HOUSE OF LORDS

AGRICULTURE, FISHERIES AND ENVIRONMENT SUB-COMMITTEE

Innovation in EU Agriculture

Written Evidence

Contents

Memorandum by British Agrifood Consortium and the Meshfield Foundation (IEUA 3)

1. Background

1.1 The British Agrifood Consortium is a knowledge based organisation with two key objectives that are mutually relevant;

1.2 To ensure imported agricultural products to the EU are subject to the same standards and controls as demanded from local producers.

1.3 To provide agribusiness development and thereby assist the most appropriate organisations in developing markets, resulting in improved export capabilities.

1.4 The Meshfield Foundation is a trans-disciplinary consultancy based in Cape Town and committed to creating inspiring and innovative ways to thrive on our planet. Their work is informed by bringing the dimensions of psychology and culture to transform sustainability initiatives, ensuring more robust, resilient and context responsive strategies and solutions.

2 General Perspective

2.1 There is a growing awareness that agriculture and by implication food security are becoming more and more challenging for countries to address through the current methodologies at their disposal. In the last twenty years, funding for agricultural research has declined along with the infrastructure to transfer agricultural technology.

2.2 This is not only true of the United Kingdom and the European Union but also true for other countries including South Africa. Concern for the future of agriculture / food security lies even deeper given the rise in production costs over the last thirty years and producer prices for food have not kept pace with general market trends.

2.3 Efficiencies (Just In Time and other operational management concepts) in food supply chains have had the inadvertent impact of reducing the world food reserves to the point where given an international disaster there is too little time to grow and replace food reserves.

2.4 Externalising the impact of modern agricultural methods reveals a dark underbelly of negative environmental impacts such as increasingly low quality irrigation soils, impacting on the quality and quantity of water reserves. This is clearly identifiable by the declining aquifers and rivers that no longer join the sea, with the consequent potential to irreversibly impact on biodiversity.

2.5 In addition, consumers are raising concerns on the impact of pesticides and there are a variety of unexplained ailments that only further enhance these fears, casting doubt on how food is produced and how animals are treated. Consumers (through a series of food scares) have become more alert and are now prepared to either boycott or support an agricultural product based on their individual fears and understanding.

2.6 The commercialisation of farming has reduced the number of farmers and increased the size of the farms in order to meet the commercial demand for quality and quantity in the

marketplace, driven particularly by food retailers. Concomitantly the public have been able to use the food retailers to address their fears and force greater transparency and integrity into the food supply chain. The fears and guilt of consumers has supported the growth of new market segments such as organic, free range and fair trade.

2.7 Although these condensed views so far fail to convey a positive perspective of agriculture, many achievements have been made – and this response is purposely positioned to make the case for a different approach to the challenges of agriculture by addressing a different and more generic process by which ideas are conceived, developed and deployed throughout the agricultural sector. The motivation for this non-mainstream approach is to explain both the innovation and the balance between increasing demand for agricultural production and respect for rural economies and communities.

2.8 It is argued the exploration of complexity of agriculture should allow us to build a resilience into our food supply systems, the way we approach production should not only include the use of resources such as soil and water and their impact, but also the social impacts of their use – the need for communities to survive beyond their current market dependency must also be a consideration.

3. Innovation in agriculture and how it impacts on the EU

3.1 There can be no doubt that many new innovations have facilitated a massive increase in agricultural production through research and technical advances. The new capabilities of communication and the internet have also made a significant impact on information sharing and access, which brings the marketplace into the farm environment, making the supply side opportunity appear ever more attractive in the short term.

3.2 However what is become increasingly "clear" is the incredible complexity of food production which now has even greater complexity with the awareness of climate change, water scarcity and the need to encourage sustainable improvements in productivity, not least in the context of food security. The complexities of different agricultural systems (how can the different lenses of climate change, and the scarcity and quality of water be addressed in the face of food security that is unsustainable?) are questions being asked across the world. They are not merely the challenge of the EU but belong to everyone involved in every food chain.

3.3 In a recent sharing on the these challenges between the UK British Agrifood Consortium, Woolworths SA and the Meshfield Foundation SA, the parallels in the respective challenges faced were so obvious that it was agreed a partnership is required to begin to communicate these issues.

3.4 It was further recognised that the challenge of complexity can be met through methodologies harnessed by the Meshfield Foundation that does not only allow the exploration of complexity but finds the simplicity without which we cannot function. The exploration of complexity of agriculture should allow us to build "resilience" into food supply systems. The way we approach production should not just focus on the use of resources such as soil and water but also the impact on these resources and in turn the potential social impacts – the need for communities to survive beyond their current market dependency.

3.5 This word "resilience" features heavily in the challenges identified. As an example, resilience could be the outcome to a farm community if a food retailer stops trading with producers for produce from a farm in South Africa because:

- Climate change has changed weather patterns and rainfall is no longer sufficient to grow the crop to the required quality parameters?
- Water quality has now deteriorated and contains harmful bacteria and the fruit is seen as a safety risk and rejected?

3.6 As a further example, the leading South African food retailer, Woolworths, have been faced with the complexity of how to address the ecological footprint of the agricultural activity undertaken on its behalf by their suppliers? Although Woolworths has less than 10% of the retail market share in South Africa they have a very big market share in fresh produce; more than 30%. This big market share carries the burden of a bigger responsibility of caring for the soil and water and also impacts on biodiversity. Although a limited organic offer was and continues to sell in Woolworth stores, the marginal soils in South Africa and increasingly limited water sources required the initiation of a programme that today is known as "Farming for the Future", where agricultural methods new and old have been combined into a focus on managing the biological component of the soil to create 'living soils'. This milestone which is now part of a broader Woolworths' initiative called the "The Good Business Journey" was developed in the last ten years using an action enquiry process where sadly universities and government institutions could not assist since they lacked the integrated knowledge required to develop the agricultural thinking that would create and manage the living soils.

3.7 The initiative (although developed for environmental sustainability) has also paid dividends in reducing the input costs of fertiliser and pesticides, improving the yields and general quality. Further benefits are being realised by improved water retention in the soils and increased organic content which can reduce soil erosion and water run-off.

3.8 The initiative which has led to a new scientific study in support of the programme sponsored by Woolworths also offers the opportunity to become a new training direction that does not only ensure the production of safe quality food but at the same time meets the requirements for improved environmental sustainability.

3.9 Although the practical application of food security at a subsistence level has not been evaluated; the opportunity exists to expand the basic premise of reduced inputs of "Farming for the Future! into low/no input (fertiliser, pesticides and land till) production systems through the management of life in soil.

3.10 This programme demonstrated that existing systems can be re-evaluated and the complexity explored to develop a new understanding. By incorporating the new challenges of climate change through CO2 reduction, using compost which reduces fertiliser and pesticide, managing water more carefully and reducing on-farm solid waste.

3.11 The resilience of the agricultural system has been improved and this work inspired Meshfield foundation to expand into other methodologies to support the alignment of systems other than agricultural. The methodologies are designed to fit the question and create an alignment by continuously challenging what is the question, who is asking the question and what is the question? This iterative process allows en route findings to be implemented and again challenge the question.

4 Our challenge

4.1 The Meshfield and British Agrifood Consortium approach proposes that before new innovations in agriculture are embarked on, before we all adopt the shiny new ideas to be the salvation for our future, that EU agriculture challenges itself with an innovatively designed process that will ask critical questions of "resilience" in agricultural systems.

4.2 This "resilience" can be understood by using different lenses, by reviewing and understand the various shortcomings and highlights of agricultural systems and by carefully evaluating the impact of new technologies.

4.3 The approach is certainly not to reject new technologies but to prevent technical solutions becoming trapped by their own design without recognising the complexity of the system and the impacts on its alignment. For example genetically modified plants are a fantastic technological breakthrough with huge financial investment, but precipitate the challenges of the "resilience" of the food system.

4.4 The science of agriculture is based on the study of its components. This approach over the last 150 years has created a very good understanding of these various components, whether microbiology, soil science, horticulture or other relevant ones. Each of these components have become expert fields and through the scientific process of peer review have been driven for their own excellence.

4.5 Biotechnology was born in the field of microbiology, which in turn has become a focus in itself. What was lost was the benefit of integrating the knowledge to understand for example the life of soil. It is logic that innovation would now be cradled into new expert fields, as issues that are either important or becoming important through the lenses of climate change and water are receiving little or no attention.

4.6 Using new methodologies that look at the "resilience" of an agricultural system will highlight these gaps and urge more innovation on the expert fields that are currently aligned to traditional systems. We believe that the answer to sustainable agriculture and improved food security is through asking different questions.

September 2010

Memorandum by British Beet Research Organisation (IEUA 4)

1. **Definition of "innovation" in the agricultural context**
   As well as the components identified in the Call for Evidence (new technologies, machinery, incremental change, deployment of novel ideas), innovation also includes the re-appraisal and application of archived data to the solution of new problems; so-called 'data mining'. To this end, free exchange of commercially non-sensitive data between researchers should be encouraged. BBRO has derived much benefit from this approach.

2. **Innovation in EU agriculture as a strategic objective**
   In agriculture (except possibly for the highly specialised area of molecular genetics), strategic research has been systematically removed from publicly funded programmes, particularly in the UK, since the mid-1980s. These 'near-market' policies were introduced primarily to save tax-payers' money and they forced the agricultural sector (individual agri-focussed companies as well as farmer levy organisations) to fund more of the strategic research from which they benefit, resulting in such research being better targeted; but at the expense of a large volume of applied though non-specific science in universities and research institutes. Such publicly-funded research as remained has, for the most part, been understandably directed towards public-good targets such as water quality, soil erosion, animal health, welfare, and off-target effects of agrochemicals, all brigaded under the banner of "sustainability" and little of it being strategically innovative.

3. **Innovation today**
   Unfortunately, funding available in the private sector to support strategic programmes reached its limit several years ago and the volume of strategic research diminishes year-on-year in relation to financial strictures affecting the incomes of industrial sponsors. One area showing promise 20 years ago was robotics: applications were under development for many activities to replace monotonous human input, particularly in horticultural crops. Apart from one or two exceptions, these programmes were severely curtailed; a major remaining one being GPS guidance technology which has the advantage of spin-off from its military applications. Another seriously affected area is weed science; public sector programmes apart from those associated with GM safety do not exist; weed scientists are becoming extinct. The agriculture sector is best able to innovate when there is adequate publicly funded applied science to be exploited; that is not the case now. Even the BBRO, which has a 70-year history of funding across the full Frascati spectrum can no longer afford truly strategic research. Our key genetic targets, control of flowering, drought tolerance and disease resistance remain in our programme but progress has been severely hampered by lack of public funding over the last 20 years.

4. **Obstacles to innovation**
   The shortfall in research capacity has already been mentioned. Even where new methods or equipment become available, farmers often ignore them because prices paid for their crops are too low to give them the confidence to invest for the longer term. Withdrawal of market support within the CAP, coupled with the opening of EU markets to the world, exacerbates this situation. Such openness, though laudable, exposes us to competition, often from countries where labour is much cheaper, and matters such as environmental, operator and pesticide safety are unregulated, leading to a situation where imported commodities may have been produced using systems that would be illegal in the EU. This is unfair and needs to be addressed: withdrawal of market support

under the CAP, and the EBA policies must be managed together, and sympathetically, to ensure that EU farmers are not unfairly disadvantaged.

5. Demographic structure of the sector

Age is much less of an obstacle to innovation than unprofitability is. The greatest incentive to encourage young people into agriculture would be the promise of a secure future where competition within and beyond the EU is fair, and efforts are adequately rewarded.

6. Future challenges driving innovation forward

The obvious future challenges are climate change and the possibilities for mitigation of that and other environmental issues such as water quality, soil erosion and off-target effects of agrochemicals. In the sugar beet industry, breeders already have objectives to produce varieties that carry less soil away from the field, and programmes stimulated by BBRO research are in place to develop varieties tolerant of drought and resistant to diseases. There is also potential for production of renewable energy via bioethanol and biogas, again genetics could produce varieties which are best suited to biodigestion. Crop protection and the need to ensure that available pesticides are delivered only when and where necessary, in exactly the right quantities and with no off-target effects, are objectives of all levy-funded programmes and have obvious congruence with government environmental objectives.

Another, possibly more important problem is that of the increasing world population. It has been predicted that, as the climate changes, Europe will become relatively more important as a producer of food for the world. A recent analysis from Copenhagen University suggests that numbers of hungry people will continue to grow whilst the rate of yield-increase in the staples: wheat, rice and maize, is slowing down. Three key components to a world strategy to address this challenge are proposed:- genotype, environmental demands and management (GEM). These components are variable in extent and detail between countries, and the optimum balance between them will be different in each situation but, in finding that balance, nations will need to focus more on food systems instead of crop systems. Plant varieties appropriate to environmental conditions will be required, and the production, harvesting, transportation, storage and processing of the produce will require integration and cooperation between nations.

7/8. Knowledge and innovation systems, Research and Development

In the UK, the government departments that had "Agriculture" in their title, usually led by the old MAFF, determined research priorities in consultation with a Priorities Board comprised of representatives of consumers, producers, retailers, advisers, the research community and the departments themselves. The focus of government departments moved away from food production, leaving individual levy boards to operate similar groups, eventually becoming the sector companies of the Agriculture and Horticulture Development Board. This model should generate nearer market priorities but there is potential disjunction at the commercial/public funding interface which government(s), seeking to fund research in support of legislation should address. The agenda for R&D determined by such a system requires implementation across the full spectrum from strategic research through near-market research to technical development. The industry levies are best-placed to cover priorities peculiar to themselves but Government could take the lead on cross-commodity issues such as effects in crop rotations, and clearly must take responsibility for research in support of legislation. Here, as has been demonstrated in research on nitrates in water, and pesticide safety, programmes that are

jointly funded between the private and public sectors can ensure the achievement of government targets whilst minimising negative impacts on farmer profitability. The level of funding will be determined by the urgency of the problem being researched and the fortunes of companies and nations but, unfortunately, sources of funding are immutably: levy payers, tax payers and share-holders.

9/10. Education and skills, Knowledge transfer

The near-demise of the free advisory service (ADAS) is well known. Its function has been taken over, though on a smaller scale, by private advisers and by research institutes through grower membership schemes and "friends" organisations. Colleges and universities continue to run courses covering agricultural production but the teaching of advice-giving is mostly ignored. Like other levy organisations, the BBRO runs a programme of knowledge transfer incorporating a mixture of publications, web-based information, technical conferences, on-farm demonstrations, advisory visits, a clinic, machine-operator training and the provision of information to independent agronomists. Unlike others, the system of levy-collection whereby every grower must contract in advance to supply beet to the processor means that the BBRO knows and is able to reach every sugar beet grower in the country. Other crop levies are denied such comprehensive information by the Data Protection Act. Some easing of regulations to allow levy boards to identify all their contributors would do much to improve the transfer of knowledge to producers.

11. EU policies

The need to coordinate revision of the CAP with EBA is alluded to under item 4 above; some restriction on imports to ensure that the EU's competitors must adhere to the same environmental, sustainability, welfare and social standards as our own is imperative. We also need access to GM varieties across the EU. Not only will this enable our fairer competition with countries where such crops are already produced, but it will also foster the production of varieties that require lower inputs of agro-chemicals, in line with government(s) objectives for environmental sustainability, and giving some amelioration of the difficulties imposed by banning of key pesticides under revised EU regulations.

28 July 2010

Memorandum by British Crop Production Council (BCPC) (IEUA 5)

BCPC's principal concern is that the Committee should set its inquiry into "Innovation in EU Agriculture" in the appropriate context. We are concerned that UK governments, the governments of other Member States and the EU governance system (Council, Parliament and Commission) have made little public acknowledgement of how that context will change in the foreseeable future. They show little appreciation of the long-term effects of current practices in food production and of the potential effects of predicted changes, particularly in world population and climate.

Food security should be at the top of the agenda of all these levels of governance within the EU, taking all the relevant worldwide factors into account. Food security will be achievable only with sustainable production systems, that is, systems that are biologically and geologically sustainable in the long term. Issues of sustainability will be of increasing relevance to food security during the next few decades, and most certainly in the periods beyond. 'Innovation' of many kinds will be essential to address these issues and 'innovation' should be a strategic objective in EU agriculture.

BCPC summarised its concerns on these issues in its response to the consultation by DEFRA on the "Food 2030" plan in October 2009, a copy of which is attached. The Committee will see that BCPC saw a central role for 'innovation' in all its forms in tackling the crop production challenges that will surely face all in the EU and beyond.

Please do not hesitate to contact us if you require any further information or wish to discuss any of the points we have raised.

DEFRA Consultation on Food 2030

Response from BCPC

The British Crop Production Council (BCPC) welcomes the Government's intent to develop "an overarching plan to make the food system more economically, environmentally and socially sustainable". BCPC is pleased to have the opportunity to comment on the issues that have been raised so far.

BCPC is, however, disappointed that, judging by the various background statements and the related questions in this consultation, the emerging plan shows little appreciation of the long-term effects of current practices in food production and of the potential effects of predicted changes, particularly in world population and climate. In consequence this response is mainly about the general policy and does not give answers to all the specific questions.

Food security should be at the top of the Government's agenda, taking all the relevant worldwide factors into account. Food security will be achievable only with sustainable production systems, that is, systems that are biologically and geologically sustainable in the long term. Issues of sustainability will be of increasing relevance to food security during the lifetime of the present plan and certainly in the periods beyond.

The Food System – what *should* we be aiming for?

To use global natural resources and existing, emerging and new technologies in an environmentally sustainable way to feed a growing global population and contribute to global health and food security.

A policy aim like this should be at the forefront of the whole Plan and should be apparent in the policies and proposed actions in every section.

A plan for "Food 2030" must deal with the changes that are likely by 2030. But it should also lay the groundwork for a food production system for 2050 and even for 2070.

In contrast, the principal aims of the Plan set out under the heading "The Food System – what are we aiming for?" all reflect a short-term view, with comparatively minor variations on "business as usual".

Some these "bigger issues" are raised in later, specific sections. However, consideration of a question like "*How will farming have to change in a world of 9 billion people?*" is absolutely fundamental to planning the food production system for 2030 and beyond. An appreciation of the challenges such issues will present should be at the very forefront of the whole discussion and should be reflected in every section of the plan. Sadly, that is not the case.

Issues that need to be addressed

The current food production systems of the developed world, and of much of the developing world, are not sustainable. These systems depend on inputs that are not being replaced, biologically or geologically, and are not being recycled. The only truly sustainable systems are closed systems, where all essential inputs, other than energy from the sun, are recycled. Such closed systems of food production are practised in some parts of some countries, but they feed only a very small proportion of the world's population.

