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Innovation Hub

SUSTAINABLE AGRICULTURE,
LANDSCAPES AND COMMUNITIES

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Soils Capacity Gap Analysis

Southern NSW

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Background

The National Soil Strategic Plan identified future priorities to address gaps in soil knowledge and extension across Australia. These were developed further in the National Soil Action Plan

The action plan focuses on 4 priority actions:

- 1) Develop an agreed national framework to support the measurement, monitoring, mapping, reporting and sharing of soil state and trend information, to inform best practice management, decision making and future investment in soil.
- 2) Partners to develop a holistic policy and strategy approach where soil function is recognised, valued, and protected for the environment, economy, food, infrastructure, health, biodiversity and communities.
- 3) Accelerate the adoption of land use and management practices that protect soil and improve soil state and trend.
- 4) Identify and develop the soil workforce and capabilities needed to meet current and future challenges for Australia and the region.

To action priorities 3 and 4, a National Soil Science Extension Team Coordinator was appointed to coordinate 8 Regional Soil Coordinators across Australia. This enabled both universal soil issues, and regionally specific priorities to be developed. An important component of the RSCs remit was to identify gaps in soil knowledge and the adoption of soil information on farm. It was agreed that the most efficient way of providing quality information was to undertake the gap analysis at the regional level.

The Regional Soil Coordinators (RSC's) within their respective regions identified challenges and opportunities in improving soil knowledge and extension in their areas. Collectively, the RSC group determined five key themes to form the basis of the report; soil advice, soil information, barriers (to adoption), soil management and soil issues and constraints.

Method

The RSC representing the Southern NSW Innovation hub predominantly used semi structured interviews. The content of this report is a summary of the results of semi-structured interviews of identified soils experts of the Southern NSW region and is augmented by results of the National Soil Survey and relevant regional literature.

Method 1, Semi-structured interview.

The interviews allowed us to explore in depth the real issues behind the gaps in soils based on the extensive experience of 25 people interviewed. The interviews were a mixed of face to face, online one on one, or over the phone. The interviews were guided under the five themes, however the interviewee had the liberty to discuss the issues they felt were most important.

Semi Structured Interviews of soil people from the following sectors were conducted:

- Landholders
- Soil farm advisers (eg agribusiness agronomists)
- LLS (Agriculture)
- Soil researchers
- Soil educators (tertiary level)
- Specialist Soil consultants
- Soil conservationists

- Soil Carbon aggregators & researchers
- Soil pedologists (keepers of public soil data)
- Farming systems group agronomists
- University Ag Extension academics
- Soil CRC staff
- Government Ag Extension staff
- Soil mapping personnel
- Fertiliser company researchers

Method 2, Review of literature.

A review of literature relevant to the identification and prioritisation of soils related issues in Southern NSW was conducted. The literature comprised of strategic plans from several Local Land Services, soil extension journal articles, soil survey articles, and soil properties of southern NSW publications. After identifying the major outcomes from the semi structured interviews, these were cross checked with the reviewed literature to determine the extent of support for the interview results.

Method 3, Online National Soil Survey

The RSC's co-developed and distributed a National Soil Survey to provide evidence-based information to support the Soil Capacity Gap Analysis.

This survey was designed and developed by the University of Melbourne (Fisher et al. 2023) with input from the Regional Soil Coordinators and National Soil Science Extension Team (NSSET). The survey was distributed nationally by the Regional Soil Coordinator network, NSSET, and many farming system groups, natural resource management organisations, and state agencies. Results were divided into the relevant regions by postcode and supplied to each RSC. Biometric analyses of the results have not been completed, as this is currently being undertaken at a national level. The results of the online survey have been cross checked with the semi structured interviews to determine whether the priorities of the semi structured interviews match. This was determined by assessing the national soil constraints listed in the survey, and matching them with the interview results.

Results for semi structured interviews on soil capacity gaps for Southern NSW

In line with the methods used to conduct the semi-structured interviews, the identified gaps are presented under the five themes, soil advice, soil information, barriers to adoption and soil management and soil issues and constraints. For the purposes of reporting, barriers to adoption and soil management were combined into one theme.

