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Foreword

Significant interest exists within Australia and internationally to quantify the impact of land use and applied management practices on stocks of soil organic carbon. This has resulted from the recognition that soil organic carbon and its associated elements (N, P, S, O and H) can make positive contributions to the productivity and resilience of agricultural soils and from the potential to mitigate greenhouse gas emissions through the capture and storage of atmospheric carbon in managed soils. Although the introduction of agricultural production has typically led to reductions in soil carbon stocks, the development and application of more "soil carbon friendly" practices (e.g. reduced tillage, stubble management, green manuring and application of organic amendments) have the potential to reduce the extent, arrest or reverse this trend. Given the diversity in climatic conditions, topographic features, access to irrigation water and soil types that exist across Australia's agricultural zone, a wide range of agricultural systems and management practices have developed. It is therefore likely that solutions which allow the sequestration of atmospheric carbon in soil will be regional and industry specific.

In 2009 the Australian government recognised a critical need to define realistic and scientifically robust carbon sequestration options for agricultural soils. In response, the **Soil Carbon Research Program (SCaRP)** was established as part of the Climate Change Research Program within the Australia's Farming Future initiative of the Australian government with additional investment from the Grains Research and Development Corporation (GRDC). The **SCaRP** brought together research staff from national and state government organisations and universities across Australia to deliver a coordinated program of research on soil carbon. The project was tasked with delivering a coordinated set of projects that were consistent with national greenhouse gas inventory methodology, would aid in the development of emissions trading policy and could identify practical greenhouse gas mitigation programs. The specific objectives of the **SCaRP** were to:

- assess rapid and cost-effective methodologies for deriving the data required to quantify soil carbon stocks and composition (allocation to particulate, humus and resistant forms of carbon) and for measuring soil bulk density;
- develop and implement a nationally consistent approach to quantify soil carbon stocks under major land-use and management regime/climate/soil type combinations used for agricultural production in Australia; and
- quantify the input and subsequent fate of carbon added to soil by agricultural systems based on subtropical perennial pasture species.

This special edition of ***Soil Research*** – **Soil Carbon in Australia's Agricultural Lands** – presents the results obtained by the SCaRP. The papers presented have been organised into three sections:

1. methodological developments that allowed quantification of soil carbon stocks and composition;
2. regional assessments of the soil carbon stocks present under different land-use and management/climate/soil type combinations; and
3. quantification of the impact of subtropical perennial pastures on soil carbon stocks.

The main soil collection and analysis activities conducted by **SCaRP** were completed on soil collected from the 0–10, 10–20 and 20–30 cm soil layers of farmer managed paddocks. Individual sampling sites corresponded to a 25×25 m area located within a paddock. Each sampling site was considered to be a single representation of a defined combination of land-use and management regime/climate/soil type. Within each agricultural region studied by **SCaRP**, soil was collected from multiple sampling sites representative of each land-use and management regime/climate/soil type combination being investigated. Aggregation of the soil organic carbon stock data generated across all sampling sites within the region provided an indication of the magnitude and certainty associated with soil carbon stocks under the different land-use and management regime/climate/soil types included.

A second smaller soil collection activity revolved around the resampling of previously sampled field experiments. Resampling and analysing the soils from these experiments has provided temporal soil carbon stock data for eleven locations having a range of soil types and climatic conditions.

Soils from a total of 4572 locations amounting to 20 495 samples were analysed making the **SCaRP** the largest soil sampling exercise conducted for Australia in which all data required to quantify soil carbon stocks and composition were collected. The methodologies developed and used within **SCaRP** and the data acquired will be useful in generating additional outputs beyond those identified for the **SCaRP** itself. For example, development of methodologies within Australia's Carbon Farming Initiative, provision of mechanisms to obtain the soil carbon data required to initialise models such as that used in Australia's National Greenhouse Gas Inventory, and the generation of maps of soil carbon stocks and composition. However, it needs to be acknowledged that **SCaRP** was not comprehensive in either the range of soils or management regimes examined. New and innovative approaches to improving agricultural production and the return of carbon to soils are constantly being developed by landowners and these will need to be continuously assessed.

It also has to be emphasised that, other than the second smaller soil collection activity which added to an existing set of temporal soil carbon stock measurements, the bulk of the soil sampling conducted within **SCaRP** represented a baseline measurement of the soil carbon stocks associated within the various land-use and management regime/climate/soil type combinations investigated within each agricultural region. Temporal variations in soil carbon stocks were not measured for these combinations. Thus the data from the main soil collection activity cannot be used to provide estimates of carbon sequestration since no indication of the temporal trajectory of soil carbon change was acquired.

We would like to thank all staff involved in the collection and analysis of the soil samples included in the **SCaRP**. It was a very significant undertaking that involved many hours of field work, soil sample preparation, sample analyses and data collation and interpretation. The program would not have been possible without the widespread cooperation of Australian landholders in providing access for soil sampling and information on management history. The **SCaRP** is grateful to the farming community for actively engaging in this project. Funding provided by the Australian Government and GRDC is acknowledged as is the contribution of each of the authors and reviewers involved in the preparation of the 18 papers included in this special issue. Additional resources associated with the **SCaRP** include:

1) **SCaRP** web pages containing summary information and full project reports (www.csiro.au/Organisation-Structure/Flagships/Sustainable-Agriculture-Flagship/Soil-Carbon-Research-Program.aspx).
2) The **SCaRP** database: Accessible from the CSIRO Data Access Portal (https://data.csiro.au) under the title Australian Soil Carbon Research Program.

Jeff Baldock, Lynne Macdonald and Jon Sanderman