SOIL SCIENCE AUSTRALIA

Soil Science Australia Position Paper

Soil Security

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"...a framework for multi-dimensional assessment taking into account the balance of social, economic and environmental capital."

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1. KEY CONCEPTS & RECOMMENDATIONS

In the preparation of this position paper there are a number of key terms with specific meaning. These have been identified in italics and are defined within the glossary (Section 2).

> ***We propose the development and adoption of a national framework, based upon the Soil Security concept, to provide a National Account for Soil and thereby facilitating world's best land management practice of Australia's soils.***

The *Soil Security* concept provides a market- based approach to land assessment and management that has the capacity to identify niche markets though *decommoditisation*, whereby current commodities are inextricably linked to land function and production practices providing them enhanced value at the point of origin.

The *Soil Security* concept supersedes traditional single-dimension land capability assessment and provides a framework for multi-dimensional assessment taking into account the balance of social, economic and environmental capital. Such a framework would be a global first, cementing Australia as global leaders with regard to land management. Importantly, the *Soil Security* concept allows simultaneous management of production and environmental systems, with the potential to better inform public investment in ecosystem services, as the private investment will be market-driven.

To utilise the *Soil Security* concept as a national management framework, the following **recommendations** are included:

- Development and reporting of a *National Soil Capability Statement* at the appropriate scale that underpins a *National Account for Soil*;
- Adoption of evaluation strategies and indicators of the continuum of soil condition to inform best soil management at local spatial and temporal scales;
- Reporting the value of the soil asset through developing a statement of *Australia's Natural Capital*;
- Developing a *National Account for Soil* that recognises the value that soil contributes to the financial and business sectors;
- Increasing society's *connectivity* with the soil by recognising it as one of Australia's greatest national assets;
- Creating incentives for private industry and landholders to provide their local soil sampling and analysis information – achieved through public-private partnerships;
- Creating a set of agreed regionally and **soil-specific** *best land-management practices*;
- Developing incentives that reward, or provide tax credits for individuals or firms that adopt *best-management practice* to secure their soil.

2. GLOSSARY

Australia's National Capital – Australia's natural capital is considered a function of ecosystems services, such as the capacity of the soil to store carbon, provide riparian filtration, and biodiversity maintenance. Natural capital[14] places a value on natural resources such that they can inform decision making processes; value is in terms of the ecosystem function, and service this delivers, as well as economic value. In some cases, the ecosystem services value will be of more importance than the economic value. For specific definition of capital within the Soil Security concept, see ***"Soil Security Dimensions:*** *Capital"* below.

Best-management practices; best land-management practices – Methods or techniques found to be effective and practical in achieving a production objective within the context of sustainable natural resource management, (such as preventing or minimizing pollution) while making the optimum use of the economic, social and environmental resources. A singular, national scale best-management practice

scheme cannot exist on the basis of soil variation, highly complex and differing environments, and different land uses. They need to be regionally tailored and industry-specific. Additionally, best-management practices do not seek to optimise all factors, or objectives, as individual aspects, but rather as the whole production system and wider ecosystem the production system exists within; i.e. suboptimal performance within some system aspects, or objectives, can result in optimal holistic system performance providing sustainable benefits in perpetuity, which is why regionally tailored and industry-specific best-management practices are required.

Decommodity; Decommoditisation - in agriculture refers to the segregation of products (crops and animals) at source and their transport through supply chains to consumers. The principal reasons are to gain consumer confidence (around product quality, integrity and method of production) and thereby achieve a premium in a discerning market. High-value wine is the classical example.

Ecosystem Services (reproduced from Footnote 15) – Ecosystem services are the benefits provided to humans through the transformations of resources (or environmental assets, including land, water, vegetation and atmosphere) into a flow of essential goods and services e.g. clean air, water, and food. Some ecosystem services, such as the regulation and stabilisation of climate, water flow, and the movement of nutrients have been even less visible until recent times, when disturbance to these systems has exacerbated climate change, soil erosion or eutrophication. Like all complex systems, ecosystems can appear to be working well until they suddenly collapse, as the supporting base may have eroded without obvious warning symptoms.