Soil Advice

- **Land managers need for soil advice delivered at all levels of understanding is not being suitably met.** Land managers have a strong appetite for information such as interpreting ‘what the numbers mean’ in soil test results, through to what soils best management practices are right for them to implement.
 - While seemingly basic, accurate interpretation of soil test results and the following recommendations require a systems level understanding of soils. Often this understanding only comes from extensive experience as a soils practitioner in the area local to where the advice applies.
 - **Due to limited access to soil experts, soil laboratories are often expected to provide advice on test results.** Often for meaningful interpretation a local understanding is necessary, and it is hard to make more than a generalisation from out of context soil test results.
- **Soil advice is best given by skilled practitioners who understand the local landscape, from underlying geology, through to local farming systems.** This is only achieved through years of experience and cannot be immediately recruited.
- **Land managers struggle to find independent advice on soils.** The gap of unbiased land management advice which was left from the phase out of the District Agronomist advisory model has been filled by private industry, including agricultural product resellers and corporate agronomy companies. Often, due to the breadth of agronomic disciplines that they must advise on, or in line with the priorities of their private organisations, the quality of soils management advice can vary.
 - **Many private advisors actively seek further soils upskilling.** However, those qualified to deliver and support the training are often overcommitted and overstretched.
 - **Early career agronomists/advisors have a high turnover rate.** It is challenging to develop strong local soils workforces which can provide high level advice.
- **Soil experts are retiring without adequate succession.** Many of the experts equipped to provide high levels of advice are reaching retirement age, leaving a break in succession due to lower numbers of early and middle career soil experts. As this is a highly skilled discipline, it takes significant time and resources to train soil practitioners to expert levels and without succession and mentoring programs, this will often occur from scratch.
- **The soil advice space is often unregulated.** This has given room for advisors to enter the market and deliver services which may not be evidence-based.
 - **Accreditation and training are not mandated for soil advisors.** Some advisors have completed courses such as Fertcare accreditation, however this is not mandatory and levels of the quality of advice given to farmers can vary.

Soil information

- **There is a constant demand for the fundamentals of soil science.** Both landholders and advisors seek access to information on the basics of soil science. Often this information can be hard to source as it may exist in outdated media (factsheets that have not been updated,

magazines or field notes etc.). Soil educators are only as good as the research that keeps them up to date.

- **Soil information needs interpretation.** While the fundamentals can be understood, it requires expert knowledge to contextualise the concepts to the level that can be applied towards best management practice of any given system.
- **There is a significant focus on information related to soil carbon.** The quality of the available information varies which makes it challenging for land managers and advisors to ensure they are getting the most accurate and scientifically valid information.
- **Media and popular attention of one aspect of soils may distract from other important areas.** Soil carbon and soil biology dominate media attention on soils, however from a scientific and soil management perspective, soil physics and soil chemistry are at least equally as important.
- **The delivery of soil information needs to suit the consumer.** Soil information can be delivered in a variety of media, however concepts of source of delivery need to be tailored to suit the consumer. While this is understood by soil scientists, it is challenging to achieve under project-based funding models whereby the researcher is expected to publish journal articles under time and funding pressure.

Barriers to adoption and soil management

- **Promotion of soil best management practices is not coordinated across industry organisations.** While some individual organisations may support soils best management practices and deliver extension, this is not unified and the advice being given and practices promoted by one organisation may not align with those of another.
- **Soil extension activities may not be efficiently delivered when there is strong separation between the organisations responsible for the delivery.** While the Regional Soil Coordinator position has significantly contributed to a re-unification of soils extensionists, there are still institutional challenges that prevent unity across soils extension.
- **Land managers often rely on 'rules of thumb', rather than up-to-date science.** Rules of thumb are easy to understand and implement, however they can become easily outdated and may only be applicable in certain context.
- **Soil management is the sum total of soil advice, information and adoption working together.**

Soil issues and constraints

- Major regional issues to Southern NSW include:
 - Increasing sub-soil acidity
 - Declining soil organic matter
 - Soil erosion
 - Soil structural decline
 - Dispersive and hardsetting soil

Review of literature

A review of the literature showed that the priorities identified in the semi structured interviews and online survey were poorly catered for. There was information and advice for addressing soil acidity, primarily resulting from a national acid soil action program and its subsequent extension and activities. LLS Strategic plans were varied, with most having minimal or no information on soil management or priorities. The only LLS plan to cover a soil issue was Western LLS, which had a priority program of growing natural capital (soil Carbon). For more recent issues, such as soil biology, there is much less information. The NSW DPIRD soil website contains a vast suite of relevant publications on a range of soil issues <https://www.dpi.nsw.gov.au/agriculture/soils/guides>

Results of on line survey for S NSW

Soil Advice

The growers' response to identifying where they get their soil advice supports the outcomes discovered by the semi structured interviews (Table 1). Growers value independent advice and often get their information from commercial agronomists (who are often aligned with agribusiness). There was a smaller response to government extension options.

Table 1 Source of advice for grower respondents

Who are the most important people and organisations you rely on for quality information, advice or support on soils management? Other growers / neighbours vs Main occupation.

Main occupation	Importance of info from Other growers / neighbours			
	Not at all important	Slightly important	Moderately important	Very important
Farm/Property owner	0	7	4	3
Farm/Property manager	0	1	0	2
Farm/Property worker	0	0	0	0
Farming systems group employee	1	0	0	0
NRM organisation employee (e.g. CMA, Landcare)	0	0	1	1
Researcher	0	2	1	2
Government extension	0	0	2	3
Independent consultant/advisor	0	1	5	4
Ag-Industry (e.g. fertiliser, machinery)	0	1	4	3
Other (please add any additional information)	0	1	2	2

Soil information

Soil information results were difficult to extract from the survey data provided, however, when the national survey is statistically analysed, we expect this to be examined in more detail. Preferred method of receiving information advice and support varied widely, with the highest preference for in person group experience, for example field walks and demonstrations (Table 2). The second highest was group training workshops and courses. The lowest scoring preference was from social media. These results support the interview outcomes highlighting the importance of a variety of delivery method to suit the individuals.

