

Soils: A Knowledge Map and Action Plan



In 2008, the Royal Agricultural Society of England's "Practice with Science" Group commissioned Professor Dick Godwin and supporting authors to undertake a report on soil and water management in England.

The ensuing report, "The Current Status of Soil & Water Management in England", championed soil and brought a neglected subject back onto the agenda of Government, the research community and farmers. It encouraged farmers to undertake good long-term soil and water management and highlighted the fact that in recent years there had been little investment in drainage. The limited teaching of soil management in the Further and Higher Education curriculum was pointed out, together with the dearth of future soil scientists and engineers, particularly those with supporting practical agricultural as opposed to environmental knowledge. Knowledge Exchange between the research community and farmers in soil and water management was thought to be weak.

Since 2008, soil and water issues have increased in profile, and there is a growing understanding of their vital role in meeting the challenge of producing sufficient food for growing populations, using fewer inputs and nurturing the environment, all against a background of climate change.

The RASE therefore commissioned Cranfield University to consider whether the resources were in place now and for the future to ensure optimal soil and water management: whether relevant research was being carried out and adequately passed on in education, innovation and information, whether there were enough specialists to deliver advice and training, and whether there was a robust knowledge network to support development. The report, **A Gap Analysis on the Future Requirements of Soil & Water Management in England**, was financially supported by Defra, the Environment Agency and Natural England. It was launched at an industry workshop at Stoneleigh on 8th November, 2010. The workshop's purpose

was to seek the 40 attendees' views on priority areas for action.

RASE "Practice with Science" Group

"Practice with Science" is the motto of the Royal Agricultural Society of England and still represents its core purpose today. The Society's "Practice with Science" Group, chaired by Professor David Leaver, is tasked with identifying issues of strategic importance to agriculture, and advising the RASE Executive and Trustees accordingly. More information about the Group, and the Society's Agri-Science Department, can be found on the RASE website, www.rase.org.uk/what-we-do/core-purpose-agricultural-work/index.asp

A link to relevant articles from the Journal of the Soil & Water Management Association can also be found on this page of the RASE website.

The Soils Gap Analysis Report by Cranfield University can be viewed at www.rase.org.uk/pdfs/Soils_gap_analysis_final_report.pdf

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KEY FINDINGS FROM THE SOILS GAP ANALYSIS

The authors consulted many involved in soil and water management at all stages, such as farmers, advisers, researchers and educationalists, and the findings reflect the views of these people, notably the Members of the Soils Gap Analysis Project Advisory Group. This document summarises the Report's findings, which can be seen in full at www.rase.org.uk/pdfs/Soils_gap_analysis_final_report.pdf

Firstly, the Report reminds us of soil's vital importance:

SOIL IS A BASIC RESOURCE

It is:

- Non-renewable because it is being lost quicker than it can be formed
- Critical for food and energy security and climate change adaptation
- At the heart of the "sustainable intensification" of agriculture required to produce future food and multifunctional landscapes
- At risk of degradation (e.g. erosion, loss of organic matter, compaction and contamination)

SOIL AND WATER MANAGEMENT GAPS

The Report identified the following weaknesses and knowledge gaps amongst the Groups:

