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2010 soils planner - development of the US soil survey

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Abstract

The Soils Planner is a calendar with a soil science theme that USDA-Natural Resources Conservation Service has published yearly since 1999. The 2010 Soil Planner focuses on the history of the US Soil Survey and its important contributions to the cooperative land conservation. Historic highlights of the US Soil Survey and Soil Conservation Movement are portrayed in the calendar, which combines important scientific aspects with strong visual images to encourage the public, as well as SSSA scientists, to contemplate soils and land conservation throughout the year. Communicating scientific ideas with images and clear concise language encourages everyone to appreciate the subject and give it some thought with each month. It forms a succinct monthly reminder of the importance of soils and conservation to human existence. From the beginning, SSSA has partnered with NRCS to produce the Soils Planner.

Key Words

Soil Survey, history, public awareness.

Introduction

The Soils Planner is a calendar with a soil science theme that USDA-Natural Resources Conservation Service has published yearly since 1999. The 2010 Soil Planner focuses on the history of the US Soil Survey and its important contributions to the cooperative land conservation. In the context of historical development, we emphasize the interdisciplinary aspects of the Soil Survey and Conservation Movement. Both these endeavors integrate landscape ecology, agriculture, chemistry, physics and other earth sciences. Soil survey in the United States developed only a little more than a century ago, starting in the late 1890's with several state and regional projects focused on agricultural soils. It is important to point out that development of the soil survey program parallels the developments in the related sciences. The US Soil Survey used existing and developing techniques in its operations and staff training, and provided equipment and facilities to ensure that observations and measurements were correct and reproducible. By tying history, conservation and soil science together the Planner educates and engages many different audiences. Not just soil scientists!

Soil survey is a multi-disciplinary science that requires an appreciation and understanding of related sciences such as ecology, geology, climatology, botany and zoology. To understand the complexity of soil, soil science brought together the tools of chemistry, physics, biology, climatology, geography and other sciences. As the scientific field of soil survey was developing, the Soil Conservation Movement began to gain momentum in the late 1920's. With a surge in interest in healing and protecting the land for Agriculture, the US government moved closer to the establishment of an agency that would deal head-on with the issues of soil erosion and land degradation in the US. The purpose of the Soil Survey from its beginning was for the wise use and management of soils. Soil Survey process and products are focused towards that end.

Soil conservation work nationwide was hastened with the passage of the Soil Conservation Act in April of 1935. Recognition of the first conservation district, bounded by the Brown Creek watershed in North Carolina, on August 4, 1937, established a method for the Service to assist farmers in the conservation districts. Locally elected citizens established priorities and plans for the district's work. The Department of Agriculture merged most of its soil survey functions with the Soil Conservation Service in 1952. Here are a few highlights of historical significance that are portrayed in months of the 2010 Soils Planner of the US:

Origins of the national cooperative soil survey

In 1893, President Grover Cleveland asked Charles W. Dabney to be Assistant Secretary of Agriculture and charged him with creating a nonpartisan, professional scientific corps in the USDA. Dabney, who had a doctorate in agricultural chemistry from the University of Göttingen, created the Division of Agricultural

Soils and chose Milton Whitney to be its director. Five years later, the Division of Soils initiated the US Soil Survey, and USDA soil scientists began to systematically investigate the origins and properties of the nation's diverse soils. These events marked the beginning of a federal commitment to Soil Science and Soil Survey activities as part of USDA's scientific work that persists to the present

Soil conservation crusade

No other person did more to alert the country to the problem of soil erosion than Hugh Hammond Bennett. Bennett joined the USDA Bureau of Soils as a soil surveyor in 1903. Through his work, Bennett became deeply aware of the problem of soil erosion and its deleterious effects. In 1928, he co-authored "Soil Erosion, A National Menace," which attracted widespread attention and confirmed Bennett as the nation's foremost crusader for soil conservation. His efforts resulted in the creation of the Soil Erosion Service in 1933 and its subsequent transformation into the Soil Conservation Service in 1935 with Bennett as Chief.

Land capability classification

When the Soil Erosion Service started operations on September 19, 1933, Director Hugh Hammond Bennett needed soils information to recommend soil conserving methods to farmers. County soil surveys published by the Bureau of Soils covered only a selected portion of the country. To meet their needs, SCS staff developed groupings of soils under the "use-capability" concept. Each class related soil to the combination of practices required for sustained production. The land capability classification accommodated the rapid growth of the soil conservation program on a sound basis. After merger of the Soil Survey Division into the Soil Conservation Service, Charles Kellogg directed that the Soil Surveys include the land capability for each soil type.

Aerial photography

The U.S. Soil Survey pioneered the use of aerial photography for making soil maps during the 1920s. The first county Soil Survey based entirely on aerial photographs was made by Thomas W. Bushnell of the Jennings County, Indiana Agricultural Experiment Station in 1929. Bushnell recognized the advantage of aerial photography over the conventional method of soil mapping using a plane table and alidade. Surveyors found that using aerial photographs allowed them to make more accurate maps in nearly half the time. As airplanes and cameras became more reliable, the use of aerial photography for soil mapping became a standard practice for the soil surveyors in the 1930s.

Unification of the soil survey division and scs soil conservation surveys

Secretary of Agriculture Charles Brannan unified the soil survey work in 1952 when he transferred the Soil Survey functions to the USDA Soil Conservation Service (SCS). The merger linked the US Soil Survey with a principal user group, soil conservationists doing conservation planning on farmlands.

Soil taxonomy

Soil Taxonomy and its associated science developed in the 1950s and 1960s after Charles Kellogg asked Dr. Guy Smith to lead an effort to create a new soil classification system to replace the system outlined in the 1938 Yearbook of Agriculture. The 1938 system relied heavily on theories of soil genesis and subjective visual observations. The new system developed by Smith and his colleagues relied on standardized measurements and could be applied consistently across diverse environments by the more than 1400 field soil scientists then working on the nation's Soil Survey. Smith produced an ingenious system for classifying soils using observable, quantitative "*diagnostic horizons and features*" to group genetically similar soils together. The effect was to put all soil scientists from the recently hired to the most senior on an equal basis in their ability to classify soils in the field.

Soil geomorphology

The scientific contributions of USDA soil geomorphology studies are largely the product of two successful research initiatives. The integration of soils and geomorphology research originated in the 1930s when the SCS Office of Research's Climatic and Physiographic Division brought soils and geomorphology researchers together to study soil erosion processes in Arizona, Mississippi, Kentucky, and South Carolina. This effort was continued after World War II by Dr. Robert V. Ruhe, who from 1953 to 1970 led soil geomorphology research in the Soil Survey Investigations Division with projects in Iowa, New Mexico, North Carolina, and Oregon designed to soil processes in different geomorphic, stratigraphic, and geographic settings. This research provided significant breakthroughs in the science of geomorphology and served to facilitate more accurate soil surveys.

International assistance

Throughout its history, the Soil Survey has provided assistance to foreign countries. During the 1910s and 1920s, Hugh Bennett worked in many Central and South American countries. In the 1930s, James Thorp conducted and wrote a soil survey of China. Through the 1940s and 1950s, Charles Kellogg initiated studies of tropical soils and worked to assist developing countries to achieve food self-sufficiency. In the 1970s, the U. S. Agency for International Development (USAID) started the Soil Management Support Services (SMSS), which has organized workshops and training courses around the world. SMSS staff sampled soils in more than 100 countries. These samples were analyzed by the USDA National Soil Survey Lab, and used to develop the Global Soil Regions map, which has been adopted worldwide as a standard reference resource.

Web soil survey

The Web Soil Survey is an easy-access, self service system to retrieve local soil information which allows for consistent updating of data, and substitutes for the familiar printed soil survey books. Whenever soil information is needed for agronomic, forestry, construction or urban development, the Web Soil Survey draws on the most current, up-to-date official USDA soil survey information available. Web Soil Survey can display soil maps and interpretive thematic maps. A customer is able to build a report or data file customized to their individual needs to address questions on potential land use. Web Soil Survey version 1.0 was released for public use in August 2005. Version 2.1 was released in November 2008. To date, about 3.75 million internal USDA and external public customers have used Web Soil Survey, currently averaging over 110,000 per month or about 4,200 per day.

Conclusion

The 2010 Soils Planner presents the historic highlights of US Soil Survey and Conservation Movement in which two disciplines of thought came together to consider landscape ecology, agriculture, chemistry, physics and geosciences, supporting each other to eventually create a body of knowledge that serves the US in all aspects of its development and sustainable environment. The 2010 NRCS Soils Planner provides a sense of the arc of this history through imagery that depicts developments in the history of the U.S. Soil Survey.

Using the communication tool of a calendar targeted to professionals, laymen and students, the USDA-NRCS Soils Planner (with SSSA, and other groups partnering in printing and distribution) has been successfully distributing soils information to a diverse audience over a 10 year period. As the U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) approaches its 75th Anniversary, the Agency looks forward and reflects on its accomplishments and discoveries during the initial Conservation Movement in the United States and the people and their ideas that made it happen. The partnerships of the US Soil Survey and the Natural Resources Conservation Service have provided the science and the dialog necessary to transfer technology into action to conserve and sustain our natural resources.

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Analysis of the information and data requests to a national soil data centre

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Abstract

The InfoSol unit of INRA (French National Institute for Research in Agronomy) in Orleans serves as the organization managing data on soil for all of France. Several hundred requests for information reached the InfoSol Unit in each of the past few years. We developed a hot-line system and a database recording all the requests, their origin, the data needs, and the response that were made. Analysis of these data shows a large variety of requested information from various sources. The request point out that end-users often lack data, and sometimes, lack a good understanding of soil databases. The most important threats were contamination, erosion and soil organic carbon decline. Soil acidification appeared to no longer be a priority. We observed a lack of awareness on topics such as soil sealing and soil compaction.

Key Words

Soil, communication, data request, information, hot-line.

Introduction

Information on soil may is requested by numerous people having various concerns about soil use, soil quality and impacts of soil on the other environmental components. Therefore, it is useful to get an overview of the kind of questions that may be addressed to a national soil information agency, and to analyse how these questions are answered. Important issues may include i) the origin of the request, ii) how to classify the data requests according to their topic of interest, the kind of data, the ability to provide a quick answer, etc. In this paper, we review ca 400 requests that came to our national institute from mid 2008 to end of 2009.

The French national unit for soil mapping and monitoring

This InfoSol Unit belongs to INRA, and is part of the Environment and Agronomy department. INRA is the leading European agricultural research institute and one of the foremost institutes in the world for agriculture, food and the environment. The InfoSol INRA team has a wide experience in soil data handling and processing. It is responsible for the constitution of the soil information system for French soils and involved in several European projects linked to soil monitoring and modelling (Arrouays *et al.* 2009). It is identified as the national counter or box-office for soil information (www.gissol.fr).

Results

Requests were received either by phone call, or e-mail, surface mail or FAX. All the requests received by InfoSol were stored in a database. Requests are received at a mean rate of about 1 per day and address a lot of topics (Figure 1). Many of the questions are linked to the different threats to the soil (CEC 2006; decline in organic matter, soil erosion, compaction, salinisation, landslides, floods, contamination, sealing). Policy decisions and laws on the environmental protection generated a lot of requests on soil characteristics. Using this database we can see directly the impact of some policies on the need for taking into account soil characteristics.