Table 2 Source of soil information preferences for all respondents

Summary for Q39: "How do you prefer to receive information, advice and support for managing soils?".

Subquestion, and option	advisor, N = 74	farmer, N = 33	Overall, N = 107
In person, one-on-one			
Low Preference	8	3	11
Medium Preference	10	7	17
High Preference	18	6	24
Group listening in person (eg conferences, GRDC Updates)			
Low Preference	3	3	6
Medium Preference	15	7	22
High Preference	18	7	25
Group listening on-line (eg webinars, podcasts)			
Low Preference	4	5	9
Medium Preference	20	6	26
High Preference	12	6	18
Group experiences (eg field walks, demo)			
Low Preference	2	0	2
Medium Preference	7	8	15
High Preference	27	9	36
Group training (eg workshops, courses)			
Low Preference	3	1	4
Medium Preference	14	5	19
High Preference	19	10	29
Social media (eg Facebook, Twitter, WhatsApp)			
Low Preference	19	10	29
Medium Preference	14	4	18
High Preference	3	3	6
Documents (eg web-sites, fact sheets, magazines)			
Low Preference	2	0	2
Medium Preference	18	9	27
High Preference	16	7	23
Academic journals /research papers			
Low Preference	8	2	10
Medium Preference	9	6	15
High Preference	19	8	27
Other			
Low Preference	0	0	0
Medium Preference	0	2	2
High Preference	0	4	4

Barriers to adoption and soil management

The on line survey did not specifically address barriers to adoption, however did ask about research and extension needs. The highest scores for more research and extension were for sub soil amendments (30), deep lime placement (29) and sub paddock zoning (27).

Soil issues and constraints

Soil issues and constraints were ranked for survey respondents (Table 3). The top 5 were impact from

- declining nutrient status of soils,
- poor water infiltration,
- poor soil structure (slaking and dispersion),
- low soil biological activity,
- waterlogging

The most important issue identified by the online survey participants differed markedly from the interview responses. Nutrients were not considered a priority for the interview group, who were predominantly non growers. There was considerable overlap however with the importance of soil structure and water infiltration/waterlogging constraints. It was noted that the online survey participants identified low soil biological activity in their top priorities.

Table 3 Importance of soil constraints in S NSW

	None	Small	Medium	Large	total	ML/Total
Impact from declining nutrient status of soils	6	14	22	29	71	71.8
Impact from poor water infiltration	9	14	27	24	74	68.9
Impact from poor soil structure (slaking and dispersion)	10	13	17	31	71	67.6
Impact from low soil biological activity	10	11	23	19	63	66.7
Impact from waterlogging	5	20	31	17	73	65.8
Impact from low organic carbon level	8	17	18	29	72	65.3
Impact from topsoil compaction	12	15	26	19	72	62.5
Impact from within paddock variability requiring different inputs	8	19	14	29	70	61.4
Impact from shallow topsoil (duplex soil)	11	16	27	16	70	61.4
Impact from subsoil compaction	14	13	21	21	69	60.9
Impact from soil borne pests and diseases	13	13	28	10	64	59.4
Impact from topsoil acidity	13	19	15	29	76	57.9
Impact from subsoil acidity (deeper than 10cm)	11	19	22	19	71	57.7
Impact from nutrient leaching	11	19	26	10	66	54.5
Impact from low water holding capacity	10	26	14	22	72	50.0
Impact from water erosion	12	30	18	17	77	45.5
Impact from wind erosion	19	24	23	7	73	41.1
Impact from salinity	11	21	14	7	53	39.6
Impact from nutrient toxicity	21	18	19	4	62	37.1
Impact from soil water repellency (non-wetting soils)	36	13	13	8	70	30.0
Impact from chemical residue in soil	22	22	13	4	61	27.9

Key Recommendations

Key recommendations were derived from a combination of the semi structured interviews, the review of literature and the online survey results

1. Programs should be developed to support the mentoring of early and middle career soil scientists/soil practitioners. As many highly skilled soil professionals reach the end of their careers there will be a skillset gap in what is left of the soils workforce, as much of their expertise will not be passed on.
2. Most soil management advice given to landholders comes from private agronomy companies. There should be more effort put into connecting these companies with soil industry experts to further develop their skills through training. The experts providing the training should be supported to do so. A review should be conducted to determine what the training needs are of private agribusiness.
3. There needs to be greater collaboration by organisations delivering soil information. The Regional Soil Coordinator is poised to help facilitate this, however further support is needed, including encouragement of connections between private and public organisations. Soil information delivery should consider multiple effective methods, eg growers still prefer in person individual and group events.
4. The findings of this gap analysis should be presented by the Regional Soil Coordinators to Local Land Service agencies, commercial agronomists and advisors, local/state/federal government agencies and Soil Science Australia.

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