VIEWPOINT

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Repairing a fractured pipeline: improving the effectiveness of agricultural R & D in the UK

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ABSTRACT

The farming industry in the United Kingdom faces considerable challenges in playing a proportionate role in meeting increasing global food needs whilst minimising the environmental, social and economic impacts of production agriculture. To do so effectively requires the generation, promotion and uptake of new knowledge, skills and technologies. This article discusses the significant changes that are needed in order to meet these goals.

KEYWORDS: Agriculture; research; development; knowledge transfer; policy; industry

Agriculture worldwide has benefitted enormously from the effective application of appropriate science and technology. Without the development of high-yielding crops and animals, effective agrochemicals, veterinary medicines and improved cultivation practices, we would not be able to feed the current world population, let alone contemplate meeting the demands of nine billion humans by the middle of the 21st century. In most cases, these successes were based upon a solid foundation of innovative basic science that linked effectively both into directed strategic and applied research and into effective deployment of new knowledge and practice by producers.

In the UK, the 20 years immediately following World War 2 were a kind of 'golden age' for this process. Because of pressing needs to stimulate home production and reduce imports, there were real incentives to link all the different components of the 'research pipeline' together. Basic science was delivered by universities but also by a large number of Research Institutes that were focussed on specific sectors and that were also engaged in the strategic and applied research that would foster effective delivery. Initially at least, the Agricultural Research Council controlled the funding for both basic and strategic/applied research, and linked closely with the development and extension activities of the National Agricultural Advisory Service (NAAS)[2] and the Levy Boards[3]. As an example of how effective this process was; over the period 1950–1970 average wheat yields doubled from ca 2-ca 4tonnes/ha driven roughly equally by the development of new varieties and by improved cultivation practices. There were also good links between government-funded research in universities and institutes and the 'in-house' research and development (R&D) of (e.g.) agrochemical companies, catalysed by arrangements such as joint studentships and fellowships. Perhaps even more importantly, producers were rewarded not only by sale of produce but also by significant production support from government.

Unfortunately, this 'golden age' began to tarnish and challenges began to emerge from the 1970s onwards. Ironically this was just as I was looking for my first permanent job in agricultural research, and the sector seems to have been undergoing major upheavals ever since! There were three major causes for these challenges. The first was the success of the process, leading to the complete disappearance of food shortages in developed countries and indeed significant over-production in some areas. The second was the ever-increasing costs of government support for farming, which became unpopular as shortages vanished whilst the third was the increasing globalisation of developed-country economies, which opened up imports of produce, often at lower cost. At the same time, the environmental movement began highlighting some of the negative impacts of intensive production systems in terms of habitat loss and damage together with increased diffuse pollution. Increased food security, driven by globalisation and production increases impacted directly and negatively on farmers in terms of reduced margins, since processors, retailers (and ultimately consumers) were always able to deal with a range of primary providers, all of whom were in competition with each other.

If one examines the way in which agricultural research is organised in the UK today, and how that impacts on producers, the position is much more complex and much less integrated. The majority of basic research is still funded via the research council system but both the Biotechnology and Biological Sciences Research

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[2] A free public-sector extension service.

[3] Quasi-governmental organisations engaged in research and development in production of specific commodities (e.g. meat, potatoes, cereals), financed by statutory levies on farmers and growers.

Council (BBSRC) and the Natural Environment Research Council (NERC) have remits that go well beyond farming and land use. The role of universities as research providers has increased and that of research institutes has decreased, and funding for strategic and applied research has been separated from that for basic research. Defra[4] emphasises research in support of policy rather than in support of industry and its research budget has fallen significantly in real terms. Although there is considerable global investment by industry, consolidation and European antagonism to agricultural biotechnology means that the industrial R&D base in the UK is much smaller than it used to be. There is no longer a free advice and extension service for farmers in England, although mechanisms do exist in Scotland, Wales and Northern Ireland. On the positive side, Levy Boards still fund applied research and development, and the recently-created Technology Strategy Board (TSB) is beginning to fund applied research linked to industry needs and industry involvement.