Environmental policies on wetlands and soil erosion protection generated numerous requests. A large variety of technical products were requested, from published maps in paper or digital format to large databases access, or even for new modelling of soil processes. The time between the data request and the answer was also registered and analysed in terms of reactivity. On average, requests were answered after less than 5 days. Spatial coverage ranged from point data to the entire national territory. The origin of the demands ranged from individual people to national or European organisms.

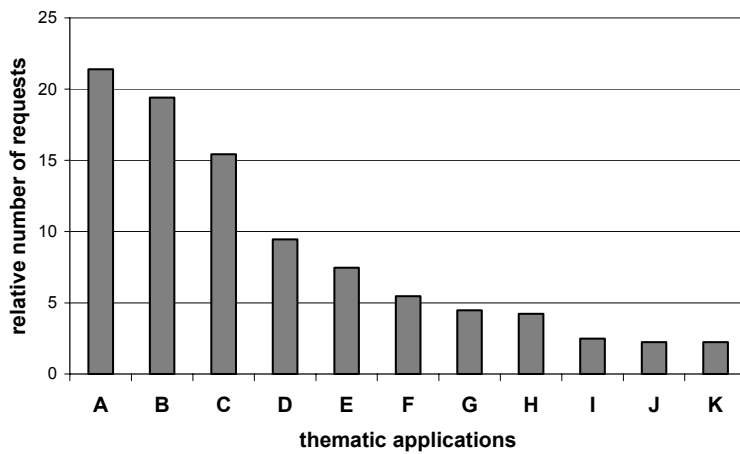


Figure 1. Classification of the requests according to their thematic application: A) water protection, B) soil protection (erosion), C) soil and human health, D) suitability for crops, E) land use planning, F) biodiversity, G) greenhouse gases, H) wetland protection, I) geotechnical purpose, J) terroir and quality of products, K) manure, composts and sludge

Conclusion

Despite being a fundamental resource that supports all life on Earth, soil often falls well below the radar as an important environmental issue. However, we show that requests on soil are becoming more and more numerous and that soil databases are going to become more and more necessary. There is a need to develop simple soil quality indicators and to make them easily understandable and available.

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E-learning for improving soil use and management in Andalusia, Spain

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Abstract

E-learning offers interesting features to complement traditional training and technology transfer in the agri-food sector of Andalusia, Spain. The severe erosion risk in a large proportion of the territory makes it necessary for farmers to protect the local soil resources and to familiarize them with alternative soil management strategies. In order to achieve this, the *Instituto de Investigación y Formación Agraria y Pesquera* (IFAPA) set up a specific training program and developed the on-line course *Soil Use and Management*. The course content responds to criteria of usability, accessibility and SCORM, and relies heavily on the use of ICT, making it possible to include interactive tools that increase the user's motivation, promote more active attitudes during the learning process, and make it possible to adapt the course content to the particular needs of each user. The course was designed based on motivational resources, accompanying most of the studied processes, concepts or practical case-studies with visual impact resources and interactive tools. The inclusion of specific indicators allows the evaluation of the on-line learning process and suggests, after two editions, that 98% of the students have achieved the goals set at the beginning of the course.

Key Words

Soil use and management training, e-learning, information and communication technology, interactive tools, motivational resources.

Introduction

Thirty-five percent of the territory of Andalusia, about 3 Mha, is affected by severe erosion. Locally, as occurs in the eastern part of Andalusia, this proportion can increase up to 70%. Especially woody crops are affected, in particular, olive groves of which 59% of the dedicated area is situated on slopes between 5 and 20% and 24.5% on slopes of more than 20% (Gómez and Fereres 2004). As a result, the *Instituto de Investigación y Formación Agraria y Pesquera* (IFAPA), which has among its competences technology transfer and training in the agro-food sector in Andalusia, has started a series of activities aimed at improving agricultural soil management practices in order to achieve a more sustainable use of the soil resources in the region. Within this context and based on previous experiences, such as the design of on-line training tools on irrigation, pesticides and animal welfare, an on-line course on soil management has been developed in order to increase the awareness of farmers with respect to adequate soil management practices, by providing practical information and assessment tools to help them with the implementation of soil conservation strategies at their own farms. The aim of this paper is to provide a general overview of this new on-line course, with special attention for the technological and educational concepts and guidelines on which it is based.

E-learning: Basic concepts and technological support

As a result of multiple regional initiatives, important progress in geographical and sociocultural equality with respect to the use of Information and Communication Technologies (ICT) has been made in Andalusia, leading to unprecedented possibilities for accessing ICT in rural and remote areas, and making E-learning a valid alternative for traditional technology transfer and training models. The main features of our E-learning model are flexible learning methods, the use of motivational resources, support and follow-up of the learning process, permanent improvement by evaluating the learning process and collaborative work.

One of the most outstanding advantages of using ICT in adult training is the possibility to use interactive tools that increase the user's motivation and promote active and participative attitudes. It is well known in adult psycho-pedagogy that these kind of tools are extremely efficient in achieving significant learning. At the same time, pedagogical efficiency of visual elements is considered superior to document reading. Among the most relevant technical criteria considered in the design of the soil use and management course are those related with usability, accessibility and the Sharable Content Object Reference Model (SCORM). Usability is an attribute of quality that indicates how easy the web interfaces can be used. A usable website can be defined as one "in which the users can find what they need, can understand what they find, and can act

properly... within the time and the effort that they consider proper to do so”(Dumas and Redish, 1999). The Web Content Accessibility Guidelines (WCAG 2.0, 2008) provide not only criteria for improving web content accessibility to disabled persons, but also to other groups such as the elderly, persons with low instruction levels and with a limited command of language or internet users with slower connections or older technology. These guidelines also reduce the complexity and facilitate access to non-frequent or new internet users. On the other hand, SCORM is a collection of standards and specifications for E-learning. SCORM also defines how a content can be packaged in a transferable file to gain interoperability between platforms.

New on-line course *Soil Use and Management*

General characteristics and objectives

In the design and development of the contents for the *Soil Use and Management* course, extensive use was made of motivational resources by offering interactive access to the materials, and accompanying most of the studied processes, concepts or practical case-studies with visual resources. The use of interactive tools made it possible to adapt the contents to the particular needs of each user. Every decision taken by the student is transformed into a personalized learning scheme, so that different needs of heterogeneous student groups can be satisfied. Starting from real-life situations and case-studies, the student’s acquired practical experience enables him/her to understand the general concepts.

The course contents were deployed in Moodle, an Open Source E-learning platform, which allows the full course management. Different web programming languages such as XHTML, CSS and Javascript were used to develop the course contents, resulting in many interactive multimedia exercises, demonstrations or samples embedded into the XHTML contents. These multimedia slices have been developed using Adobe Flash CS3. The general objectives of the course are summarized in Table 1.

Table 1. Cognoscitive, procedural and attitudinal objectives of the on-line course *Soil Use and Management*.

<i>Cognoscitive objectives</i>	<i>Procedural objectives</i>	<i>Attitudinal objectives</i>
<ul style="list-style-type: none"> • Acquire a positive attitude towards new soil management techniques • Understand the implications of soil degradation • Understand the concepts of water erosion and runoff • Understand the links between erosion and runoff, and loss of soil and water resources • Demonstrate the effect of soil management on soil quality • Learn how to use soil and crop indicators to evaluate soil quality 	<ul style="list-style-type: none"> • Evaluate erosion risk <i>in situ</i> • Distinguish the importance of the different factors that cause erosion and runoff • Evaluate soil quality for local crops • Learn how to observe soil and crop indicators • Distinguish different degrees of soil quality as a function of the indicators 	<ul style="list-style-type: none"> • Increase awareness with respect to soil degradation and the importance of adequate soil management to preserve soil and water resources • Consider the evaluation of soil quality as just another field operation.

Motivational resources

The most innovative and attractive contents integrated in the on-line course are the motivational resources. These elements reinforce the student’s effort and participation during the learning process, carrying him/her unconsciously away, while improving his/her interest for the course contents. Graphical interfaces to execute simulations enable the users to make their own runoff and erosion calculations, compare the effect of different soil management scenarios or to evaluate soil quality for the conditions of their own fields. These tools were developed, based on published research results from SCS (1972), Renard *et al.* (1997), Gómez *et al.* (2003), Milgroom *et al.* (2005), Shepherd *et al.* (2008a,b,c), and Romero *et al.* (2007). Screen shots of the erosion and runoff simulation tools are shown in Figure 1. Other tools show how to execute simple field experiments to measure soil parameters (*e.g.* infiltration rate or aggregate stability) which are used in decision making (Figure 2), while image galleries help to achieve attitudinal objectives by increasing the awareness on the importance of soil and water conservation. Also interactive graphs (Figure 3), which enable the users to enter and represent graphically their own data, videos, and “Did you know that ...?”-sections are used throughout the course. The latter stimulate the students to search for more in-depth information on certain issues, through odd observations or phenomena, causing a strong impact that generates further interest in the specific subject.

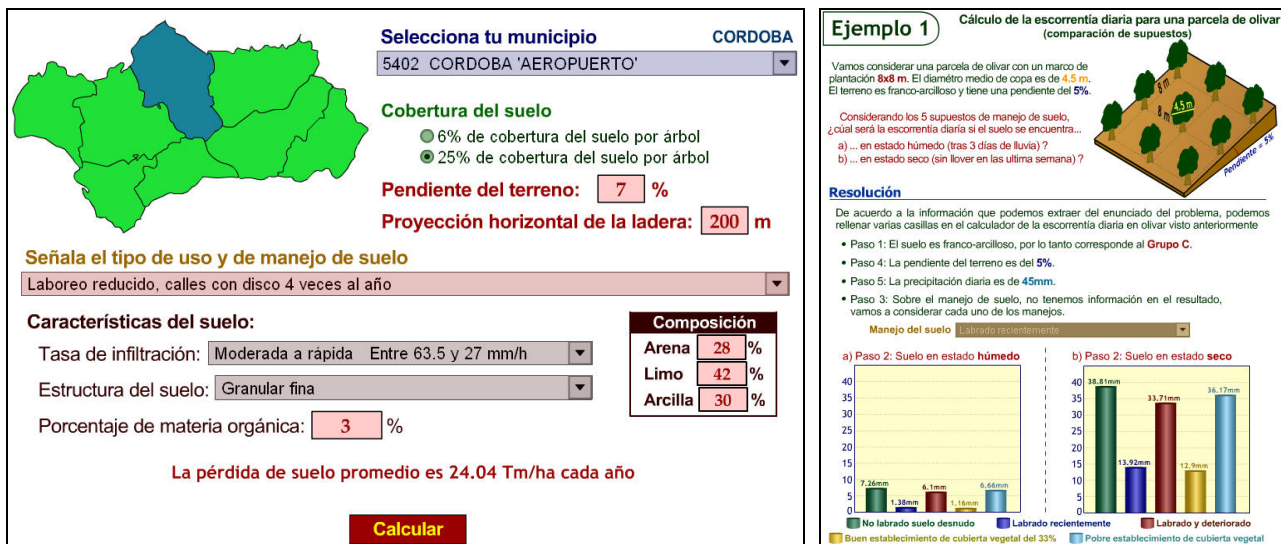


Figure 1. Screen shots of simulation tools. Data input window to calculate erosion rates (left) and results of a runoff simulation for an olive orchard comparing different soil management scenarios (right).



