Australia: Country Case Study

A Process Toward Strengthening National Soil Information Services (SIS)

CABI

ISRIC World Soil Information

Bill & Melinda Gates foundation

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A process toward strengthening national soil information services.

INTRODUCTION

As part of the Process Toward Strengthening National Soil Information Services project, staff and associates from CABI and ISRIC – World Soil Information compiled published reports, conducted interviews, and collected first-hand perspectives and information from SIS developers and stakeholders in each of nine countries. This information was synthesized to document the background, origins, current status, and challenges encountered in each country's unique SIS case.

HISTORY OF SOIL DATA AND INFORMATION IN AUSTRALIA

Prior to the 20th century, explorations conducted by Strzelecki in 1845 provided one of the earliest documented descriptions of Australian soils. His observations laid the groundwork for subsequent scientific inquiry into the vast and varied soil landscapes of the continent (Strzelecki, 1845).

Moving into the early 20th century, the pioneering work of Prescott in 1931 aimed to better understand the intricate relationships between Australian soils, vegetation patterns, and climatic conditions. Prescott's insights provided crucial foundations for ecosystem studies and management practices (Prescott, 1931).

The mid to late 20th century witnessed significant institutional developments, notably with the establishment of the CSIRO Division of Soils in 1927. This marked a milestone in Australian soil research, institutionalizing systematic scientific exploration and analysis of soil composition and behavior (Lee, 1998). Concurrently, publications such as *A Handbook of Australian Soils* by Stace et al. in 1968 served as comprehensive resources, consolidating knowledge and classifications of Australian soils (Stace et al., 1968).

Throughout this period, soil survey initiatives, including those conducted at the Ginninderra Experimental Station, played a critical role in advancing classification and survey methodologies. These efforts contributed significantly to the understanding of soil diversity and distribution across Australia's diverse landscapes (Webster & Butler, 1976).

Entering the late 20th and early 21st centuries, technological innovations began to reshape soil information management practices. The development of the Australian Soil Resource Information System (ASRIS) in the 1990s represented a paradigm shift, providing a centralized platform for storing and accessing soil data (McKenzie & Jacquier, 2004). Concurrently, the advent of digital soil mapping techniques, pioneered by studies such as those by McBratney et al. in 2000, brought about new possibilities for modeled soil characterization and mapping (McBratney et al., 2000).

Efforts to standardize data exchange protocols, exemplified by initiatives like the Soil Information Transfer and Evaluation System (SITES), further facilitated collaboration and interoperability among researchers and institutions (Peluso & McDonald, 1995). The establishment of collaborative programs such as the Australian Collaborative Land Evaluation Program (ACLEP) aimed to streamline soil data collection and management processes, fostering interdisciplinary cooperation (Minasny et al., 2012).

In the 21st century, the launch of the Australian Soil Classification (ASC) system in 1996 provided a structured framework for organizing and classifying Australian soils, enhancing comparability and consistency in soil analyses (Isbell, 2002). Advancements in digital soil mapping culminated in the development of the Soil and Landscape Grid of Australia (SLGA), offering high-resolution soil attribute maps for various applications (Grundy et al., 2015; Viscarra Rossel et al., 2015).

Furthermore, the integration of climate data into soil mapping endeavors bolstered the accuracy of predictive models, enabling more informed decision-making in agriculture and land management (Webb et al., 2015). Ongoing efforts to enhance soil information accessibility, exemplified by the development of standardized data exchange formats like OzSoilML and ANZSoilML, have fostered widespread data sharing and collaboration, contributing to the continued evolution and advancement of Soil Information Systems in Australia (Simons et al., 2013).

ORIGINS

The Australian SIS began as the Australian Soil Resource Information System (ASRIS) in 1998. The federal government and industry recognized significant soil degradation across Australia, so a national committee brought stakeholders together to discuss and act. It was part of a larger 25-year strategy and investment plan in land and natural resources in Australia called Landcare. At the beginning, ASRIS was funded by the federal government with contributions from the states, and the SIS was primarily focused on soil mapping.