National Account; National Account for Soil – A National Account for Soil encompasses the concept of soil having capital value within production systems, and the broader ecological systems these exist within. The national account is, in essence, a bank balance providing the current balance of soil capital. Most importantly, the *National Account for Soils* would provide the trajectories against that balance in a regionally-specific manner, meaning that Australia can account for its soils at any point in time and forecast future projections. The *Soil Security* concept provides the means for accounting, while the *National Soil Capability Statement* provides a measure of this account against the current vulnerabilities, providing the soil management plans that would help the nation achieve enhanced Soil Security, and the associated production benefits this brings (See *Soil Capability Statement*).

National Soil Capability Statement – Soils, like any asset, have vulnerabilities to their value. In the case of soils, the condition (see *Soil Security dimensions: Condition*) and *capability* (see *Soil Security dimensions: Capability*) determine the production capacity (economic and environmental), which in turn affects the capital value. Soils will have current and potential capabilities, which need to be accounted for (see *National Account for Soil*), as well as vulnerabilities to these capabilities, which further infers that resilience to these is an important factor that requires addressing. The national capability statement details soil capability on a regionally-specific basis, nationally, and details the resilience of these soils to the identified vulnerabilities. These vulnerabilities might include erosion, salinity, climate change, urban encroachment etc.

Soil Security – Rather than a single-dimensional land assessment approach, such as land capability mapping (largely considering only soil and landscape biophysical features)13, the Soil Security concept incudes consideration of other allied soil facets, including societal connections, education, policy, legislation, current land use, condition, and the economic and environmental value of our soils. Soil Security does not simply identify discrete soils, rather aspires to quantify additional stimuli which could result in soil becoming unsustainable, or not secure, and in quantifying this provide a framework for realising the potential for improved productivity, function, and ecosystem services. In this way, Soil Security is much more than soil health, or soil quality, which are encapsulated within *"Soil Security dimensions: Condition."*

Soil Security dimensions (reproduced from Footnote 8):

Capability – What can this soil do? i.e. Focusing on what the soil is used for.

The dimension aligns with the biophysical capacity of the soil to perform a task, and is interrelated with the soil's condition. This, as well as more specific land suitability, has been one of the major forms of soil assessment in the past, generally applied globally according to the FAO (1976)[13]. This has historically been applied in Tasmania as a seven class land capability assessment (Grose, 1999a; Grose, 1999b), assessing soil attributes, landscape position, parent material and climate.

Condition – Can the soil do this? i.e. 'Is the soil being improved, maintained or degraded by a particular land use'?

In this case, the soil's condition can be considered as the deviation of key soil attributes from known or perceived soil condition target or threshold values for different soil-land use combinations. This is often measured by long-term monitoring of the soil attributes, for example, soil carbon or pH, for different soil type and land use combinations, and is often considered as a measure of soil health or quality.

Capital – Placing a value on "things" ensures contribution of said things to decision making processes and asks, 'What economic or ecosystem value does the soil provide?'

Soil capital can be difficult to quantify, also containing several different elements; economic, social and natural. For the purposes of this example, we will consider the economic and natural components. Economic capital is considered as the potential earnings a soil landscape could deliver for a particular land use or enterprise.

Codification – 'What regulations guide or control appropriate soil use?'

Soil codification is considered as the public policy, regulation, guidelines and legislation pertaining to soil use, management and conservation. In Tasmania, as per many parts of the world, soil regulation and policy is limited; however, in determining soil security, appropriate policies and incentives can have a large bearing on the other four dimensions in guiding, encouraging or enforcing appropriate uses, management, identification of degradation and education.

Connectivity – Those who know care, and those who care lobby, and is focused on, 'How much is known about the soil and its appropriate use?'

This dimension encapsulates the social aspects of the soil; how it is treated, valued, understood and/or respected. Although difficult to quantify for many land uses, in this case it is focused on the knowledge of the land manager in regard to appropriate and sustainable soil management, identification of soil vulnerabilities, and risk minimization strategies. This could also concern whether the land manager has access to the appropriate tools to effectively manage their soil, for example, soil mapping, education, and training.