The end result of these changes is that, although a considerable sum of public money (estimated at *circa* £365 million[5] in 2010[6]) is used to fund research on aspects of agriculture and land use, the impact of this is problematic. There is a range of reasons for this including:

- The needs of research providers to demonstrate academic excellence as well as relevance or impact. This particularly impinges on the award of competitive funding for basic research, where the strategic needs of end-users may not be paramount.
- The emphasis on environmental research that does not directly address the needs of the industry. This shift in emphasis is justified by increasing concerns over issues like climate change and habitat damage, but this has been driven almost entirely by re-directing existing funding away from 'production-oriented' research.
- The net reduction in funding for strategic research. Declines in industry and Defra funding means that it is much more difficult to bridge the gap between a potentially valuable piece of basic research and the demonstration of commercial value. There are still ways of doing this but the imbalance means that potentially valuable knowledge does not always get taken up and used.
- The decline in profitability in the industry reducing the value of the levy and thereby the amount of development and knowledge transfer that can be carried out.
- The lack of a comprehensive, integrated UK-wide extension service.

In the early years of the 21st century, there were those who suggested that farming should be treated like other 'sunset' industries, and that the UK should treat food as a widely-traded global product that could be accessed from whichever source was the cheapest. Whilst there is no doubt that developed countries like the UK will continue for the foreseeable future to be able to purchase food in a competitive global market, attitudes towards maintaining a viable UK farming industry have changed recently. The UK Government Foresight analysis on food security (Foresight 2011; Beddington 2011, *inter alia*) rehearses some arguments in support of this:

- The need to underpin the UK food industry (its largest industrial sector)
- The societal value of maintaining a resilient food chain with high safety and welfare standards at a time of increasing global demand;
- The preservation of the delivery of essential ecosystem services as a consequence of maintaining viable farms;
- Minimising the adverse environmental consequences of food production and promoting the effective integration of land use into the UK climate change policy framework;
- Promoting an integrated and effective approach to the growing threat of animal disease and zoonoses;
- Maintaining public confidence in the UK food chain from farmers to retailers;
- Supporting a shift to land use systems where food and renewable resources both need to be generated efficiently and sustainably.

It is my submission that this shift in attitude to farming will require a further realignment of the way in which research is managed in order to improve both its focus and its delivery. Whilst there are some examples of current good practice in the management of basic, strategic and applied science; financial constraints will force us to consider new ways of working that will help to restore the integration of the immediate post-war years whilst accepting that the target has widened to include financial, environmental and social gains as well as production ones.

At a strategic level, I think four main issues need to be addressed:

1. *Ensuring that the farming industry has a stake in the entire R&D strategy.*
   This means that the R&D and knowledge transfer (KT) priorities of the levy bodies must (a) be effectively integrated with those of other providers and (b) recognise the need to invest in longer-term developments that will help to prepare for the new opportunities and challenges of a food-hungry and energy-hungry world. This is a very challenging objective. Low profitability not only reduces the amount available to invest but also tends to shorten horizons since survival is paramount. Farming needs to look ahead and develop a framework for R&D that identifies the key knowledge and skills gaps that are likely to reduce competitiveness over the next 20–30 years. As well as developing this framework, there needs to be better communication between those looking for 'industry-relevant' R&D and those setting the basic and strategic research agenda. Some progress is being made via the Agricultural and Horticulture Development Board (AHDB), TSB, Defra and the UK Research Councils, and the Scottish funding model does seek to deliver an integrated

[4] The UK government Department for Food, Environment and Rural Affairs.
[5] In early October 2012, £1 was approximately equivalent to US$1.61 and €1.25 (www.xe.com)
[6] See the Oxford Farming Conference Research on agricultural research needs and priorities: http://tinyurl.com/9mkw4jr

stream of policy- and industry-relevant research that is linked directly to effective on-farm KT. Nevertheless, there remains a pressing need to improve clarity, focus, integration and longer-term relevance of industry-funded R&D