Origins – success factors

- The SIS was started as part of a broader land and water resources strategy
- The maintenance of voluntary, customary agreements across the national and state governments has allowed the SIS to be sustained
- Initial funding was available not only for developing the SIS itself, but also for supporting each of the states in building its system capacity and ability to deliver data
- Soil data champions and advocates within the federal and state governments played a crucial role

Origins – challenges

- A federated national government comprised of large states posed challenges
- Ongoing collaboration between the states, the federal government, and CSIRO is not mandated

CURRENT STATE

Current status of the SIS

In 2021, ASRIS was superseded by the Australian National Soil Information System (ANSIS), although ANSIS currently focuses on delivering soil site and analytical data. It accesses the best available information across Commonwealth, state, and territory agencies, as well as other organizations, to deliver soil profile data, digital soil and land resource maps, and other datasets. It supports national and global priorities, including food security, climate change adaptation and mitigation, economic prosperity, and environmental sustainability. Users of ANSIS can discover, filter, access, and view relevant soil data, download soil data in a standard format for use in modeling or analysis, and use an Application Programming Interface (API) to connect soil data through ANSIS to another system or application.

Ownership and accountability

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) is a government agency responsible for scientific research in Australia and serves as the institutional host of ANSIS. Within CSIRO, there is a strong group of soil data advocates who act as champions of the SIS; a couple of key individuals have been especially active in developing ANSIS and driving it forward. Currently, efforts are underway to determine how to maintain the system beyond the current five-year time frame. As a federated system, the SIS relies on data from states and other organizations, including research, community, industry, and private sectors, to function.

Institutional environment

The federal government and CSIRO are the key partners in the SIS. They work together with the state governments in a cooperative federalist system—there are no mandates for this arrangement, but it works for now because the states and central government have agreed to collaborate. The SIS is heavily dependent on the state governments, which contribute data to the system, and on this network of jurisdictions working together under the national soils strategy. ANSIS has been developed through collaboration among governments, research organizations, industry, the private sector, and the community.

Legal and policy environment

There is no federal government mandate related to soils or soil information. There is strong interest in soil data within Australia among policymakers, researchers, universities, and agricultural advisory/extension services. In particular, Australia's participation in the Global Soil Partnership and other international communities has highlighted the need for accurate, locally produced data about Australia's soils.

IT and Human Resources

Technical capabilities vary across Australia. Over four years, the internal CSIRO team has grown from three to seven people. However, as the system transitions from the development phase to the production phase, a different set of roles is needed. Within CSIRO itself, there are skills in system administration and user administration, but these may not be sufficient for managing the SIS as it launches and rolls out. It seems that the pipelines for technical training are adequate to meet the needs of the SIS. Data development and administration, mapping and spatial modeling, and other key technical expertise are represented on the SIS team. Capacity gaps have been filled by hiring external support from private sector service providers.

Users and use cases

There have been several user needs assessments and efforts to understand use cases throughout the project. For policy, industry, and research needs, the objective for ANSIS was to generate data and products that are consistent and representative of soils across Australia. For these and other users, there is also a plan to conduct intermittent, formalized user assessments with industry and government groups as the system continues to be enhanced. The process seems to be approached in iterations—first user assessment, then system building, followed by returning to users to evaluate how well the built system meets their needs, and finally determining where the gaps are. As one source remarked, there is a challenge to making clear links between user needs, data, and the right design for a delivery platform: "Everybody focuses on the bright shiny object and the portal and whatever, and then go, wait, there's no data behind it!"

User groups included policymakers who need soil data for local and national decision-making, farmers and extension services who use the data to better understand the management needs of their soils, and researchers who require standardized soil properties data for modeling and other analyses. In addition to management of water resources and land-use policy and planning, further applications are envisioned for sustainability credentialing programs for farmers. The data will also be used by a new National Soil Monitoring Program to identify locations across the country that have low representation in the ANSIS data. After the new data system is fully launched, ANSIS developers will undertake a process to develop strong policy- and industry-relevant applications.

Current success factors

- Iterative user assessments generate clear uses and use cases
- Sufficient technical capacity exists in Australia, and pipelines exist for filling any future technical gaps
- A supportive institutional environment includes strong working relationships across the federal government, state governments, and other partners

Current challenges

- Stakeholders tend to focus on “the shiny object” of a new portal rather than on the generation of actionable data and information
- Consistent delivery of data from the states into the SIS requires continued collaboration from the states, along with their ability to cover the costs of their own data collection to the standard of the SIS and manage delivery to ANSIS. This makes the national system vulnerable to changes in political and funding agendas across jurisdictions

FUTURE PLANS

Growth of the SIS

Presently, there is no established long-term funding stream for enhancements and additions to the SIS. Funding comes through project investments from the government for system maintenance. ANSIS has incorporated a feature to track access and usage of the data, which will enable greater knowledge of users and use cases.