The most obvious inputs that are not being replaced or recycled are the major plant nutrients, nitrogen, phosphorus and potassium (NPK). For every kilogram of these nutrients that is taken off an area of land as food, a kilogram has to be brought in if the productivity of that land is to be maintained. Similar considerations apply to many of the minor plant nutrients.

Water is already a limiting input for crop production in many parts of the world. Increasing world population and climate change will both exacerbate these problems.

Food production in the developed world, and in much of developing world, is wholly dependent on extracted petroleum oil for motive power and crop processing. This applies to all systems of crop production, including organic agriculture, that are employed to produce significant quantities of food. Opinions vary widely about when 'peak oil' will occur, but it would be wise to include some acknowledgment of the challenges diminishing petroleum resources would bring, including increases in the cost of this source of motive power, as these may well take effect within the time horizon of the draft plan.

The world's population is predicted to rise to 9 billion by 2050. The increase from the present 6.8 billion is already in train and is unstoppable, barring natural disasters, pestilence or war on an unimaginable scale. The rate of increase beyond 2050 may slow very

considerably and there are demographic projections for significant decreases in population. These projections; however, are predicated on the continued trajectory of global development and increases in prosperity which may falter if the major challenges relating to water, food and energy are not effectively addressed in the next few decades.

How and where will the additional food be produced for these additional people? Where will these additional people live? What implications will that have for land availability for food production? The projected increases are not uniform by continent or country: what changes are likely within the UK? What will be the effects of mass population migrations when regions at lower latitudes become too hot and dry for crop production?

Views vary widely about the likely extent of climate change within the period of this plan and within the foreseeable time horizon beyond. If sea levels rise significantly by the end of the present century, very large numbers of the increased population will be displaced. They will lose both the land on which they live and the land that produces their food. Although these are most likely to occur in countries far from the UK, the UK food system will not be immune from the effects of these losses and displacements. If sea levels rise significantly, a substantial part of the UK's limited resource of Grade 1 agricultural land is likely to put at risk. It is this land that can profitably produce the widest range of crops, including the field-scale vegetables needed to maintain healthy diets on a national scale.

Climate change is also predicted to bring significant shifts in the distribution of rainfall: food production will decrease or stop in new areas of drought. Even in areas with more equitable climates, the distribution of rainfall between seasons may be seriously disturbed, with drier summers and wetter, warmer winters. Pest and disease pressure on crops will increase without the normal 'winter kill', and pathogens hitherto unseen in the UK may become prevalent. These factors would certainly affect food production within the UK.

Another predicted effect of climate change is to make weather patterns more variable: that in turn would make land-based food production more variable. It is unlikely that these weather disturbances could be predicted, so it will be difficult or impossible to take in-season action that would mitigate the effects on food production. Thus there will be a real challenge in how to make the system more resilient, especially in view of the other adverse factors that will likely have increasing effect by 2030.

Maintaining a thriving food economy

Without food security, underpinned by sustainability, there will be no prospect of a thriving food economy.

Ensuring Access to and Affordability of Food

In so far as it is able, it is the second priority of government to ensure that the people have access to adequate food. There are likely to be substantial challenges on this front towards the end of the Plan period because of the rising world population and the predicted effects of climate change. To some extent, these effects may be mitigated by advances in the technology of crop production.

Availability, and variability of supply, will affect affordability. It is possible that in the foreseeable future a greater proportion of personal disposable income will have to be spent on food, reversing the trends of the past fifty years. As disposable incomes have risen, it has

been the near-universal experience in countries across the world that food consumption patterns have changed towards greater consumption of meat and dairy products.

These changing patterns have increased the demands on crop production and it is remarkable that over this period grain production per person has increased by 17% while the population has expanded by 117%, and yet only 12% more land has been cultivated. This has been possible because of the advancement of technology resulting in a per hectare yield increase of over 120%. The trend of increased demand for livestock products (meat and dairy produce) is likely to continue, moderated only by market forces. This will place increasing pressure on land availability for grain production unless grass and other forms of forage begin to predominate in animal production systems. If these issues are not addressed, the divide between rich and poor in access to affordable food will inevitably be exacerbated.

Climate unpredictability may have huge effects on crop production in major exporting countries like Canada, Australia and the Ukraine. This would impact on global prices and we cannot assume that, throughout the period of this Plan, we shall be able cheaply and easily to make up for shortfalls in UK production by buying crops in a stable global market.

Reducing the Food System's contribution to Climate Change

There is undoubtedly scope for reducing the Food System's contribution to climate change, but attention must also be given to the effects of climate change on the food production system.

Reducing diet related chronic disease

The principal diet-related chronic "disease" in the UK and many developed countries is obesity, which in turn triggers or promotes several other chronic diseases and conditions. Food policy alone will not address this major health, economic and social problem, but it has a contribution to make.

Reducing food-borne illness

BCPC has no comment on this topic.

Living within environmental means

We are not "living within our environmental means" in employing the current food production systems we use in the UK and much of the developed world.

On a world scale, the availability of water is likely to be the biggest environmental constraint on crop production. Depending on how climate changes, it may have a significant impact on crop production within the UK, when the effects would likely be greatest in the main cropping areas of southern and eastern England. These parts of England are currently experiencing increases in population and hence increased requirements for water for non-agricultural purposes, with a concurrent loss of agricultural land to new development. There will also be increased demands for reduced pollution of water resources by all forms of agricultural activity including crop production.

Our present approach to essential plant nutrients, especially P (phosphorus) and K (potassium) is exploitative - they are mined elsewhere in the world and imported to be spread on food producing land. These resources are not unlimited. The plan should include

a requirement to make realistic assessments of the extent of the concentrated reserves around the world and of their likely availability. Cost, and the ability to pay, is likely to be major factors as these resources diminish. These assessments must take into account relevant global economic and political factors.

Increased attention must be given to recycling more, or all, of these inputs that are essential for plant growth. In the longer term, that will become necessary to sustain food production. The costs of changing to a nutrient recycling system for established urban populations would be very great, but much less for new developments.

Improving the food system through research and innovation

Research, development and innovation offer the only prospects for improving the food system to make it more sustainable and more secure. The first requirement is for government and the other stakeholders to accept that the food system is facing these challenges. Then government and the other stakeholders must accept that a great deal of research and development will be essential if the problems are to be quantified and solutions are to be found.

Although there have been some very recent encouraging signs of such investment, it has to be recognised that a great deal more will have to be done to reverse the effects of the policies of successive UK governments which have withdrawn R&D funding over several decades. There also needs to be a greater focus on research that will deliver solutions to practical problems, as well as continuing to undertake more fundamental 'blue skies' studies.

It will be necessary to increase the UK R&D skills base in relevant disciplines as this has been allowed to run down. Increases will be needed in salaries for researchers, to take into account the level of training required before beginning a research career and to make agricultural research a more attractive career proposition for talented people.

The challenge of getting proven developments put into practice must not be underestimated because primary food production is a highly atomised industry, with a very large number of individual decision-makers. Experience shows that these decision-makers respond well to clear market signals and to some publicly funded incentives, but effective knowledge transfer will also be required. The market alone is unlikely to provide effective knowledge transfer on the scale required.

No technology that could contribute to sustainability should be excluded. The current 'risk averse' climate in the UK must be confronted with the realities of long-term sustainability and the implications for a sustainable and secure food system. The current obsession in the European Union with 'hazard' when we should be considering 'risk', must also be confronted. This does not mean *carte blanche* for the development and introduction of any and every technology, but it does mean making realistic risk assessments of any potential harm to human health and of any potential adverse environmental effects.

Sustainable Farming

The systems that currently produce most of our food, including systems designated "organic", are not sustainable. The recognition and the acceptance of this fact have to be the starting point for the development of any plan for "sustainable farming".

The sustainability issues about water and some major plant nutrients are dealt with above.

The most obvious non-sustainable input is extracted petroleum oil used in farming primarily for motive power. Alternative energy sources must be identified and developed for practical use. A great deal of work is being done on developing cars for personal transport that are powered by alternative energy sources. In contrast, very little work is being done on identifying suitable alternative energy sources to power the motive units currently required for crop production and farming more generally. This should be a research priority.

Nitrogen is the main driver of crop growth on which all farming ultimately depends. Nitrogen fertiliser, in a variety of forms, is a very large imported input to most of the crop production systems used to produce most of our food. A great deal more could be done to recycle a substantial proportion of the nitrogen carried off the food producing land with each crop, although the costs of re-engineering our sewage disposal systems to achieve that would be substantial and some social sensitivities would have to be set aside.

Much of the nitrogen fertiliser used in farming around the world is synthetic. It has been estimated that about one-third of the world's population is sustained through the use of synthetic nitrogen fertiliser. That proportion is likely to rise as world population increases and more food must be produced from the same or a diminishing area of land suitable for crop production. The present methods of producing this synthetic fertiliser are not sustainable because they depend on extracted hydrocarbons both for feedstock and for energy. The renewable alternatives are not currently cost-effective in money economics. Diminishing supplies, and consequent increasing costs, as well as recognition of the need for sustainability, are likely to change that short-term perspective.

Plant breeding technology may offer an alternative sustainable approach to providing crop plants with the nitrogen needed for growth. This would involve the transfer of a nitrogen-fixing capability to crop species that do not naturally have it. The yield of such nitrogen-fixing plants is likely to be slightly lower than that of similar plants fed synthetic nitrogen fertiliser. Determining which approach is likely to be the more 'cost-effective' when assessed in terms of sustainability should be a research priority within the Plan.

Reducing and reusing waste

Waste should be reduced wherever possible throughout the food production system. Some material that is presently designated "waste" could almost certainly be recycled and so should be regarded as a potential source of inputs rather than as "waste". For example, it has already been shown that some "waste" can be used as a feedstock for energy production in anaerobic digestion systems and the residue used as plant nutrients and soil conditioners. A change of mindset is likely to be needed as much as a change in market forces or a change in public incentives.

Our Action Plan

The Plan rightly recognises that there are many stakeholders in the UK Food System and that they all have a contribution to make to any plan designed "to make the food system more economically, environmentally and socially sustainable". It must, however, be the responsibility of central government to bring all the stakeholders to a common understanding of the challenges the Food System really faces. Until that is done, there is little prospect of devising a worthwhile plan to cope with the changes that will occur by

2030 and lays the ground-work for a secure and sustainable food production system in the periods beyond.

Annex

BCPC - Promoting the Science and Practice of Sustainable Crop Production

BCPC (The British Crop Production Council) is an independent body which promotes the use of good science and technology in the understanding and application of effective and sustainable crop production. It represents the interests of Government departments, the agrochemical industry, farmers' organisations, advisory services and independent consultants, distributors, research councils, agricultural engineers, environment interests, consumer opinion, training and development.

BCPC derives its opinions from a network of experts in a wide range of organisations involved in crop production, and from its Expert Working Groups on Weeds, Pests & Diseases, Applications, and Seed Technology.

BCPC is a Registered Charity and a Company limited by Guarantee.

BCPC's Corporate Members are:

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Campden & Chorleywood Food Research Association
Chemicals Regulation Directorate, HSI
Department for Environment, Food and Rural Affairs
Department of Agriculture and Rural Development – Northern Ireland
Environment Agency
Imperial College, London
Lantra
National Association of Agricultural Contractors
National Farmers' Union
National Consumer Federation
National Institute of Agricultural Botany
Natural Environment Research Council
Scottish Executive Environment and Rural Affairs Department
Society of Chemical Industry – Bioresources Group

23 September 2010

Memorandum by Crop Protection Association (IEUA 8)

Definition of "innovation" in the agricultural context

We have outlined above how we currently perceive "innovation" in the agricultural context but we would welcome views on your interpretation of innovation in the agricultural sector.

As the representative bodies for the manufacturers of crop protection products in the UK and Europe, the Crop Protection Association (CPA)* and the European Crop Protection Association (ECPA)** regard innovation as critical to the future of a sustainable European farming and food production industry.
For our sector, innovation not only means new technologies (such as biotechnology or biopesticides) but also new developments in existing technologies. For synthetic pesticides, these will include the discovery of new chemical compounds or the development of new formulations of existing compounds. In addition innovation means the development of all aspects of a product such as better packaging and labelling as well as working with others to find ways of improving how products are used.
Whilst the ultimate driver for innovation is commercial, there are many contributing factors including user and environmental safety.

* www.cropprotection.org.uk ** www.ecpa.be

2. Innovation in EU agriculture as a strategic objective

The EU believes that innovation and knowledge are key to the EU's economic growth and that all sectors should play their part. Do you agree that innovation in EU agriculture should therefore be pro-actively encouraged? Alternatively, do you see agriculture as a distinct sector faced with particular challenges to which the sector will inevitably react in an innovative manner?

Innovation plays a key role in the development of a competitive agriculture sector and must be pro-actively encouraged.
Given the challenges faced by agriculture, it is inevitable that the sector will act in an innovative manner. It should however be stressed that investment in innovation will only take place in a competitive and profitable agricultural sector.
The CAP must play a role in encouraging innovation and ensuring the use of the most relevant tools for a competitive European agricultural sector. This can best be done by ensuring that the sector is profitable and able to invest.
The focus of DG Agriculture is very clearly on the CAP. Beyond the CAP funding tools, DG Agriculture is inactive on wider issues that impact the competitiveness of agriculture. This is especially true for policy areas that are managed at the EU level by other Directorates General in the European Commission (including research and the use of agricultural inputs).

- For example, DG Agriculture's input on the revision of the pesticide legislation was minimal and no real consideration was given to the impact of the legislation on the competitiveness of European agriculture.
- On GMOs, the role of DG Agriculture has been limited to evaluating the impact on the animal feed sector.

3. Innovation today

How is EU agriculture innovation now? Can you explain under what conditions the agricultural sector is best placed to innovate? Do you have examples of circumstances where innovation would have been possible and would have been helpful, but did not occur?

In the crop protection sector, a recent study of Research and Development (R&D)* shows that the costs associated with the discovery, development and registration of a new product have increased in a decade by 68.4% to €189m. The study shows that the process leading to the authorisation of a new agrochemical molecule is complex, costly and time consuming with particularly steep rises in the development costs of toxicology and environmental chemistry. It takes an average of 9.8 years between the first research tests and authorisation of the product. Total R&D expenditure for the companies surveyed in 2007 was €1701m, amounting to 6.7% of their agrochemical sales. Their overall expenditure on agrochemical R&D is expected to increase a further 26.4% between 2007 and 2012, with increases spread across the entire spectrum of the R&D process.

Before any product is put on the market, all components undergo exhaustive laboratory and field tests. In addition, companies must anticipate the changing regulatory requirements their products are likely to have to satisfy at the time they apply for authorisation. In order to foster innovation in our sector, legislators must establish a stable, science-based regulatory framework and develop policy which is grounded in the reality of agriculture.

Despite the EU's Strategy 2020 aspiration to 'grow innovation', the reality for our industry is quite the opposite and it is becoming very hard to justify agrochemical R&D in the EU.

*The Cost of New Agrochemical Product Discovery, Development and Registration in 1995, 2000 and 2005-8. R&D expenditure in 2007 and expectations for 2012 - Final Report

4. Obstacles to innovation

What are the current obstacles to innovation? Is there a shortfall in research capacity and in technology transfer? To what extent do issues such as intellectual property rules, resistance to new ideas, inertia, fear of failure and lack of communication block innovation in the agricultural sector? What are the obstacles to land mangers incorporating forestry into their businesses?

The farming sector is naturally innovative and, in our experience, the uptake of new technology in the sector is good. The key limiting factor is often cost. For example the purchase of new spray equipment which could lead to more targeted applications represents a major outlay for a farm. Similarly the installation of biobeds which have been developed to improve the disposal of sprayer washings is a cost to the business which, whilst having an environmental benefit, cannot be recouped.

5. Demographic structure of the sector

-

6. Future challenges driving innovation forward

Looking forward, agriculture faces significant challenges, although those challenges may bring opportunities too. What challenges do you think will drive forward innovation in EU agriculture in the future? What do you think should be the response to these challenges, and who would you expect to deliver these responses?

Future challenges such as food security, invasive species and climate adaptation are global in nature and make the need for agricultural innovation urgent and crucial. But the lengthy timelines and high costs referred to in "3" above, make a rapid response impossible. Therefore it is vital for EU institutions to urgently work with Member States and global organizations to define strategies and priorities for action and to develop an environment that encourages rather than impedes the development of new solutions.

7. Knowledge and innovation systems

-

8. Research & Development

Assuming that R&D has a role to play as part of knowledge and innovation systems, how should the research agenda be established in the field of agriculture? How should such research be funded, particularly in the light of budget cuts driven by austerity measures?

Industry will continue to invest in R&D provided the economic and regulatory environments are appropriate. However there will always be areas which are not of interest to commercial companies which have to be funded by the Government. It is vital that mechanisms are in place to ensure coordination and to prevent duplication of effort and so make best possible use of the funds available.

9. Education and skills

-

10. Knowledge Transfer

-

11. EU policies

What are the roles of the Common Agricultural Policy and EU research policy, including the Framework Programme for Research and Development, in helping to resolve the issues highlighted above? Where public intervention is desirable, what is best done at a lower level of governance?

The CAP has a role in improving the competitiveness of European agriculture but it is only one of a number of areas of EU policy that have an influence. With the CAP policy having moved away from market intervention, there is a need for DG Agriculture to look at the bigger picture, ensuring a better understanding of the impact of other EU policy areas – and influencing those policy areas in order to preserve and promote the competitiveness of European agriculture.

Memorandum by Dairy UK (IEUA 9)

Dairy UK represents the interests of dairy farmers, producer co-operatives, manufacturers of dairy products, and processors and distributors of liquid milk throughout the United Kingdom. Between them Dairy UK's members collect and process about 85% of UK milk production.

This document follows the questions set out in the call for evidence.

Definition of Innovation

We would broadly accept the definition on innovation set out in the call for evidence.

Innovation in Agriculture as a Strategic Objective

Innovation needs to be proactively encouraged. There are many dynamics within the private sector that encourage innovation. The competitive discipline of the market place is the foremost spur to innovation. There are also a lot of private sector providers of innovatory products to agriculture that meet the demand for innovation. However, market based activity needs to be supplemented by an appropriate private/public sector partnership, especially on generic issues that cannot be addressed by action from individual enterprises.

Innovation Today

Dairy farming is innovating in a number of ways, some of which are challenging to consumer perceptions of agriculture. Government support is required to communicate to the consumer the efficacy of these innovations. In dairy innovation includes:

- Development of permanent housing milk production systems: in these systems dairy cows are not grazed but instead are housed for a significant part of their lives. This allows for better control over nutrition and animal welfare. However these systems are attracting the opposition of animal welfare NGOs.