Figure 2. Screen shots of the required materials to execute simple field experiments. Measurement of infiltration rate (left) and aggregate stability (right).



Figure 3. Screen shots of interactive graphs for evaluating the erosion risk using field indicators (left) and for providing the soil texture class from particle-size distribution data.

Conclusion

Until now, two editions of *Soil Use and Management* course took place, with participants with training levels ranging from primary to graduate education, more or less related with agriculture. The new Internet-based training method offers an individualized follow-up of the students and takes into account the heterogeneous

education levels and professional profiles far more efficiently than a traditional classroom environment. At the same time, the design of the course materials allows the student to choose freely and interact with the content, contributing to the generation of a personalized information scheme in each case. Besides the common evaluation parameters of any training action, our evaluation takes into account some specific indicators that allow us to assess the on-line learning process. Based on evaluations, the training method is very well received with approximately 98% of students saying that they had achieved the goals set at the beginning of the course.

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ENSA - European network on soil awareness

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Abstract

A European network on soil awareness was established in 2009. The goal of the network is to bring together soil scientists with non-scientists working on soils in Europe to enlarge the group of people interested in soil awareness in one or the other way. This group includes administrators, consultants, scientists, and colleagues working in education, or for non-governmental organizations, and who are interested in working on outreach and/or education on soils and in exchanging their knowledge with colleagues within Europe. The network on raising soil awareness in Europe ENSA will help the public to become more familiar with soil and soil protection.

Key Words

Soil awareness, European network, outreach, education.

Introduction

The discussion on a European Network on Soil Awareness was initiated as part of the “Education in Soil Science and Raising Public Awareness” symposium at the Eurosoil Conference in Vienna in August 2008. Colleagues from many European countries (Austria, Belgium, Bosnia and Herzegovina, Czech Republic, Finland, France, Germany, Ireland, Italy, Poland, Slovenia, Switzerland, The Netherlands, United Kingdom) as well as from the USA and Canada attended the discussion. The group discussed how soils can be more successfully presented to the public and emphasized the need for a common European approach to enhance awareness of soil issues additional to national and international approaches. Moreover, national activities like the “Soil of the Year” approach were presented.

Results

- The objective of the European Network on Soil Awareness ENSA is to bring together all people working on soils or being interested in soils and related activities that may increase soil awareness in the public in Europe. This group includes administrators, consultants, scientists, and colleagues working in education, or for non-governmental organizations, and who are interested in working on outreach and/or education on soils and in exchanging their knowledge with colleagues within Europe.
- In Europe strong activities on local and regional scales are needed in close cooperation with target groups such as teachers, but the European Network does not want to compete with national activities. The network would like to help in those countries where national activities in raising soil awareness are still lacking like in many Eastern European countries. At national and international scales, we will share ideas how to bring forward soil protection in Europe through soil awareness. A strong cooperation with national ministries and other organisations is intended. One significant step forward could be for group members to cooperate with experts in marketing and public relations.
- The International Union of Soil Science has been involved in the establishment of ENSA and supports a network on soil awareness which would help to strengthen communication on soils.
- The EU encourages a European platform to raise soil awareness, which has already high priority within the EU soil activities (<http://eussoils.jrc.ec.europa.eu/Awareness>). Numerous activities have been started already from the Joint Research Centre (JRC) of the European Commission in Ispra, Italy to make soil and related problems accessible to the public (<http://eussoils.jrc.ec.europa.eu/Awareness/Methods.html>). A network would help to ease the realization. Thus, the ENSA activities are carried out in close cooperation with the EU, especially with the members of the recently established Working Group “Soil Awareness and Education” of the European Soil Bureau Network ESNB. Overlapping activities to raise awareness on soils within the EU will be avoided.
- The Eurosoil conferences can be used to organise special symposiums and meetings of the people involved in outreach and education activities. Moreover, national meetings and meetings at the IUSS conferences could provide opportunities to exchange ideas.
- An internet platform run by ELSA (European Land and Soil Alliance, www.soil-alliance.org), located in Osnabrueck, Germany, will be established which can be used for exchange of information and can act as

“umbrella” for national websites on soil awareness. ELSA relies on memberships of communities or other administrative districts to finance outreach activities. Members of the ENSA network could help to motivate more communities of their own country to join ELSA. This would help to run the website even better and would thus help making ENSA and ELSA successful.

- In September 2009 the first ENSA Conference took place in Osnabrueck, Germany in the “Museum am Schölerberg” with a permanent interactive soil exhibition and an “underground zoo” exhibiting various living soil organisms in their “natural” habitat. The conference was organized by the European Land & Soil Alliance (www.soil-alliance.org), the German Soil Association (www.bvboden.de) and the European Commission. Colleagues from 14 different European countries (Austria, Belgium, Finland, France, Germany, Hungary, Ireland, Italy, Luxembourg, Slovakia, Spain, Switzerland, The Netherlands, United Kingdom) and the USA attended the conference. In the final discussion a broad agreement on a European Network on Soil Awareness became apparent.
- Moreover, the discussion showed that interdisciplinary cooperation is absolutely necessary to raise awareness on soils. Soil scientists should cooperate with colleagues from related fields, with geologists in Geoparks or with biologists in nature reserves. Meanwhile, members of the European Geoparks Network already cooperate with ENSA.

Conclusion

A close cooperation between the European Network on Soil Awareness ENSA with the International Union of Soil Science and other organizations would help to spread ideas on raising soil awareness worldwide and would motivate soil scientists to work together with parties other than scientists in the field of outreach and education.



Exploration of global soil resources using Google Earth

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Abstract

Geographic exploration of global soil resources can be facilitated using Google Earth (GE). Using our digital library with over 500 images of soil profiles from many countries, we developed an educational resource utilizing the widely accessible GE program. In this paper we detail the methods used to prepare the images and develop the information content for use in GE. Customized tours can be created that include images and map overlays.

Key Words

Soil education, soil images, Google Earth.

Introduction

Educational trends show an increasing reliance on Internet resources for classroom content. Development of educational materials on soils must utilize the latest technologies to ensure that we are reaching the widest audience possible. Google Earth (GE) provides an excellent venue for introducing soils to a wide audience. It has already become an indispensable reference tool for accessing online geographic information. A growing user community exists that readily shares new content and offers students a variety of topics to explore. For over 30 years we have created a collection of slides from all over the world of soil profiles, landscapes and people in the field. This collection is now digitized and many are georeferenced. A prototype format has been created for use with GE and it is hoped that the soil science community will improve and enhance this initial effort. The GE content will be available online at soils.usda.gov/use/worldsoils/gsr/.

Methods

Digitizing 35mm Slides

All of the images used in this project were originally 35 mm slides taken from 1968 to 1998. Digitizing the images was accomplished using a commercial slide scanning services company. The collection of over 5,000 slides was scanned at 2,000 dots per inch (dpi) and was stored on archival quality DVDs as JPG images.

Image Database

An Excel spreadsheet was used to catalogue the scanned images. Each image record includes: file name, slide notes, slide description, country, city, date taken, photographer, soil feature, soil classification and pedon ID.

Georeferencing Images

Many of the soil profile images were taken during international field tours held over the past 30 years. The field tour guide books either provided the latitude/longitude coordinates or had a tour map with profile locations indicated. For some slides the location was listed in the soil profile description found in the National Cooperative Soil Characterization Database managed by the USDA-NRCS, National Soil Survey Center (Soil Survey Staff 2009). Where no documentation could be found we relied on our knowledge of a region to provide a reasonable estimate of the location and designated those images as having an approximate location.

Creating Content for Google Earth

Keyhole Markup Language (KML) is the formatting language for displaying content within the GE environment. The KML syntax is similar to hypertext markup language (HTML) and so is familiar to web programmers. Icons are used to represent locations on the GE map. As shown in Figure 1, clicking on an icon opens up a content window that is often referred to as a description balloon. The description balloon contains the soil image and descriptive text as well as a hyperlink to the pedon description when available. For each image a KML file was created which can be grouped within a single zipped (KMZ) file that will be

placed online so that users can download all the images for use in GE. Adding map data is accomplished by using geographic information system (GIS) software to convert polygon maps to the KML format (Figure 2). ArcGIS has a 3D Analyst tool for converting a shapefile to KML. All of the polygon attribute information is retained in the KML version of the map and is accessed simply by clicking on the map.

Discussion

The tools for developing easily accessible geographic content online are readily available. The user community is growing and there are many other geographic datasets that are accessible with GE, including natural resources, climate and socioeconomic data. This provides students the ability to explore a wide range of information. We believe that it is incumbent on the soils community to take advantage of the GE platform to create content to help people better understand soils.

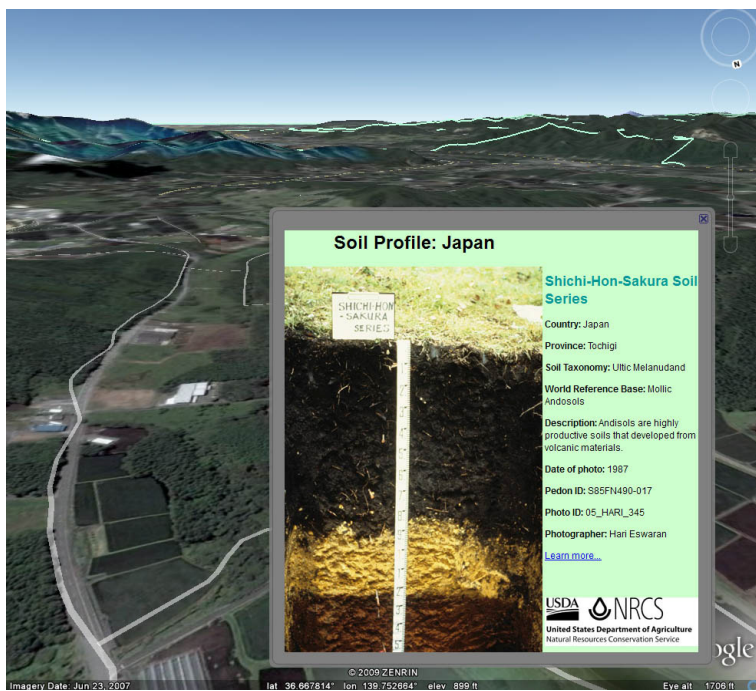


Figure 1. An example of a soil profile description balloon displayed within Google Earth.