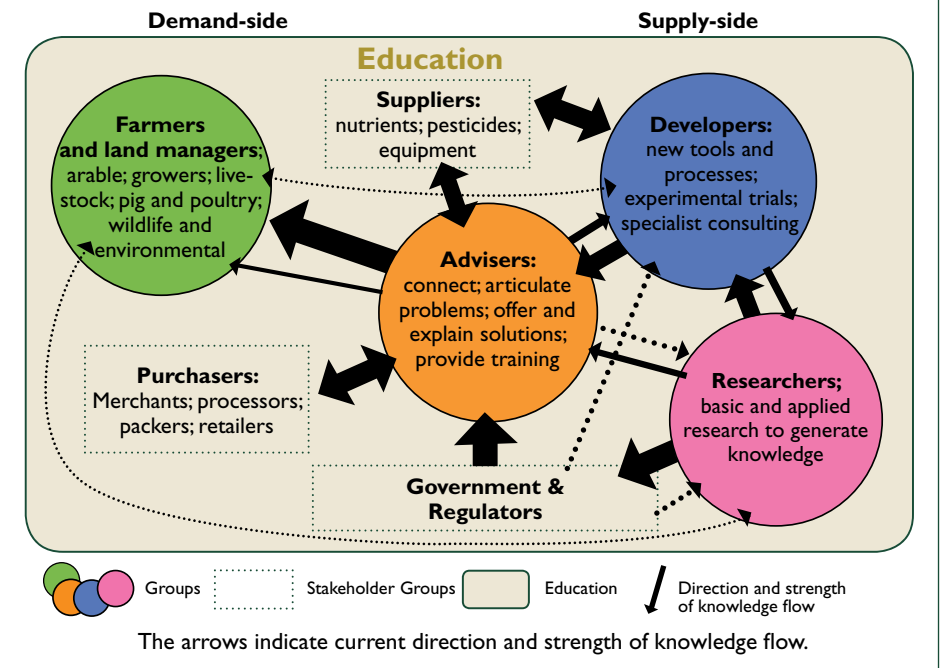
Farmers

- Weak coverage of soil and water management within FE and HE courses, leading to inadequate farmer knowledge for operational and strategic decision-making
- Poor access to sector-specific, authoritative, clear and summarised soil and water information
- Uncertainties about the competence of advisers



WHO IS INVOLVED WITH THE DEVELOPMENT AND TRANSFER OF SOIL AND WATER MANAGEMENT KNOWLEDGE?

Today, the structure of the network through which knowledge of soil and water management is developed and transferred is very complex but can be simplified: there are four key groups, namely farmers, advisers, developers and researchers who both demand and supply knowledge. The drive for knowledge and provision of knowledge is influenced by external stakeholder groups, while the ability to understand and utilise knowledge depends on education. The current flow of soil and water management knowledge, as seen from the perspective of the farmer can be illustrated as:



- Uncertainty over risk of undertaking soil and water management due to limited knowledge and unknown economic impact within their farming system

Advisers

- No industry accreditation (requiring a mix of operational knowledge, formal education and continuing development) so the quality of advice is not clear to farmers
- Value of advice not backed up by economic assessment and demonstration
- Many lack practical agricultural experience making it difficult to establish a trusted relationship with the farmers
- Many have only basic soil and water knowledge as it is not their speciality
- Supply of soil and water specialists is inadequate leaving a vacuum to be filled by non-specialists or not at all

Developers

- The developer community appears weak and dispersed, reducing its effectiveness
- Weaknesses in the connection between them and researchers is constraining the transformation of new information into production-ready technology
- More infrastructure is needed for prototype development, evaluation and demonstration

Researchers

- There appears to be a lack of a supportive vision and governance that is shared with the industry

- Funding opportunities have dictated the direction of research in soil and water management and this is currently more aligned to public environmental needs than to raising productivity
- Research should be focused more towards areas of soil and water knowledge that are critical to innovation for higher productivity
- Linkages, especially to developers and also advisers, need strengthening so that new discoveries can be quickly put to practical use.

Education

- Much more coverage of soil and water is required within FE and HE courses to meet the requirements of the industry
- The FE as well as the HE delivery should be drawing down more cutting-edge material from developers and researchers to improve the effectiveness of knowledge transfer
- A strong connection to practical agriculture is essential to ensure the groups have the ability to understand practical issues as well as communicate more effectively
- More graduates should be entering the soil and water specialism via agriculturally-orientated Masters level soil and water courses, but these hardly exist at present

CONCLUSIONS

The Report reached a number of conclusions: some of these are summarised here for specific areas related to soil and water management:

WHAT KNOWLEDGE IS REQUIRED BY THE DIFFERENT PEOPLE INVOLVED?