2. *Ensuring that new knowledge and skills reach the end user effectively and uniformly.*
   Even in its heyday, agricultural extension in the UK only reached directly a minority of farmers. Others learned from their more innovative neighbours whilst a substantial 'rump' did not benefit at all. Even to meet the current rather modest targets for greenhouse gas (GHG) reductions on-farm it will be necessary to change practice across a substantial majority of farms, and this is even more true of the longer-term challenges outlined above. I find it difficult to see how this will happen across the UK despite the best intentions of levy bodies and some agricultural charities. There are examples of good practice, such as the implementation of GHG inventories and models on farm, but uptake is patchy and differs markedly from region to region. I remain particularly concerned that, whilst there may be sufficient resources to achieve effective uptake of new knowledge in terms of increasing profitability, no-one is really considering how to implement best practice in terms of balancing production gains against impacts on ecosystem service provision, or even balancing the costs and benefits of alternative land use systems. Failure to transfer knowledge effectively negates much of the value in creating it, and I perceive a need for organisations all along the R&D pipeline to consider innovative modes of knowledge transfer as a matter of urgency.
3. *Aligning more effectively policy-oriented research with the future direction of the farming industry.*
   The significant reduction in strategic R&D funding from Defra is unlikely to be reversed in the short- or medium-term and there remains a need for research to support both policy development and policy delivery. However, effective delivery of key land use policies depends upon the active and informed participation of farmers and land manages. 'Sticks and carrots' will always play a part, but seeking ways of increasing the involvement of farmers in the processes of setting the research agenda and delivering the desired policy outcomes will help to ensure both value for money and the minimisation of unintended consequences. The farming unions are active in representing their member's interests in both national and European discussions on agricultural policy. A more joined-up and participatory approach to assembling the evidence base might be of value to all and improve the effectiveness of government intervention.
4. Maximising the value of basic research.
   World-class basic research is the intellectual capital upon which future technological advances will be built and UK Research Councils have been extremely successful in promoting such research, even at a time of financial pressure. However, the Government's Impact agenda has focussed attention on how the products of this research can 'trickle down' to promote economic activity and benefit 'UK Plc'. In agriculture, BBSRC (with other academic partners) has addressed this by involving industry and others in the development of Research Clubs[7]. These clubs are established specifically to promote the direct uptake of knowledge from basic research by land-based industries. They also give the industry greater involvement in suggesting research priorities. The challenge is to maximise the opportunity for research to generate impact whilst maintaining an appropriate breadth of basic research and not stifling ambition.

The move towards funding larger, integrated cross-disciplinary projects improves the chances of successful innovation but also increases the significance of 'failure' and tends to focus efforts in some areas at the expense of others. As the challenges become more complex, it is likely that new approaches will need to balance benefits and disbenefits across the full range of inputs, outputs and systems that comprise modern farming (Pretty, 2003). This will require basic research across biological, physical, environmental and social sciences to be integrated and managed effectively and for the results to be used coherently for the benefit of the sector. The recent Royal Society report on food production refers to the concept of 'sustainable intensification' (Royal Society 2009); increasing yield whilst decreasing footprint. This is a major scientific challenge that lies beyond the remit of any single research funder to underpin, so the task remains to improve the integration not only across scientific disciplines but right along the R&D pipeline.

In this brief article, I have argued that there is a compelling need for UK agriculture to define a significant national and global role for the future, in which the challenges of meeting increased demand for food can be balanced against the need to deliver other ecosystem services and to broaden the range of products from land. If this role is to be sustained, then I believe that the industry has to change its approach to commissioning R&D and to delivering extension and training, and research funders need to adapt to an environment where effective deployment of innovative multi-disciplinary research is seen as an essential part of the process rather than an infrequent by-product.

About the author

Chris Pollock is the former Director of the Institute of Grassland and Environmental Research in Aberystwyth. He has a long-standing interest in the management of strategic and applied agricultural research and has provided advice in this area to BBSRC, Defra and the Welsh Government. He also chairs the statutory advisory committee that advises UK governments on release of GM organisms into the environment.

[7] E.g. its Crop Improvement Club: http://www.bbsrc.ac.uk/publications/innovation/circ-brochure.aspx

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