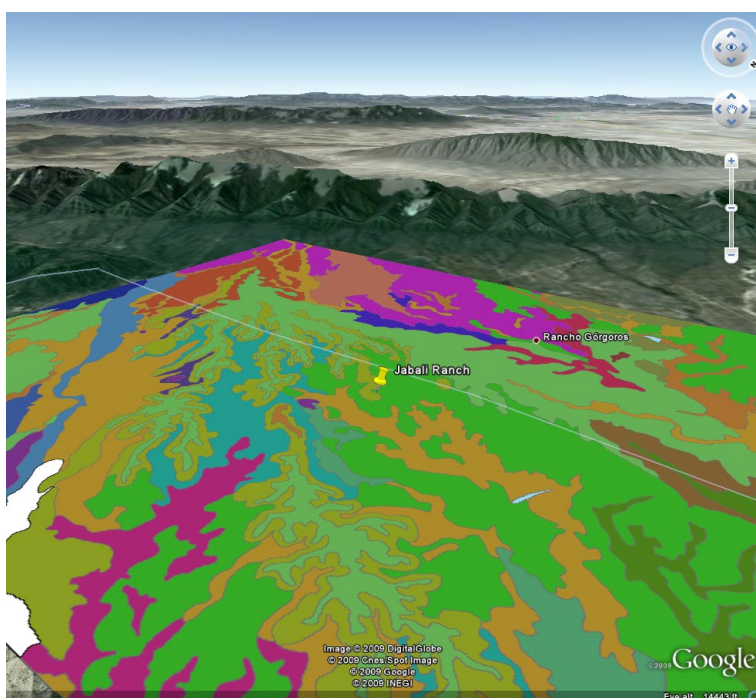


Figure 2. A polygon map can be overlain on the topographic data within Google Earth. The soil map is of the Jabali Ranch, Nuevo Leon, Mexico. Polygon attribute data is displayed by clicking on the map.

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Field day: a case study examining scientists' oral performance skills

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Abstract

Communication is a complex cyclic process wherein senders and receivers encode and decode information in an effort to reach a state of mutuality or mutual understanding. When the communication of scientific or technical information occurs in a public space, effective speakers follow a formula for content delivery. Participant observation of 11 presentations during a 2009 Field Day and content analysis of videotaped faculty and scientists' oral performances generated suggested best practices: distribution of keyword outline of content/findings, use of a microphone, highlighting importance of presentation during introductory and concluding content, and using scientific and laymen's terminology concurrently.

Key Words

Oral performance, non-scientific community, communication.

Introduction

Saito *et al.* (2006) support that comprehension of the indigenous knowledge of soils by local farmers is critical for "success or failure of agricultural development" (p. 64). The authors make the argument that if researchers understand how the audience they intend to serve makes sense of information; they are more likely to use the information if it is presented in a manner they understand. Conversely, indigenous knowledge can serve a useful purpose if "documented" or "extracted" through detailed local-level work (Howes and Chambers 1980; Farrington and Martin 1988; Warren 1990). Researchers from the University of Bergen approach the relationship between the designer (scientist) and user (farmer/community) and the knowledge design, testing and distribution environment from a systems perspective. Dea and Scoones (2003) assert

- [D]ifferent understandings of soils and their management are seen to be bound up
- with the contexts within which knowledge about soils are created – the networks of actors
- engaged in building knowledge, the settings within which ideas about soils are tested
- and examined, the wider assumptions and beliefs that different people have (461).

The scholars advance the correlation between power, control over people's lives and knowledge. From a communication perspective, Dea and Scoones aptly capture the essence of Shannon's (1948) information model of communication which evolved to the Shannon-Weaver model (1949, 1963) and depicts communication as information processing; information that reduces uncertainty for the receiver. More recent studies have refuted aspects of the model while other studies have embellished key components of the model such as noise, message, channel, encoding, decoding, etc. In the communications discipline, effective communication is achieved when a receiver decodes a message in the manner the sender intended despite noise and transmission device. This mutual interpretation of information or the symbols used to express ideas builds on a foundation which evolves with age and experience yielding knowledge, and thus, the ability to interpret and use information which ultimately extends knowledge. The complexity of the experiences and depth and breadth of the knowledge positions the communicator to be effective at different degrees of interaction. When scholars and practitioners interact with community residents, there is a need to speak in the vernacular of the audience. An audience analysis is a tool communication scholars promote in the instruction of public speaking to empower the speaker to craft messages designed for the intended audience. In essence, the speaker's effort to ascertain the demographic and psychographic characteristics of an audience with whom effective communication is desired, prior to interaction, influences message design, and therefore, the ability to share information designed to enhance knowledge of a phenomenon (Lucas 2008). To ascertain if scientists conduct effective audience analyses and deliver content in a manner suitable for knowledge enhancement, a qualitative content analysis of videotaped recordings of presentations at a community education event was conducted.

Methods

Participant Observation

In order to ascertain if scientists conduct effective audience analyses and deliver content in a manner suitable for knowledge enhancement, the first data collection effort involved participant observation of an event advertised in two area newspapers. The Field Day tour, hosted by two state's University Research Extension Centers, featured presentations contributed by United States Department of Agriculture, Applied Research Services scientists, cooperating farmers and industry representatives and the two state's University Extension faculty. The presenters explained research field studies, research outcomes, and impact to the agricultural community of farming practices, pending legislation, and economics associated with import/export of crops. Participants boarded tractor-pulled platform seating flats and were chauffeured through fields with approximately 15 minute stops where presenters showcased the research products/findings of USDA scientists and faculty, and extension agents. There was a distance of approximately 20 to 30 feet between the audience and the presenter. To kick-off Field Day Activities, local and state government officials and Farmers' interest group representatives offered brief presentations that weren't included in the analyses. The presentations were videotaped. The researcher also scribed notes about the presentations that included: assessment of delivery components and content; general reaction to the delivery of information, and its' likelihood to enhance knowledge.

Analysis

After the presentations, the researcher transcribed her field notes yielding 44 pages of single spaced data regarding the performance attributes of the speakers, presentation content, audience reaction and information imparted. A code sheet outlining the components of effective presentations was devised and used as a coding instrument for the 150 minutes of analyzed footage. The results of the coding are displayed in Table 1, Evaluation of components of a public presentation.

Results

Eleven presenters offered more than 100 attendees 15 minutes of information-rich content. The general presentation format included an introduction of the speaker, formal presentation and question and answer components. The presenters were predominately male (9) with two female presenters serving as the book ends for the presentations. Two presentations featured teams; one same gender team and one mixed gender team. The topics covered during the presentation focused on two areas designed to 1) enhance knowledge of agricultural management practices, and, 2) specific crop knowledge enhancement. The agricultural management practices topics included: irrigated cropping systems, management of high value horticultural crops, delayed nitrogen fertilizer, alternative crops, disease management, and oilseeds for biodiesel/biobased products and corn/small grains for ethanol. Specific crop topics included: sugarbeet crop and outlook, safflower research and management, durum research and development, spring wheat varieties and development, and barley varieties and development.

Oral Presentation Assessment

Participants learned the name, expertise, and topic of the presentation from an independent coordinator traveling with the group and assigned the task of keeping time. The majority 90.9% of speakers explained what information would be covered in their discussion, why the information was important to the listener, and then discussed the content. Few of the presenters recapped the content and reinforced why the presentation was important. Less than half of the presenters offered visuals to support their message or created a handout for the audience; some may have assumed that the actual crop served as a visual; however, when an audience member is exposed to significant content in a short period of time, handouts and visuals aid recall of the information. Of the 11 presenters, 18.2% used a microphone/speaker combo to address the group. Several presenters asked the audience if they could be heard with ease to which the audience appeared mixed; however, the presenter didn't use the available technology. Several of the participants had notebooks and were observed jotting down notes during particular presentations. All presenters wore comfortable clothing (jeans, cotton shirts with their affiliation over the right shirt pocket, work boots, and many wore hats being the name of the organization for which they spoke to protect them from the July sun. Less than 36.4% of the presenters appeared uncomfortable with the group as was evidenced by the ability to maintain eye contact, respond to questions and move about while speaking. The actual rate of speech was problematic in less than half of the presentations. Vocal variety was strong. The use of scientific terminology coupled with laymen's definitions was evident in more than 75% of the content. However, the audience was diverse demographically and with respect to affiliation. Therefore, more consistency with use of terminology would

be beneficial. The two predominant themes that emerged from the general presentations were 1) community building, and, 2) research results leading to advice for productive farming and economic practices.

Table 1. Evaluation of components of a public presentation.

Component	Observed	Not Observed	Recommendation
Introduction			It would be beneficial to use the attention getter to support why the presentation has relevance. Do you want to ensure that your farm will be sustainable beyond 2050?
Attention Getter			
Name	90.9%	9.1%	
Credibility statement			
Reason to Listen			
Outline discussion topics			
Body			
Mainpoints	100%		
Evidence			
Conclusion			To aid the audience with retention of critical information, cycle back to the reason to listen and recap mainpoints.
Recap mainpoints	36.4%	63.7%	
Reinforce reason to listen			
Visualization			No consistency in style, content or format. Consider single approach
Keyword outline/poster	45.5%	54.6%	
Performance			Rate and volume of speech were the areas most problematic; all speakers should use a microphone and time their presentation to ensure a slower paced delivery.
Maintained eye contact			
Vocal Variety	63.7%	36.4%	
Rate of speech			
Volume of speech			

Themes: community and bonding from productive farming and economic practices

All of the presenters made reference to the importance of the information they were sharing to the vitality and growth of the community through farmers' ability to remain economically stable by altering agricultural practices involving selection of seed type, yield enhancement, water requirements, and disease management. Researchers also credited either the ARS or the Research Extension Center for collaborations. One presenter stated, "We are working together to make our vision a reality." This message was consistent from local to regional to national relationships in government as well as government, university and community interdependency.

Conclusion

Participant observation of 11 presentations during a 2009 Field Day and content analysis of videotaped faculty and scientists' oral performances generated suggested best practices: distribution of keyword outline of content/findings, use of a microphone, highlighting importance of presentation during introductory and concluding content, and using scientific and laymen's terminology concurrently. The findings suggest the participants' knowledge of the relative information was enhanced.

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SASSA: an open source, Wiki soil based knowledge and decision support tool for archaeologists

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Abstract

Soils are an integral part of our cultural record and the importance of studying soils and sediments on archaeological sites is well established. However, many field archaeologists have had minimal or zero training in soil science and as a result feel overwhelmed by the specialist terminology and the complexity of the very medium that provides context to the archaeological artefacts and structures. SASSA (Soil Analysis Support System for Archaeologists) is a web-based knowledge base and decision support system that is designed for use both in the office as a reference and training tool, and also in the field, using a laptop or smart phone, to aid the description, sampling and interpretation of soils on-site. The architecture of SASSA, particularly with respect to the in-field support of students, provides a framework for other soil-education initiatives. The mobile technology and decision support tools of SASSA are also being explored as a possible basis for emergency response systems.

Key Words

Geoarchaeology, soils, decision support tool, web-based.

Introduction

Soils are historical entities that preserve legacies of their past formation, development and management, and hence are an integral part of our cultural sites and landscapes. On archaeological sites, soils provide context to archaeological structures and artefacts, determine processes of post-depositional alteration, and may even represent the degraded remains of archaeological materials. Field archaeologists recognise the importance of understanding the soils they routinely trowel away but most have little or no formal training in pedology or soil science. Traditionally, the interpretation and analysis of archaeological soils and sediments has fallen to specialist geoarchaeologists who may have entered into the subject via either archaeology or soil science. However, field archaeologists still need to make day to day decisions on the importance and meaning of the soils and sediments they encounter. They need to be able to effectively record and sample these soils, be able to recognise the potential information the soils may yield, and decide when specialist geoarchaeological help is required.