The Gap Analysis looked in detail at the knowledge needs of different Groups to achieve future requirements. Increasing production and reducing environmental impact

depend both on knowledge of technologies and an understanding of soil systems and their responses to interventions. Farmers, advisers, developers and researchers require different levels of knowledge to undertake their roles effectively, for example:

	Farmer	Adviser	Developer	Researcher
Agricultural System: e.g. Nutrient uptake; water and wind erosion; soil biodiversity; soil pollution	General appreciation of soil-water-plant-animal system	Specialist S&W expertise. Scientific understanding of soil-water-plant-animal system	Scientific expertise in S&W science and engineering Scientific understanding of soil-water-plant-animal system, including current research	Cutting edge fundamental understanding of soil-water-plant-animal system
Technological: e.g. Drainage; irrigation; tillage and traction; grazing management	Up-to-date information about production methods and tools, including their economic valuation	Familiarity with and evaluation of, innovative methods and tools	High-level expertise and awareness of global developments	Understanding and engagement

Within the knowledge exchange network there are also different levels of knowledge complexity:

- Operational Putting knowledge to practical use e.g. knowing what to do and when.
- Strategic Gathering and interpreting system and technology knowledge that can be used to set priorities and plan long term strategies.
- Fundamental Why and how things work.

While an in depth knowledge is desirable the same level of understanding is not required by each group, however, a critical level can be described.

	Farmer	Adviser	Developer	Researcher
Operational	Critical for on-farm in-season optimisation	At least to same level as farmers	Basic practical	Familiarity
Strategic	For business planning and production choices	Identification and analysis of production options	Understanding of industry S&W challenges and opportunities	Understanding of industry S&W challenges and opportunities
Fundamental	Not necessary	Familiarity	Important to ensure knowledge is used effectively	Detailed understanding

To meet these different requirements, there is a need for each group to have an appropriate initial education and on-going training. This is proposed as follows:

	Farmer	Adviser	Developer	Researcher
Education	At least FE level education	At least BSc/BEng level education	At least MSc/MEng level education	PhD/EngD level education
On-going learning process	Mainly via advisers From other farmers Publications	Mainly via strong engagement with developers Continuing Professional Development - CPD Access to R&D literature	Mainly via strong engagement with researchers and advisers From other developers (informal and formal channels) Access to R&D literature	Scientific literature Strong international engagement with peers Strong engagement with developers

This indicates that farmers should continue their education at least to completion of a vocational course at a Further Education (FE) college. Preferably they should gain a more in-depth understanding and ability to manage soil and water resources via more advanced study in Higher Education (HE) or an equivalent learning experience.

Information

- Information for farmers needs to be more accessible (speed, ease and relevance) and supported by practical demonstration and economic justification
- There is a need for more sector-specific information relevant to specific production systems
- An open-access, adviser-orientated information exchange, fed by developers and researchers, would strengthen the knowledge network and encourage better exploitation of existing knowledge

Education

- Increased coverage of soil and water is essential within the FE and HE agriculture curricula to ensure farmers, advisers and developers have sufficient knowledge to improve industry performance
- There is an apparent lack of agriculturally-orientated soil and water science provision within HE
- Approaches are required that will invigorate soil and water education at all levels

Technology development and adoption

- A strong and well-resourced developer community is needed to support innovation that matches industry soil and water opportunities. The current one is too thin and dispersed and lacks adequate experimental infrastructure

Research (fundamental and strategic)

- Within the funding landscape, soil and water research aimed at supporting productivity is not sufficiently prioritised relative to other research topics
- The research community is strong and active but, partly for the reasons above, its current capacities and outputs are under-exploited
- The industry, Government and the research community should develop an effective, agreed and implemented agenda for soil and water management.

Supply of soil & water specialists

- BBSRC has recently announced a 'highlight call' for soil and water research proposals and is funding an Advanced Training Programme for agriculture which may include development of soil and water specialists – however, even with these initiatives, there will be a strategic shortage of soil and water specialists with agricultural understanding, educated to Masters level and entering the adviser community
- A stimulus is needed to encourage interest in acquiring specialist knowledge in soil and water management
- Some form of industry certification is needed for advisers providing soil and water specialist advice

Robustness and adequacy of the knowledge network

- The soil and water knowledge network is likely to continue to be driven mainly by market forces. As Government funding has focused more on informing environmental and related policy, the industry has not been investing sufficiently in production-orientated soil and water management education and innovation. A shared industry and Government initiative is needed urgently to support soil and water management for sustainable intensification.