3. ISSUES

3.1 Background leading to the need for Soil Security

The Soil Security concept[9], initially developed in Australia and now receiving global recognition, provides the opportunity to develop a national framework supporting a *National Account* to address the issues raised below. This concept is motivated by sustainable development and is driven by the need to secure food and fibre production, preserve our biodiversity, and contribute to our water and climate sustainability, all of which are critical to human health and the health of the nation. It is therefore an integrated framework identifying the economic value of our soils to multiple uses and providing a systematic way of determining land-use well beyond current compartmentalised systems. This position paper aims to demonstrate how the *Soil Security* concept can aid Australia to become global leader in simultaneously managing our natural assets for betterment of our domestic society, whilst also meeting global requirement.

In reading this paper, it is important to note that *Soil Security* is not intended to be a framework for locking up soil (i.e. protection through legislation), but instead a framework designed to empower and reward good soil stewardship through *decommoditisation*; the concept of *decommoditisation*, and how this can be realistically achieved, is explained below in Section 2.4.1. In brief, the soil security framework utilises the heightened, and inevitable, global demand for traceability ('provenance') of food and fibre produce. Traceability is clearly linked to quality control, but it will inevitably be linked to the social licence for agricultural organisations to operate that consumers will demand.

Australia's greatest natural asset is its soil. Soil accounts for 80% of Australia's environmental assets with an estimated value of $3,860 billion[1]. Some 45% of the nation's soil is used for agricultural production, with 84% of this used for grazing, 8% for cropping and the remaining for forestry and other practices[2], resulting in an output of $37 billion[3]. This is a share of 2.7% of

all national industry, employing over 320,000 people.

There is increasing demand being put on the soil resource, such as being able to produce more food with less and at the same time to sequester carbon to mitigate climate change. This is driven by the need to ensure reliable, clean and nutritious food for national markets, along with the longer-term vision of Australia providing for the 70% rise in food demand internationally, and food diversification globally (FAO 2011). Adding to this is the need to restore the productive capacity of degraded soil. While there is continuing improvement, the loss of soil capability through acidification, salinity, structural decline and erosion remains a threat, especially related to gazing land management[4]. This equates to a global requirement to produce twice the output of the so-called 'green revolution', in half the time (i.e. by 2050). To achieve this Australia requires new and empowering market-based approaches to soil resource management. This is what a *Soil Security* framework offers.

An emerging issue is the loss of agriculturally useful soil due to urbanisation, with urban and peri-urban usage encroaching into agricultural green-fields and flood plains around our non-capital cities[4] and resulting in the loss of horticultural soil around our capitals. There is a growing need to consider the optimal use of soil in and around cities to ensure its security and maximise its potential, as the current soil resource will already struggle to meet the global production demand without minimising the available land.

Globally soil contains 25% of terrestrial biodiversity. Soil has a significant role in supporting and protecting our biodiversity through its contribution to the National Reserve System and providing a sanctuary for soil biodiversity. CSIRO estimate that more than 25% of Australia's above ground biological carbon stock (i.e. 20 million hectares) exits in protected areas[5]. More recently, the *"soil carbon 4 per mille"* initiative of the Paris Climate Accord led from France has focused the attention on developing soil carbon stocks. For Australia, it is estimated that 25 GT is stored in the top 30 cm of soil[6], supported by a healthy soil biome.

Australia is the fifth largest country by size, covering some 5% of the world's land area. The capital value of the world's soil stock is equal to $325 trillion, suggesting that Australia's contribution is $16 trillion. The annual value of ecosystem services contributed by soil is estimated at $11.4 trillion, suggesting that soil provides $570 billion to Australia's ecosystem services annually[7].

