

## Securing food supplies up to 2050: the challenges for the UK.

Evidence for the Environment, Food and Rural Affairs Committee of the UK House of Commons

### Summary

1. This submission concentrates on the science base which I understand the Committee is now taking a particular interest in.
2. The growth in yield in agricultural crops world-wide is slowing and is now lower than the growth in population. This is one of the fundamentals that indicate that the food crisis is not temporary. Primary agricultural production (crops and forages) will need to approximately double by 2050. A significantly different scenario involves either drastic cuts in the consumption of livestock products in the developed countries or continued dietary poverty in the developing world (or a combination of both). This presents a challenge for research investment world-wide.
3. The main focus of this submission is the effect of the research management mechanisms used and the profound implications of changes in research management within Defra. An account of the development of Defra's approach to the management of agricultural research is provided. It is concluded that the research management mechanisms now used by Defra are suited to investing in relatively short-term research that is tightly focused on current policy questions and on environmental monitoring. This decentralised research management approach presents special challenges for investment in strategic agricultural research needed to underpin longer-term technical change and innovation required to address food security.
4. Proposals for the future are made. Special attention needs to be given to identifying strategic public research needs in terms of coherent research targets and key capabilities that serve a range of policy outcomes. The public agricultural research effort needs to be rebuilt and reconfigured, parity of esteem for researchers conducting and delivering applied research needs to be restored, and we need to replace 'funding' with 'investment'. A natural tendency for most interested parties to look at the volume of investment should to be complemented by the Committee's consideration of the public sector research management mechanisms used.

### Background

5. I am a general agricultural scientist working independently in the space between science and public policy development. I have a broad agricultural science and economics background with a career that spans farming in Ireland, the development and delivery of farmer-owned research in the north of England, research work in the German Ministry of Agriculture, and work in Defra. In addition to supporting research groups with insight into public research policy, I am embedded as a policy/delivery specialist in several research teams across Europe. I am also involved in studies of the environmental performance of the UK food system from a global perspective.
6. In relation to the Committee's interest in science, my most relevant experience arises from my close involvement in the development and management of the Defra agricultural research programme between 1999 and 2007, including 18 months as Defra's first Farming and Food Science Coordinator working in an acting capacity. I was therefore closely involved in the direction of Defra's agricultural and food research effort, and in the changes in research direction and management following the formation of Defra. I was Defra's assessor on the Defra Research Priorities Group and I am familiar with how Defra responded to its recommendations. I am familiar with the UK agricultural science base and the challenges facing it.
7. Before going into detail, I want to record my high regard for Defra as a policy making-making body. I can assess it from a perspective of having worked in two other European countries. From that experience I regard Defra as a world-leader in environmental and forward-looking agricultural policy. I believe that Defra is a very professional organisation and well ahead of other European

agricultural departments in addressing the links between agriculture, food and the environment. There is a deep commitment in Defra to public service and to policy based on evidence.

### **Growth in global crop yields is slowing**

8. Other submissions will have set out the evidence that the 'food crisis' is not just temporary. I want to briefly underscore that here. Recent developments in food markets are at least partly due to underlying and fundamental trends in the demand and supply of food that are here to stay. The risk of a modern food crisis was noted in the then Ministry of Agriculture, Food and Fisheries (MAFF) as far back as 2000, and research and debate about future levels of production was initiated<sup>12</sup>. This risk was mentioned in Defra's assessment of future research needs in 2004<sup>3</sup>. Analysis of FAO data shows that the rate of growth in the yield of staple crops has declined from 2-3% in the 1960s to 0-1% today while the rate of growth of the human population is about 1.4%. In contrast to the situation up until about 2000, the rate of growth of the human population now exceeds the rate of growth in crop yields. In addition, the global demand for resource demanding livestock products is increasing. A combination of growth in population and changes in diet means that primary agricultural production (crops and forages) will need to approximately double by 2050. A significantly different scenario involves either drastic cuts in the consumption of livestock products in the developed countries or continued dietary poverty in the developing world (or a combination of both).

### **Increased research investment is needed**

9. The growth in agricultural output world-wide to meet growing demands to date has been enabled by a significant agricultural research effort after 1945. There has been a decline in public agricultural research globally since about 1985, particularly in the developed economies<sup>4</sup>. This has happened in the UK too where, in addition to cuts in spending, the public good nature of agricultural knowledge and technology has been under-estimated and the ability of the private sector to deliver knowledge and technology has been over-estimated. It is sometimes forgotten that the great step changes in agricultural science in the 20<sup>th</sup> century were the product of public investment delivered mostly into the public domain. The momentum in knowledge and technology supply generated in the period 1945 to 1985 combined with the lag-time built into the agricultural knowledge supply chain has delayed the manifestation of the effects of cuts in investment over the last twenty years. It can be argued that that period of living off the intellectual and technical capital built up over the previous forty years is now ending.

