

England's farmers face the challenge of increasing yields while reducing inputs, improving soil health and generally enhancing the environment. The RASE commissioned a report to understand how realistic these demands are in the light of current trends in soil and water management.



Key questions:

- Are our soils fit for purpose?
- Is appropriate research in the pipeline to help?
- Will there be enough specialists to help?
- Is new information filtering through to farmers quickly and effectively?

From their investigations, the authors conclude there are considerable challenges in meeting the demands of:

- i. increasing food production and security at national and international level
- ii. demand for alternative fuels
- iii. climate change
- iv. soil protection
- v. flood and pollution control
- vi. water resource availability for crop and animal production combined with diminishing labour supply which will continue the drive for larger machines.

In the main, today's soil scientists are working in areas which concentrate on environmental care rather than productive agriculture. Since the mid 1980s, when Government withdrew financial subsidy for field drainage and the decline in farm profitability began, soil and water management has slipped down the priority list for both managers and policy makers.

At the same time, the research, development and advisory effort in soil and water management has gradually reduced.

Currently, due to policy changes and economic pressures linked to the retirement of key applied physicists and engineers, there is a much depleted professional body of specialists who can address the research, extension and training issues required to support the farming community and work with the environmental bodies. The career structure for new entrants to these professions is poorly defined, and this discourages entry. Immediate attention needs to be given to the provision of a small cohort of professionals that can supply the necessary expertise, whilst there is sufficient time for them to be mentored by those (now mostly retired) with a proven field record.

However, there is a considerable store of fundamental research information available and whilst there is a need for some further supplementation, the prime requirement is to use and develop this existing information, linking in with field experiences elsewhere, to address current problems.

Future emphasis, therefore, needs to be given to applied research and development, conducted by personnel with a good understanding of agricultural and environmental needs who can 'design' innovative solutions to practical problems. These professionals need also to be encouraged to provide extension advice and practical training for farmers and agronomists.

The specialists require suitable academic backgrounds in engineering or applied physical science including soil science together with a good base and support structure (possibly

at colleges or universities or within a Government Agency) and need to be in regular contact with farmers and farming problems.

This summary is based on a report entitled 'The Current Status of Soil and Water Management in England' which was prepared for the RASE's 'Practice with Science' Advisory Group by: Professor Richard Godwin, Professor Gordon Spoor, Brian Finney, Dr Mike Hann and Dr Bryan Davies. The report was prepared with financial support from the Felix Cobbold Agricultural Trust.

Full copies of the report can be obtained from

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RESPONSES TO THE RASE PRACTICE WITH SCIENCE GROUP

Q1 **Is the UK's soil and water management research capability 'fit for purpose' and does it have a vision for the future of the science and the needs of a changing UK farming industry?**

UK soil and water research is not as it should be and has diminished catastrophically from its peak. Many key applied soil science, soil physics and engineering researchers have now retired. There is little connection with agriculture and apparently no coordinated vision for applied research. Recently 'piece meal studies' have been conducted where researchers 'grab' whatever funds they can.

Internationally, the state of soil and water research is less robust. The UK cannot 'buy into' other nations' research, especially as soil and water topics are very local site and weather specific.

There has been a significant move to relatively inexpensive computer modelling. However, models need validating with real data and cannot provide total practical solutions to applied research problems.

The good news is that a significant amount of good science and engineering has been conducted. It now needs to be applied to meet UK agriculture's changing needs.

Q2 **What future soil R&D will be required to ensure the agricultural industry can meet the challenges of increasing output whilst reducing dependence on agro-chemicals, pesticides etc and improving the environment?**

The immediate future depends on using the storehouse of applied research and development, although some fundamental work will be needed. The main topics for UK research identified are:

Fundamental research

- An effective design procedure to identify risk and measures required to reduce runoff and control soil erosion.

Applied research

- Relationship between good field drainage and flood risk, including using soil for water storage and retention in both lowlands and uplands. Linking this to managing

- uplands for increased food and fuel production, whilst maintaining water supply, bio-diversity and carbon storage;
- Control of nitrates and soluble phosphates in drainage water;
- Practical adoption of internationally well-tried soil conservation measures to reduce runoff and erosion without restricting mechanised field operations;
- Improved methods for controlling runoff from tramline wheel marks;
- Appropriate cultivation systems for 'novel' crops for a range of soil types;
- Selection of tyre/wheeling management systems, including controlled traffic, to reduce compaction and the need for deeper tillage and tillage energy;
- Application techniques and nutrient accumulation for farm wastes, composts and bio-solids to reduce demand for fertilisers;
- Techniques for improving water use efficiency and precision farming;
- The spatially variable fertiliser application to target inputs and reduce residual N;
- Reduction in overall herbicide and pesticide applications.