- Very large farms: the market imperative for efficiency requires farmers to seek economies of scale in order to spread fixed costs. This can create very large management units of several thousand animals. Again this is attracting the opposition of campaigning NGOs.

- Progeny of clones: embryos from clones born in the USA are available for import into the UK. However the interpretation by the UK of the legal framework provided by the EU means that product from the progeny of clones cannot be marketed in the EU.

- Nutrition and health claims: the industry is seeking to develop products that address consumer concerns over health and nutrition. However the requirements put in place by the EU Nutrition and Health Claims means that many claims put forward by the dairy industry that are based on well established science will not be permitted.

Obstacles to Innovation

We would identify the following broad obstacles to innovation in dairy.

Capital: the dairy industry operates on thin margins. It does not have the funds necessary to sustain a large R&D capability.

Access to EU funding: The current format of the EU research framework programme is a barrier to usage by the dairy industry. The programmes are intended for basic research within academia and are not appropriate for industry-based research. Many opportunities to provide valuable research are therefore lost by technical barriers to necessary financial support. In addition the bureaucratic procedure to access the framework is too cumbersome for many companies, and inhibits SMEs especially from access to research support.

Co-ordination of knowledge: the extensive R&D activities undertaken throughout the EU by public bodies is not properly co-ordinated or communicated to ensure that its value is maximised. There is no framework that allows the specific needs of the sector at an EU level to be identified or for research results to be shared across Member States. The current frameworks are confusing, and as a result, probably inefficient.

Education: the fragmented nature of dairy production means that sustaining innovation at farm level or for issues concerning the whole chain (sustainability) requires a significant effort of communication and education into new technologies and techniques.

Consumer attitudes: the centrality of dairy to the diet means that consumers are naturally cautious about innovations that challenge their perception of dairy farming and dairy products.

Research facilities: the UK dairy industry no longer has dedicated research facilities available to it and instead has to rely on research institutes in the EU.

Demographic Structure of the Sector

The demographic structure of the dairy sector is not an obstacle to innovation. Concern is generally expressed about the average age of dairy farmers but there is little evidence that this has changed significantly over past few decades. Dairy farming is still essentially a family run business and the owner of the farm is not necessarily the member of the family in charge of its development. The industry is examining how the issue of farm succession can be addressed and government support in this area would be useful.

In developing career opportunities for younger generations recognition needs to be given to the fact that career progress may not necessarily mean farm ownership in the future. Instead individuals may find themselves employed in positions of management by outside investors. This can still provide a rewarding and challenging career structure.

Future challenges driving innovation forward

Future challenges for the dairy sector include:

Potential for product innovation

Ample opportunities exist for developing new dairy products. Further developments are possible in isolating and processing milk components. In the longer term opportunities need to be examined to develop non-food uses for dairy fractions. This is particularly the case for butterfat given the continuing emphasis on low fat diets in the EU.

Maintenance of product safety

The safety of dairy products is an absolute pre-requisite for the future sustainability of the sector. A major risk for the dairy industry comes from zoonoses. Defra and the EU needs to ensure that it has the research capacity to identify potential zoonotic hazards and deal with them rapidly. Bovine TB is a zoonosis, but there currently is not a successful strategy in place to tackle this disease.

Minimising environmental impacts

The industry needs to minimise its environmental impacts. In the long term the main challenge will be to respond to the climate change agenda through reducing greenhouse gas emissions from the sector. This means reducing methane emissions from cows and improving energy efficiency at all levels of the supply chain, but also optimising land-use / land-use change aspects of the dairy farming.

Exploiting by-products

The industry will need more knowledge and possibilities to exploit by-products and waste streams. For example, this includes knowledge on anaerobic digestion technology both at farm and processing levels.

Improving efficiency

The CAP Reform will place an even greater requirement on the industry to achieve cost efficiency to maintain its competitiveness. More knowledge will be needed at every level of the supply chain:

- Efficiency at farm level:
    - Main feed inputs - improvement on the nutritional value to dairy cows of grass and other feed inputs;
    - Efficiency of the dairy cow - the ability of the cow to convert feed inputs into milk can still be improved through breeding technology;
    - Health and wellbeing of the dairy cow - mastitis, lameness, infertility and Johne's disease are the principle challenges to the productivity of dairy cows.
- Energy efficiency: this needs to be addressed at both farm and processor level.

- Management capability and methods: The industry needs to attain higher levels of professionalism at all levels of the supply chain.

- Scale of operation: for any given level of technological capability, further cost efficiency is usually attained by increasing the size of operation in order to achieve economies of scale through spreading fixed costs. This is true at both the producer and processor levels.

Knowledge and Innovation Systems

We would concur that innovation is best served by drawing upon the expertise of researchers, consumers, producers, retailers, advisors and government. The one component of the food chain missing from the list set out in the call for evidence is food processors. Ultimately informal systems have to feed into those networks that play a role in directing the sectors R&D resources and which then disseminate information back into the supply chain. Formal structures can be established by industry trade bodies and government. The difficulty with the dairy sector is that many of the formal structures are horizontal and embrace other sectors, which, whilst related to the dairy sector, do not have the same distinct needs.

Research and Development

Government, whether the EU or Defra, has to play the lead role in high-level theoretical Research and Development. The dairy sector does not have the resources to undertake this type of activity, especially as it might not attract the type of investment required because of the uncertainty surrounding its commercialisation. Maintaining the Government's role in time of austerity will require some imaginative solutions that could include more partnership working with the private sector.

Education and Skills

There is a general perception that the current state of education and skill provision in respect of agricultural research is inadequate and account needs to be taken of this deficiency in the development of the Government's skills agenda.

Knowledge Transfer

Knowledge transfer can be achieved by a variety of means. There are private sector providers in the form of farm consultancies. However, there remains a key role for the industry's levy funded development body DairyCo to undertake this function. It is therefore important that the statutory underpinnings for this body should remain in place.

EU Policies

The EU and Defra needs to maintain and increase their contribution to long term high order research and development to sustain the future technological development of the dairy industry. The EU is shifting expenditure away from market management with a view to making the sector more internationally competitive. The EU dairy industry will not be able to compete with low cost producing regions unless it can sustain its technological capability. Shifting budgetary resources over to R&D is a logical consequence of the evolution of EU agricultural policy

Efforts must be made to create a framework that allows the industry to determine research priorities for the sector and to share in the results of research. This requires the creation of a forum where this can be achieved. The priorities set by this body would inform Defra and EU expenditure and act as a guide to activities funded by the industry. At the same time, it could also provide a mechanism that facilitated the communication of public research undertaken by individual Member States across the EU.

The EU should look for a common approach to provide operators in the sectors with a stable framework for their decisions.

Legislation should not ban the application of new technologies indefinitely, e.g. new "pasteurisation" approaches, GM. Instead any delay in accepting the application of new technologies within the EU should clearly state how any outstanding concerns over their adoption can be addressed.

If the EU is to restrict the EU dairy industry from adopting new technologies by then it must take counter-veiling action to ensure the maintenance of a 'level playing field' with the EU's competitors. This could take a variety of forms depending on the nature of the technology involved

The EU and Defra should play a role in explaining to the consumer innovations in dairy technology and management methods. An agricultural policy that seeks to drive efficiency will necessitate the adoption of new methods and techniques. The EU should assist the industry in explaining the acceptability of these new methods.

24 September 2010

Memorandum by European Economic and Social Committee (IEUA 10)

Introduction

The following document presents evidence on the behalf of the European Economic and Social Committee (EESC) NAT Section that will hopefully serve the Committee in formulating conclusions and recommendations to present to the House of Lords regarding the development of innovation policy in EU agriculture.

It is the mandate of the EESC to be the bridge between organised civil society and the European Union. As such, the EESC strongly supports the European Commission's initiatives to establish a joint programme that will comprehensively coordinate and establish cooperation between all groups in society. In order to move forward, and ensure European agriculture can meet and overpass international trends in demand, all interested groups, from society and the national governments, must work together, launching joint activities and common research calls.

1. Definition of "innovation" in the agricultural context

The EESC warmly welcomes the Commission approach in devising a broader definition of agricultural research, reflecting the challenges for European agriculture including, in particular, adapting to and mitigating climate change, the development of renewable energies from agricultural sources, conservation of biodiversity, sustainable management of water resources, not to mention the promotion of information and communication technologies and the quality of production.

Agricultural research should provide the knowledge that is necessary for a thorough understanding of rural development, of the drivers and impediments for sustainability, and provide new technologies and innovation needed for the development of the agricultural sector. It should facilitate knowledge acquisition to improve, among other things, our understanding of market dynamics

2. Innovation in EU agriculture as a strategic objective

3. Innovations today

4. Obstacles to innovation

Research efforts often remain fragmented and poorly coordinated; there is underinvestment and a lack of critical mass.

5. Demographic structure of the sector

The role and functions of European agriculture have been transformed over the last 50 years, reflecting the changes that have marked the European society and economy and involving citizens and consumers, moving from a "rural" to a "post-industrial" agriculture. Consequently, it is now established opinion the farm sector should be seen in multifunctional or agro-territorial terms, i.e. no longer solely in terms of production. The same criterion should therefore apply to the definition of "agricultural research".

6. Future challenges driving innovation forward

It is imperative for the European Union to adhere to the scheme set forth in the Europe 2020 Plan. Agricultural growth, like any growth within the European Union must be sustainable, inclusive, and smart. This is essential not only for ourselves as Europeans, and the competitiveness of EU agricultural products in the world market, but also imperative for preserving life on Earth.

The challenges of water scarcity, food security, food competitiveness, climate change, increasing contamination and a growing ecological debt due to over-consumption, will all have negative effects on agriculture. As such, the manner in which farming is conducted in Europe must be analysed and assessed. This demands a solid program of constant ongoing research conducted by academics and researchers in many different areas of the sciences associated with agriculture. Innovation must be pursued through research in renewable energy, biobased commodities and emerging areas of green chemistry.

7. Knowledge and Innovation Systems

It is the view of the EESC that research and innovation in agriculture must be conducted through a system with a strong element of participation and cooperation from the countries taking part. Cooperation across different institutions within the EU must also be strengthened; the transfer of information is essential to building a comprehensive database of knowledge to understand rural development. Participation of all interested parties including the private sector, especially businesses, mainly in the identification of research objectives is essential. The EESC has encouraged the Commission's new governance model, agreeing that the "new" Standing Committee on Agricultural Research will play a role in coordinating and promoting joint initiatives at the EU level as well as effective and concrete resource sharing. Furthermore, the EESC has endorsed a system based on the principle of flexibility, staying with reforms that have already been implemented.

In the context of a joint programme towards a European Research Area for agriculture, the mapping should not be based on ad hoc initiatives, but on a continuous and regularly updated process. This structural system will encourage innovation as well as free flow of information ad knowledge across the levels horizontally and vertically.

8. Research and Development

The Standing Committee on Agricultural Research has adopted a structured approach to the prioritisation of research topics for further collaboration, through the establishment of a number of Member/Associated State Collaborative Working Groups which work in a similar way to ERA-NETs, in that they follow the same step-by-step approach – focussing on information exchange during the early stages, identifying gaps in research and priority areas for collaboration and, where applicable, launching joint activities and/or common research calls.

9. Education and skills

10. Knowledge transfer

11. EU policies

The Standing Committee on Agricultural Research will play a coordinating role in promoting joint initiatives at EU level and in mapping the competences of the research programmes promoted, it should be based on a principal of fundamental flexibility in order to stay abreast of reforms implemented.

20 August 2010

Memorandum by Farm Ideas (IEUA 30)

This submission is made to highlight the importance of innovations created and developed by farmers, farm workers, and others working directly in the industry.

Farming is, by nature, experimental. "What if... we increase/decrease the quantity of fertilser, seed, depth of cultivation, livestock feed?" are questions which occur regularly on every farm. It's a short step to modifying and improving machinery, and this leads to major adaptations to existing equipment, and the design and construction of bespoke machinery.

On-farm innovation is done in a hap-hazard way and is entirely funded by the farmers involved. Many farmers find themselves solving the same problems, resulting in a duplication of effort. Most farm innovations are made in order to benefit the individual farm - any wider commercial application is not pursued. Only a small proportion is taken up by manufacturers to become products.

This lack of take-up is not a reflection of the function and application of these innovations. Some of the ideas are only economically feasible when made using scrap parts such as gearboxes, axles etc. Others are seen to have too small a market. Farm machinery manufacturers are careful of new products, too many have invested heavily in r&d in machines which have failed to appeal to farmers - the Allis Chalmers round baler of the 1960s, the square plough of the 70s are two examples.

Innovations created in the farm workshop are of immense value to the industry. What works on one farm - be it a new design of feed barrier, a modification to a cultivator or plough, a home built safety feature on a tractor (the list is almost endless) - is likely to have an application on many others. Moreover, what has been built in one farm workshop is feasible to be built in others.

Their value is two-fold - there's a benefit to the farmer through raising the efficiency of farm operations, but there are also frequently benefits to the environment. Innovations in cultivations often lead to a reduction in fuel use, either by reducing the number of times a field is worked, and/or by reducing the work load of each pass, and that fuel saving reduces carbon emissions. Small savings, multiplied over thousands of hectares, come to useful sized figures. Reducing waste on the farm, through more efficient livestock feeders for example, again not only provides the farmer with advantages, but benefits the economy as a whole.

Some farm-bred innovations have wider benefits, and have the potential of contributing to the greater community in additional ways. Grassland aerating, for example, improves grass production and has the concomitant benefit of reducing water run-off and consequently flooding. Aerating remains an uncommon practice, yet can be achieved with low cost machinery.

Harnessing the innovation of farmers

These on-farm innovations are largely unpublicised and therefore unknown to many farmers and advisors. Innovation is now seen as the job of the supply trade. However, previous generations of farmers actively shared their ideas. The agricultural reformer Coke of Norfolk, 1st Earl of Leicester, (1754 - 1842) held regular meetings with tenants and others at Holkham where stock was shown and methods and innovations assessed. This led to the

formation of agricultural societies, their initial purpose being as much educational as providing a venue for competition. Farmers' innovation was replaced by machinery marketing, though shows such as the Bath & West continued with a 'Farmers' Brainwaves' competition (won in 1991 by this author) until it was recently abandoned.

Farming media, including shows and events such as Cereals, focus almost entirely on products rather than ideas as manufacturers are a major source of funds. The BBC's farming output has little interest in farming methods, though they do promote some events and conferences.

It is, in fact, the author's publication, Practical Farm Ideas, which alone collects and reports on-farm innovations for dissemination to farmers. The opportunity for a faster and wider take-up of ideas is very considerable, and the benefits, as outlined above, accrue not only to the farmer but to the wider public.

Mike Donovan
Nov 13, 2010

NB Photographs were supplied but not reproduced.

Memorandum by Hugh Crabtree, Farmex Ltd (IEUA 7)

Background

The application of Information and Communications Technology (ICT) in agriculture is widespread. However, whilst its use in arable farming includes many developments of machinery based technologies as well as business management; in livestock production its application has been rather more limited to business management tools such as herd recording, production records and marketing software. An exception to this is the ICT provision in dairy parlours. It is right to say that intensive poultry and egg production makes use of ICT at the production site but this data tends not to be remotely accessed for strategic commercial purposes. This submission focuses on UK pig production which is a sector that has the potential and it is believed, the growing will, to apply ICT in a radical and collaborative way.

Most industrial processes these days are closely monitored to ensure optimum performance of the process. Resource and materials use, quality control, compliance, efficiency and output are all measured in real-time. The truism "you can't control what you don't measure" is well understood and acted on. Many innovations that improve the process result from analysing the data flowing from that process.

Farm Energy & Control Services Ltd (Farmex)

An SME employing 6 people that has been in business for 30 years – originally set up to bring innovative ventilation systems for pig production to market. In the last 15 years the company has been providing real-time monitoring to pig production and crop storage sites both in the UK and overseas. Currently, the company gathers data remotely from about 500 sites. Most of these are pig farms in the USA but almost 100 sites are in the UK and there are a further 90 potato stores monitored in the UK. The company has amassed a huge database of over 10 billion records during the period and has invested significant sums in data analysis and interpretation. ICT has become an engine of knowledge creation for Farmex.

UK Pig Production

The UK industry has severely declined in numbers over the last decade but has been an exemplar sector in its efforts to create a sustainable future for its practitioners and those that work for it and with it. Pig production, both intensive and extensive, is an industrial process. At every stage of the process there are opportunities to improve efficiency and reduce environmental impact by judicious use of ICT. In addition to this, animal health and welfare can be improved and perhaps most significantly, using ICT as the mechanism for knowledge transfer, operators can be up-skilled and trained to make best use of the various mechanisations at their disposal. Over a decade of real-time monitoring clearly shows that it is the operator who is most influential in determining success or failure. Since pig production is a process that involves sophisticated biology, it is a process that will never be able to be completely mechanised. The person doing the job, at the coalface as it were, will always be a vital component of production.

The PIVIT Initiative

Pig Improvement Via Information Technology (PIVIT) is an initiative in development which is a collaboration between producers, academics and suppliers. The ambitious goal is to have most professional UK pig production sites on line and subscribing to data analysis, interpretation and knowledge transfer services within 10 years. The pilot stage of the project is seeking funding at present. The two crucial points to understand about PIVIT are that a) it is concerned with continuous flow data streams from the production process which can only be accessed remotely through broadband connection and b) it will set up an industry-wide commonly accessible knowledge resource to act as the human interface with the knowledge created. Utility and water use, feed intake, environment and growth will all be measured in real-time. These relatively simple measures also provide an insight into both pig and operator behaviour.

Barriers to ICT Adoption

It's a rare farmer that cannot see the potential in measuring his operation. Unfortunately, it is also a rare farmer that can get over the hump of the necessary investment of time and money to achieve the clear benefits that can ensue. This is because most producers do not have the time, skills or will to engage with the massive amounts of data that result. ADAS luminary Andy Offer summarised succinctly: "If the work to achieve the benefit is perceived to exceed the benefit – the technology will not be adopted". It remains the case that most UK pig production businesses do not yet have the wherewithall or confidence to make the necessary investment in ICT as individual businesses. Thus was conceived the idea that a collaborative approach might be the way forward – PIVIT.