Australia is regarded as having a highly educated and advanced land-holder population, which would help facilitate best soil management practices. Nevertheless, there is always a need around ongoing soil and land literacy of these land-holders who are, in a sense, the proxies for the whole population in the care of much of our productive soil resource. Perhaps more importantly, there is a clear disconnect with the clear majority of the population and the land-holders, and in turn the soil. Food is produced anonymously to the consumer. However, there is a small but growing demand by consumers for information on how and where their food is produced. This growing connection has the potential to link consumers back to the soil through the concept of 'provenance'. Such connection will be vital in driving Chinese import of provenance identified agricultural products; in recent history small scale *decommoditisation* has resulted from Chinese markets seeking premium Australian products. Technologically this is becoming more feasible through digital agriculture. Younger generations of Australians are developing a strong social conscience, identifying that domestic social licence to operate will be a key economic driver of provenance-based markets. In the future we imagine the general population to be concerned about best management practice for soil via the production for food and its associate social licence.

The continued development of remote and proximal sensing technologies has increased the opportunity to routinely assess the soil's capability and condition at both regional and local scales. The use of these technologies is also increasing in Australia's agriculture sector, through precision agriculture and robotic

innovations. This is coupled with the increasing innovations and adoption in digital soil mapping (DSM), united with digital soil assessment (DSA)[8], that is increasing the opportunity for recognising and enabling best management practices.

In order to address the issues discussed above, there is need for sustainable development that secures food and fibre production, preserves biodiversity, and contributes to water and climate sustainability, all of which contribute to human health and the health of the nation. The *Soil Security* concept provides the foundation from which to construct such a framework. *Soil Security*, as a multidimensional concept, is underpinned by the need to assess and manage our soil determined by its *capability* and asks the question, 'what can this soil do?'. This can be reported as a National Capability statement. Both at local and regional scales the continued monitoring of the soil's *condition* will provide the information needed to ensure sustainable use of the soil in-line with adoption of best-management practices. The concept also incorporates the need to value soil's contribution to ecosystem services along with production systems, i.e. it's *capital*, contributing to a statement of *Australia's Natural Capital*. This is all affected by people's *connectivity* to soil or knowing and valuing soil as one of Australia's greatest assets. The need to develop governance, i.e. codification, both in the public and private sectors to ensure appropriate use and management of soil is also recognised in the Soil Security concept. The five dimensions of capability, condition, capital, connectivity, *codification* ensure a holistic approach to securing soil by encompass the biophysical, social and economic dimensions. A proof of concept has been implemented in the state of Tasmania as a first approximation of *Soil Security* demonstrating the feasibility of the approach[10].

3.2 Role of Scientific Professions in achieving Soil Security

The implementation of a national land management framework based upon the *Soil Security* concept will require concerted effort from scientific organisations, working in tandem with State and Federal Government, and their counterparts, as well as all stakeholders of soils. As the non-governmental peak body for soil and soil scientists, the role of Soil Science Australia is to act as the scientific custodians of Australia's soil resource. To recognise its capability and condition and to provide to government concepts and methods that can facilitate good public policy for the security of our soil. Soil Science Australia is an organisation that provides information and education about soil to government and the general community, via the delivery of initiatives and projects in the interest of Australia's soils and people.

Soil Science Australia developed, and continues to support, the professional standards of practise in soil science. The Certified Professional Soil Scientist (CPSS) accreditation is the hallmark of professional confidence in expertise. As an organisation, Soil Science Australia is well positioned to assist governments in developing and driving frameworks, such as *Soil Security*, both in terms of our mission and our professional technical-capability.

Soil Science Australia works closely with the National Committee on Soils and Terrain, which is the Government peak body for soils and land management, consisting of State and Territory Government representation, as soils are managed at the State level. Soil Science Australia will need the support of the other professions to help achieve its policy goal of *Soil Security*.

3.3 How do 'soil health' and 'soil quality' relate to Soil Security?

There is a current focus on 'soil health' and 'soil quality' in Australian agricultural and environmental industry. These terms are similar, and often used synonymously, but do have some nuances. In general, both terms describe that soil exists on a continuum in terms of being somewhere between good and bad. These approaches seek indicators that are measurable to subsequently report in a quantitative manner as to how good/bad a soil is in relation to the numerous indicators, providing a means to understand production capability and what might be done to improve it.

Soil Security is more encompassing than soil health or quality, whereby soil health/quality are essentially equivalent to the soil condition criteria of the Soil Security concept (1/5 criteria).