### **Managed public sector agricultural research has contracted in England and Wales**

10. Throughout the developed world, particularly in Europe, national governments have withdrawn from strategic agricultural research, particularly in research institutes. What is left is an increasing proportion of fundamental research that uses agricultural species as models, and an array of private sector activities. This fundamental research is particularly footloose in Universities. In the UK, particularly England and Wales, the combination of cuts in public investment in agricultural research, changes in Defra's approach to research management, the over-estimation of the ability of the private sector to compensate for cuts, and the lower rewards given within and by the research community to investigators who deliver solutions to practical problems have

---

<sup>1</sup> Defra research project report: Yields of UK crops and livestock: physiological and technological constraints, and expectations of progress to 2050.(CTE0207) - IS0210.

<http://sciencesearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=11508>

<sup>2</sup> BCPC Forum on "Enhancing Eco-Efficiency in Agriculture: The agenda for the Future?" - IS0217

<http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=12662>

<sup>3</sup> Defra (2004) Evidence and innovation: Defra's needs from the sciences over the next 10 years.

<sup>4</sup> Falcon, W.P. and Naylor, R.L. 2005. Rethinking food security for the 21st century. American Journal of Agricultural Economics

contributed to the condition of UK agricultural research today. Some of the underlying forces leading to this situation can be traced to changes in MAFF and Defra since about 1980. Following two decades of decline in budgets, changes between 2001 and 2004 to the research in Defra effectively closed what was left of the centrally and scientifically led strategic agricultural research programme that had formed the core of the UK agricultural research effort up to that point. So before considering options for the future, it might be useful to examine what happened in MAFF and especially Defra over the last thirty years.

11. Until about 1970, UK scientists and policy makers lived in parallel universes under the principles for the public financing of research laid down by Lord Haldane in 1918. The fact that a large proportion of the UK science budget is still governed by these principles ninety years later says something about the value of Haldane's principles and the resilience of the scientific community in the face of change. Some real change came in the early 1970s brought about by Lord Rothschild who considered the growing role of science in policy making in the "white heat of technology" era. Lord Rothschild reported to parliament that *"the country's needs are not so trivial as to be left to the mercies of a form of scientific roulette"*<sup>5</sup>. This led to the transfer of a significant part of the UK research budget from the research community (ie the Research Councils) to individual government departments.

12. Lord Rothschild was clear that the job of leading and managing research investment in a government setting was not a trivial one. He stipulated that government departments accepting research funds from the Research Councils to be administered for the benefit of specific sectors of society (e.g. agriculture) should set up dedicated science management capabilities led by departmental Chief Scientists. MAFF implemented this fully and maintained and directed a strategic research capability of world-wide significance under its Chief Scientific Advisor and Chief Scientists. Successive Chief Scientists, supported by a broad team of in-house scientists in the Chief Scientist's Group (CSG), led the conversation between the research community and policy makers, both in relation to the financing and direction of research on one side and harnessing of scientific evidence in the making and delivery of policy on the other. The CSG was outward looking engaging as scientists with the wider expert and external user communities. The word 'Liaison' was built into all its scientists' job titles. For the first decade after the Rothschild reform, MAFF management of the research effort was light-handed by today's standards. It was informed and monitored by external expert input at the programme level.

### **The development of the gap between strategic and applied research**

13. The MAFF research effort was subject to radical cuts in the 1980s. MAFF responded strategically informed by an internal review led by Mr Chris Barnes (the 'Barnes Report'). This identified the 'near-market' part of the MAFF research effort that the industry could be expected to pick up in line with Treasury policy at the time. This introduced a boundary between underpinning strategic research and the down-stream applied research and development needed to ensure delivery to users. To my knowledge, the boundary between research to be funded by MAFF and by the industry (for example through the Levy Bodies) was not precisely defined. However, MAFF to its credit engaged in a significant liaison effort which continues to this day to manage and often lead research investment at that boundary. MAFF also establishing and managing LINK Programmes that provided a platform for public investment in research owned and led by the private sector straddling public and private interests. However, the cutting of 'near-market' research investment inevitably left a very long and dark shadow in MAFF and Defra.