Innovation

Real-time production process monitoring is not new as previously indicated. However, in livestock production management it certainly is. Widespread adoption will depend on highly innovative wireless sensor technologies to reduce installation costs associated with the data capture platform on farm. Pig farms look set to join the so-called "machine to machine" (M2M) communications revolution with whole production sites permanently connected to the internet and data analysis tools. Such innovation deserves the attention of funding bodies as the benefits to the businesses involved, the country's environmental obligations, the animals and the people in the process will be significant.

Benefits From ICT Adoption In UK Pig Production

1. An industry knowledge creation and communications resource.
2. A mechanism to encourage the professional development of production unit managers, stockmen and women.
3. A quantitative basis for quality assurance assessment and health management.
4. UK pig industry productivity improved by 30%.
5. UK pig industry energy use reduced by 50%.
6. UK pig industry water use reduced by 70%
7. Quantification of UK pig industry carbon footprint in terms of carbon per kg pigmeat produced.
8. Quantification of other UK pig industry emissions.

9. Potential to link production, processor, retailer and consumer information to improve whole chain communications, food traceability, animal welfare and environmental impact.

Research & Development Funding

There is a need to shift R&D funding from "blue sky" science to more applied work capable of delivering measurable benefits in the short term. Fortunately, the Technology Strategy Board and the Science Research Councils appear to be contemplating this shift. From the perspective of this practitioner in the field of livestock production, the shift cannot come quickly enough.

September 2010

Memorandum by Macaulay Land Use Research Institute (IEUA 13)

1. The Macaulay Land Use Research Institute is an international centre, partly funded by the Scottish Government, for research, consultancy and training on the environmental and social consequences of rural land uses. It has undertaken many projects at local/regional, national (Scotland/UK) and international (EU/global) levels relating to agriculture and forestry. On the basis of this work, and our corresponding experience with the design and delivery of the EU's research strategy, we offer the following evidence relating specifically to the following issues identified in the "Call for Evidence" dated 28 July 2010. Some paragraphs relate to forestry.

Definition of "innovation" in the agricultural context

2. The term "innovation" can be extended to cover new structures and arrangements in the management of agricultural and forestry enterprises. These might include contract farming, corporate or partnership ownership or control (e.g. by retailers, or by NGOs), collaborative marketing, finance, etc.

3. In the context of the "new challenges", "innovation" needs also to cover "new thinking", i.e. the readiness of farmers and others (contractors, processors, advisors, input suppliers, etc.) to take more into account the effects of their activities on public goods such as the avoidance of pollution and the mitigation of and adaptation to climate change.

Innovation in EU agriculture as a strategic objective

4. We agree that innovation in EU agriculture should be pro-actively managed (which we take to mean: provided with governmental as well as commercial and NGO support for R&D and other innovation-stimulating activities), not so much because "*innovation and knowledge are key to the EU's economic growth*" (this is true of almost any sector), but because the structure of most EU agriculture is highly fragmented and heterogeneous, with many relatively small farm businesses having little capacity to undertake much research or self-financed and risky innovation. Moreover, commercial research for agriculture is highly concentrated, with most of its activity being undertaken by large-scale and global corporations whose interests may not coincide in the short or long terms with either most farmers or the general EU (or global) public. Innovation in land and water management, e.g. via grazing practices, is particularly vulnerable to neglect and/or bias by commercial research since it is not directly input- or product-linked.

5. We do however see agriculture as a "*distinct sector faced with particular challenges*", partly due to the fragmentation referred to above, and partly due to the increasingly varied demands made upon it. These demands, commonly referred to as "multifunctionality", range from the provision of food and fibre (incl. for energy), through the sustainable management of natural resources such as air, soils, water and wildlife ("ecosystem services", some reflected in the "new challenges"), to the maintenance of socio-cultural assets such as valued landscapes and heritage customs. Markets for some of these demands, especially "public goods and services", are frequently absent or imperfect, thus suggesting the need for both private solutions (such as product labelling) or public support and/or regulation solutions (such as farm-level limitations on net GHG emissions).

Innovation today

6. No comment in time available.

Obstacles to innovation

7. A number of barriers to innovation in agriculture and forestry exist (or are seen to exist, by operators and others). They include:
    a) Regulatory obstacles (especially planning where buildings etc. are involved), in terms of both actual constraints and requirements, and the time and costs of obtaining agreement/approval
    b) Difficulty in obtaining reliable and skilled workers (though this of course may stimulate labour-saving and other innovations).
    c) Uncertainty as regards product acceptance by mainstream retailers
    d) Lack of trust amongst producers (sometimes necessary to reach sufficient scale) and between producers and supply chain intermediaries.

    It may be helpful to classify such barriers as being on the "supply" or "demand" side, or in between (transaction cost barriers).

8. As regards land managers incorporating forestry into their businesses, the main obstacles are likely to include:
    a) Long-term and uncertain returns
    b) Unfamiliarity with forest husbandry or intermediaries (advisors, contractors)
    c) Fear of "border effects", e.g. vermin, shading
    d) Loss of CAP land or payment eligibility, either now or in future
    e) Uncertainty as to future UK tax treatment.

9. A recent paper[1] (Dwyer *et al*., 2010) examined the potential use of Health Check and European Economic Recovery Plan (EERP) funds via Rural Development Programmes (RDPs) to address the "new challenges". From analysis of proposed budget allocations by EU Member States, the authors concluded that over 40% of the available funding will go to dairy restructuring and biodiversity, while most new MSs are not allocating any funding to climate change and renewable energy. Moreover, after considering the RDP process of design, delivery and evaluation, "*Successful climate change adaptation and mitigation will require (amongst much else) a shift in resource allocation and governance in rural development, as well as new technologies, institutions and behaviours*." In the English (and perhaps UK) context, attention is drawn to the recently announced abolition of Regional Development Agencies, which have proved a useful framework for encouraging, assisting and funding innovative rural development.

Demographic structure of the sector

10. Concerns about an ageing farming population have existed for many decades. The picture is clouded by statistical uncertainties (i.e. whether the registered farm owner or occupier is the actual land manager or worker), and is likely to vary across EU Member States and

[1] Dwyer, J, Pereira, S., Mikk, M., Peepson A. and Thomson, K. (2010) *RDP Capacities, Changing Governance Styles and the New Challenges*, paper delivered to 118th EAAE Seminar 'Rural development: governance, policy design and delivery' Ljubljana, August.

regions. A recent survey[2] in the North-East of Scotland, which contains a wide variety of farms including large-scale crop and intensive livestock units as well as hill enterprises, concluded that this region, at least, does not suffer a demographic problem in terms of agricultural innovation. The Scottish Agricultural College has seen a rise in its Agriculture students (degree and diploma) from about 150 in 2007/08 to around 220 in 2010/11. Efforts within the first few years of the Scottish Rural Development Programme to encourage new entrants into farming were largely unsuccessful, due to the nature of the measure (interest subsidies, at a time when market rates were low) and to eligibility problems. The Scottish Government is intensifying these efforts, but the effect is likely to be marginal. High land prices – due to both continued CAP support and to amenity demand – makes it harder to effect innovation, which has been shown often to follow change of "ownership".

Future challenges driving innovation forward

11. The main challenges facing innovation in EU agriculture include:
    a) Public concerns over genetic modification (whether by engineering or cloning etc.) and animal welfare
    b) Governmental regulation (or uncertainty over such regulation) at EU and/or national/regional levels for licensing etc. in the light of a), or for other reasons, e.g. environmental.
    c) Uncertainty over continued acceptance by major retailers of products produced in certain ways.

    A PEST (Political, Economic, Social, Technological) analysis of a wider range of such challenges might be illuminating.

Knowledge and innovation systems

12. Innovation is by its nature and scope so varied that highly co-ordinated systems seem unlikely to prove successful except perhaps at very general levels (i.e. EU/national research strategies, to decide where scarce public funds should be allocated) or very specific levels (e.g. potential approval of particular new technologies).

13. The crux here is to understand the Knowledge Information Systems that support agricultural innovation. Extension science has moved a long way away from the 'linear' expert-dependent knowledge-deficit model and towards a social learning model. This recognises the value of cooperative learning, which is probably most valuable where dealing with provision of public goods where there is no "commercial in confidence" interest. However, there is perhaps a need to distinguish between public good and "commercial" research since "transparency" may not work well if there are IPR issues. This comment applies equally to the previous remarks on research and development.

Research and Development

14. While "pure" KE is important in disseminating innovations and good practices amongst farmers and others, R&D seems essential in maintaining a dynamic within fast-moving and global markets, with growing demands not only from the "new challenges" but also from far-away markets such as China and India. In the context of agenda building by the UK

[2] Cook, P. (2008) *Agriculture in Aberdeenshire: Looking to the Future*, report of study for North-East of Scotland Agricultural Advisory Group, Aberdeenshire Council and Scottish Enterprise. http://www.aberdeenshire.gov.uk/support/agriculture/future.asp.

Research Councils and the European Commission's DG Research, perhaps a more transparent method for any individual, institute or consortium to promote ideas for research would be advantageous.

Education and skills

15. A recent review of the reasons for the apparent (and probably real) decline in the total factor (i.e. overall market-measured) productivity of UK agriculture over the last two decades concluded that "it is difficult to disagree with Spedding's (1984) assertion that publicly funded agricultural research in the United Kingdom no longer exists"[3]. Certainly research in UK universities and research institutes directly aimed at agricultural productivity (as conventionally measured, i.e. excluding "public goods") has been substantially reduced over recent decades, and has been reflected in institutional closures, mergers and re-focusing. Anecdotal evidence suggests that this process has proceeded much faster in the UK than in other EU Member States, with some possible exceptions, e.g. Denmark and Sweden.

16. Although there has been some name-changing and inter-faculty staff movement, there has been a decrease in the number of bachelor-level degree programmes in agriculture (and forestry) available from UK universities. Conversely, there has been a rise in the number of "conservation management" degree programmes. The commissioners[4] of a HEFCE-funded review of UK higher education in land-based subjects (Gill, 2007) found that "*in recent years the number of providers has decreased. While we accept that this has not yet created a crisis, the potential for vulnerability in the future is strong*".

17. In terms of agricultural (and forestry) research, 36 "units of assessment" (university departments) were submitted to the UK-wide Research Assessment Exercise (Agriculture (incl. fisheries) 19; food science and technology 11; veterinary science 6). This compares with 30 units (undifferentiated, but roughly 18; 6; 6) submitted in 2008, with about 1000 research-active staff in each case. However, recruitment of young UK staff with specialised agricultural degrees is becoming increasing difficult, especially in the social sciences, where new UK-born PhD graduates in agricultural economics have practically vanished. The UK Borders Agency Points Based System for all non-EU-based applicants, which was introduced in 2008, has reduced the UK's ability to attract such applicants, as the onus and cost is now on the applicant at the upper end of this system.

Knowledge transfer

18. As indicated in 1. above, "innovation" might be taken as wider than "new technology", and so translation of knowledge to farmers and others may take a number of forms, including demonstration farms, farmer circles, KE activities by research institutes and universities, etc.

[3] Piesse, J. and Thirtle, C. (2010) Agricultural Productivity in the United Kingdom, Ch. 7 in *The Shifting Patterns of Agricultural Production and Productivity Worldwide* (ed. Alston, Babcock, Pardey). Midwest Agribusiness Trade Research and Information Center, Iowa State University, Ames. www.matric.iastate.edu/shifting_patterns.

[4] Gill, M. in foreword to JM Consulting and SQW Inc. (2007) *Review of Provision for Land-Based Studies*, final report to HEFCE.

EU policies

19. Although the CAP has undoubtedly sustained EU agriculture at levels above that which would pertain if all support were to be removed (as is highly unlikely), innovation has probably been faster in sub-sectors without CAP support than in those with it. Thus, technological, product and marketing innovation has been notable in those sectors for which a CAP commodity regime was, prior to "decoupling", light or absent, such as pigs, poultry, potatoes and most fruits and vegetables.

20. Within the current regime, the major support measure of the CAP's Pillar 1 Single Farm Payments, though coupled only to keeping eligible farmland in Good Agricultural and Environmental Condition (a weak requirement), has been widely argued to have the effect of stimulating investment (and hence innovation) by farmers. The same is probably true of the remaining (and substantial) CAP border support for livestock products. Within Pillar 2, 35% of planned expenditure by all Member States goes to Axis 1 ("Improving the competitiveness of agriculture and forestry"), and hence directly to investment/innovation (both "hard", e.g. equipment, and "soft", e.g. training). However, the UK receives a relatively low level of Pillar 2 funding (about Euro 46 per ha in 2013, much the same as France, Denmark, Spain, etc.)[5], and has allocated most of this to Axis 2 ("Improving the environment and the countryside"), especially in England.

21. On the research front, the EU's Framework Programmes (FPs) have developed considerably in structure and (since 2006) in funding during successive budgeting periods, with agriculture-related research now, in FP7, scattered amongst different "thematic areas" (e.g. "Food, agriculture and fisheries, and biotechnology", "Environment (including climate change)" and "Socio-economic sciences and the humanities", alongside the "People" programme (e.g. Marie Curie scholarships) and the "Capacities" programme (e.g. research for SMEs). Within these, there are a number of funding schemes, co-financing rates, etc., and there are also significant funds available – usually on a restricted basis - from DG Agri etc. The design, application, delivery and audit procedures for EU research projects are highly complex, and a substantial sub-industry – some public, some private – has grown up, offering advice to potential applicants. Although the UK (after Germany) has been relatively successful in obtaining FP funding, a website petition[6] reflects unhappiness amongst many – though self-selected – researchers over the administrative burden that this imposes.

22. The basis for success in FP7 application – which runs at about 1 in 6 for both projects and funding over all areas – is still somewhat obscure, but seems to depend more on longer-established networks of mutually trustworthy (and Commission-trusted) researchers than on innovation *per se*; this may not be too surprising given that the declared purpose of most FP research is to support EU initiatives and policies, rather than "blue-sky" activity. In general (and in comparison to auditing), scientific evaluation of delivered FP7 projects by the Commission or its agents (e.g. reviewers) seems "light", with little attempt to ensure or measure (e.g.) EU-wide scientific cross-fertilisation, or effective Knowledge Exchange (KE) with farmer, trade or policy organisations.

[5] http://www.reformthecap.eu/key-data-on-the-cap

[6] http://www.trust-researchers.eu/index.php?file=home.php

23. In relation to Forestry, a recently completed project[7] concluded that "*innovation has become an issue in, and is recognised by, most policy fields that are relevant for forestry and forest-based industries. The concept of innovation, however, is often used rather symbolically, without appropriate or substantive measures. There is a trend in most policy documents to describe the issue of innovation support from a systemic view; however, the measures often come from the traditional innovation support toolbox* [i.e. assuming that innovation is a linear process]. *In the forest sector, innovation policies mainly support diffusion of new technologies in timber production and processing. The support of radical innovations, learning or goods and services other than wood, is rare.*" Moreover, "*Innovations in the forest sector do, all in all, address current societal challenges, e.g. in the fields of bio-energy and recreation. At the same time, it seems that a number of blind spots exist: environmental services such as biodiversity conservation, drinking water production, protection against natural hazards and health-related or spiritual services are only recognized to a minor extent. Possible future markets such as sustainable construction (with wood), or bio-based products (food or chemicals) could be pursued much more strongly in the sector. As a general picture, it seems that radical innovations are developed more outside the traditionally defined forest sector than within it. The forest sector seems more active in diffusion than in supporting the development of novelties in the first place*."

September 2010

[7] Rametsteiner, E., Weiss, G. Ollonqvist, P. and Slee, B. (2010) *Policy Integration and Coordination: the Case of Innovation and the Forest Sector in Europe*, final report of COST Action E51, Luxembourg: Publications Office of the European Union, 2010. ISBN 978-92-898-0049-5.

Memorandum by Regional Development Agencies (IEUA 15)

Regional Development Agencies (RDAs) have made strategic investments in sectors of regional importance which are either key to the economic growth and development of the region or are of recognised regional priority, including innovation in the agriculture sector and if required we could give a number of regional case studies which can validate this for instance Incrops in the East of England which will expand the business support and commercialisation opportunities in the alternative and non-food crops sector in the East of England. And the Monitor Farm Project from used in the North East which aims to improve the performance and profitability of a commercial farm, typical of the local area, over a three year period.

Please note that this response does not by any means reflect a full RDA view to your consultation as not all RDAs have responded to the questions in this instance.

Definition of "innovation" in the agricultural context
We have outlined above how we currently perceive "innovation" in the agricultural context, but we would welcome views on your interpretation of innovation in the agricultural sector.

The EU should actively encourage innovation in agriculture through whatever means possible. Whilst the statement and definition of "innovation" seems all encompassing, at present this would not be see in the context of today which seems to be limited to the high end – i.e. cloning, GM, low carbon, which favours larger businesses and isolates the smaller farm units. Agriculture has become an industry which is more than just growing food for a nation. Its focus has widened to include global food production, couple with the vagaries of climate change and the emphasis on environmental protection of the countryside. We would suggest that applying innovative thinking in a business context is not really on the radar at the moment. Would it not be just as innovative to seek outside the box and to add the statement that innovation in agriculture can go beyond just the agricultural sector and help to innovate other sectors too and bring it up to the standards for the 21st century.

Innovation in EU agriculture as a strategic objective
The EU believes that innovation and knowledge are key to the EU's economic growth and that all sectors should play their part. Do you agree that innovation in EU agriculture should therefore be pro-actively encouraged? Alternatively, do you see agriculture as a distinct sector faced with particular challenges to which the sector will inevitably react in an innovative manner?

Yes it should be pro actively encouraged to meet future demands for produce, not only in relation to arable but also livestock. Greater emphasis on increasing and joining up University research and transferring this knowledge to businesses would be beneficial to the sector – establishing Agriculture Innovation connectors, for example. AD and renewable energy generation are key opportunities for the sector that would benefit from further research and support to develop.

Other challenges include, food security, climate change.
Strategic objective – FP7 has all the key themes in – GM, Low carbon, better resource usage. Whilst focussed at smaller businesses, it is often difficult to ensure success in engagement with smaller businesses, and therefore there is a real need to use credible organisations to

disseminate the knowledge to small businesses that make up a significant part of the farming community

Innovation today

How is EU agriculture innovating now? Can you explain under what conditions the agricultural sector is best placed to innovate? Do you have examples of circumstances where innovation would have been possible and would have been helpful, but did not occur?

The industry is very much a responsive industry and to some extent they are bound by extensive regulations which can sometimes inhibit innovation eg water supply solutions which will comply with the Water Framework Directive, and abstraction licensing (Water Resources Act 1990). However, there has been a reduction on innovative capacity over the last couple of years with the removal of funding to HRI and similar organisations. This will make it more difficult to support innovation by the sector and removes specific capacity for scientific innovation.

