001).

When exploring what needs to be improved in terms of soils data and information, we need to understand the contemporary needs of stakeholders particularly where soils data and information may be implicit or part of an underlying model or assessment tool. There are various reviews of stakeholder needs and how these levels of information could be improved which have been carried out in recent years (Black et al., 2012; Prager et al., 2014; McKee, 2014; Valentine et al., 1981; Grealish et al., 2015; Omuto et al., 2013; Houšková et al., 2010; Panagos et al., 2012). However, these reviews have generally assumed that stakeholders have some knowledge of soils or are fully aware that they are using soils data and information. The aim of this study is to understand soils data and information stakeholders' needs across Europe from a non-expert perspective.

Jones et al. (2005) reviewed soils resources and information use across Europe and determined that these are traditionally associated through the function of food and fibre production, with increasing applications to other issues such as climate change and water resource

* Corresponding author at: The James Hutton Institute, Craigiebuckler, Aberdeen, AB15 8QH, United Kingdom.
E-mail address: Grant.Campbell@hutton.ac.uk (G.A. Campbell).

management (Blum, 2005; Grealish et al., 2015; Haines-Young, 2011). Soil maps, data and information are used in many sectors besides soil science, such as farming, hydrology, land degradation, policy and environmental modelling (Valentine et al., 1981; Mather, 1988; Houšková et al., 2010; Hallett et al., 2011; Omuto et al., 2013; Prager et al., 2014). The majority of soil information users indicated that key soil attributes are readily available (Wood and Auricht, 2011). However, improvements in a range of soil properties such as soil moisture, toxicity, biology and carbon are required (Auricht, 2004; Grealish et al., 2015).

Furthermore, engineering properties such as subsidence and corrosion are also of interest (Pritchard et al., 2015). These types of information are available but awareness of data accessibility and where to find them remains challenging. Information needs are also specific to stakeholder requirements and the spatial resolution of the undertaking. Black et al. (2012) consulted a wide range of stakeholders in developing the Soil Monitoring Action Plan for Scotland with further consultation taking place with farmers and local authorities by Prager and McKee, (2014). Key improvements mentioned were finer spatial resolution, soil trends, soil biological and physical indicators and sealing.

The FAO (2012) identify three major challenges in addressing soil information availability. The first of these focusses on the importance of soil protection, particularly to the global modelling community as it will help mitigate and adapt to issues such as climate change and food security. A second consideration is soil monitoring, focusing on improving global soil data at finer scale resolution. The third looks at advancing Digital Soil Mapping (DSM) and Digital Soil Assessment (DSA) techniques. DSM and DSA offers potential to map soil properties at detailed and broad scales (McBratney et al., 2003; Behrens and Scholten, 2006; Carré et al., 2007; Hartemink et al., 2008). However, it is not clear how any of these challenges reflect the needs of stakeholders, and difficulties remain around integrating the capability of models and the envisioned users of this data.

Stakeholder interaction and participation should be considered from the outset, and this is very rarely done (Reed, 2008). Studies by Bouma et al. (2012) and Black et al. (2012) highlighted that end-users were often not aware that they were using soils data and information so could not easily communicate further needs. It is therefore not straightforward to assume what the needs of envisioned users of 'new' soil information are, in particular where this information is embedded in derived tools. Here we planned a survey of non-expert users to investigate their current needs and perceived gaps in their ability to deliver in their work activities. This information is vital in addressing how new soil tools and products, such as DSM and DSA, might (or might not) meet the stakeholder requirements and the likelihood of such products being of practical use. Our aim is therefore to investigate what soils assessments and tools stakeholders currently use and what improvements, if any, required for future soil products/information sets.

2. Methodology

A detailed questionnaire was carried out to consider the range of soils data and information currently being used across Europe with a focus on explicit and hidden soils information being used by non-expert stakeholders: non-experts being people who use soils information or data in their everyday work but who are not expected to be academically trained soil scientists.

The questionnaire was compiled using the web-based survey programme Qualtrics (<http://www.qualtrics.com/>). In addressing the different uses of soils data and information, we considered it important to address functions of soils and contact stakeholders with close connections in and around these functions. Therefore, stakeholders were identified in order to be representative of the primary functions of soils

(<http://www.fao.org/resources/infographics/infographics-details/en/c/284478/>) including biomass production, cultural heritage, regulating, biodiversity/habitats and infrastructure. A list of organisations across Europe, with named soil contacts, was drawn up by accessing published materials, on-line searches and personal knowledge. The remit and primary activities of these organisations corresponded well with at least one of the soil functions and provided coverage across the soil functions. Stakeholders were based around commercial organisations, learned societies, non-governmental organisations (NGOs), local authorities and government organisations. A total of 98 organisations were contacted across 22 countries in Europe. Of these, 34 organisations can be considered trans-European in their activities i.e. no specific alignment with any one region or country. A pilot study of the questionnaire was conducted with staff at The James Hutton Institute (Aberdeen) and the Scottish Government's ethics committee; the questionnaire incorporated amendments following relevant feedback. The survey was carried out from July to August 2015 and was made accessible to stakeholders through an anonymous online link.

3. Questionnaire results

3.1. What sectors use soils information?

There were 310 individual responses to the questionnaire from 77 out of the 98 organisations we contacted and, from this, 93% of stakeholders said that they handled information about soil in their work.

Stakeholders were asked to identify what best describes the activities of their organisation. Stakeholders could tick more than one option for this question in order to obtain a broader understanding of activities associated with individual organisations. The top three activities were agriculture, research organisations (universities, institutes etc.) and conservation (Fig. 1). Stakeholders who ticked 'other' ranged from people who worked in landscape photography, archaeology and oil and gas services. This shows that there is a wide array of stakeholders who have an interest in soils data and information and who may use certain tools and assessments related to activities within their organisation.

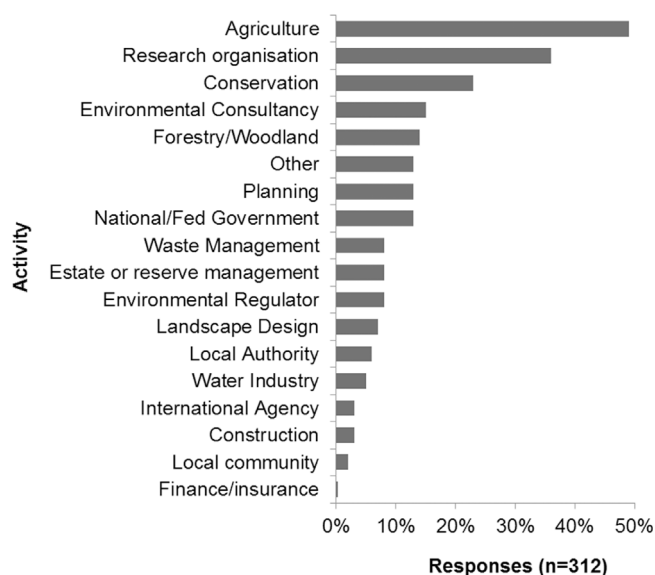


Fig. 1. Range and type of organisations and the percentage of responses to the questionnaire.

This was to get an understanding as to the variety of organisations people worked for. n.b. Stakeholders could tick more than one option for this question.

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