14. Market failure provides the rationale for public intervention at the working level. In that context, the 'near-market' debate left a legacy of a widely held assumption at the working level that near-market research would be picked up by industry. In other words, it was assumed that 'near-

---

<sup>5</sup> Report of *The organisation and management of Government R&D*, in *Cabinet Office, A framework for Government Research and Development*, London, HMSO, November 1971 (The "Rothschild Report")

market' research is not subject to market failure because it is concerned with marketable, or potentially marketable, technologies and services. This faith in the ability or inclination of the private sector to invest in 'near-market' research was fostered untested by the Treasury. This led to under-investment in some research areas and a growing gap between the MAFF research base and the private sector effort required for its exploitation<sup>6</sup>.

### **The fragmentation of ownership of the MAFF research programme**

15. Until about 1991, the MAFF research budget was held centrally in MAFF. The Programme as a whole was led and managed by the Chief Scientist and a Group of about 100 staff – the Chief Scientist's Group (CSG). About half of the CSG staff comprised scientists trained up to PhD level, senior members had brought broad experience in practical research, agriculture and related businesses from outside making the CSG a significant scientific and expert resource in its own right. In about 1991, ownership and ultimate control of the bulk of the MAFF's R&D was passed from the CSG to senior policy administrators in MAFF split in 20 to 30 programmes, each aligned to one of the Ministry's policy programmes. Administrators leading these policy programmes were policy customers for the corresponding research programme. The research continued to be commissioned by scientists in CSG under the 'double lock' arrangement which tried to attribute equal weight to the views of CSG scientists and the respective policy owner. The relationship between CSG research managers and their research policy customers was collegial and equal and the system worked well. This success was due in large part to the active engagement of the Chief Scientist. He was broadly familiar with the content of programmes and, crucially, he line-managed the scientists running these programmes and in providing scientific advice to policy colleagues. More detailed research administration and evaluation procedures were introduced in the early 1990s to reinforce a customer-contractor relationship with research providers using the so-called ROAME system.

### **The fragmentation of the management of the Defra research programme**

16. This independent and influential position of the CSG in MAFF with a centralised 'intelligent customer' function was the focus of a great deal of attention when Defra was formed in 2001, especially since it came with a ring-fenced research budget. It contrasted with the DETR's decentralised approach with individual policy makers owning and managing individual research projects focused on very specific policy questions. At first, the two approaches ran in parallel. An internal debate about the future management of the Defra research effort as whole followed the appointment of Sir Howard Dalton as the new Chief Scientific Advisor (CSA) in March 2002. Having considered the evidence that emerged in that debate, Professor Dalton initially favoured the use of the centralised (MAFF) approach across Defra. However, an 'integrated approach', which turned out to be a stepping stone to a fully decentralised model, was adopted starting in 2003/04. Responsibility for the ownership, resourcing, direction and procurement of agricultural research was decentralised to policy teams. Most of the ex-MAFF scientists previously managed by the Chief Scientist/CSA were also dispersed into policy teams. About a year later, the financial ring-fence protecting Defra's research budget from financial pressures within the Department was breached.

17. Behind the decision to opt for the decentralised approach lay some legitimate concerns that the formal separation of research direction from policy leaves the science effort vulnerable to capture by other forces. It was seen as vulnerable to being distracted away from the policy agenda by either the research community or by narrow agricultural sectoral interests (or both). So the strategic R&D investment serving the improvement of the environmental and economic performance of English and Welsh agriculture ceased to exist in its own right and is now part of

---

<sup>6</sup> Defra research report ST0158. The role of future public research investment in the genetic improvement of UK grown crops  
<http://sciencesearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=10412>

wider ('cross-cutting') efforts serving policy objectives that go well beyond agriculture and food. So the taxonomy of the (reduced) agricultural research effort now mirrors the taxonomy of the wider public policies that that the research is supposed to support. The direct coupling of research programmes with individual policies means that the flap of a butterfly's wing in policy development or even just in the way policy is communicated by ministers can cause a storm in research prioritisation, particularly when using the bottom-up processes described below and when exposed research budgets are at stake. A spending moratorium was used to accelerate the change in direction of research programmes<sup>7</sup>. Another followed to address Defra budget problems. In a Full Economic Cost recovery world, direct exposure to the vagaries of Departmental budgets can do great damage to key research resources arbitrarily and at short notice. 'Decentralisation' had numerous far-reaching implications for the management of research at the working level.

18. Responsibility for identifying and prioritising the research 'owned' by the farming and food part of Defra was delegated to committees comprising policy makers from right across Defra responsible for climate change, water, food, and farming systems and biodiversity. The idea was to link the farming and food research effort to Defra's wider objectives and to cultivate support across Defra for Defra's investment in agricultural R&D. It is noteworthy that the agricultural and food part of the Defra research effort was the only part of the Defra research portfolio subjected to this form of cross-departmental governance of research. These committees were inclusive of a wide range of policy staff at the outset with varying levels of experience and interest in agriculture. Decision-making processes had a strong 'bottom-up' character. Unanimous support for research spending plans at the project level was required. These committees found it difficult to give priority to strategic under-pinning research essential to the long-term progress of agriculture over shorter-term research more tightly focused on specific current policy questions. The challenge was such that Defra had to procure more external analysis to inform investment decisions in this environment<sup>8</sup>.