It is useful to consider the cases of *decommoditisation* and *land-use planning*, in further understanding the *Soil Security* concept.

3.4.1 Soil Security and decommoditisation: incentivising agriculture

Decommoditisation in agriculture refers to the segregation of products (crops and animals) at source and their transport through supply chains to consumers. The principal reasons are to gain consumer confidence (around product quality, integrity and method of production) and thereby achieve a premium in a discerning market. High-value wine is the classical example. The proposition is that with sensor and digital technologies this can be achieved at scale for all products. It requires new systems and the

education of consumers.

So, where does soil come in? With a *'decommodity'* one can think of a consignment moving through a supply chain from producer to consumer. The consignment consists of the 'product' along with information about the product. When the consumer searches with the intent to purchase, 'product + information' is found, whereby the information provides consumer confidence in the product quality, but also the sustainability of its production; the information contributes to the value add. The information which is attached to the consignment, by say blockchain technology, would consist of:

(1) Compositional information on the product itself; minimally quality criteria (protein content, contaminants) and more generally compositional characteristics that could indicate place of production (provenance, terroir) (e.g., stable isotope composition, DNA/ metagenomics information – such information will largely reflect the soil environment.)

(2) Information on the method of production (a compilation of digital information from digital farms records on how the crop or animal was grown, e.g. for a crop – sowing dates, fertilisers, herbicides applications etc., harvest date, irrigation). Part of the decommoditisation dividend comes from 'Certified' or Best-Practice approaches. For soil, Best practice would suggest growing crops or animals on soil that is highly suitable for that purpose, and in a manner that is sustainable – the capability dimension of Soil Security.

(3) Information on the state of the environment where the crop or animal was grown (this is a time-stamped or longitudinal record of the state of the environment at the place of production – this would include a number of environmental entities, but vegetation and soil would the key ones. A key part of the decommoditisation dividend comes from evidence of sustainability – a stable or non-declining environment. For soil this is the dimension called Condition – and would be measured by properties such as soil carbon, pH, microbial diversity, bulk density, salinity etc. Additionally, this information could provide localised information on the ancillary ecosystem services provided by the environment in which the crop or animal is grown – the ecosystem services – this is the capital dimension of Soil Security.

So, we see immediately that *decommoditisation*, which is a way of assuring quality and sustainability of agricultural products and thereby attracting a financial premium, connects growers and consumers and utilises a number of the dimensions of Soil Security. Through this approach consumers can evaluate soil condition, capability and capital and the linking of consumers to producers. All of this is encapsulated in a digitally-enabled market-based mechanism which can increase confidence for consumers, producers, business and governments. Soil Security is a key part of agricultural *decommoditisation*, and also is likely to be achieved via this mechanism. There IS a market-based mechanism for achieving *Soil Security*.

As an example, Australia is currently highly reliant on a live export market in terms of meat as a commodity. However, live export to Europe is not feasible due to distances and restrictions on live export. The *Soil Security* framework, with concerted industry, government and peak-body effort, could realise a significant European market. It is entirely possible through a market-based *Soil Security* approach that the meat industry could develop a sustainable and gourmet niche market to Europe, where ecosystem service contribution (soil capital) and sustainable practices are the value-add that realises *decommoditisation*. This would bolster the Australian industry through the creation of new markets, while augmenting existing markets simultaneously (e.g. Chinese demand for quality assurance and genuine product).

3.4.2 Soil Security as a superior land planning framework

The analogy of 'urban creep' into productive land, in relation to the concepts of soil health/quality, allows better understanding of the interrelation of soil health and soil quality terms, and how soil condition provides a metric with more clarity.

Focusing on just soil health or soil quality and their indicators does not directly address urban creep into primary production land. If a soil is healthy/high quality, or the reverse, this ranking does not formally affect the ability to make decisions about urban development; building an urban precinct on it, for example.