The problems specific to accessing and using geoarchaeological information that were identified by field archaeologists during an initial consultation prior to the development of SASSA were:

1. Geoarchaeology involves extensive field recording and sampling, which is time consuming and requires specialist input.
2. Soil analysis is expensive and time consuming and often provides little useful or new archaeological information.
3. Geoarchaeology involves dense terminology and scientific language making reports and books on the subject virtually unintelligible to the non-specialist.
4. There is a general lack of training in soil science that makes field interpretation and identification of key questions difficult for field archaeologists.

This consultation identified a need for an easily and freely accessible knowledge base aimed at supporting field archaeologists in the description, sampling and interpretation of soils.

The problem does not stem from a lack of literature on the subject. A number of very good books have been published in the last 20 years, including some aimed directly at field archaeologists (for example, English Heritage 2004; Goldberg and Macphail 2006). However, the pressures on field archaeologists to be conversant with a multitude of disciplines, and the specialist terminology involved in soil science, means they have had limited impact in the field. The Internet provides the opportunity to provide information in easily accessible bite-sized chunks and in a format that can evolve and change in line with user needs. The rapid rise of mobile technologies such as “tough-books”, PDAs and smart phones also now allow this

information to be accessed almost instantaneously in field situations, such as on-site during an excavation. This paper describes the development of a recently constructed web-based system (SASSA www.sassa.org.uk) that makes use of these technological developments to provide help and support on soils to archaeologists working both in the office and the field.

Development and consultation

In order to succeed in bridging the gap between archaeologists and soil scientists it was important that both groups would need to be included in the development process. To this end two advisory panels were formed: 1) an academic advisory panel to advise on and provide content and included members from archaeology, geoarchaeology and soil science; and 2) a user advisory panel that included field archaeologists from commercial, research and curatorial backgrounds. Both groups also aimed to have an international element with representatives from the UK, Europe, North America and Australia. These panels were involved in the consultation process and provided feedback on early versions of SASSA throughout its development. The academic group were also approached for material to populate the knowledge base, in particular case studies, whilst the user group were very helpful in providing field tests of both software and hardware. Additionally online archaeological discussion lists were used to elicit further ideas and feedback as well as to publicise SASSA, whilst early versions of the software were made available on-line alongside prominently featured feedback forms.

SASSA content and structure

The SASSA web system consists of two distinctive parts, each underpinned by different software.

1. SASSA knowledge base
2. SASSA field tool

SASSA knowledge base (http://www.sassa.org.uk/index.php/Main_Page)

The knowledge base essentially contains tutorial type materials including an introduction to geoarchaeology (scope, scale and research questions), a soils and sediments tutorial (erosional and depositional processes, soil forming processes, post-burial processes and anthropogenic soils and sediments), information on field recording, sampling and interpretation of soils, information on post-excavation analytical methods, case studies and a glossary of soil science and geoarchaeological terms. This information is held within a wiki powered by MediaWiki free server-based software. This is the same software that is used by Wikipedia. This particular software package was chosen on the basis that users would already have some familiarity with using Wikipedia and it was hoped this would encourage user participation in the development of SASSA beyond the end of the original project.

SASSA field tool (http://www.sassa.org.uk/index.php/Field_Analysis:Field_Tool)

The field tool is accessed through the wiki site but is actually a separate system built using XML data format. As the field tool has a data storage capacity users have to register and obtain a unique user name in order to access the field tool. The field tool can be used in two different ways.

Soil description tool: this feature walks the user through the process of recording and describing their soil or sediment and saves data within a hierarchical site, section/trench, and context data structure. The system is flexible so that as much or as little information may be recorded as needed, and if the system is downloaded and used in a stand-alone mode the interface can be modified to suit the users individual needs, typically this might involve slimming down the recording options or incorporating aspects of an archaeological context recording sheet. Information links in the field tool link to the knowledge base and provide information on how and why they might record particular soil characteristics.

Soil interpretation tool: this feature uses decision support trees to walk the user through the process of answering some of the most commonly encountered soils-related questions. Including: “Is this a buried soil?”, “Has this deposit been affected by in-situ burning?”, and “Has this deposit been affected by waterlogging and iron movement (gleying)?”. The user is walked through a series of simple questions relating to the soil material and its local environment to produce a score on a scale of 0-100, 0 being a negative answer, 100 a positive answer, and 50 an inconclusive answer. Links are also provided to explain how the answer was reached, what the confounding factors and errors might be, and what follow-on analyses might be considered. An example of the interpretation tool interface is provided in Figure 1.

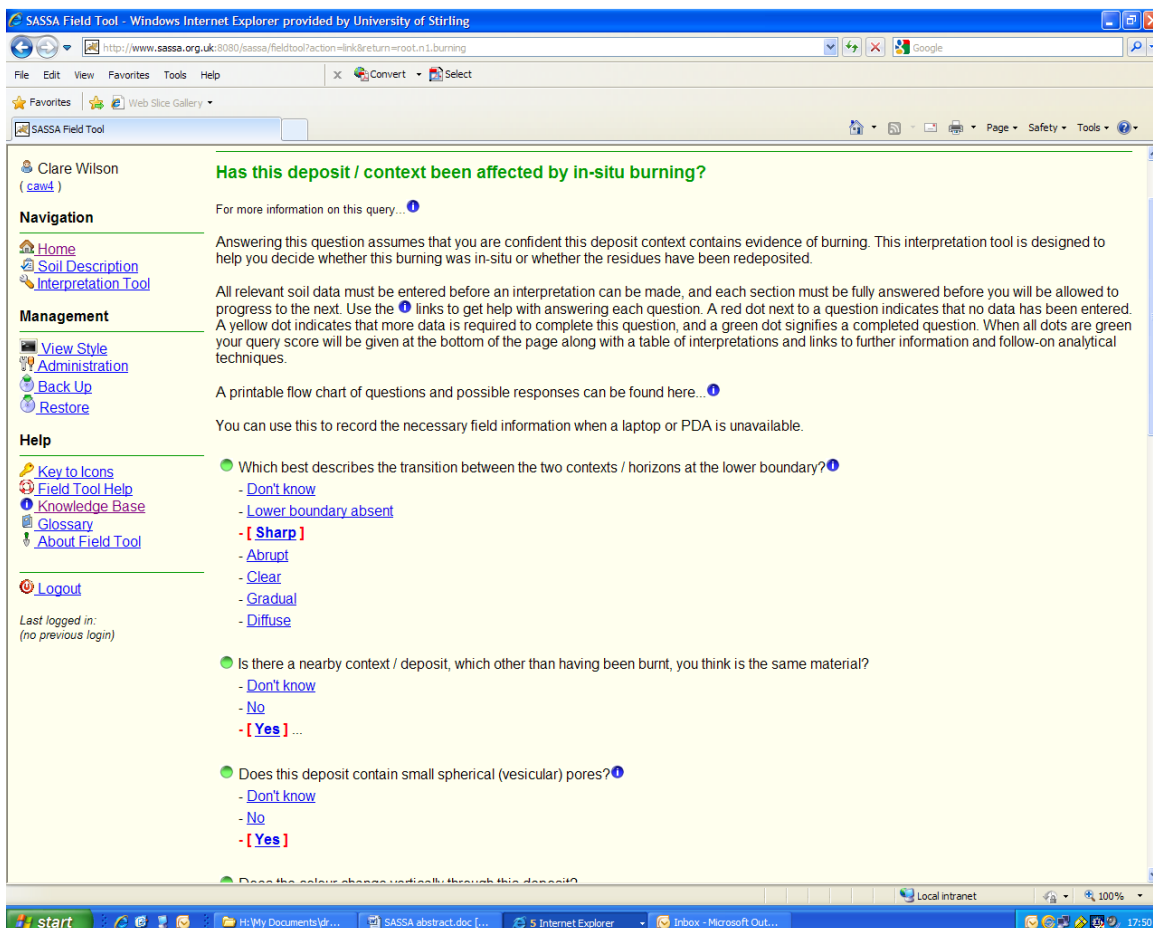


Figure 1. The user interface and question structure in the SASSA interpretation tool.

Design features

The SASSA field tool incorporates a range of features that support its use in field conditions.

Multi-user recording

If the system is to work as a recording or interpretation tool on complex archaeological sites it must be capable of building a single, logical 'site archive' of soil descriptions from the work of multiple users. Users could of course log into a single 'site' account but this risks data corruption as multiple users try to access and edit data entries. The compromise reached was to insist that each user has an individual account, and to provide a multi-user function that allows periodic importation and collation of data by a single designated user.

Mobile decision support

Decision support systems typically involve considerable computational and processing power limiting their use to desktop systems; however, the new generation of compact, mobile technologies is changing this. Mobile technology is rapidly developing and encompasses a considerable number of devices, from small personal digital assistants (PDAs), to laptops and tablet PCs (Derballa and Pousttch 2004). Mobile devices include the laptop computer, handheld devices, telephones, hybrids (e.g., 'smart phone' PDA/telephone), and vehicle mounted devices with enabling technologies such as GPS and Blue Tooth. While all such devices can provide decision support benefits and, in a general sense, be considered mobile, devices in the form of PDAs and Smart Phones are of most relevance and are becoming increasingly popular with general users (Burstein *et al.* 2004; Carlsson *et al.* 2005)

SASSA has been designed primarily as an internet resource that will also run over a wireless connection. A 'light weight', low-image version is available for use over mobile phone networks in order to reduce costs and to provide an interface appropriate to small screened devices. SASSA automatically identifies most currently available devices and presents the lightweight version, but in cases of non-recognition the view style can easily be changed via a link in the management toolbar. A downloadable version of SASSA is also available which can be installed as a stand-alone on a laptop or tablet PC, or can be loaded onto a USB memory stick for use as a plug and play device.

Uptake and usage of SASSA

The SASSA development project ended in January 2008 and since this time the site has continued to run with minimal maintenance. Although web usage figures are a crude measure of success there are now 95 registered users of the wiki knowledge base and 228 user accounts for the field tool. The field tool and tutorial pages have been the most popular parts of the site, although all the core components of the knowledge base have had in excess of 2000 views. The site is being accessed and used and as administrator for the site, I have been receiving regular e-mail communications from users typically requesting help and advice or offering case study material for the knowledge base. However, to date no users have actually added to or edited the wiki web pages, and efforts to encourage direct participation have largely failed. Users are happy to send data for inclusion on the site but appear not to be confident in adding these themselves. This raises issues for the future maintenance and development of SASSA that were neither foreseen nor budgeted for.

Conclusion

The SASSA project has been driven by a real need for soil information and support as identified by members of the archaeological community. Their involvement in the design and development of the system has been vital to its success. The site is now being routinely accessed by the community of users it was designed to support, and the feedback has been overwhelmingly supportive. The Achilles heel for the project so far has been in encouraging the user community to participate fully in the on-going development and evolution of the website. Since the end of the development project the site content has been static reflecting a lack of confidence by users in contributing to the wiki database. If SASSA is to become a site for discussion, debate and support, this is one problem that remains to be solved.

Acknowledgments

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Soil and landscape visualisation on the internet

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Abstract

The Victorian Resources Online website is the principal means for accessing soil and landscape information via the internet in Victoria, Australia. A key focus of the website is the presentation of spatially-based information that currently relies on clickable maps and links to ancillary information. Information presentation is now being continually enhanced by incorporating visualisations that include real-life demonstrations, 'virtual tours' and animation sequences. A 'Virtual Soil Profile' (VSP) is being developed as an interactive three-dimensional (3-D) visualisation of a soil profile. It is being created to increase understanding of the complex dimensions and properties of soils, with an initial focus on understanding soil structure, biology and key soil processes. The VSP incorporates interactive images and animation sequences as well as links to supplementary information.

