SUBMISSION ON INQUIRY INTO AGRICULTURAL INNOVATION

BY

THE AUSTRALIAN SOCIETY OF SOIL SCIENCE INC.

(SOIL SCIENCE AUSTRALIA)

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The Australian Society of Soil Science Inc. (now referred to as Soil Science Australia) is a professional society that represents over 900 members across Australia. It comprises a Federal executive and seven branches, one in each state and one in regional New South Wales. Each branch has its own executive committee. Membership consists mainly of consultants, academia, CSIRO and soil scientists in state and territory agencies. Membership also includes some farmers. See http://www.soilscienceaustralia.com.au/ for more detail.

Soil Science Australia (SSA) welcomes the opportunity to make a submission to the inquiry. The society supports the strong emphasis given in the Commonwealth 2014 green paper to the importance of good soil management for Australia to achieve agricultural competiveness. Ambitions to dramatically increase agricultural production will need to rely on agricultural intensification and expansion, putting greater pressure on the soil resource. Leading members of SSA believe such additional pressure will require a focus on R&D innovation and management practices that enhance not only soil resilience but also soil security.

SSA suggests that the inquiry should focus on two aspects, not only the potential of emerging and new technologies but also the need to raise the adoption rate of proven technologies. Members cite many anecdotes where unnecessarily expensive or ineffective farming decisions have been made because of a lack of knowledge/advice using the basic fundamentals of soil science.

New and emerging technologies

On farm data integration

This refers to the emerging process of collecting paddock level data on weather, soil, management and crop/pasture performance and transforming it into real-time, user friendly decision support tools. It takes advantage of the rapid development in high performance computing, digital communication and processing, geolocation recording (GPS), guidance systems, imagery from drones, remote sensing, and the automation and monitoring capacity of farm machinery.

A product of this collection of innovation tools will allow farm resources to be used more efficiently and includes precision agriculture. However this process depends on the quality and timeliness of paddock scale data being available. To make management decisions that improve nutrient and water use efficiency, the most difficult and expensive data to collect is soil data. This is more critical to Australia than for North America or Europe, because of the fragile, old and low fertility soils that many Australians farm. Some of the emerging rapid soil testing and sensing technology with great potential is described under a separate heading.

Big soil data platform

This was the subject of a national conference in June 2015. It collects and makes available data on a regional, industry, state or national scale to help farmers make better management decisions. It includes state and national resource datasets as well as farmer and industry statistics and data, but there are challenges with confidentiality and concern about the potential misuse of farmer data. It relies on an open data system being made available to consultants and farmers. It allows comparative regional and contextual information as well as farm specific information to be made available to farmers. The recent allocation of funds to CSIRO to build an interactive system to digitally link information about farm soils, climate and other data to aid farm decision-making, commences this approach in Australia.

Network Learning

Networked learning is going to provide great insight into applying the above two innovations, whereby users are connected to other users, content experts (anyone with the useful answer to a question), and content. However, this alone will fail and needs to be coupled back to on-farm integrated data systems. These systems must not only access/utilise data generated on farm and external to the property (automated and through everyday business), but must also integrated human mediated data (the power of community - a digital community of practice). This is NOT a centralised digital information repository but a centralised and intelligent processor/integrator of information/data with informed outcomes to aid in risk mitigation on-farm. This process will affect all aspects of form management.

Another important related point to this is that Australian agriculture is on the cusp of being able to use data in a sensible fashion that allows reinvestment of data value back into agriculture. However, we have as a nation been incredibly slow to move on this and we run the risk now that a corporatised model will be introduced that fails to reinvest, thus losing the true value of on-farm data. It's important to note that individual data is effectively worthless, it's only of value in aggregate. So, a direct payment to data owners for data would also not realise the true, and fair, value of data. Some sort of social enterprise is required whereby it needs to make a profit to run, but has a very transparent mandate to reinvest the value of data back into agriculture/land management.

Cheap and Rapid Soil Testing

Soil scientists have been researching the capability of a range of rapid and cheap new tests for a wide range of soil nutrients, a number of which are being used widely in the USA. However although lab results are encouraging, the tests are yet to be calibrated under Australia’s wide range of natural soil conditions. To value add the potential of these tests requires further testing and validation in pot trials and field experiments. These tests include using near infra-red NIR), mid-infra-red (MIR) calibrations and Mehlich 3 extractions.