Examples in the North East include:
Monitor Farm skills approach recently launched in the NE. This tried and tested approach (in NZ and Scotland) to improving farming practices to improve productivity and efficiency is proving very effective in engaging with hard to reach farmers in the Livestock sector and supports the theory that innovation thrives on collaborative thinking and activity. (see attached case study example)

Obstacles to innovation

What are the current obstacles to innovation? Is there a shortfall in research capacity and in technology transfer? To what extent do issues such as intellectual property rules, resistance to new ideas, inertia, fear of failure and lack of communication block innovation in the agricultural sector? What are the obstacles to land managers incorporating forestry into their businesses?

i) There are many obstacles like the lack of investment in necessary research to feed the system, transferring this knowledge to farmers in an effective way and access to and use of broadband.
ii) To improve adoption of innovation by agriculture it needs to be focussed on achieving business aims, therefore agriculture needs to be seen as an economic business rather than just delivering wider common good. Innovation which delivers added value for the business will more likely be adopted.
iii) In cutting public sector funding in favour of private sector taking the lead, there is a danger that large organisations such as Monsanto and Syngenta etc. would completely dominate and as a result could control seed prices for example. Therefore decisions on private sector funding of innovation need to be balanced taking into consideration the supply chain characteristics and possible monopolistic behaviour by businesses within it.
iv) An ageing sector will tend be more risk averse and therefore more likely to be resistant to new ideas. The fear of failure is huge.
v) Land managers decisions about incorporating more forestry into agriculture will be driven by economic benefit over other options. Innovation along the supply chain may make it more profitable, but currently this is not the case and the forestry choice is driven by different objectives.

vi) Public perception of innovative technologies will remain a barrier e.g. the scares over GM and animal testing, destroying trial crops etc. and so careful management is also needed for dissemination.
vii) Future proofing and blue sky thinking of what the future may hold is also important.
viii) Lack of confidence and time, money and/or the possible loss of money as a result of an innovative idea, it is not regarded as a long term investment and farmers are not generally leaders in innovation. Farming is very often an isolated occupation; there is a need to get information out to farmers to persuade them of its value.

To what extent is the demographic structure of the sector (an ageing farming population) an obstacle to innovation; and, conversely, might greater innovation in agriculture serve to bring new recruits to the sector? What incentives currently exist to encourage young people to agriculture; what further efforts might be made?

Ageing is an issue – this industry is perceived as dominated by older farmers and this is true as farmers don't tend to retire. Much of the farming work is however carried out by the younger generation but the financial control is still held by father (or mother) who retains control of the finances. As a result any innovating practices are not encouraged or acted upon until control is passed to the younger generation (by which time they are normally in their 40's).

Greater innovation might increase entrants but better pay would have a greater impact. There can be regional differences here and in some regions. In the East of England there is a genuine interest in farming at Primary School, which falls away by teachers and parents perceptions of the sector as being low paid. Innovation may help change that perception – i.e. high science. The production of food must be promoted – farming is the ultimate environmental science.

Whilst in the North East this is not always the case. Home to a high proportion of hill farmers, matched with the consequences of out migration of the young and housing affordability issues – an aging farming demographic remains a key issue and thus could be seen also as an obstacle to innovation as younger people tend to be more open to new approaches and less risk adverse. New entrants bring new ideas.

A problem which Yorkshire Forward has struggled with for a number of years is how to encourage a more free flowing turnover of farming businesses which enables older farmers to retire at state retirement age (or earlier) to allow the younger generation to take over?

In terms of incentives the National Farmers Union (NFU) is actively involved with schoolchildren, a number of other organisations do target schoolchildren but mostly at junior school level. More information needs to be shared throughout all school ages, particularly where Careers options are discussed, better use of media outlets used by young people. The different options available within the industry need to be updated and presented (in a similar way to the Army advert on TV). There needs to be a gateway for young entrants.

Future challenges driving innovation forward
Looking forward, agriculture faces significant challenges, although those challenges may bring opportunities too. What challenges do you think will drive

forward innovation in EU agriculture in the future? What do you think should be the responses to these challenges, and who would you expect to deliver these responses?

The challenges in the future are not solely related to innovation – access to fair prices, access to markets may drive some innovation, but these are not the themes that are being explored at the moment. The challenges of feeding more with the same amount of resources, whilst maintaining environmental diversification will be the biggest challenge the world/innovation has to face.

Food is a common good and one of the few 'human rights' that should be in law. It therefore is common good and well as being driven by the private sector. The private sector at the larger end e.g. Monsanto will drive their own agendas – to get it into smaller and more diverse applications requires public funding on the key issues. Also see Monitor Farm example.

Knowledge and innovation systems
Analysts have suggested in the past that innovation is best served by co-ordinated formal and informal systems of researchers, consumers, producers, retailers, advisers and government. What sort of systems do you think are required to support innovation in EU agriculture?

There are a variety of organisations that potentially could do informal and formal links – NFU, CLA, RASE, AHDBs, EFFP

Research and Development
Assuming that R&D has a role to play as part of knowledge and innovation systems, how should the research agenda be established in the field of agriculture? How should such research be funded, particularly in the light of budget cuts driven by austerity measures?

There is an inherent suspicion within the industry of private sector (company) funded research because of a perceived company self interest. An intermediary organisation is usually the best approach. Given the budget cuts to public funding this is an area which will need to be discussed. An option would be investigate a fund provided by the private sector specifically for organisations to bid into for R&D?

Education and skills
What is the current state of education and skills provision relating to agricultural research, the agricultural sector and advisory services? How might such provision be enhanced?

One anecdotal perspective is that *"From the few universities and colleges I have seen, my one concern could be that Food Production/agriculture is not a STEM priority and so funding may drive a lack of investment in courses or even the running of courses. If the courses are highly priced then again students won't do the courses. Teachers need to understand that the sector is scientific and therefore a good career option to promote to the high achievers as well as the less able."*
Colleges do have a role teaching innovation and demonstrating how innovation can be applied to a farm scenario.

Knowledge transfer
How should research be translated into technology transfer and advice to practitioners? What are the respective roles, for example, of professional advisers, professional organisations, peer groups and the public sector?

There seems to be a gap between science driven innovation and applicable on-farm innovation. It appears research is not reaching farmers to work with and drive innovation. There is a need to apply science and innovation to make it relevant e.g. rainwater for hydroponics. Lead organisations should have credibility from whoever, which would suggest peer groups/AHDB type organisations. Also see Monitor Farms example above
Research is very often not applied in knowledge transfer, whether this is because there are not the vehicles to communicate this through to the industry, or because the research although useful, is prohibitive because of cost/investment. These barriers should be investigated if they have not already been done so.

Farmers do like 'Demonstration Farms' where they can go and see new ways of working and new technology in situ and working. Although there are many difficulties with setting up and funding Demonstration Farms there doesn't seem to be a workable alternative at present.

Those professional bodies and advisers also need to be able to translate investment costs into longer term business profits for a farming business. So not just understanding technology and innovation but being able to translate it into a business investment.

EU policies
What are the roles of the Common Agricultural Policy and EU research policy, including the Framework Programme for Research and Development, in helping to resolve the issues highlighted above? Where public intervention is desirable, what is best done at a lower level of governance?

CAP should support market led development, CAP should promote R&D and skills led change to increase productivity, CAP should help to develop by supporting competitiveness and employment growth, exports and global markets, CAP should support environmental markets in renewable materials and energy by improving resource efficiency, CAP should promote effective risk management by promoting use of risk management tools.

Potentially EU policy can help support innovation (see para2 on FP7). However, the complex rules can hinder drawing down EU funds or prevent innovation. Therefore if innovation is to become a new goal of EU policy changes to the application of funding regimes should be made to ensure this aim can be achieved.

To reiterate that this does not by any means reflect a full RDA view or response as not all RDAs have responded to the questions.

September 2010

Memorandum by Philip Richardson (IEUA 16)

1. Successful agricultural innovation is characterised by:
   - Ability to provide a useful benefit over existing practices
   - Potential to provide improved financial return
   - Availability of a market.

Without all these traits new ideas may be tried in the short term, but will fail to be taken up widely.

2. Farming is primarily a small business activity which, uniquely, faces two categories of risk; the risk, inherent in any biological system, of variation in output and/or quality of product resulting from climatic variation or disease; and market risk where there is often significant price instability and an inability to influence output levels in the short run. Together, these factors tend to make farmers more risk averse, suspicious of innovation and less willing to invest.

3. Measures which encourage price stability and the prospect of longer term return are hugely important in stimulating investment and uptake of new techniques. The post-war period, in the UK, of guaranteed prices, publicly funded research and advisory services and commercial innovation was dramatically successful in raising farm output and changing farming practices. That success ultimately contributed to over-production, withdrawal of much public funding for production research and for knowledge transfer, and for public interest in agriculture to be 'out of fashion' for almost thirty years.

4. A considerable body of contemporary literature heralds the return of worldwide political interest in agriculture. Increasing population, changing consumer demand, overuse of limited resources, environmental pressures including climate change and biodiversity loss and apparently increasing volatility in world food supply presage a looming crisis which demands action sooner rather than later. The post-war technological revolution in Western agriculture was followed by the Asian 'green revolution' but rate of progress in productivity in both these areas has slowed significantly over the past decade. The single goal of increased yield has been superseded by the infinitely more complex concept of maximising 'sustainable yield'. Yet technology and innovation are widely proclaimed as the principal means of avoiding a future crisis.

5. This places enormous pressure on researchers, whose numbers were severely diminished when agriculture was politically out of fashion. Without a clear career structure in public or quasi-public service, and with severe cost pressures on agriculture and supply industries, a generation of production oriented scientists has been lost. Equally concerning, the demise of publicly funded advisory staff has created a vacuum in effective knowledge transfer and interpretation of innovatory techniques which has been only partially filled by commercial companies, levy funded industry bodies and agricultural charities. Links between 'blue-sky' research and practical application on-farm have withered significantly. A new career structure to attract entrants to agriculture at all levels is badly needed.

6. Recent UK Government changes to research funding allocation may not be helpful to farming. Although BBSRC now gives more priority to agriculture and food security than before, the research structure encouraged by Government favours large supply companies rather than levy funded producer organisations. Statutory levy spend no longer attracts 'multiplier' funding which severely reduces its potential impact. The interests of farmers and

supply companies are by no means always the same. Many research contracts, ostensibly designed to promote efficiency responsiveness to market needs, are too short term to allow proper examination and are de-motivating to researchers. Defra's research portfolio is focussed on supporting Government policy, which currently implies little emphasis on productive agriculture. Because research expenditure is not a politically sensitive topic it is an easy target in an economic downturn. Its value is long-term, but funding decisions are usually taken for short-term gain. A longer term perspective is urgently required.

7. Farmers are recipients of a plethora of advice on environmental and food safety issues supported by considerable research, funded largely by the public purse. It seems evident that a re-balancing of public interest and expenditure is overdue in order to stimulate the innovation required to increase yields in a more sustainable and environmentally friendly way.

8. The market, and in particular, food retailers play a significant role in innovation in both processing and primary production. Their commercial strength, however, enables them to pressurise margins in all sections of the supply chain. Heralded as 'good for the consumer' there is little political incentive to try to ensure sufficient 'margin' is left within the chain to allow a satisfactory level of investment. This is a particular problem with primary producers in unsupported agricultural production sectors. Margin instability (para. 2) coupled with consistent downward price pressure threatens long-term investment, and this effect is exacerbated by increasing globalisation of supply.

Summary:

9. This is not a plea to return to a protected and 'feather-bedded' form of agriculture, but there is a case for Government to recognise the unique nature of farming and to reflect that in appropriately designed policies and strategies. A secure food supply is fundamental to life. As the risk of insecurity caused by global changes grows, policies which seek to minimise that risk at both international and national levels are essential. This implies review of strategic food stocks, (actual or virtual), market interventions to improve price stability, and regulations to improve the negotiating strength of primary producers within the supply chain.

10. Innovation from primary research to widespread commercial usage can often take 15 to 25 years. By 2050 world population will be half as many again as it is today. If innovation is to play a significant role in meeting this challenge decisions taken over the next few years will be crucial. Production research needs encouragement, together with greater emphasis on moving new ideas into practice through effective knowledge transfer. This should not be left entirely to the market place and commercial interests. Government must assess the risks of failure of markets in providing adequate incentives and signals to producers, and be prepared to intervene in ways which assist rather than impede the efficiency of markets. Government needs to be clear what it requires from agriculture. 'Sustainability' of agriculture is a widely used term which lacks clarity of meaning and encourages misunderstanding.

11. Commercial forces alone will not provide the necessary increase in trained personnel for the new 'greener revolution' that is needed. If the industry itself can be relatively assured of a prosperous future, it will stimulate increased interest in working within the sector. But Government has a role in stimulating that demand, providing appropriate training facilities and the prospect of a career structure, at least partially within public service. The importance of international long-term food security needs to become a political priority,

recognised at head of Government and cross departmental levels in the same way as climate change has been recognised (and measures to mitigate incorporated into UK legislation).

21 September 2010

Memorandum by Research Councils UK (IEUA 24)

SUMMARY

1. Innovation in agriculture must be viewed in a broad context, not only in terms of the development of novel products, such as new pesticides or improved plant varieties, but also in terms of less tangible changes to farming practices and systems at a range of scales. Agricultural innovation also includes explicitly the emerging bioenergy and industrial biotechnology applications such as renewable chemical feedstocks, fibres and biopolymers, for example biodegradable plastics.

2. Drivers for innovation in EU agriculture include: the potential for the agricultural sector to contribute to economic growth in the EU, including through the development of renewable materials and liquid biofuels to substitute for fossil carbon; alleviation and mitigation of climate change and meeting emissions targets; the need to respond to the global challenge of securing sustainable supplies of food for a growing population from the same or less land and with fewer inputs of water, energy and nutrients, whilst minimising adverse environmental impacts; and changes in legislation that will require cost-effective solutions for compliance.

3. Obstacles to innovation in the agricultural sector may include the diverse nature of the industry and those who work in it, as well as a perceived dearth of funding, and limited capability, for the applied research and associated knowledge transfer needed to translate the findings of underpinning science into practical application by the farming industry. In some aspect of agricultural innovation the resistance in Europe to genetic modification (GM) methodologies applied to food and agriculture is also a barrier.

4. EU strategic investment on research capability and infrastructure to underpin agricultural research is critical if the EU's targets to achieve innovation and growth are to be achieved

5. Translation of knowledge generated through research into practice and policy is an important route to innovation. Effective mechanisms for knowledge exchange are therefore essential. BBSRC and Defra (on behalf of the cross-Government Food Research Partnership) have recently commissioned a study to understand better the nature of knowledge transfer in the UK agriculture and food industries.

6. The report from the Food Research Partnership Skills Sub-group on 'High-level skills for food'[8] identified an urgent need to increase the skills levels of current owners, managers and workers in both agriculture and the food sectors, which would require partnership between all relevant industry and users, skills providers, research and policy makers. The BBSRC Advanced Training Partnerships (ATP) scheme[9] brings together key stakeholders from the agri-food industry and the academic research base to provide high-level skills training for those employed within the agri-food sector.

7. The important challenge of global food security is established in the EU 2020 Strategy, and the building of a bio-economy by 2020 is one of the deliverables under the Innovation Union flagship initiative. This should help future Framework Programmes

[8] http://www.dius.gov.uk/assets/biscore/goscience/docs/h/10-929-high-level-skills-for-food.pdf
[9] www.bbsrc.ac.uk/atp

and other EU funding mechanisms reflect the importance of the agriculture sector in EU innovation and the European Research Area.

INTRODUCTION

8. Research Councils UK (RCUK) is a strategic partnership set up to champion the research supported by the seven UK Research Councils. RCUK was established in 2002 to enable the Councils to work together more effectively to enhance the overall impact and effectiveness of their research, training and innovation activities, contributing to the delivery of the Government's objectives for science and innovation. Further details are available at www.rcuk.ac.uk.

9. This evidence is submitted by RCUK on behalf of the Research Councils listed below and represents their independent views. It does not include or necessarily reflect the views of the Science and Research Group in the Department for Business, Innovation and Skills (BIS). The submission is made on behalf of the following Councils:

    - Biotechnology and Biological Sciences Research Council (BBSRC)
    - Economic and Social Research Council (ESRC)

10. This response focuses only on those questions or parts of questions relevant to RCUK or the individual Councils who have contributed to the response.

Definition of "innovation" in the agricultural context

Q1 We have outlined above how we currently perceive "innovation" in the agricultural context, but we would welcome views on your interpretation of innovation in the agricultural sector.

11. Innovation in agriculture must be viewed in a broad context, not only in terms of the development of novel products, such as new pesticides or improved plant/crop varieties (e.g. varieties with higher yields, increased drought- and heat-tolerance, or optimised composition for bioenergy), and the evolution and introduction of new services, but also of less tangible changes to farming practices and systems, including those that benefit or improve the ecosystem services upon which this sector inherently depends.

12. Innovation takes place at a range of scales, be that the individual farmer, local farm or catchment scale.

13. Realising the full potential of innovation in agriculture will require a holistic view of the range of goods and services that can be derived from the land not only in food production but also, for example, in energy crops, bio-feedstocks for industry, flood control, renewable energy, recreation, education, rural tourism, waste management, composting, forestry and carbon sequestration.

Innovation in EU agriculture as a strategic objective

Q2 The EU believes that innovation and knowledge are key to the EU's economic growth and that all sectors should play their part. Do you agree that innovation in EU agriculture should therefore be pro-actively encouraged? Alternatively, do you see agriculture as a distinct sector faced with particular challenges to which the sector will inevitably react in an innovative manner?

14. It is without question that innovation in agriculture must be actively encouraged in the EU (and worldwide). As the global population increases, agriculture worldwide faces the critical challenge of needing to either distribute existing food resources more efficiently, or produce substantially more food if it is to meet the rising demand. Moreover, increased production will have to be achieved from the same or less land, using less water, energy and other inputs, while reducing waste (including pre- and post-harvest losses) and adverse environmental impacts - particularly emissions of greenhouse gases - in order to sustain other essential ecosystem services. Existing techniques will not be able to meet these demands, and so it is only through innovation - some of it radical - that agriculture will be able to address these challenges.