On the other hand, if this urban precinct is built, it will have some effect on the quantum of land used for primary production. The question then is: "If the urban precinct was built on poorer health/lower quality land would this have less of an effect for Australia as a whole than if it were built on healthy/high quality land?" The short answer is yes. Covering productive land with urban development places pressure on the remaining productive land to either produce more, or expand into less productive regions. To quantify this somewhat, a square meter of high productivity coastal land (e.g. Hunter Valley, NSW) is roughly equivalent to a tennis court worth of land[12] in less productive regions (e.g. Dubbo, NSW). This means for every hectare of productive land lost 10,000 tennis court equivalents of land would need to be introduced to replace this lost land. With a rapidly diminishing capability to farm new land, this actually equates to increasingly immense pressure on current production systems.

In this analogy, knowing whether the soil is healthy or of high quality does not allow us to make land-use decisions in a systematic fashion. It might inform such decisions, but not within a single framework. The Soil Security concept provides the framework with which to make these decisions well informed, not just on the productive land in the region, but on a larger scale and across mores aspects (e.g. ecosystem services). The soil health and quality intentions are captured within 'soil condition' and then expanded on through the framework to directly inform such issues as urban creep via quantifying the natural capital of the land within a single framework.

A *Soil Security* framework allows Australia's food and fibre producing land to be protected from undue minimisation through urban encroachment, but it is not done at the expense of urban development. It allows the most strategic land for urban development to be simultaneously identified in the same assessment that strategic agricultural land is identified. That is, Soil Security provides governments with a framework that simultaneously rewards land stewardship via decommoditisation, improving ecosystem services through this incentivised improved land management, strategically identifying urban development locations, and better defining where public money needs to be spent on managing environmental services.

3.4 Outcomes sought through a national framework

1. A national soil capability statement and map at the resolution of 100 m. Updatable to accommodate new capability requirements, i.e. crops, land uses.
2. Regionally differentiated national evaluation protocols of soil indicators and condition.
3. Annual statement of soil natural capital[11] (varies with condition).
4. Delivery of an Industry-relevant National Account for Soil account.
5. Facilitate decommoditisation of agriculture to improve profitability and product and consumer awareness, thereby better connecting consumers to land-holders and the land.
6. A reimbursement scheme to provide a proportion of the costs of soil sampling analysis to landholders who make their local soil information publicly available.
7. An agreed set of regionally- and soil-specific best-management practices.
8. An incentive scheme for landholders that adopt agreed best-management practices to secure soil.

4. CONSULTATION ON THE POLICY

This position has been developed after extensive consultation on the Soil Security concept at a global level. Global Soil Security Symposia were held at in Texas (2015) and in Paris (2016) with the 3rd instalment to be held in Sydney this year (4-6th of December 2018). The first two symposia provided rigorous discussion of the Australian conceived Soil Security concept, leading to refinement over several years with contribution from some of the world's best scientists and leading stakeholder organisations.

The December symposium in Sydney provides a unique and open platform for government, scientists, and stakeholders to further develop an Australian framework through consultation. This platform could, and should, be used to demonstrate that Australia is a global leader in *Soil Security*.

5. IMPLEMENTATION OF THE POLICY

There are no immediate significant financial costs to implementation.

Stage 1 of developing a *Soil Security* framework is a consultation and communication process. Stakeholder engagement in scoping the framework is required. Promotion with the general public will be required.

Stage 2 is the development process and Stage 3 is the implementation process. There will be financial considerations associated with these stages, with these being identified throughout

Stage 1.

Market driven approach: A key driver for the *Soil Security* concept will be to determine, in a manner that facilitates quantification, how it integrates with industry and to demonstrate that adoption of it serves to simultaneously reward good management (based on soil-specific criteria), while promoting *decommoditisation* and the creation of new markets.

Public vs. Private investment: *Soil Security* will allow the Australian government to identify where public investment is needed, and where it can be reduced/withdrawn, due to private investment addressing flow on effects to *ecosystem services*. For example, where agricultural industries seek to develop provenance-based niche markets based on *best-management* practice, this has flow on effects for ecosystem services the Government currently invests in. It is likely a government would be able to justifiably reduce identified investments through the *Soil Security* concept. There is an associated need to determine the flow on links, and to develop a manner of quantifying these within the capital development. It is important to remember that *Australia's National Capital* value is not simply economic, indeed it is a function of ecosystem services (environmental and social capital).

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