WORKSHOP CONCLUSIONS

Professor Kibblewhite of Cranfield University presented the Report's Conclusions at the Workshop held at Stoneleigh in November 2010. Those attending prioritised the areas as follows:

Priority	
Economic valuation of soil and water management	<ul style="list-style-type: none"> • Demonstrate the value of soil and water management through a qualitative description of economic benefits, bearing in mind that generic values are hard to define when taking account of differences in soil types and sectors. • Relate the identified benefits and costs to the land owner as well as the land manager. • Important potential partners are the National Ecosystem Assessment exercise and machinery manufacturers.
Increasing capacity for soil and water management through education	<ul style="list-style-type: none"> • Developing good information for learning is critical. Build on the success of farmers' soil groups and seek ways to connect disparate groups. • Understand why there has been a decline in student recruitment and then engage to deliver an attractive career path; • A role for industry apprenticeships should be considered. • Potential roles should be considered for retailers, levy bodies and bodies such as NFU/CLA, the latter particularly in communicating with farmers. • Researchers and developers should be linked to education to ensure that the teaching of soils includes up-to-date science and technology; • Greater use should be made of outputs from the Soil Management Initiative. • A review should be undertaken to assess whether BASIS courses include adequate soil and water management.
More innovative research aimed at improved soil and water management practice	<ul style="list-style-type: none"> • Collaborative/partnership approaches between different groups (researchers, developers, advisers) are a priority, supported by dialogue and coordination between the main funders.
Supporting and growing the developer community for soil and water management	<ul style="list-style-type: none"> • A strategic approach is needed to ensure adequate funding for this community, as distinct from the researchers. • Effective knowledge exchange to and from developers requires intermediaries: these could include public bodies, private consultants, agricultural/environmental bodies and commercial buyers from and sellers to farmers.

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- All Members of the RASE **"Practice with Science" Group**;

Following the Workshop, the RASE has identified those actions for soil and water management which it is able to take forward. The Society has also suggested messages and actions which it feels the agricultural industry as a whole should consider.

Specific Actions by RASE

- RASE to explore with LANDEX a greater emphasis on basic soil science and "best practice" soil and water management practice in the curriculum;
- Discuss ongoing CPD and accreditation in practical soils advice with the Association of Independent Crop Consultants, NIAB-TAG, BIAC and others;
- Commission information on the economic value of good soil and water management;
- Use this information to promote the importance of good soil and water management to farmers;
- Promote good soil and water management to farmers through the

Society's events and information provision;

- Champion the need for greater emphasis on applied research focussed on greater agricultural productivity whilst using less inputs;
- Continue to support and promote applied research and knowledge exchange projects, such as the work of the Allerton Project and the Warwickshire Rural Hub Soils Group;
- Continue to promote Soil & Water Management Association articles via the RASE website.

Messages and Actions for Consideration by the Agricultural & Food Industry

- All parts of the industry, including food retailers, to adopt and encourage the need for good on-farm soil and water management practices;
- The industry to consider the development of a strategic grouping to outline applied soil and water research needs for production as well

as environmental purposes and to work with BBSRC, the Government and others to bring this research about as quickly as possible;

- Those bodies and companies employing on-farm advisers to invest in soil and water CPD for their advisers, and to ensure that they also have good agriculturally-related experience in soils;
- Gaps in knowledge flows between farmers, advisers, developers and researchers need to be bridged and the industry needs to become better at adopting new research and technology;
- The industry should tackle the problem of the lack of developers capable of transforming fundamental research into practical on-farm application;
- To encourage greater numbers of soil scientists/engineers to enter the agricultural industry, the industry should be able to demonstrate clear career paths.