15. Innovation in agriculture could also play a significant role in fostering the competitiveness of a 'knowledge-based bio-economy' in Europe[10], with the potential to bring new, sustainable non-food products and processes based on renewable raw materials to the market. For example, progress in crop improvement could help to reduce our dependence on petrochemicals by increasing the availability of novel chemical and fuel feedstocks from plant biomass and agricultural/organic waste. In this way, agricultural could provide the foundation for entirely new low-carbon business sectors and green jobs. At the same time as helping to develop a low-carbon economy, plants can also contribute to tackling climate change; for example we can breed deeper rooting plants with the potential to sequester considerably more carbon in the soil. Building on existing initiatives such as the 'Food, Agriculture and Fisheries, and Biotechnology' cooperation theme of the Seventh Framework Programme[11], innovation in agriculture must continue to be actively encouraged to support the growth and competitiveness of the European food, bioenergy and industrial biotechnology industries.

16. In 2009, agriculture contributed £7.4 billion to the UK economy and provided 1.6% of the UK's workforce[12]. The strength of the UK research base underpinning plant and animal production means that the UK is well positioned to drive, and capitalise on, innovation in agriculture to generate further economic and social impact.

Innovation today

Q3 How is EU agriculture innovating now? Can you explain under what conditions the agricultural sector is best placed to innovate? Do you have examples of circumstances where innovation would have been possible and would have been helpful, but did not occur?

17. Innovation in agriculture has the potential to contribute some important solutions to some of the major challenges facing the world today, and to contribute to the development of a knowledge based bio-economy in Europe. However, to innovate effectively the sector will require a strong underpinning research base, co-ordinated mechanisms for knowledge exchange, and appropriate regulatory and legislative frameworks.

[10] The European Commission uses the term 'bio-economy' to include all industries and economic sectors that produce, manage and otherwise exploit biological resources (e.g. agriculture, food, forestry, fisheries and other bio-based industries); the European bio-economy has an approximate market size of over €1.5 trillion, employing more than 22 million people. See ftp://ftp.cordis.europa.eu/pub/fp7/kbbe/docs/about-kbbe.pdf

[11] http://cordis.europa.eu/fp7/kbbe/home_en.html

[12] Agriculture in the UK - 2009 report, Defra

18. An example of an area in which opportunities for innovation in agriculture may not yet have been fully realised is in the EU is the adoption of new biotechnology-based approaches to crop improvement, including genetic modification (GM). Modern molecular biology and genetics, including the development of high through-put genome sequencing technologies, have facilitated a massive increase in the understanding of the genetic basis of the traits necessary for a step change in improving plant breeding and its scientific basis. This has the potential to stimulate many types of new biotechnology-based approaches to crop improvement, including GM, which could produce new varieties with potentially beneficial characteristics for growers, consumers, and the environment such as drought resistance, salt tolerance, pest and disease resistance, improved yield or enhanced nutritional status. These technologies offer the potential to stabilise and increase food and non-food crop production more radically and more rapidly than is achievable through conventional breeding alone. They also offer unique opportunities to improve the nutritional value of some food. However, a lack of private sector investment in these approaches, due in part to resistance in Europe to GM technologies has meant that the full potential of crop biotechnology has not been fully explored in the EU.

Obstacles to innovation

Q4 What are the current obstacles to innovation? Is there a shortfall in research capacity and in technology transfer? To what extent do issues such as intellectual property rules, resistance to new ideas, inertia, fear of failure and lack of communication block innovation in the agricultural sector? What are the obstacles to land managers incorporating forestry into their businesses?

19. The appearance of an innovation in agriculture may create opportunities for improvements in efficiency but these may not be realised immediately for multiple complex reasons. For example, markets for new technologies are characterised by a lack of transparency and by imperfect information. This is not so much a lack of information on the existence of the innovation, but rather uncertainty about the operating conditions, risks and performance characteristics of the new technology. However, as the number of adopters of an innovation increases and information is generated, the implementation and spread of the innovation gradually accelerate among the potential adopters.

20. The trend for gradual diffusion of innovations is not a market imperfection, but due, in part, to differences in the benefits that potential adopters may gain. Benefits will vary depending on such characteristics as firm size, market share, market structure, R&D expenditures, input prices, labour relations, firm ownership and current technology. Firm size and market share are the two variables that appear most often in the diffusion models and the usual hypotheses are that large (but not too large) firms and firms with substantial (but not too much) market power are most innovative[13]

21. Agriculture presents particular challenges to the take-up of innovation, not least because of the nature and structure of the sector relative to other, more centralised industries: agriculture is diverse, involving the production of many different crops and animals in a wide variety of farming systems, and for a range of end uses.

[13] Kamien M.I., Schwartz N.L. (1982). *Market Structure and Innovation,* Cambridge University Press.

22. Added to this complexity are barriers thrown up by the structure of the industry which comprises a very large number of independent small and medium-sized enterprises as well as large multinational producers. There are considerable variations in these organisations' ability and interest in innovation (and corresponding variations in the scope to implement best practice more widely).

23. The composition of the sector also means that the majority of companies involved are not able to invest significantly in R&D, even if their business model is suited to such innovation.

24. More specifically, it is widely thought (at least in the UK) that there is a dearth of funding, and possibly also of capability, for the applied research and associated knowledge transfer needed to translate the findings of underpinning science into practical application by the farming industry[14]. Other barriers to innovation in agriculture include legislative requirements - and associated compliance costs - for example, for the licensing of plant protection products or genetically-modified (GM) crops. In addition, public opinion about scientific developments in agriculture and food production has, in some cases, precluded or dramatically slowed down the introduction of new technologies into the sector; the use of GM crops would be a clear example of this challenge.

25. RCUK, having recognised some of these challenges, has supported the Rural Economy and Land Use (RELU) research programme[15]. RELU is co-funded by the ESRC, BBSRC, NERC, Defra and the Scottish Government and is one mechanism through which interdisciplinary research on agriculture is being driven forward in the UK. In addition to encompassing research specifically focused on innovation and its obstacles (including, for example, in the areas of energy crops, farming for enhanced biodiversity and the recycling of livestock waste), RELU also offers a route to support and encourage knowledge exchange between industry, policy and research. This in itself has served to confront many of the challenges relating to innovation in the agricultural sector and is one way in which the translation of research findings into practical application is being encouraged.

Demographic structure of the sector

Q5 To what extent is the demographic structure of the sector (an ageing farming population) an obstacle to innovation; and, conversely, might greater innovation in agriculture serve to bring new recruits to the sector? What incentives currently exist to encourage young people to agriculture; what further efforts might be made?

26. Whilst, over the past ten years, the age of innovators in business have tended to go up (with the highest rate of entrepreneurial innovations in the USA taking place in the 55-64 age group[16]), this may not be the case in the agricultural sector. For example, an empirical research project that directly addressed the issue of age and innovation uptake

[14] *Reaping the Benefits*, pp50-51. Royal Society (2009)
[15] The RELU website provides an overview of all the research it covers and is a useful resource for exploring the depth and breadth of interdisciplinary research activity in this area. The website can be found at www.relu.ac.uk
[16] Dane Stangler, 2009 http://www.kauffman.org/uploadedFiles/the-coming-entrepreneurial-boom.pdf`

in agriculture indicated that the age of farmers correlated negatively with the probability of their being a frontrunner in the uptake of innovation[17].

27. In the past rural sociology as a discipline emerged around the study of the uptake and diffusion of innovations amongst farmers. Indeed, the first systematic models of knowledge transfer – the so-called linear model – were derived from this work. Most of that traditional literature would imply that younger farmers, other things being equal, are more innovative than older farmers. This is complicated by the fact that traditionally, if farmers are going to receive any technical education, they typically experience this as youngsters, and take this new technical knowledge with them into their early farming career. However, there is an additional complication, in that most countries including the UK, most young farmers are succeeding to the family farm, and there is certainly a strong element in the motivation of at least young farmers to do things differently from the previous generation.

28. Many studies in the past 20 years have focused on this succession dynamic. These demonstrate that older farmers do things quite differently on their farms depending upon whether they have an heir to succeed them. Indeed many older farmers with an obvious successor are themselves often driven to innovate to ensure, for a period at least, that there is more than one income from the farm business, to support two generations. That has been seen to be a motive for farm diversification and strategies.

29. The easy conclusion that older farmers without heirs tend to wind down the farm is overturned somewhat by research that found that among such farmers there was often a keen interest in introducing novel conservation management and practices (although for many it was simply farming in a traditional manner that made them more conservationally-benign).

30. There are also questions about the ability or interest in identifying new innovations from the market amongst older farmers. Older farmers are known to have, on average, a lower level of education, which is thought to be linked to the ability to judge opportunities to innovate. They also tend to adopt shorter time horizons and be less inclined to invest in longer term innovations. Age is also related to farming expertise; those with greater expertise tend to rely less on external information, and may therefore not have as high awareness of innovations in the market as early as their younger colleagues[18].

Future challenges driving innovation forward

Q6 Looking forward, agriculture faces significant challenges, although those challenges may bring opportunities too. What challenges do you think will drive forward innovation in EU agriculture in the future? What do you think should be the responses to these challenges, and who would you expect to deliver these responses?

31. As noted in paragraphs 14-16 above, innovation in agriculture in the EU and worldwide will be driven forward by the need to respond to the increases in global population by producing substantially more food, as well as changing and enhancing distribution

[17] Diederen et al 2003, Innovation Adoption in Agriculture: Innovators, Early Adopters and Laggards, *Review of Agricultural and Environmental Studies no.67,* http://www.inra.fr/esr/publications/cahiers/pdf/diederen.pdf

[18] Schnitkey G., Batte M., Jones E. and Botomogno J. (1992). Information Preferences of Ohio commercial farmers: implementation and extension, of innovation. *American Journal of Agricultural Economics*, vol. 74, pp.486-496.

mechanisms, and doing so in ways that are environmentally, socially and economically sustainable. These major challenges will be compounded by global climate and other environmental changes that can be expected to threaten food production and supply, for example through changing patterns of rainfall, increasing incidence of extreme weather and shifting distribution of diseases and their vectors.

32. Furthermore, the building of a 'low-carbon economy' and targets for reducing emissions will also drive innovation in agriculture, increasing demand for renewable sources of energy, chemicals and industrial feedstocks, for example from non-food crops.

33. Legislative requirements and regulatory frameworks which can sometimes act as barriers to innovation (see paragraph 24 above) can also be used to drive innovation, where new practices and technologies are required to deliver cost-effective strategies for compliance. For example, the EU Nitrates Directive, which sets limits on nitrate levels in receiving waters, will require the development of farming systems that make more efficient use of the nitrogen that is applied, and will also boost demand for farm-level livestock waste treatment technologies; the Water Framework Directive, water scarcity and tighter licensing conditions will drive development of water-efficient technologies; and the EU directive 91/414/EEC on the use of pesticides will necessitate new plant protection products and alternative pest management systems to reduce dependency on pesticides.

34. Additional factors that will impact on innovation in EU agriculture include: information diffusion and take up; stakeholders' recognition of the need to innovate; the existence of supportive markets and investment capital; long term confidence in the prosperity of the industry, making significant investment appealing; the attitudinal and behavioural characteristics of the agricultural community; and the pace of climate change.

35. Responding to the challenges and opportunities that will drive forward innovation in EU agriculture will require co-ordinated systems for knowledge exchange, innovation and research, as discussed in paragraphs 36-49 below.

Knowledge and innovation systems

Q7 Analysts have suggested in the past that innovation is best served by co-ordinated formal and informal systems of researchers, consumers, producers, retailers, advisers and government. What sort of systems do you think are required to support innovation in EU agriculture?

36. New knowledge generated through research must be translated into practice and policy if it is to achieve impact. Effective mechanisms for knowledge exchange are therefore essential. We agree that bringing together and promoting communication among the key parties is an important requirement for knowledge exchange.

37. In the UK, the cross-Government Food Research Partnership (FRP), chaired by the Government Chief Scientific Adviser, was set up under the auspices of the Government Office of Science to bring together senior representatives from the public sector with key stakeholders from the agri-food industrial and academic base. The partnership was established to promote cross-sector dialogue and enhanced leadership in addressing key strategic issues in maintaining the health of the agri-food research and innovation chain.

38. BBSRC is a partner, with Defra, in the Technology Strategy Board's Innovation Platform in Sustainable Agriculture and Food[19], which aims to stimulate the development and adoption of new technologies to help improve the productivity of the UK food and farming industries (covering production of livestock and food and non-food crops), while decreasing their impact on the environment. The platform will engage with businesses, regulatory bodies and research organisations across all parts of the agri-food industry, including the agricultural supply sector, primary producers, food processors, manufacturers, distributors and retailers, as well as leading players in environmental sustainability and resource management.

39. One of the aims of BBSRC's new Advanced Training Partnerships scheme (see paragraph 52) is to help reconnect and re-establish networks between research organisations, research users and other bodies.

40. BBSRC and Defra (on behalf of the FRP) have recently commissioned a significant study to understand better the nature of knowledge transfer in the UK agriculture and food industries (see paragraph 54)

Research and development

Q8 Assuming that R&D has a role to play as part of knowledge and innovation systems, how should the research agenda be established in the field of agriculture? How should such research be funded, particularly in the light of budget cuts driven by austerity measures?

41. Innovation in agriculture is dependent on high-quality, cutting edge multidisciplinary research and training. Protected, long-term support for research in key underpinning areas such as plant and animal genetics, genomics, phenotyping and breeding is critical if agriculture is to address the major challenges of global food security and renewable energy, as well as increasing the competitiveness of the sector in the UK and Europe. BBSRC's Strategic Plan 2010-2015 demonstrates BBSRC's commitment to these vital research areas, in which the UK excels.

42. The research agenda in agriculture should be established with the involvement of all relevant stakeholders. Co-ordination between researchers, government and business is needed to ensure that research is appropriately orientated toward practical needs, and that the economic and social impacts of research underpinning the agricultural sector can be fully realised.

43. An example from the UK of how multi-agency co-ordination and stakeholder engagement is helping to shape the research agenda in agriculture is the development of the BBSRC-led Global Food Security (GFS) programme[20]. GFS brings together the interests of the main public funders of food-related research and training in the UK, including relevant government departments, Research Councils and the Technology Strategy Board, to help meet the challenge of providing the world's growing population with a sustainable and secure supply of safe, nutritious and good quality food from less land and with lower inputs, in the context of global climate and other environmental change. The programme includes research across the whole food supply chain from

[19] http://www.innovateuk.org/_assets/pdf/corporate-publications/sustainableagriculturefood%20ip-final.pdf
[20] http://www.foodsecurity.ac.uk/programme/index.html

primary production through to consumer choice, with agricultural research as a key component.

44. A major aim of the GFS programme is to promote coordination across partners and increased collaboration in areas of synergy. In the current economic climate, maximising the value of each partner's funding in this way is increasingly important. The programme will also engage with consumers, producers, retailers and other stakeholders both within the UK and beyond to ensure the investments and activities supported by the programme are appropriately orientated toward practical needs. Underpinning these objectives, at the heart of the programme, lie the principles of engaging with stakeholders at all stages of the programme, including in the co-design and production of research and knowledge. Further details of the GFS programme are at **Annex 1**.

45. Much can also be learned from the RELU Programme in terms of interdisciplinary and multi-partner working in this area. RELU encompasses cutting edge research on a number of agriculture-related issues and has established close connections with a range of key stakeholders in the process. The experience and knowledge gained by RELU will be a key input to the ensuring the future success of the GFS Programme.

46. High quality research is dependent on the availability of a modern research infrastructure. A key goal for BBSRC is to boost national capability in research underpinning agriculture through major infrastructure and facilities. These facilities also act as focal points for industrial engagement and translation of knowledge from basic research into practice. Examples include:
    - The eight members of the BBSRC family of institutes[21] provide vital national capability, specialist facilities and expertise in areas such as sustainable agriculture and land use, livestock diseases, biorenewables, fundamental plant science and crop genetics.
    - The BBSRC Sustainable Bioenergy Centre, established in 2009, represents a £26M investment that increases UK bioenergy research capacity, bringing together six world-class research groups and creating a network with expertise and specialist resources that span the bioenergy pipeline from growing biomass to fermentation for biofuels. Fourteen leading industrial associates bring business expertise and perspectives, and support totalling around £6M, helping to ensure that research outputs are translated into practical applications as quickly as possible. Ensuring that bioenergy is economically, environmentally and socially sustainable is core to the Centre's programmes.
    - The Genome Analysis Centre (TGAC) has been established in Norwich by BBSRC with support from the East of England Development Agency and Local Authorities. The Centre is a national genomics and bioinformatics centre which addresses problems in agriculture, sustainable energy, food and nutrition, through novel approaches in genomics and specialising in genomics technology, high throughput data analysis, advanced bioinformatics and innovation. These technologies have facilitated a huge increase in the understanding of the genetic basis of the traits necessary for a step change in improving plant breeding and its scientific basis, with the potential to stimulate considerable innovation in crop improvement,

47. Public engagement is also important in developing research policy. Many innovative advances in agriculture, such as genetic modification or production of bioenergy crops,

[21] http://www.bbsrc.ac.uk/organisation/institutes/institutes-of-bbsrc.aspx

hold great promise to increase prosperity and address global challenges, but also pose challenges that must be addressed by society as a whole. RCUK has a strong track record in public dialogue activities, and will continue to engage the public around the issues raised by the research it funds, particularly in global challenge areas such as food security and bioenergy.

48. Regarding EU approaches to agriculture R&D, the UK is a successful partner in the EU's Seventh Framework Programme, especially in the Cooperation Theme: *Food, Agriculture and Fisheries, and Biotechnology*. The Research Councils are actively working with BIS to ensure continuation of relevant opportunities in future Framework Programmes. The European Research Council (ERC) is another important source of funding for research projects and the UK has attracted more funding in ERC calls than any other country in Europe.

49. The UK is leading, with France, on a Joint Programming Initiative: *Agriculture, Food Security and Climate Change (FACCE-JPI)*, which is bringing together 22 European countries to create a shared vision and strategic research agenda. When reaching implementation, this will coordinate research and associated activities across the participating countries, reducing fragmentation and overlaps between national programmes, and offer the opportunity for leverage of funding across national budgets. This JPI is at an early stage of development, with a proposal to the European Commission under preparation to resource a secretariat and activities to achieve JPI objectives.

Education and skills

Q9 What is the current state of education and skills provision relating to agricultural research, the agricultural sector and advisory services? How might such provision be enhanced?

50. In January 2010 the Food Research Partnership Skills Sub-group published the report 'High-level skills for food'[22]. This report describes available data, information and reports relating to the current provision of undergraduate and postgraduate skills in agriculture and food. Such information includes the HEFCE-commissioned 'Review of provision for land-based studies' (May 2007) and information about the EU-funded Rural Development Programme for England, as well as data relating to the supply of, and demand for, skilled people in the Higher Education and agri-food sectors.