Key Words

Land resource assessment, communication, spatial, animation, 3-D visualisation, virtual reality.

Introduction

The Internet provides information access to a broad audience, meaning that the type of information presented needs to be well thought out and packaged. The audience generally can not be specifically targeted, so the onus is on the publisher to produce information with a broad appeal as well as extensive useability. The rapid development of digital communication technologies in recent years has created opportunities for improving both the quality of information presentation and its flexibility to cater for the diverse needs of a range of users. Presentation of information, whether as simple text pages through to more complex dynamic and interactive pages, needs to be in forms that maximise end-user understanding. During the past 12 years, the Victorian Resources Online (VRO) website has been the principal means for disseminating soil and land information via the Internet in Victoria, Australia. The website currently consists of around 7500 web pages as well as 1900 maps and 1000 downloadable documents and reports. Information is provided at a range of scales – from statewide and regional overviews to more detailed catchment and sub-catchment levels. At all spatial scales, information is organised around the key 'knowledge domains' of climate, landform, landuse, soil, water, biodiversity and land and water management. In 2009 the website attracted an average of over 1000 unique users per day.

The VRO website provides a comprehensive range of soil and landscape information, including maps, geomorphological sites of significance, land degradation and soil health information as well as soil pit site details. Where possible, this information is presented at varying levels of detail to cater for a range of users. The website is also a repository for many reports (contemporary and historical) that have been digitally captured, customised and made available as downloadable documents. Soil terminology is linked to a glossary of terms that is being continually enhanced with inclusion of images and visualisation examples (e.g. animation depicting processes such as the soil carbon cycle and dispersion). User profiling shows a wide range of users accessing and using soil and landscape related material – including students and teachers, researchers, consultants, librarians, advisers and extension staff. Visualisation techniques can be used to better communicate spatial and scientific information about soils and landscapes to a range of users such as scientists, administrators, educators, students and the general public. Three-dimensional (3-D)

representations can improve user understanding of soil and landscape relationships, which can be enhanced by incorporating interactivity. 3-D graphics and animation bring more life-like digital reality to computer-based information and the use of video files (ranging from simple animations to full-quality movie video with sound) adds rich information content to a web-pages. Virtual Reality (VR) is the capability of a person to navigate in a digitally generated 3-D environment and interact with computer-generated objects that resemble the appearance and habits of what they are trying to simulate. VR is recognised as an innovative tool for visualising and communicating data to an audience, i.e. an education tool (Barraclough and Guymer 1998), and basic VR functionality is now being explored as part of the early development of the 'Virtual Soil Profile'.

Methods

Landscape and soil visualisation

The desk-top Geographical Information System (GIS) *ArcScene* is being used to overlay spatial information and create 3D scenes. It includes analytical tools and functions that allow the creation of realistic 'fly-over' animations. Other 3-D visualisation programs that produce photo-realistic still images or animations of landscapes using GIS and Digital Elevation Models (DEMs) are also being utilised. The 'Hillshade' tool within *Spatial Analyst* has been effective in generating more realistic map bases that can then be clicked on to access site specific information. By draping aerial photography over the DEM and setting 50 % transparency, a realistic 3-D effect is created for the web-based image map. If available, detailed DEMs have been utilised to create more realistic 3-D landscapes and fly-overs. LiDAR (Light Detection and Ranging) technology uses laser pulses to generate data on the physical layout of the landscape. Aircraft-based LiDAR generates a 3-D data structure using a 1 metre grid and is available for some parts of Victoria. Incorporation of video materials, which can include landscape fly-overs, is now routine within VRO. Screen-capture software is used to record a video file that is then converted to *Flash* format for integration in VRO web pages. Interactive panoramic images have also been developed using open-source *Flash*-based software and included on the website. A range of animation sequences is being created, from simple 2-D process animation (e.g. soil carbon cycle) to more complex 3-D scientific animation (e.g. breakdown of organic material in soil). Animation is created by professional artists from 'storyboards' (a series of hand-drawn sketches that outline all the events in the animation) developed by soil scientists.

Virtual soil profile (VSP)

A 'Virtual Soil Profile' is being constructed as an interactive 3-D visualisation of a three dimensional body of soil from images taken of a field excavated pedon. Utilising *Flash* format, the VSP is being designed so that users can explore it through a web browser. A number of images taken in the field and via light-phase microscope and Scanning Electron Microscopy (SEM) have been used as linking images and as the basis for creation of linked animation sequences. Navigation has been created as a menu option and via clickable 'hotspots' within the soil profile.

Results

Information presentation on the VRO website is now being enhanced with the incorporation of visualisation products to support the more standard web content, i.e. text and graphics. Examples of these are described below.

Landscape visualisation

A focus of the VRO website is the presentation of spatially-based information, including a range of spatial visualisations. There are many examples of site-based information (e.g. soil pit sites, sites of geomorphological significance) adapted (or 'spatialised') into clickable maps that users can click to reveal site-specific information products. Presenting parameter surfaces 'draped' over a DEM can be a useful way to communicate landscape-related patterns and processes. Clickable maps, used on the website to show locations of sites (e.g. soil pit sites), have been enhanced by adding a realistic 3-D background (using DEM and satellite imagery) as depicted in Figure 1. Realistic landscape visualisations are also being developed to demonstrate landscape processes and relationships (e.g. Figure 2).

The information provided on the 'Sites of Geomorphological and Geological Significance' section of the website has been derived from a number of limited distribution publications and developed in association with retired specialists. The VRO website provides maps showing locations of many hundreds of these sites, as well as associated text and images. Video clips are now being routinely used to provide enhanced web

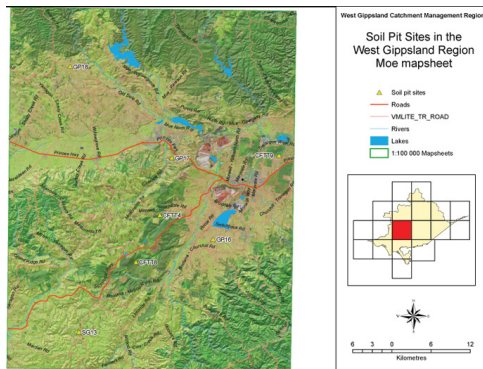


Figure 1. Example of an image map base used to show site locations that can be clicked on to access relevant information.



Figure 2. A visualised landscape showing the estimated mid-Holocene high sea stand of 1.5 m AHD, indicating where Coastal Acid Sulfate Soils may occur.

content and animations. Content includes landscape fly-overs that are being developed to provide a ‘virtual tour’ of these sites (e.g. Mt Noorat example shown in Figure 3). There is potential to supplement these with historical footage and audio-visual recordings of retired experts describing landscapes in the field (e.g. retired specialist providing commentary on a landscape as shown in Figure 4).



Figure 3. On-line video clip of a ‘virtual tour’ of Mt Noorat (a site of geomorphological significance).



Figure 4. On-line video clip of retired expert (Jim Rowan) describing landscape features in the field.

Soil visualisation

A current focus of the website is on providing access to ‘soil health’ related information. Recent developments have centred on providing information on topics such as soil structure, soil biology and organic matter. This is being continually enhanced with the inclusion of multi-media material such as videos and animation sequences, aimed to provide users with a more interactive and visual learning experience.

Virtual soil profile

A ‘Virtual Soil Profile’ is intended as an educational aid to increase understanding of the complex dimensions and properties of soils. It is being progressively developed as a visualisation tool to enhance soils education and training through improved awareness and understanding of soils and their function. The initial objective has been to display aspects of soil morphology and biology and their relationship to soil aggregation and management as well as depicting key soil processes (e.g. residue decomposition and the soil carbon cycle). Zooming functionality allows viewing at increasingly finer scales – from the pedon and component soil horizons, to peds, through to macro- and micro-aggregates. Animation is being developed to enable soil biology to be viewed at increasing levels of detail - ranging from macro-fauna (e.g. earthworms) to litter transformers (e.g. nematodes) to bacteria and fungi. Initially the VSP is being developed to support soils education and training as a stand-alone application, but will be progressively incorporated into the Victorian Resources Online (VRO) website for access by a broad range of users.

Supplementary images, analytical data, publications and other websites are being linked to the VSP through a simple menu that allows exploration of soil properties and functions. Navigation is available via a menu option or by clicking ‘hotspots’ on the soil profile. Apart from rotating and zooming, users are also able to click on ‘hotspots’ linked to images, video and animation related to aspects of soil aggregation (e.g. macro-

aggregates, micro-aggregates), physico-chemical processes (e.g. dispersion) and biological processes (e.g. microbial decomposition by extra-cellular enzymes, soil carbon and nitrogen cycles). Figure 5 provides examples of material being presented.

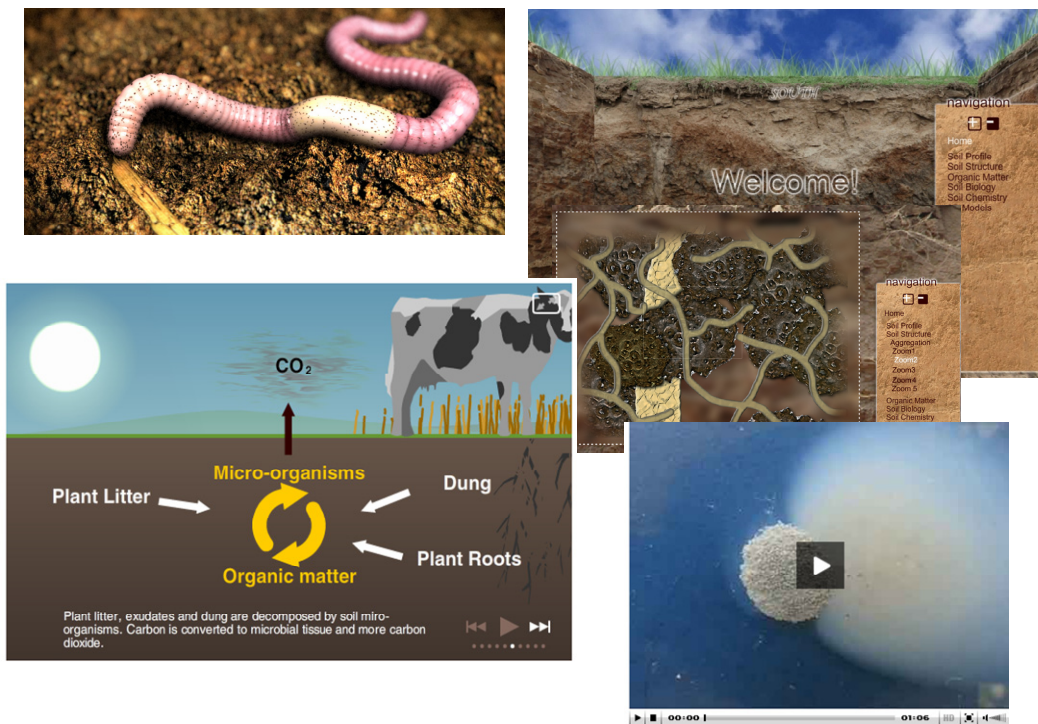


Figure 5. Examples of material presented as part of the Virtual Soil Profile and Victorian Resources Online website: (upper left) earthworm animation; (lower left) soil carbon cycle animation; (upper and centre right) Virtual Soil Profile menu views; (lower right) video clip of dispersion.