SOIL DATA RESOURCES

Name	Description	Link
The Australian National Soil Information System (Since 2023)	The SIS spearheaded by CSIRO aimed at offering accessible, nationally consistent soil data and information. ANSIS facilitates the retrieval, filtering, and visualization of standardized soil data, which can be downloaded in a standard format for modeling and analysis purposes. Additionally, ANSIS supports the creation of national soil property maps by leveraging harmonized, directly measured soil data from across Australia. It also supports distributed soil data management systems to enhance data exchange and utilization, ensuring improved access to trusted soil information.	Access to the **ANSIS** portal
APSoil	Database of soil water characteristics, facilitating the estimation of Plant Available Water Capacity (PAWC) for various soils and crops across multiple cropping regions in Australia. Regularly updated, APSoil is tailored for simulation modeling and agricultural practices. Its features include the ability to view soil and crop data in spreadsheet and graphical formats, create personalized directories of locally relevant soils, adjust soils to suit local conditions, ensure compatibility with the APSIM model, and execute the APSIM model using soils developed within APSoil.	Access to the **APSoil** portal
Atlas of Australian soils	The Atlas of Australian Soils, compiled by CSIRO in the 1960s, serves as a foundational resource offering a uniform national overview of Australia's soil characteristics. It consists of ten maps along with explanatory notes, primarily assembled by K.H. Northcote and collaborators. Originally compiled at scales ranging from 1:250,000 to 1:500,000, the published maps are at a scale of 1:2,000,000. This atlas provides detailed descriptions of soil landscapes and constituent soils. Soil classification within the Atlas is based on the Factual Key, a widely utilized soil classification system predating the Australian Soil Classification. Originating in 1960, the Factual Key drew heavily from approximately 500 profiles, predominantly from southeastern Australia. In 1991, the Bureau of Rural Science digitized the Atlas, creating the Digital Atlas of Australian Soils from scanned tracings of the original hardcopy maps. This digital version is accessible as a shapefile, offering enhanced accessibility and usability compared to the physical format.	**Atlas of Australian soils**
Australian Soil Classification	The Australian Soil Classification, a collaborative effort led by the National Committee on Soil and Terrain and other partners, offers a detailed systematic classification of soil types across the country. Initially developed in 1996 by Ray Isbell, a former CSIRO soil scientist, the classification has undergone revisions over the years, with the latest edition released in March 2021. This edition introduced a new soil order, reflecting ongoing advancements in soil science. In late 2021, the TERN Australian Soil Classification Map was launched, providing a modelled depiction of soil types at a resolution of 90 meters. Leveraging Digital Soil Mapping technologies and real-time collations of soil attribute data from TERN's Soil Data Federator, this map serves as a valuable resource for industries and land managers, facilitating informed decision-making and cost-effective practices. The map needs to be updated to incorporate new soil order data, ensure accuracy and relevance in depicting the spatial distribution of soil types nationwide.	**Australian Soil Classification**

Name	Description	Link
Australian Soil Resources Information System (ASRIS)	The Australian Soil Resource Information System (ASRIS) was decommissioned in May 2024 because its mapping tool is no longer compatible with the latest technologies. Much of the data on ASRIS will be available via the Australian National Soil Information System (ANSIS) portal.	Australian Soil Resources Information System (ASRIS)
Natsoil	The CSIRO National Soil Site Database, or Natsoil, is a robust repository containing over 21,000 soil site investigations. It encompasses morphological descriptions, chemical, physical, and mineralogical properties, as well as spectral predictions and soil specimen management data. Together with The Australian National Soil Archive, it forms the basis for the national soil spectral library and supports TERN Landscapes national soil property modeling through a federated collation of available soil databases. With origins dating back to 1948, Natsoil initially comprised data from CSIRO-managed research projects and field stations. Over time, it has expanded to include sites from national collaborative initiatives such as The Northern Australia Water Resource Assessment (NAWRA). Additionally, data submitted to the Australian National Soil Archive by state and territory agencies and other organizations are incorporated into the database. Ongoing data curation ensures its relevance for research projects and for the maintenance of the Australian National Soil Archive. As new projects contribute data and specimens, the database continues to grow.	Natsoil
Soil and Landscape Grid of Australia	In 2011, the development of the Soil and Landscape Grid of Australia commenced. As the world's first comprehensive continental soil data system. By 2014, the Grid was released, representing Australia as a digital grid consisting of two billion 'pixels,' each about 90 by 90 meters in size, extending to a depth of two meters below the surface. Since its launch, the Grid has experienced significant demand, with over 1.3 million downloads. Continuously evolving, the Grid amalgamates both historical and current data from various sources, including sampling, laboratory sensing, modeling, and remote sensing. It is increasingly utilized in planning and decision-making processes. Aligned with the GlobalSoilMap.net specification, the SLGA offers a resolution of approximately 100 meters. It is accessible online, via Google Earth, or for direct download. In addition to soil properties, the Grid also provides numerous landscape attributes, such as the Prescott Index for water balance and solar radiation.	Soil and Landscape Grid of Australia