51. From the information provided, the Sub-Group concluded that:
    - There is not an immediate issue in the supply of people with high-level skills to the agri-food sectors. However, this does not properly take into account the major re-focusing of research in agriculture and food, the skills that will be required for the application of the new technologies and developments arising from this, nor the aim for greater professionalisation of the sectors. In the context of food security, the strategic importance of subjects supporting the agri-food industry may require re-appraisal.
    - The immediate and urgent need in both agriculture and the food sectors is to increase the skills levels of current owners, managers and workers. Continuing professionalisation of the sectors is necessary to enable an effective response to the increasingly complex context in which food is produced and consumed.

[22] http://www.dius.gov.uk/assets/biscore/goscience/docs/h/10-929-high-level-skills-for-food.pdf

- The nature of the supply of and demand for high-level skills in agri-food is such as to require partnership between all relevant industry and users, skills providers, research and policy makers so as to understand the issues and develop solutions to addressing them.

52. One of the principal recommendations of the Sub-Group was *"To support the development by BBSRC of Advanced Training Partnerships to address in particular very high-level skills needs in the agriculture and food sectors".* The BBSRC Advanced Training Partnerships (ATP) scheme[23], which was launched alongside the industry-led AgriSkills Strategy[24], brings together key stakeholders from the agri-food industry and the academic research base to provide high-level skills training for those employed within the agri-food sector. BBSRC has committed up to £15M for this scheme, to support the development and delivery of postgraduate training over five years. Further information is at **Annex 2**.

53. BBSRC also supports skills provision relating to agricultural research through several other mechanisms, which are described at **Annex 2**.

Knowledge transfer

Q10 How should research be translated into technology transfer and advice to practitioners? Where are the respective roles, for example, of professional advisers, professional organisations, peer groups and public sector?

54. The agricultural innovation system is complex, diverse and fragmented, making it difficult to articulate current practice in relation to knowledge and technology transfer (including the respective roles of the various 'actors' involved), or to collate and analyse relevant evidence and data. For this reason, BBSRC and Defra (on behalf of the Food Research Partnership) have recently commissioned a research project, to provide improved and evidence-based understanding of the nature of knowledge transfer in the UK agriculture (and food) industries. The project has two components: the development of generic methodology that can be applied to deliver robust evidence about the nature, effectiveness and responsiveness of knowledge transfer and translational research in the agriculture and food sector; and the application of this methodology to a specific example (wheat in the UK, set in an international context). The improved understanding of translation in the agriculture sector achieved through this project will enable an evidence-based approach to considering appropriate interventions that will deliver more effective knowledge transfer, translation of research outcomes and advice to practitioners. The project will report in March 2011.

55. The RELU Programme has funded a number of projects focused on knowledge transfer both in relation to specific agricultural issues and in relation to the issue of rural land use more broadly. The final round of RELU funding, with successful projects starting in July 2010, was particularly focused on knowledge exchange mechanisms relating to 'Adapting Rural Living and Land Use to Environmental Change'. Projects funded include 'Linking Evidence and Policy for Managing Biodiversity in the Agricultural Landscape', 'Sustainable Uplands: Transforming Knowledge for Upland Change', and 'Collaborative

[23] www.bbsrc.ac.uk/atp
[24] Towards a New Professionalism: The Skills Strategy for agriculture and horticulture, www.lantra.co.uk/agriskills/launch/

Conservation in Agri-Environment Schemes'. Most projects are due to end in December 2011 and the findings will be made available on the RELU website[25] shortly after completion.

EU policies

Q11 What are the roles of the Common Agricultural Policy and EU research policy, including the Framework Programme for Research and Development, in helping to resolve the issues highlighted above? Where public intervention is desirable, what is best done at a lower level of governance?

56. The important challenge of global food security is established in the EU 2020 Strategy[26], and the building of a bio-economy by 2020 is one of the deliverables under the Innovation Union flagship initiative. This should help future Framework Programmes and other EU funding mechanisms reflect the importance of the agriculture sector in EU innovation and the European Research Area.

57. The Research Councils are aware of the suggested third line to the Common Agriculture Policy for furthering translation and other activities in the agriculture sector which are not covered by, but complement, the EU Framework Programmes. Research Councils are keeping a watching brief on developments.

58. The Joint Programming Initiative outlined under Q8 is another example of how Member States and Associated States in the EU are working together under defined governance arrangements to cooperate in scoping a shared Strategic Research Agenda and means of joint actions for its implementation.

Annex 1
GLOBAL FOOD SECURITY

BBSRC is leading the development of the Global Food Security (GFS) programme[27] which brings together the interests of the main public funders of food-related research and training in the UK. Partners include the relevant government departments (BIS, Defra, DFID, FSA, Scottish Government), Research Councils (BBSRC, EPSRC, ESRC, NERC, MRC) and the Technology Strategy Board.

The GFS programme aims to help meet the challenge of providing the world's growing population with a sustainable and secure supply of safe, nutritious and good quality food from less land and with lower inputs, in the context of global climate and other environmental change. This includes challenges facing the UK food system but also international issues, for example the many challenges confronting the developing world. The programme includes research across the whole food supply chain from primary production through to consumer choice, and agricultural research is a key component. The programme is based around four themes (economic resilience, resource efficiency, sustainable production, and sustainable healthy safe diets) and these are described in more detail on the GFS website at http://www.foodsecurity.ac.uk/programme/themes.html.

[25] www.relu.ac.uk
[26] http://ec.europa.eu/eu2020
[27] http://www.foodsecurity.ac.uk/programme/index.html

A major aim of the GFS programme is to promote coordination across partners and increased collaboration in areas of synergy. In the current economic climate, maximising the value of each partner's funding in this way is increasingly important. The programme aims to complement the partners' own strategies and bring additional coherence by acting as a focus for joint activities and alignment of their individual activities around shared goals.

The programme will engage with consumers, producers, retailers and other stakeholders both within the UK and beyond to ensure the investments and activities supported by the programme are appropriately orientated toward practical needs. Underpinning these objectives, at the heart of the programme, lie the principals of engaging stakeholders at all stages of the programme, including in the co-design and production of research and knowledge.

A commitment to stakeholder engagement is reflected in the development of the GFS programme to date. A wide variety of stakeholders were consulted on potential research priorities for the programme in May 2009, and again at a workshop in June 2010. The research priorities are now being finalised and will feature in the 5-year strategic plan for the GFS programme, due to be published in late 2010. The plan will provide the basis for the UK research agenda in agriculture, and will also feed into the EU Joint Programming Initiative.

EXAMPLES OF BBSRC SUPPORT FOR SKILLS PROVISION RELATING TO AGRICULTURAL RESEARCH

Advanced Training Partnerships (ATPs)

The ATP scheme was launched in February 2010. Following an outline proposal stage, nine consortia were invited to develop and submit a full application for the competition. These proposals cover a wide range of areas, including aquaculture, livestock, crops, food science, horticulture and agricultural systems. The partnerships being developed consist of consortia of organisations including universities, agricultural colleges and other research institutions, as well as, among others, supermarkets, levy bodies, private research organisations and the farming community. These partnerships will be ideally positioned to understand the high-level skills needs of the agri-food sector and to offer targeted high quality training that will address these needs.

Full details of the ATP scheme and of the nine consortia developing proposals are available at www.bbsrc.ac.uk/atp.

The closing date for full proposals is 26 October 2010, with awards starting in Spring 2011.

Masters Training Grants

In the last competition of BBSRC Masters Training Grants, applications were particularly invited that support programmes providing strategically important training for industry, including in Agricultural Sciences. Six institutions were successful in receiving support for a total of 25 places per year (starting in 2010, 2011 and 2012) on Masters level courses relating to Agricultural Sciences.

Doctoral Training Grants

BBSRC Doctoral Training Grants support agriculture-related research in the field of veterinary sciences, by providing an enhanced stipend for veterinary students and qualified veterinarians who are studying for a PhD.

Research Experience Placements

In summer 2010, twenty undergraduate Research Experience Placements (REPs)[28] were allocated to agricultural colleges and research institutes to promote agricultural research. In addition, a total of 45 REPs were allocated to UK veterinary schools.

September 2010

[28] www.bbsrc.ac.uk/funding/studentships/research-experience-placements

Memorandum by the Royal Agricultural Society of England (RASE) (IEUA 18)

Introduction

The Royal Agricultural Society of England (RASE) was established 170 years ago at a time when UK agriculture was at a low ebb. Enlightened enthusiasts had seen the potential to develop technologies for food production using the new understanding of chemistry, physics and biology, and RASE was formed to be a catalyst to these changes. The latter halves of the 19th and 20th centuries in particular saw upsurges in the science underpinning agriculture being translated into new technologies globally. This enabled food production to grow between 1900 and 2000 at a rate that more than matched the growth in the global population which over that period increased from below 2 billion to over 6 billion people.

The motto of the RASE is 'Practice with Science' which recognises that, to be successful, the practice of agriculture must work in partnership with science. It is concerned with knowledge moving in both directions along the research chain and being adopted and adapted through further applied research as required. Unfortunately over the last 25 years, UK government policy has tended to separate science and practice to the extent that this partnership in agriculture is under serious threat. Throughout this report both agriculture and horticulture are considered under the heading of agriculture.

The implications of a non-functioning research chain are that new innovations and technologies will evolve and be adopted more slowly, UK agriculture will grow in productivity and competitiveness at a lower rate than other countries and this will result in a greater reliance on other countries to produce our food.

The food price spike in 2008 challenged politicians to re-consider their views on food security and the role of UK agriculture in food production. Nevertheless whilst a number of activities have commenced in government departments relevant actions are still awaited.

The Need to Increase Food Production Sustainably

The separation of practice from science in agriculture has occurred at a time when food production and land management have never been so important. The UK exists in a global market place for food where the forecast is that due to population growth and to dietary changes in emerging economies, there will be a requirement to increase food production by 50-100% by 2050[29], but this will have to be achieved with the added challenges of a reduced area of agricultural land available to produce it, and of using lower inputs of energy, water and chemicals.

UK agriculture can and should increase its contribution to the food supply not only to meet the rising global requirement for food, but also to meet the rising demand for food in the UK which is projected to increase in population by about 25% over the next 50 years. The UK is well placed to do this as it has an excellent climate and some of the most resilient soils capable of achieving much greater amounts of primary production. At present only 60% of our food is produced in the UK.

The need to increase food production in the UK sustainably has recently been recognized by the government which has said that *'Domestically, we want a profitable, thriving, competitive UK*

[29] The Royal Society (2009) Reaping the benefits. Science and the sustainable intensification of global agriculture. The Royal Society, London.

food sector to continue to play its part in keeping us food secure' and that *'Sustainable increases in food production can be achieved through improving productivity and competitiveness, while conserving and enhancing the natural environment'*[30].

The importance of new technologies in providing solutions to these challenges facing food production and land use have been emphasised on a number of occasions by the Government Chief Scientific Adviser, Professor John Beddington. At the 2010 Oxford Farming Conference he said that *'Deploying new technologies, processes and knowledge that make our agri-businesses more sustainable and efficient will be critical in meeting our economic, environmental and social goals, including promotion of a thriving food sector*[31].

New Technologies and the Future of Agriculture

A technological revolution has occurred in the last 10-15 years which is certain to impact in a significant way on agriculture in the future. These new technologies include biotechnology, GPS technology and in communications in particular by mobile telephone technology. The introduction of new and improved traits for crops and livestock, the development of technologies to monitor crops, livestock and the farm environment, and automated processes to assist in optimising production processes will continue to transform future production systems.

This is emphasised in a recent review of research priority areas by the Commercial Farmers Group[32] which identified two of the main priority areas as:

1. Genetic improvement in crops and livestock exploiting the latest biotechnology methods to increase productivity, to control pests and diseases, to reduce environmental impact and to increase nutritional benefits to human health
2. Increased productivity and reduced environmental impacts of crop and livestock production systems through precision technology developments

Biotechnology

Biotechnology in crops (including GM) is needed to develop the 'greener revolution' that is required to enable increased production to be achieved with lower inputs of energy, water and chemicals. Priority traits will include nitrogen fixation, increased efficiency of N, P, and K use, improved water use efficiency, resistance to pests and diseases and provision of nutrients to improve human health.

Biotechnology In livestock, in particular genome-wide selection methods will allow faster rates of genetic progress to be achieved with the objective of increasing productivity, improving the quality of the product for human health and reducing GHG emissions and nutrient (N + P) losses from the system.

Precision Technology

Precision technology in agricultural and horticultural crops will lead to increases in efficiency of production (productivity) and reduce environmental impact, through reducing the external inputs of energy, water and chemicals, and by reducing soil degradation.

Precision technology in livestock is likely to be influential in nutritional management of livestock and in the application of inputs during field operations. This technology will lead to

[30] Food 2030 Department of Environment, Food and Rural Affairs. London, January 2010.
[31] Professor John Beddington (2010) Key issues in agricultural science. www.ofc.org.uk.
[32] Commercial Farmers Group (2009) Priorities for agricultural and horticultural R&D. www.commercialfarmers.co.uk.

increases in the efficiency of production, to reduced energy inputs and to reduced environmental impacts from nutrients and GHG's.

Practice with science

Impact of Public Sector Funding Policies for Agricultural Research

The partnership between practice and science worked well until the mid-1980's with many university and research institute scientists being involved in looking for practical solutions through research to improve the productivity of UK agriculture, and doing this in collaboration with extension workers and farmers.

However over the last two decades public funding of science has not encouraged this partnership[33][34]. Government policy has been predominantly concerned with expanding its funding of science research in universities and research institutes with the objective of making this science 'world-class' as judged by the league tables relating to scientific publications in international journals. To achieve this objective the government and its agencies have concentrated their efforts on supporting basic science research. At the same time they have withdrawn funding from applied research with the expectation that the industry (farmers, suppliers, processors, wholesalers or retailers) would pick up the innovations from basic science and develop them into new products and technologies.

The first part of this policy has been highly successful with the UK now being recognised as one of the top nations in basic science (based on the citation index of its scientific publications). However, the second part involving the withdrawal from funding research directed at increasing the productivity of agriculture has not resulted in the private sector replacing the lost funding from the public sector. One outcome of this has been a falling behind in growth of productivity and competitiveness of UK agriculture[35].

Nevertheless there remains a considerable confusion over how much public sector research funding is supporting agriculture. At first sight this would appear to be substantial as government funding of 'agricultural research' for 2010 is claimed to be £280m[36]. However this is misleading as this amount is mainly spent on basic science aimed at a deeper understanding of how plants and animals function and on research to support government policy objectives. Only a very small proportion of this funding appears to be directed at improving the efficiency and competitiveness of UK agriculture.

The amount of research funding provided by the farming industry is also small. The farming industry is made up mainly of micro-businesses with low profitability and not surprisingly it does not make a significant contribution to agricultural research funding. The levy bodies of the AHDB funded mainly by farmers contribute about £23m per year[7]. Other agricultural organisations provide a further £6m and the trade £56m to agricultural R&D[7].

A clear conclusion is that the outcome of focusing government research funding on basic science and the associated loss of public infrastructure and expertise in applied research has created a gradual distancing of agricultural practice from science.

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[33] Commercial Farmers Group (2008) The need for a new vision for agricultural research and development. www.commercialfarmers.co.uk

[34] NFU (2008) Why science matters for farming. National Farmers Union, Stoneleigh.

[35] Thirtle and Holding (2003) Productivity of UK agriculture. Causes and constraints. Chapter 4. http://statistics.defra.gov.uk

[36] Oxford Farming Conference (2010) Agricultural research needs and priorities: survey findings from the food and farming industry. www.ofc.org.uk.

How are Practice and Science Linked?

The research chain, sometimes called the research pipeline, links both science with practice and practice with science. It is concerned with knowledge moving in both directions along the chain and being adopted and adapted through further innovation as required. The adaptation process is through applied research, and this is the area which has been hardest hit.

It is also important to understand that a successful research chain is also likely to be different for different types of new technologies.

The development of new technology products in agriculture such as vaccines, antibiotics, livestock feeds, seed varieties or crop chemicals appears relatively simple to understand although expensive and time consuming to carry out. It is sometimes called the 'pharmaceutical model' of the research chain and is characterised by a company identifying a potential market, and then using knowledge acquired through basic science research or applied research, from within the company or in the public domain, to develop a new product. The company then has to satisfy the legal requirements for selling the product, obtain necessary IPR protection and ultimately market the product.

This 'pharmaceutical model' of the research chain fits well with the present public sector funding model which supports basic science research to generate new knowledge with the expectation that industry will carry out the necessary translation of research into practice. In this case, industry provides the link between science and practice and through understanding the needs of the agricultural industry it also provides the link between practice and science.

Nevertheless a new product will not necessarily have been tested over a wide range of farm conditions. Performance in practice of a new crop cultivar or a new animal genotype or feed will be influenced by a range of controllable and uncontrollable factors such as soil type and preparation, nutrient or nutritional regime, disease status, management, and weather. This requires applied research by the industry to test these interactions and this has been lacking in recent times with the loss of field-scale comparisons and demonstrations.

Many of the new technologies required for the future will not however be delivered by the pharmaceutical model of the research chain. The development of new systems of production which might include for example soil cultivation systems to reduce energy use, chemical input or water loss; cropping systems to reduce pest and disease losses; nutritional regimes for livestock to increase feed efficiency; grazing systems to increase livestock productivity, reduce GHG emissions and increase carbon sequestration.

In these examples there could be a need for some industry funding of research, particularly if new or existing products are involved, but as there are potential public benefit outcomes arising from changes in productivity from such systems, including environmental (diffuse pollution/ GHG emissions/ biodiversity) and social (animal welfare/ rural livelihood) benefits, it is strongly arguable there should also be public sector funding of this type of research.

The objectives of sustainable food production systems are to deliver beneficial outcomes economically, environmentally and socially and this often requires multidisciplinary

research[37] which has a sustainable production system and not a saleable product as the output. The research chain in this case is much more complex and requires a different type of research chain and funding.

Restoring the Partnership between Practice and Science

Make Basic Science Research more User-focused

The tension between basic and applied science research is not new and does not only apply to agriculture. It is often considered that basic science should only be concerned with the deeper understanding of nature, and should not be influenced by its potential use by industry. This simplistic view that research to understand (basic science) and research to develop use (applied research) should be separate was challenged by Stokes in the USA[38] who emphasised that *'we need a more realistic view of the relationship between basic science and technological innovation to frame science and technology policies for a new century'* and he considered that *'recognising the importance of use-inspired basic research….can frame a new compact between science and practice'.*

It is important that 'blue sky' basic science research continues. However, if the principle of 'use-inspired basic science research' was adopted by the government and its agencies when funding a proportion of research programmes, and by research providers (universities and research institutes) in developing the career structures and rewards for scientists, this would represent an important first step in restoring the partnership of practice with science.