Conclusion

The Victorian Resources Online (VRO) website represents a useful model for the effective dissemination of a wide range of soil and landscape related information. Evaluation of users is providing valuable insights into how ‘next users’ access and use soil and landscape information, and has highlighted the educational benefits. Visualisations are now being increasingly added to the website to enhance communication and user evaluation will be undertaken to assess the effectiveness of these recent developments. Visualisation of complex and varied soil and landscape data can be enhanced and integrated through virtual models. The technology to create such models is readily available and affordable. The ‘learning public’, particularly those coming through school and university are now used to (and expect) high quality graphics and animation. The challenge for soil science communicators is to match high levels of graphic reproduction with good quality and stimulating information. It is proposed that the more visual and interactive material currently being presented as part of the VRO website will contribute to making soil and landscape information more attractive and understandable for young people and those without more formal training.

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The challenge for soil research to establish creative interaction with stakeholders and policy makers

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Abstract

The need for scientists to interact more effectively with various stakeholders and policy makers is widely acknowledged in literature and strategic reports. This need is particularly relevant for soil scientists as they are intimately involved with research focused on societal issues covering various aspects of sustainable development. Starting with the classic Gibbons *et al.* paper of 1994, defining mode-1 and mode-2 research, many other studies have been made introducing new terms, such as finalization science, strategic research, post-modern science, innovation systems, academic capitalism, post academic science, Triple Helix, transition management and communities of practice. All these academic endeavours have produced new insights but not as yet operational procedures that are applicable in practice. Perhaps soil scientists, in particular, are in a unique position to “come down to earth” and explore possibilities to improve our ability to effectively interact with various stakeholders and policy makers with the overall objective to improve our impact on society and public awareness. This paper explores some possibilities.

Key Words

Education, sustainable development, public awareness.

Introduction

There is by now general agreement that research aimed at societal problems needs a different approach than the classical one where researchers define the problem to be studied, perform their research and present results without any particular concern about follow-ups. In agricultural research, extension services have been effective in communicating research results to various users but commercialization of extension services has led to their disappearance in many countries, forcing researchers to be more involved themselves. But they feel uncomfortable in this position and developments since have resulted in a rather unsatisfactory condition where too many research projects are poorly connected to user demands while policy makers complain about research being “ivory-towery” or worse. Social scientists have picked up this theme since the middle 1990’s and a large number of theoretical and conceptual papers have appeared. But in practice not too much has changed. Soil scientists are perhaps in a good position to allow this discussion to: “come down to earth” and this paper will explore some possibilities (see also Bouma, 2020). Attention is paid to: (i) a brief literature review; (ii) a discussion of stakeholder demands and the way to approach them, (iii) same for policy makers, and (iv) some conclusions and recommendations for future research and its organization.

Theoretical and conceptual considerations

Hessels and van Lente (2008) have provided an interesting review of papers defining “new” types of research that would be more in tune with modern demands. Bohme *et al.* (1983) speak about Finalization Science; Irvine and Martin(1984) about Strategic Research and Functowicz and Ravitz (1983) introduced the term Post-Modern Science. Edquist (1997) defines Innovation Systems, while Slaughter and Leslie (1997) introduced Academic Capitalism. Ziman (2000) speaks about Post Academic Science and Etzkowitz and Leydesdorf (2000) introduced the Triple Helix concept. Rotmans *et al.* (2001) describe Transition Management and, finally, Wenger (1998) introduced the concept of Communities of Practice. As stated above, main emphasis in these papers is on theoretical and conceptual aspects and practical feasibility nor applicability are hardly covered, nor are specific examples presented.

The main reference is by Gibbons *et al.* (1994) who define mode-1 research versus mode-2 research. Mode-1 is academic, monodisciplinary, homogeneous, has autonomy and classical quality control (peer review); Mode-2 , on the contrary is research in the context of application; transdisciplinary (where researchers work together right from the start with stakeholders), heterogeneous, where social accountability and novel forms of quality control are enforced.

The stakeholders

The stakeholders are a highly diverse group of citizens or organizations in any project that deals with soil research with a societal impact, which would include most projects using land in some way. There are citizen groups, farmers, entrepreneurs, industries, non-governmental organizations, environmental action groups and others. All groups or individuals involved in a given project should be clearly identified right at the start.

This implies that groups that do not involve themselves should be approached by researchers right at the start if they are potentially important for the problem being studied. In addition, a systematic inventory should be made of their suggestions for and expectations of research to be performed. Only part of these expectations will be expressed: many are hidden. An effort should be made – if needed over a drink- to obtain ideas about such hidden objectives because they often turn out to be important in the end. Just asking stakeholders what research they would like to see performed without also probing their expectations is not satisfactory, nor is an incomplete cover of all stakeholders and stakeholder-groups involved.

In order to survive, researchers should be aware that they cannot possibly satisfy all expectations. So they must devise an approach that will allow them to answer questions in a satisfactory manner for at least a significant part of the stakeholders without relaxing their scientific standards. There are too many examples of studies where a particular selection of stakeholders is blindly embraced by researchers, where researchers lose their independence and get clobbered in the end. Researchers have a powerful tool in remaining independent by defining options for a given problem rather than a single solution (e.g. Bouma *et al.*, 2008 with illustrations). In mode-1, there is a problem (identified by researchers) with a solution that is communicated (or thrown over the hedge). In mode-2, a better procedure for scientists is to say: “Anything goes!” “There is no such thing as a bad or wrong idea (what is bad or wrong today may turn out to be a major innovation tomorrow!) and your idea is certainly one of the options we will analyse”.

This means that all consequences of an idea will be shown and it pays for researchers to assist stakeholders in not only generating ideas but also to clarify them as they develop. This approach is counter-intuitive: it would appear to be logical to rapidly filter out clearly wrong or irrelevant suggestions. Then, however, we often find that such ideas start to lead a separate existence in the margin of the discussions as a haven for professional nay-sayers. This can frustrate the general process. It is better to take it all along (except for unethical ones) and make the overall process transparent by showing systematically what the consequences would be if the given option would be realized.

The sustainability concept is attractive here to characterize options as it involves environmental (Planet); societal (People) and economic (Profit) considerations. Some environmentalists ignore economic aspects; social scientists tend to be weak on environmental and economic aspects and economists sometimes ignore environmental considerations. Looking systematically at all three for any option is an attractive approach to give all participants their day in court and give scientists a clear and independent possibility for objective evaluation. The ultimate “solution” of the particular problem being studied is a compromise choice from one of the options, each one of them with particular trade-offs involved. By offering “options” rather than “specific solutions” researchers can maintain their scientific independence and maintain a certain distance to the stakeholder and political arena where ultimate decisions are made.

The policy makers

Policy makers are, again, a highly diverse group operating at local, regional, national or international levels. Different political parties have different programs and there may be a next party in charge next year.

Researchers should therefore be careful to not attach themselves to a particular party. Usually politicians are elected for a limited period of time and they want to have left at least some marks on society by the time they move on. This is reasonable enough. Researchers should avoid, again, to be “his-masters-voice” for policy makers and strive for independence. If they are, rightly or not, too much associated with a particular group of stakeholders, they lose credibility with other stakeholders and with politicians. If, on the other hand, they are seen as spokespersons for politicians, they lose credibility with the stakeholders. Being a researcher in the 21st century implies being able to perform a delicate balancing act! Defining options, as discussed above, is attractive in this context and joint development of options is particularly attractive when working with politicians. A touch of Macchavellian manipulation may be useful here: “I have heard that...; if you would do this or that, then...etc. In the end, research will be judged in terms of what has been accomplished.

Conclusions

Just like with the stakeholders, the joint research approach can ideally result in a feeling that :”we have a problem and we try to solve it as best as we can” rather than a “them” versus “us” situations in which the scientists may lose their shirt. When scientists succeed in working interactively they may also have an important function in bridging the gap between citizens and politicians that is widening right now because of lack of trust. In summary, the procedures loosely sketched here may ideally strike four birds in one stroke: (i) stakeholders feel that their concerns are taken seriously; (ii) policy makers feel that scientists help them within reason to achieve at least some of their objectives, (iii) scientists are effective in applying their science and keep their independence, and (iv) scientists make a contribution towards bridging the gap between science and society, as exemplified in the mode-1 approach. The key-word of all of the above is continuous engagement. Current research programs do not allow for this nor does the current soil-research community have the expertise to realize this transdisciplinary approach. Also, many of our educational programs still follow the mode-1 approach. If all our strategic plans emphasizing the need for more interaction with society are to be taken seriously, our research planning and infrastructure and our education programs should therefore change significantly. Bouma (2008) has in this context made a plea for the establishment of “Communities of **Scientific Practice**” in which the science community should get its act together by including applied and basic scientists , as well as specialists in communication and interaction in their research teams. More time should be dedicated to guard and guide the interaction process from project initiation, as discussed above, to implementation afterwards. We don’t simply deliver information to our users, we develop it jointly along a bumpy track while demonstrating all the time that the scientific community provides major and decisive input into the learning process. This could be the way forward for soil science in the 21st century.

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Using monoliths to communicate soil information

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Abstract

Soil monoliths, often used as teaching aids in universities, are of interest to a wider audience if accompanied by a suitable explanatory display. Monoliths can be prepared with space for the display adjoining the profile. Site and land use information, and the significance of the profile or particular features in it are important when displayed in a museum to the general public. Monoliths have been a valuable component of extension programs and training courses for landholders and natural resource management authorities. Compared to soil pits, monoliths cannot display some physical properties, but when grouped together, important differences and similarities in profile features are more easily recognised.

Key Words

Monolith, extension, education, soil profile, display.

Introduction

Mounted soil profiles or monoliths have been made for over 100 years (Vanderford 1897). In Australia monoliths have generally been used as teaching aids for soil courses at universities. In rural areas extension workers with farmer groups often use freshly excavated pits. In New South Wales (NSW) the state agricultural department has also used large undisturbed soil cores to minimize the area disturbed by excavation. These cores are especially useful when several profiles are needed (Figure 1). The cores can then be transported to a central location once securely wrapped.