SOURCES AND REFERENCES

Information sources that supported the development of this case study include:

- Interviews and conversations with personnel who were involved in the development of ANSIS
- Desk research conducted by CABI and ISRIC staff and associates

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Further information

For more information on the project visit: **cabi.org/projects/soil-information-systems-review-a-process-toward-strengthening-national-soil-information-systems**

To access similar resources and explore the framework visit: **resources.isric.org/sis-framework**

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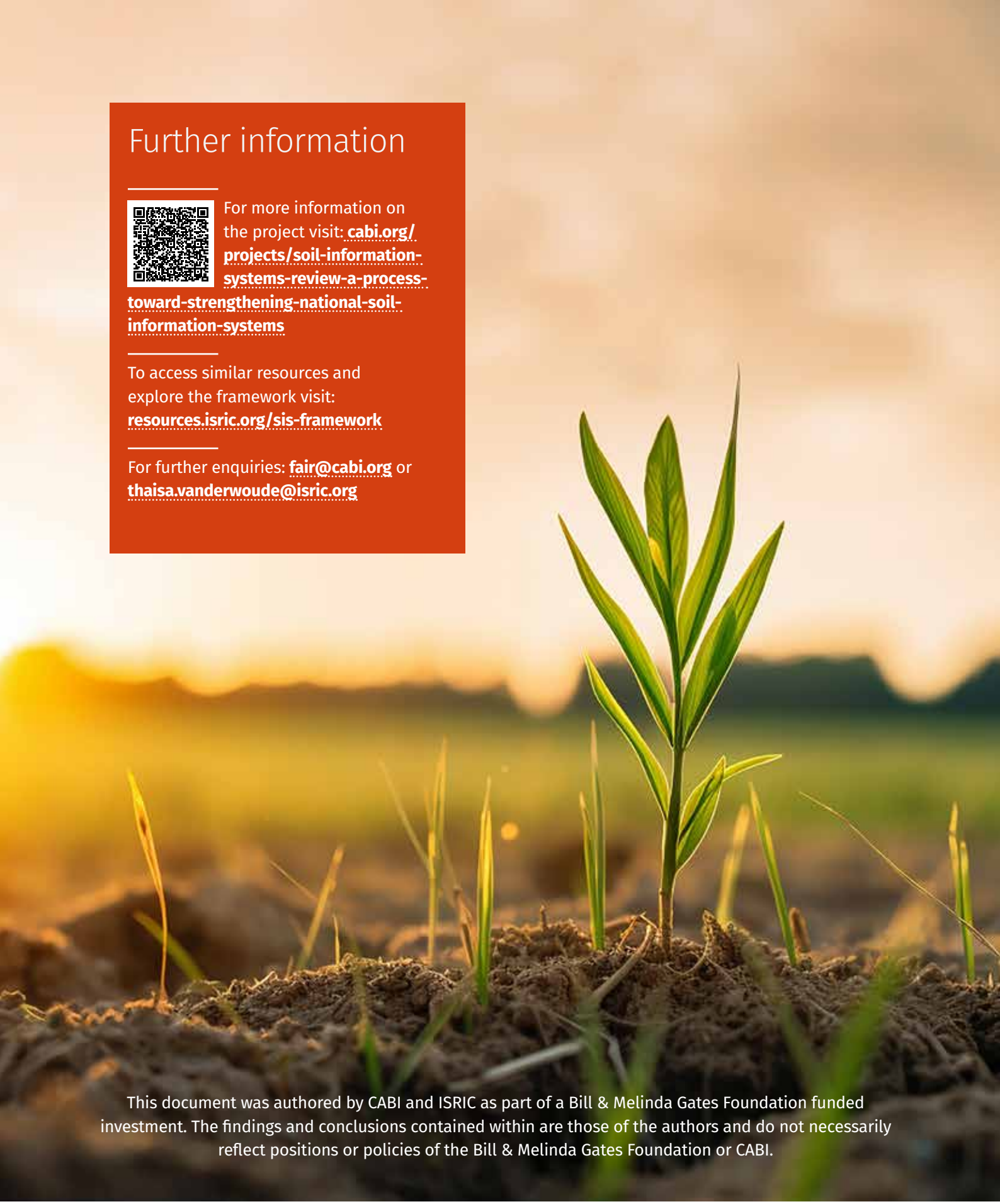

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