Q3 **Does the UK have access to the necessary soil and water management resources (including expertise), given a background of cuts in R&D capacity and expenditure?**

Physical resources: Whilst there is some concern, recent moves of the Soil Physics Group from Silsoe Research Institute to Rothamsted Research; and Silsoe College and Soil Survey and Land Research Centre to Cranfield University, have resulted in new build and refurbished state of the art soils laboratories respectively.

The pending moves of world class soil engineering and recently completed off-road traction laboratories from Silsoe to Cranfield campus will result in new laboratories housing equipment for tillage, traction and compaction, and erosion studies.

The long term tenure of Spray Applications Group laboratories currently at Wrest Park, Silsoe, a national gem, is currently being discussed with BBSRC. It is imperative that this world leading

facility is transferred and then maintained.

The 'Soil Hall' at Harper Adams University College is a valuable national resource for teaching and short courses. Further investment would increase its value.

ADAS is maintaining a presence at some former Experimental Husbandry Farms to undertake applied R&D.

Expertise: this is of much greater concern. In the short term there is probably adequate staff expertise in environmental and biological sciences. However, many key soil and water engineering researchers have now retired and there is a shortage of those with practical skills to 'engineer' sustainable solutions. This leaves applied research poorly served.

The biggest challenge is in renewing the pool of professionals from applied research to extension. These are not easy to find as they generally require a good knowledge of agriculture and have a sound science/ engineering base.

Q4 **How can UK soil and water management capability be sustained, provided with more resources and integrated with capacity elsewhere in the EU and the world?**

A change in national policy is needed from predominantly environment-driven to production in an environmentally sensitive framework. At the same time, a greater proportion of those with sound agriculture, science and engineering backgrounds need to be engaged in formulating the strategy.

Government, including Defra and the EA should 'bite the bullet' and source adequate applied work to ensure a national capability for food and fuel production, whilst meeting environmental requirements. This will reduce the UK dependence on international factors as solutions to soil problems are site-specific.

UK links to international research have been excellent and are based on parity of esteem between international scientists and engineers. For this to continue the UK needs respected scientists and engineers.



Are sufficient people being attracted to soil and water management and related areas as a career?

The answer is a very definite 'no'. Experience suggests that sufficient numbers could be attracted if there was a career structure and more job security.

The lack of postgraduate scholarships restricts the number of applicants and this must be addressed by Government agencies with help and input from the agricultural charities.

Is there a career structure which will help to retain them in the discipline/in the UK?

Currently there is no sensible career structure in the UK and in recent years it is probably only Cranfield University that has provided an 'academic' route. This has enabled the progress of a number of top quality masters students through to junior researchers and postgraduate teachers. Those staying in the UK are, however, few.

Nationally a career structure is needed to encourage graduates at all levels. Initially this is likely to be within the 'education' sector; but possibilities could exist in other bodies, eg the Environment Agency. Further opportunities may arise in government, commercial and private sectors. This needs to be heavily weighted to practical application of research into sensible on-farm development.

With such a body, a section could be established that allowed the needs of profitable production agriculture to be developed alongside those of the environment.

Consideration should be given to selecting a base for a pilot scheme. Harper Adams University College appears to have the key requirements, namely:

- The only undergraduate agricultural engineering department in the country;
- A strong agronomy/plant sciences department;
- A keen interest to develop its activity in soil and water management;
- Opportunity for staff to be involved in training, teaching and applied research;
- A large cohort of undergraduate students to undertake projects;
- A central location serving England and Wales. Also close to Stoneleigh Park, where the RASE is keen to establish soil and water demonstration activity.

Is there sufficient capacity of the right quality in the education system to train the appropriate soil and water managers of the future?

The answer to this question is 'no and the existing capacity is diminishing quite rapidly'. The major problem is that the experienced professionals have retired and their successors are not obvious because of the lack of mid-career professionals to take on leadership roles.

Currently Harper Adams University College, with its mission fundamentally aligned to the needs of practical agriculture, is moving to position itself centrally in national agricultural strategy. However, there is a need to recruit new blood to undertake the educational role

and have much more direct engagement with farmers in soil and water management. It is critical that this is undertaken in the very near future so that the existing cadre of retirees can help mentor the incoming group. Currently Reaseheath College, in Cheshire, provides a progression of students from their First and National Diplomas into the HND/Foundation Degree and Degree programmes at HAUC in agricultural engineering. The Principal of Reaseheath College is open to further discussion on extending these to encompass aspects of soil and water management providing satisfactory accreditation procedures can be established.

Do farmers and contractors receive reliable information about soil and water management?

In most cases the answer is 'yes', but there are circumstances where both quality and reliability could be improved. The situation could deteriorate as experienced providers approach, or pass into, retirement.