A significant soil constraint in broadacre production is understanding soil moisture for yield potential. While moisture sensors are routinely used for irrigated agricultural systems, there is opportunity to introduce similar sensors into broadacre cropping systems too.

Rapid assessment of paddock scale soil variability

Farmers can benefit substantially if they gain a better understanding of the variable nature of soils and what it means for farm management and optimising crop or pasture productivity. There is a little

adopted technology that can help considerably with this challenge. A *GPS linked EM31 electromagnetic ground conductivity mapping* device towed behind a vehicle can rapidly assess the variability of subsoil conditions within a paddock. The output from the device maps subsoil differences across a paddock and the different intensity signals can be investigated and understood by taking a range of soil cores and samples, and in some cases undertaking soil tests. The technology is particularly useful to detecting subsoil salinity, a major constraint for grain crops. A similar EM28 device has been found to be particularly useful for WA soils.

Another sensor system that can also operate in tandem with the EM31 is *ground based radiometrics*. Together the two sensors can greatly enhance the understanding of soil variability.

In crop soil management can be enhanced using high resolution airborne imagery captured by drones. Examples where it is being applied already is with late N fertilizer applications and determining the outcomes of soil management trial strips to decide the best fertiliser or ameliorant application rates. These images can be readily linked to yield maps to determine best management.

Other ground based sensors that works better in sandy soils include *ground penetrating radar* and portable *Mid-infrared* devices. These technologies show great potential as soil related inputs to precision agriculture.

Sediment tracing using radio-isotopes

This “finger printing” technology recognizes the different sources of eroded sediments and identifies if it predominantly from hillslope or gully erosion. On large properties it can be used by farmers and authorities to prioritise the remediation of eroding areas. This will be an important tool for farmers in catchments draining into sensitive receiving waters such as the Great Barrier Reef.

Genetic markers of the soil microbial population

Recent advancements in biotechnology and computer processing using the latest DNA sequencing techniques identify groups of microbes and then map their abundance and distribution. This technology is now fast and cheap. It can identify the functionality of the soil microbial population in terms of soil health and nutrient availability.

Adoption of proven and emerging (and existing) soil technology and knowledge

The terms of reference includes “barriers to the adoption of emerging technology”. SSA believes this issue also applies to well established soil technology and knowledge. The Green Paper as well as anecdotal evidence from SSA members confirms that the withdrawal of state government extension services and the reliance on a private extension network is failing. This is particularly in respect to the application of the basic principles of evidence based soil science to farm management. Members have observed a need for higher standards of knowledge in soil science for many agricultural consultancies, farm service providers and for those on the land.

SSA provides opportunities for training and mentoring of its less experienced members and other interested parties. Its members in academia provide courses within existing degree frameworks. Furthermore SSA has a program of accreditation, the Certified Professional Soil Scientists (CPSS)

program, whereby the farming community can have confidence in the skills and knowledge of a member with CPSS. See http://www.cpss.com.au/ for more detail.

SSA recommends that further development of any soil management related innovations that the Australian Government choses to invest in, should be led by scientists who hold CPSS. We appreciate that there are barriers to the adoption of new technologies such as cost, fear and in some cases the substantial complexity and a reluctance to share farm data.

SSA is exploring opportunities whereby soil science is used to greater effect in agricultural decisions, with CPSS accreditation being the main initiative. SSA maintains this program using volunteers within the society and would welcome the opportunity to interact with the Australian Government on how to share the responsibility of raising standards of soil management.

SSA has recently been in dialogue with GRDC and the University of Sydney with reference to the soil science competencies identified as essential for professional extension agronomists and agricultural advisors. Recently SSA decided to establish a training board to help encourage and facilitate soil science training in all its forms.

The Government is to be commended for the development of the National Soil Research, Development and Extension Strategy. The strategy aims to ensure soils research becomes more targeted and collaborative and better meets the needs of farmers. Linking such research to emerging technologies has the potential to underpin much of the soil science action that will support agricultural competitiveness in coming years. The gains hoped for through innovation will not be attained without an injection of funds to raise capacity and meet the challenges of soil security and soil resilience. As stated in the Green paper “Australia can only be a major global player in agriculture if we are at the forefront of technology and productivity”.

If requested, SSA would welcome the opportunity to elaborate further on the issues it has submitted to this inquiry.