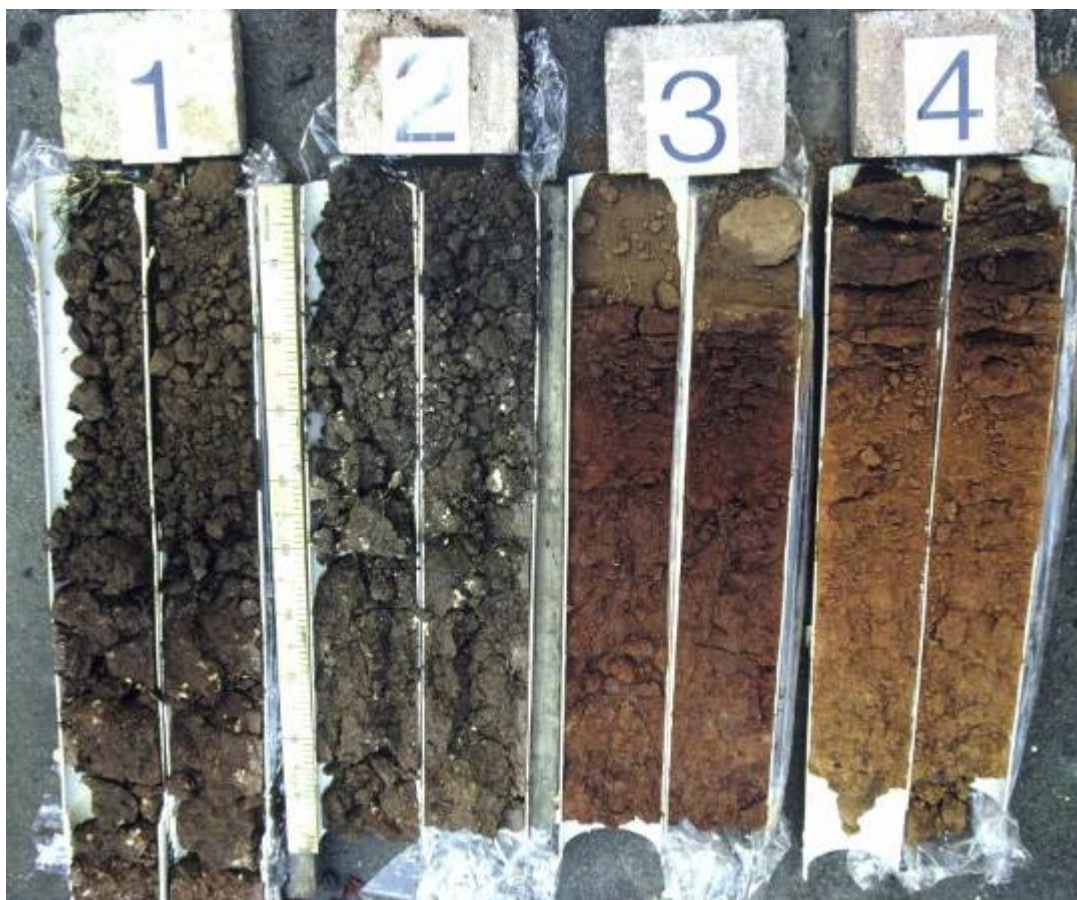


Figure 1. Freshly split soil cores (150mm diameter) from different areas around a large feedlot in central west NSW. This photograph was used as evidence in a case before the NSW Land and Environment Court. (Photo: L Turton).

Like most soil pits, the large cores can seldom be used more than once. To meet the demand from soil extension programs for repeated use of representative profiles from across regions, a technique for making monoliths from large cores was developed (Haddad *et al.*, 2009). Over a hundred monoliths from across NSW have been prepared over the last ten years using a wide range of soils, from structureless loose sandy soils to dense cracking clays. The cores used are generally 90-100cm long. In challenging sites where there is rock at shallow depth for example, the top of the weathered bedrock is normally retrieved intact because it usually contains plant roots.

The monoliths have been prepared in order to

- display soils from experimental sites, agricultural colleges and research stations
- raise awareness of soil features that are critically important for management
- represent the range of soils present in a particular district or region
- display soil properties that are likely to affect water quality
- form part of a training course, for example for local government employees



Figure 2. An example of a freshly prepared monolith lacking accompanying soil information. This monolith which has a buried A horizon (due to erosion upslope) needs the accompanying information and interpretation to draw attention to this critical detail and explain its significance (photo: L. Turton).

Method:

Each completed monolith weighs around 10kg and is mounted onto a board 1.3m long, allowing it to be transported on the back seat or in the boot of most cars. The 150mm wide profile is positioned to one side of the board (300mm wide) towards the bottom (Figure 2). This leaves space at the top of the board for a title and site photo, and at the side for a description of the major profile features. There is also room for information on site features and land use. A sub-heading outlining the significance of the profile is often added below the title. This is the place where the viewer finds information on why the soil is important enough to be made into a monolith. The main title can be a taxonomic or local name depending on the intended audience for the monolith and the objectives of the project.

Some monoliths, especially those made earlier, carried a full taxonomic title, with a detailed technical description and major chemical properties in the side text. This is important for a scientific audience, who expect to see information presented as for example in a conference poster paper. Later, batches of monoliths were accompanied by non-technical text, generally after consultation with potential users who were often experienced extension workers. Technical information could be made available either in an accompanying leaflet or sometimes printed on removable labels that could be swapped with the simpler ones, depending on the audience. The accompanying leaflets can also form part of the information package for an extension program or training course (Figure 3). When displayed the monoliths are often mounted in pairs using small folding portable stands (Figure 4) similar to artists easels. Occasionally a special display board, the same size and shape of a monolith, is used for additional explanatory information (Figure 5).

Results

The level of public interest in environmental and natural resource issues in Australia has increased substantially during the last decade or so. From the outset soil monoliths have proved very popular as an extension tool. On public display, even when viewed through a transparent perspex cover, they attract considerable attention. For example in 2002 a monolith of an acid sulfate soil was loaned to Sydney's Powerhouse Museum initially for a period of three years. This loan agreement has subsequently been renewed twice. Monoliths have also been on temporary display to large audiences at major agricultural shows and field days.

Shallow soil on steep slope

Dark loamy topsoil over light brown clay subsoil with weathered bedrock below a depth of 50 cm

Prepared by Roy Lawrie, Nawash Haddad, Lowan Turton, Georgette Atala

Site : on a steep mid-slope 40 m above the valley floor on a former dairy farm 15km east of Gloucester supporting improved pastures.

Main Features : The dark clay loam topsoil covers a yellowish brown light clay that is weakly structured. Both horizons are only slightly gravelly, unlike the deep subsoil which consists mostly of fractured and weathered bedrock.



Depth
cm

- 0 Dark brown clay loam, well structured, friable, crumbly, with plant roots abundant; slight amount of angular grit; well drained
- 25 Yellowish brown light clay with slight amount of angular gravel; friable-weakly structured, with a few fine roots, well-drained, becoming more gravelly at depth
- 40 Yellowish brown light clay, containing over 80% angular gravel, well fractured following joints in the weathered bedrock, contains many fine roots, well drained, porous

Classification : Brown kandosol



Profile with Buried Topsoil

A very dark grey clay buried under eroded subsoil from upslope

Prepared by Roy Lawrie, Nawash Haddad, Lowan Turton, Georgette Atala

Site : On a valley floor high up in the catchment east of Gloucester, 40 km inland of Wallis Lake, surrounded by steep slopes cleared for dairy farming.

Main features : A light greyish brown clayey surface layer covers a very dark crumbly former topsoil which becomes paler and structureless underneath. These buried layers are gravelly, but the mottled brown clay below has only a trace of gravel and is poorly structured.



Depth
cm

- 0 light greyish brown light clay, with dense mat of vegetation on the surface, fine roots common below the surface along cracks, low amount of organic matter
- 30 dark grey gravelly light clay; fine crumb structure; traces of rusty mottling; very dark and sticky when wet; a few fine roots
- 49 light grey gravelly light clay; powdery when dry; structureless, traces of fine root hairs
- 57 light greyish brown and light yellowish brown light clay, traces of angular gravel; weakly structured, becomes more mottled and clayey below 80 cm; few if any roots; slow to drain after wet weather

Classification : Stratic rudosol over a brown kandosol



Figure 3. An example of two accompanying leaflets prepared using non technical text. The profile on the right is the same as in Figure 2. The profile on the left is 200m upslope on the same grazing property near Taree in Eastern NSW. These leaflets were made for an extension program for landholders in the district.



Figure 4. Monoliths with transparent covers displayed on portable folding stands.



Figure 5 (right). A monolith paired with a special display board (photos by L. Turton).

A permanent monolith display has been commissioned by some clients, including two local government authorities from the NSW coast (i.e. acid sulfate soils), a university (soils used for fly ash research), a winery (the main soil from the vineyard) and a major environmental consultancy (typical soils of eastern Australia). Other clients who have commissioned them to use as an extension tool or for training purposes have been a catchment management authority, an agricultural college, two universities and a large organic waste recycling site. Most of the monoliths collected for the state agricultural authority in NSW are used for these purposes. For smaller audiences (i.e. with twenty people or less) the perspex cover is generally removed and the users can inspect the profile features up close. Under supervision viewers can see biological features like fine plant roots, and abandoned insect burrows and worm channels. Where present other features such as small pieces of charcoal, fine lime and sesquioxide concretions can also be pointed out by the presenter. Occasionally monoliths have been exhibited at the opening of new buildings, at the launch of new research

and extension projects, and even as part of the selection process when interviewing prospective new soil scientists. The accompanying leaflets have been aggregated into a useful resource; particularly by the agricultural college (see Tocal web reference). This is adding to the growing amount of pictorial, publicly available web based soils information (e.g. Imhof *et al.* 2008).

Conclusion

Monoliths made from large undisturbed cores are more versatile than pits, but there are some disadvantages that need to be recognised, along with the benefits (see table 1)

Table 1. Some advantages and disadvantages of soil monolith displays

Advantages	Disadvantages
<ul style="list-style-type: none"> • portable • can be used many times • comparisons between profiles are simple • can be grouped or arranged around a particular theme • can be viewed indoors • suitable for large groups • can be on display over long periods 	<ul style="list-style-type: none"> • do not provide a ‘hands on’ experience • cannot be manipulated or examined in detail • soil physical properties such as variation in soil moisture content, shear strength, consistence or presence of hardpans can not be demonstrated • extent of biological activity can be difficult to assess • large soil structural features apparent in pits may not be displayed. • the profile displayed in the monolith is usually separated from its natural setting.

The value of the monolith in communicating soil information increases when the text and display accompanying the profile suit the intended audience. The accompanying text can be used, and amplified, to meet the need of extension programs that aim to improve soil management.

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Citizen Scientists: Where science meets society – Soil Science Society of America efforts to inject science into policymaking

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Key Words

Congressional soils caucus, core constituent scientist teams, science policy, grassroots advocacy, legislation.

Description of the society

The Soil Science Society of America (SSSA), the largest life science professional society in the United States dedicated to the soil sciences, encompasses approximately 6,000 members plus more than 1,000 professional soil scientists who are a direct conduit to land managers across the U.S. The Soil Science Society of America's federal science policy programs, active for decades, include Washington, DC-based Director of Science Policy, Policy Programs Coordinator, Congressional Science Fellows and Science Policy Interns.

Highlights of science policy activities

Science policy activities encompass education and advocacy. Tools employed include media relations workshops and special sessions on how to communicate with policymakers for members, development of a Rapid Response Team electronic listserve, which allows for rapid access to experts and scientific expertise, a Congressional Soils Caucus, and most recently the development of Core Constituent Scientist Teams, composed of SSSA members who actively engage with Congress to promote soil and the soil sciences..

Proposed approach to 4.4.1 symposium, “Delivery of Soils Information to Non-agriculture Users.”

I will provide a quick overview of the US SSSA science policy office and strategies and tools used to influence Congress and the Administration, including the federal agencies. I will then entertain a discussion of how IUSS member countries can begin the development of their own science policy office.