If so, how and from where, and is there more that can be done?

Farmers generally obtain information from many sources, including press articles, retained agronomists, training courses (eg BASIS Soil and Water Management course), discussion groups, workshops and conferences, events, specialist publications (eg Cranfield and LEAF), and long course agricultural training programmes.

The most critical aspect is to secure a nucleus of professionals in practical soil and water management to 'feed' the above.

What should be done and by whom to encourage this?

Ensure that there are sufficient trained professionals to undertake development work and provide advice. This work should be centrally coordinated either by Defra, one of its agencies, AHDB or the RASE acting for and supported by Defra. Such personnel would be equivalent to former 'Drainage Officers', but fewer in number with broader remits.

Q10 *Are there specific knowledge transfer actions which RASE should consider?*

Yes: Possible actions include the following:

1. Encouraging Defra to be more proactive in embracing production with environmental issues.
2. Work with key bodies including: the Institution of Agricultural Engineers – Soil and Water Group; Soil Management Initiative (SMI); research, education and extension providers (eg TAG and AICC); machinery companies and the Agricultural Engineers Association; soil consultants; LEAF; FWAG; The Association of Drainage Authorities (arterial drainage systems); NFU; and the farming media.

And with these organisations:

- i. Formulate an effective Soil and Water Management network to rekindle the aims of SMI and SAWMA and its Journal.
- ii. Organise an event; integrating sections on drainage, irrigation, soil erosion control, tillage/compaction.
- iii. Consider a series of county, regional or catchment-based 'Landcare' groups and/or Soil and Water Management

Districts akin to the Australian/New Zealand and US models.

Q11 *Are soil and water management issues understood and their importance taken into account sufficiently by policy makers?*

The key major national issues are well understood by leading policy makers. Where they require further assistance they refer to stakeholder and strategy forums which include ADAS, key universities, Rothamsted Research, Environment Agency and Natural England, consultants and the NFU. Certain issues, for example those concerning rising sea levels, are considered in future Foresight projects.

In recent years official policy has focused on environmental issues associated with climate change and the decline in levels of soil carbon, erosion risks and the protection of soil and water from diffuse pollution. Discussion with Defra indicates that their proposed Soil Strategy does consider the anticipated national requirements to improve food security and provide for increased biofuel production.

Q12 *How can soil and related issues be highlighted to policy makers and advisors?*

It is sensed, that the practical agriculture community believe that in developing government policy there has been insufficient focus on measures that ensure food security whilst meeting the soil, water and environmental objectives. This deficiency appears to have arisen through a lack of connectivity between practice, science and policy. This is despite a Soils Advisory Forum with stakeholders from all these fields involved in policy development and implementation. Bringing these parties closer together and providing an advisory mechanism would appear vital when the agricultural industry manages 72% of the land area.



RECOMMENDATIONS FOR THE FUTURE

- Alert Defra and others to the issues and encourage Defra to move from its current largely environmental policy to one which embraces production within the environmental framework. The commitment of Defra and supporting agencies is critical if the current situation is to be reversed.
- The RASE, with other parties, should attempt to raise £1 million a year for five years to stem the decline in professionals. An extra £300,000 is needed to train doctoral engineers and applied soil physicists over the same period. A further £20,000 to £30,000 a year would help funding of undergraduate and postgraduate students.
- Encourage the development of research, training and professional accreditation at existing establishments and attempt to generate an atmosphere of excellent communication between all parties.
- Support the establishment of a pilot scheme providing a national centre for soil and water management and engineering which would link applied research and development with teaching, extension and short course provision.
- Encourage universities and colleges offering agriculture and soil science programmes to include modules on soil and water management in their curriculum.
- Collaborate with key groups to organise events, produce a journal (hardcopy and electronic) and develop an electronic library of soil and water management to promote good management practices and to provide a practitioners network.
- Convene a conference for interested parties (including Defra and its agencies), farmers, charities, commercial businesses, practitioners, professional and educational bodies, to review potential techniques which, with further development, would be both advantageous to profitable production and the environment.
- The Practice with Science Advisory Group should nominate a champion/facilitator to work with agri-business over time to steer new initiatives, and report to the Group.

CENTRES OF EXCELLENCE

- Rothamsted, North Wyke Research and IBERS in basic and strategic research. With the exception of Rothamsted, however, there are no applied physicists and engineers at the other two centres;
- Cranfield University in postgraduate teaching and basic and applied research;
- HAUC in undergraduate education, training and applied research;
- Reaseheath College providing Level 3 National Diploma graduates and acting as a feeder route to HAUC;
- BASIS in the further development of accredited short courses;
- Institution of Agricultural Engineers for professional accreditation.