Link Practice with Science at the Research Provider Level

The loss of capacity in both infrastructure and expertise in agricultural research has reduced the innovation needed to translate basic science and ideas generated at the applied level into practice, as has the facility to feedback information from practice to basic science about the needs of the industry.

The research institutes in particular have an important role in extending 'use-inspired' research into application through field-scale experimentation and in collaboration with industry research organisations. This will require them to restore adequate capacity in applied research including both infrastructure and expertise.

Link Practice with Science at the Industry Level

There is a need for the agricultural industry, the private sector and research providers to co-operate in establishing appropriate means of bridging the research chain gap.

The agricultural industry has been pro-active over many years in attempting to replace the loss of government applied research funding and advisory services by setting up farmer-led research organisations (eg The Arable Group [TAG], Maize Growers Association, Kingshay Trust), industry extension services (eg through the levy bodies, sector trade businesses) and farmer discussion groups. Their link with basic science has however become increasingly tenuous due to the lack of relevance of this research to the industry.

It is important that AHDB provides leadership to the industry in increasing agricultural productivity and sustainability by developing links with funders and research providers in the

[37] UK Cross-Government Food Research and Innovation Strategy (2010) Government Office for Science, London. January 2010.

[38] Stokes, DE (1997) Pasteur's Quadrant: Basic science and technological innovation. Brookings Institution Press, Washington DC, 212pp.

private and public sectors to ensure that appropriate applied research infrastructure and expertise is now put in place. The RASE has an important role to play in continuing to work with both private and public sectors to promote exchange of views, and in its knowledge transfer activities on behalf of the agricultural industry.

Current Initiatives to Address the Problem of Linking Practice with Science

Since 2008, the issue of agricultural R&D has been and continues to be widely discussed in government and by the industry. The recent government strategy report Food 2030[39] has called on government, research councils and industry to *'develop new technologies and techniques for sustainable agriculture and land use, and better knowledge transfer'*. The UK Cross-Government Food Research and Innovation Strategy[40] has nevertheless highlighted the complexity of research strategies for food research indicating that *'The topic of food is inherently complex and multi-faceted, and the research and innovation landscape reflects this complexity'*.

The food price spike in 2008 challenged much of the previous thinking on food security, the importance of UK agricultural production, and the relationship between agricultural R&D and competitiveness. Actions taken by government include:

- Food 2030 published in 2010 is the government strategy for food over the next 20 years;
- UK Cross-Government Food Research and Innovation Strategy is a research strategy report for food research and innovation that extends across the UK public sector;
- Food Research Partnership was formed by the Chief Scientific Adviser, Professor John Beddington, to provide a high level forum promoting cross-sector dialogue and collaboration across government, the research community and the private sector;
- The Technology Strategy Board (TSB) has established a new 'Sustainable Agriculture and Food Innovation Platform' to fund innovative technological research and development at a level of £90m over 5 years;
- BBSRC will coordinate a multi-partner food security research programme across research councils and government;
- BBSRC Advanced Training Partnership Scheme has been developed to provide high-level training (masters, professional doctorate and continuing professional development) to meet industry R&D needs;
- BBSRC have proposed the development of a new farm-scale research facility at North Wyke.

These initiatives are to be welcomed, but in themselves are unlikely to deliver the dynamic research chain that will be needed to meet the 2030 challenges.

Recommendations

The country needs a competitive agricultural industry to meet the future challenges of food production and land use. This competitiveness will only occur if innovations and new technologies are produced and quickly adopted by its producers. Whilst cooperation between countries is needed, the UK cannot continue to rely increasingly on other countries for its agricultural innovations.

[39] Food 2030. Department of Environment, Food and Rural Affairs. London, January 2010.
[40] UK Cross-Government Food Research and Innovation Strategy (2010) Government Office for Science. London, January 2010.

The RASE believes that a new approach is required involving both public and private sectors working together in partnership as follows:

- Currently £280m is directed by government and its agencies at what is designated as agricultural research, but this appears to be having little impact on either total production or productivity of the agricultural industry. Agricultural research should be aimed at increasing production and productivity in sustainable production systems with the clear aim of increasing competitiveness of the agricultural industry;

- Whilst 'blue sky' basic science research underpinning agriculture is important, it should not necessarily be at the funding level of the past ten years if this prevents funds being directed at this industry-directed research. The principle of 'use-inspired basic science research' should be adopted by the government and its agencies when funding a proportion of research programmes. These programmes should have increased agricultural productivity as a proposed outcome;

- Research providers (universities and research institutes) should recognise that research aimed at 'use' rather than 'understanding' is of great value to the country. This recognition should be reflected in the expertise of scientists appointed and in the career structures and rewards for these scientists;

- Universities appear to have no mandate to deliver benefits to the agricultural industry at present, and until universities are encouraged to carry out more industry-directed research, a number of research institutes should be retained to lead research for the various agricultural sectors;

- Research institutes can extend 'use-inspired' research into application through field-scale experimentation and in collaboration with industry research and knowledge transfer organisations. The restoration of an adequate capacity in applied research will be necessary including the required infrastructure and expertise;

- AHDB should provide leadership to the agricultural industry in developing a positive strategy to increase agricultural production, productivity and sustainability. This will mean developing collaborative links with government and with research providers in the public sector, extending current agricultural extension activities, and supporting the creation of demonstration farms;

- The levy bodies of AHDB also have an important role in utilising their levy funding to support applied research in their sector areas, where possible in collaboration with other public and private sector funders, and to support knowledge transfer activities.

September 2010

Memorandum by the Scottish Rural Property & Business Association Ltd (IEUA 26)

Introduction

The Scottish Rural Property and Business Association (SRPBA) is a member organisation that uniquely represents the interests of both land managers and land based businesses in rural Scotland. Our members' interests are wide ranging from farming and forestry to field sports and renewables as well as the trades and professionals who support these sectors. A great many of our members are directly or indirectly involved in agriculture and as such have an interest in this consultation. The SRPBA welcomes the opportunity to participate in the consultation exercise.

General Comments

The SRPBA works closely with colleagues in the European Landowners' Organisation (ELO) and has contributed to the ELO's position on the future of CAP reform. It is clear that the Common Agricultural Policy must in future adapt to the twin challenges of food and environmental security. Land managers have the task of producing more food for a growing global population yet in a more environmentally sustainable way and all within the context of climate change. This must involve an increased focus on research and development and the exploration of all aspects innovation and technology if we are to deliver on these challenges.

1 Definition of "innovation" in the agricultural context

In addition to the matters listed, it is necessary to extend the definition of innovation to all aspects of the agricultural sector if we are to tackle food and environmental security issues along with the need to address climate change. Innovation should include new or different management or business structures, land tenure arrangements as well as joint ventures involving all participants in the chain. In Scotland there is a tendency to cling to traditional heavily regulated historical tenancy structures which is now impeding progress in the sector. A culture change may be required in some cases to allow innovation to occur in the widest sense.

2 Innovation in EU agriculture as a strategic objective

Innovation should be at the centre of EU agriculture going forward for the reasons already highlighted. Innovate thinking should be actively encouraged throughout and in every branch of the sector. A reactive approach by governments or land managers will not be enough to meet the challenges we face. In order to meet future needs as sustainably as possible, it is essential that agriculture is constantly moving and developing, both in technology and physical skills and knowledge. The key element will be the transfer of all this to every working farmer. Many of the outputs produced by farmers are currently non market "public goods" for example in terms of management of water, soil etc and therefore private investment in innovation may be limited. As well as developing markets for these outputs where possible, the role of government at national and EU level will be important in development of the tools and farming practices to help farmers deliver these non-market goods.

3 Innovation today

The sector must have the correct legislative and political framework to allow innovative thinking to be implemented and trialled. An example would be the farm tenancy sector in Scotland which is heavily regulated with statutory prescriptive requirements and restrictions and a large degree of historical and political "baggage" which prevents development of innovative tenancy solutions.

4 Obstacles to innovation

Legislative and political obstacles have been referred to above. This can be extended to include restrictive or non-facilitative planning regimes. Rural entrepreneurs must not be over regulated and they must operate on fair terms compared to their competitors abroad and borders are well protected against the intrusion of animal and plant diseases.

In addition, farmers tend to be price takers, rather than price setters may not be able to see the investment opportunities or be able to access the necessary capital to invest in the new technology which tends to follow innovation.

Public attitudes to farming can also be an obstacle to the development of intensive farming systems which embrace technology is all respects from animal welfare to yields. The appliance of science and technology to food production appears to be negatively perceived by consumers and large agri-businesses attract negative publicity but yet these are precisely the types of businesses that will be required if we are to produce food to high quality and welfare standards at an affordable price. Public attitudes to biotechnology for example may well delay or even prevent research into this technology even taking place, which could well inform debate.

As regards barriers to land managers incorporating forestry into their businesses, there is a range of issues that may affect this including funding mechanisms, taxation, long term uncertainty/returns and knowledge/skills.

5 Demographic structure of the sector

The Scottish population is likely to grow slowly, the average household size continue to fall, and the average age of the farming population continue to rise. This projection does not mean that there are fewer people interested in farming, it highlights the fact that farming is a challenging occupation and entry is constrained and demanding – even for those who are brought up in the farming sector.

We have to recognise that the average late 50's farmer will be more comfortable doing what he has always done, there are too few young people entering the industry to act as the early adopters of new technology/ concepts/ ideas.

The Tenant Farming Forum, of which the SRPBA is a member, has actively worked to acknowledge and address barriers which prevent those who wish to establish themselves within the sector. The big barriers are availability of land (which encompasses many points on why land is not being let and why existing farmers are competing against new entrants) and profitability (which covers why capital is such an issue, why the unfair allocation of SFP is always raised and why the industry is seen as unattractive by many young people).
In creating opportunities for new entrants, there is a need for systems which allow new entrants to progressively build themselves up (contracts, share and partnership agreements,

flexible quantities of land, part time farming to earn capital outside the industry). New entrants need to exploit other and broader income sources to provide income in the investment phase and build up capital (niche markets, contracting, jobs). Networks and partnerships are important to find opportunities and get support. New entrants require the opportunity to have the same SFP position as competitors i.e. existing farmers.

6 Future challenges to driving innovation forward

Future challenges could be summarised by reference to the question above relating to obstacles. These obstacles will continue to present challenges.

Future productivity growth will mostly come, as it has for the last two centuries, from technical change embodied in new inputs (seeds, animal genotypes, crop protection, and animal health products, mechanisation, plant and equipment and management). It will also come from innovation and entrepreneurial decisions of farmers themselves and from structural change in farming.

There is little prospect of achieving 80% reductions in Green House Gas emissions from crop and livestock production in the next half century without significant technical change in plant and animal breeding, nutrition and management.

Technical change will also be the key to finding ways of applying fertilisers, using crop protection products and feeding animals within less leakage into the environment (water and atmosphere).

Providing both food and environmental security at the same time will require new techniques and technologies that are not yet developed. Funding and coordination will be essential, as will developing a business environment that fosters facilitates and rewards innovation.

7 Knowledge and innovation systems

All the parties listed in the question will continue to be instrumental in achieving innovation. Effective knowledge transfer and funding to individual farmers will be vital.

8 Research and development

Research and development is now seen as the largest supply-side constraint on production. The lack of necessary R&D is only going to continue as squeeze continues on the 'public purse'. The potential for innovative ideas and solutions are being denied due to a lack of funding. It is essential that the public sector accepts some responsibility in addressing the need to develop technologies/ techniques which are going to tackle social problems of food security and policy requirements set upon the environment and climate change targets. The private sector can not be expected to address public problems and provide support without public sector help in R&D.

There has been serious under spend in R&D since the Green Revolution – this needs to be reversed and new technologies considered. There is significant scope for improvements in productivity. As well as developing new technologies we need to prepare for new challenges such as plant and animal disease. We need to adopt a more open approach to future technologies and the opportunities that they offer. To achieve the complex challenges we

need a continuation of support from Europe to increase investment in R&D and explore the full range of technologies available to meet future challenges.

Private sector companies will only invest in R&D for products and techniques that they think will make a profit. A report published in March 2010 by Lord Taylor of Holbeach, 'Science of a New Age of Agriculture' states that partnerships between public and private companies should absorb some of the risk of innovation and incentivise investment.

9 Education and skills

The education sector is better placed to answer this question, but ongoing skills and training will be a central aspect of successful businesses within an increasing pace of change expected in the business options. Innovation may also come from utilising methods and techniques which have driven agriculture in the past. For example there is argument to suggest that shepherded hills should be invested in to revitalise interest and growth of physical farming in upland areas.

Rural entrepreneurs must not be over regulated and they must operate on fair terms compared to their competitors abroad and borders are well protected against the intrusion of animal and plant diseases.

10 Knowledge transfer

As indicated above knowledge transfer will be key. There is a noticeable imbalance in the flow of knowledge transfer between scientists, advisers and users. Greater knowledge transfer and use of best practice in management could improve financial returns, productivity and provide environmental gains and so must be encouraged through appropriate incentives and investment. Extension service and access to free and appropriate advice will be critical to promote innovation. The use of demonstration and monitor farms should be encouraged. "Farmer to farmer" knowledge transfer will be important.

11 EU policies

As indicated in our introduction, the SRPBA as an active member of the ELO has some very well developed thinking on how the CAP should evolve. The CAP can undoubtedly have an important role in incentivising and supporting farmers to change behaviour in response to innovation. CAP funds can also be used to assist in knowledge transfer and skills training. However the CAP itself should not be a significant source of funding for R&D. We understand EU research policy to be well placed to face the issues outlined above. Any R&D organised at EU level, albeit carried out or funded at member state level should encourage collaboration and sharing of knowledge between member states.

Concluding comments

There is a need to ensure the continuation of beneficial management. Market forces and technological advances continue to drive the search for efficiency gains stimulated by a growth in demand for food, bioenergy and other industrial products, coupled with pressures from the built environment.

There needs to be a clear strategy on how we are going to ensure that farmland will provide all that we are going to seek from it in the years to come. The Scottish Government is

currently consulting on the first Scottish Land Use Strategy which faces similar challenges. Can our already diminishing land bank provide all of what is required?

30 September 2010

Memorandum by Sheep Improved Genetics Ltd (IEUA 20)

Projected World demographic trends indicate that food supply and population growth will pose an even greater threat to Man's existence than that of possible climate change, so publicly prophesised.

From a UK and an EU perspective food security has to be given a far greater priority than it does currently. Land use for human food crop production has been to some large extent neglected during the last 3 decades, when food from other areas of the World has been plentiful and easily available.
To achieve a robust and efficient agriculture supplying the needs of the EU, and hopefully the wider World, will require strategic application of many existing technologies. It will also require new concepts as yet to be proven to be brought into use. It is in this area of research and development that I believe we can improve yields and output as well as minimise or even reduce our impact in terms of Greenhouse Gases.

In the grazed livestock production arena there has to be the opportunity to maximise food from our greatest land resource, grass.

Innovation in the form of research into the largely untapped genetic potential of the sheep combined with improved grass productivity and utilisation will show massive rewards.

The area showing the greatest lack of knowledge is within the genetic selection of superior grazing livestock. The "Pedigree Industry" has enveloped itself in the pursuit of animals reared with the use of various food-stocks, in themselves superior to grass but expensive, allowing traits in our current Pedigree animals to be exhibited which can not, and are not, reproduced in the rigorous and natural farm environment.

Research, using the unfolding technologies of DNA chromosome understanding, can and should be encouraged to identify animals capable of maximising the yield from our major resource, grass. The potential is coming on stream to select animals resistant, or resilient to a number of debilitating diseases (in sheep; footrot, mastitis, ento/ ectoparasites (worms/ scab- lice), contagious abortion, pneumonia, etc) but this will not be delivered with-out innovative guidance and assistance.

The current influence of large pharmaceutical industry companies will steer research into producing costly chemical or vaccine solutions, rather than encouraging the potential of natural animal selection to be the answer.

The farming community is working with grass species unchanged for decades, and the knowledge of how to use grass in sheep production has also altered little.
As an example; the understanding of mineral uptake in the grass, of its transfer to the animal, of the animal's actual need or of its demand, is scant.
On the back of this has developed an industry supplying volumes of minerals, in many forms, often with little knowledge of any real need and supplied in a very casual manner. A potential waste of a finite resource and, of greater significance, encouraging a genotype of animal dependant on artificial supplies of unnecessary minerals!

There is uptake within the dairy sector of disciplined management of grassland but this is not replicated in the beef and sheep sectors. The resultant waste (unmeasured and unquantified)

has to be considerable. The feed industry (suppliers of compound cereals and proteins) promotes the use of imported proteins, principally in the form of Soya, yet high protein grass is wasted, or at least not utilised effectively

Profit (surplus of income over expenditure) within the sheep sector has been at a very low state for so many years such that confidence has been diminished to the point that few younger members of farming families see sheep production as a future. To reinstate confidence needs not only profitability to be maintained but for the industry to be instilled with some form of self respect. Of contributing to the National need! And whilst the sheep sector can be rightly proud of its export record, it lives under the shadow of being a second class citizen. Of not being recognised for the valuable contribution made to the environment from the management of the vast areas of grassland of our country.

Wales, as a devolved Region, carry out work on grassland Research & Development but much of that is stimulated from New Zealand and uptake has not been good in the beef and sheep sectors. In terms of knowledge transfer this is an area that needs addressing.

The BBSRC via Rothamsted Research are responsible for the North Wyke experimental husbandry farm near Okehampton, Devon, the only research establishments for grassland in England. In its recent Farm Platform consultation document into how to restructure delivery from the research station was the suggestion that a third of the North Wyke site should be allowed to "naturalise" to compare & evaluate the impact of modern husbandry upon the environment.
A luxury our hungry society will not be able to afford. North Wyke should be used to improve our food-chain production methods.
It is our grand children (possibly our own offspring) who will face a World of food shortage by 2050!

Every-thing man does impacts upon the environment!
It is the costs/ value balance that should be addressed, especially if we are to take the feeding of our vastly increasing World population seriously.

The sheep, as a species, has the potential for converting vegetation (grass) from very varying landscapes into a human food source and has been grossly under researched.

Man does not have the ability to live on grass directly.

Guidance, assistance and funding needs to be applied to research to allow sheep to play a meaningful role in the feeding of the future World's population.

I hope this assists in some small way in the deliberation of the EU Environment and Agriculture Sub-Committee.

If I can assist with any further contributions I will be happy to do so.

21 September 2010