### **Leading and delivering agricultural research in the future**

19. There is Europe-wide trend of government departments withdrawing from the active direction and use of research. Given the role governments have had in investing in agricultural research over the last 60 years, the effects of this withdrawal from research is most clearly manifest in agriculture. We see an increasing proportion of fundamental research that uses agricultural species as models, and an array of private sector activities. This research is particularly footloose in Universities. Although the food and financial crises have reminded us of the role of agriculture in the health of the economy, we may assume that European national governments will not return to their previous role as leading investors in agricultural research through their departments.

20. So we need new structures and partnerships for the direction and delivery of public agricultural research that reconsider the public good nature of the knowledge and technology outputs required. By 'public good' I mean research outputs that are largely in the public domain and whose consumption is non-rival. In designing new systems to direct and deliver research based technical change, I propose four essential ingredients:

*The identification of strategic public research needs in science terms*  
*The rebuilding of the public agricultural research effort*  
*The restoration of parity of esteem for applied research*  
*The need to 'invest in', instead of 'fund,' research.*

---

<sup>7</sup> Select Committee on Science and Technology [Fourth Report](http://www.publications.parliament.uk/pa/cm200607/cmselect/cmsctech/68/6808.htm)  
<http://www.publications.parliament.uk/pa/cm200607/cmselect/cmsctech/68/6808.htm>

<sup>8</sup> Defra project report IF0101: The rationale for Defra investment in R&D underpinning the genetic improvement of crops and animals  
<http://sciencesearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=14403#Description>

These are set out in detail as follows:

*The identification of strategic public research needs in science terms*

21. The recognition of the public good nature of agricultural knowledge and technology is a prerequisite to an orderly debate about public investment in agricultural research. This knowledge and technology is a public good in itself which is used to protect and enhance public goods though enhancing the environmental and productive performance of agriculture. The public good nature of the agricultural research community's outputs has been under-estimated and the ability of the private sector to deliver knowledge and technology has been over-estimated. It is sometimes forgotten that the great step changes in agricultural science in the 20<sup>th</sup> century were the product of public investment and were based largely on knowledge and technologies delivered into the public domain.

22. It is very plausible to argue that the way to get researchers to better serve public policy objectives is to frame their work in line with those objectives. This is also attractive because it avoids the difficult job of interpreting current and future policy needs in terms of coherent research objectives. But this tram-lining of research onto policy causes fragmentation and duplication, and in the end many inaccessible research outputs delivered too late. This was found by Defra itself in an internal study in 2003 to characterise policy led research. Three things need to be kept in mind in identifying coherent research investments to serve policy. First: researchers deliver knowledge and understanding, not policy. Second: policy-makers rarely operate on timeframes compatible with those needed to identify and deliver strategic research objectives in time to support those policies. Third: policy-makers rightly respond to the political vision of the day which, particularly in the area of agriculture and the environment, is often developed later than the underlying real-world forces driving that vision.

23. The recent EU sponsored crop research priority setting exercise (EUROCROP)<sup>9</sup> emphasised the importance of identifying coherent science facing research targets that cut across the wide range of public and private objectives that should drive that research. Their thorough work showed that some areas of research core to agricultural science remain relevant across a wide range of policy scenarios and over time. This points to the need to translate present and future policy and market conditions into coherent research programmes. This involves a degree of 'intelligent decoupling' of policy (public or commercial) and research objectives which is hard but rewarding work that adds great value in the research investment process.

*The rebuilding of the public agricultural research effort*

24. In implementation of research investment, the recent emergence of the Agricultural and Horticultural Development Board offers an opportunity. There is a case for the AHDB playing a significant role in the direction and management of publicly funded agricultural research to support the technical change required to deliver Defra's policies, integrated with its existing research focused on its more commercial objectives. The recruitment of a Chief Scientific Advisor by the AHDB provides an opportunity to rebuild and reconfigure the public agriculture research effort in such a way that unifies the public agricultural research effort across the UK and even beyond.

*The restoration of parity of esteem for applied research*

25. In the UK, a researcher who addresses questions of practical significance to wider society is usually regarded as less able or less worthy of peer recognition than one who addresses research questions defined by him/herself or by scientific peers. This has done great damage to the effectiveness of the UK agricultural science base in terms of socio-political outcomes. Thanks to Lord Haldane, a change here is in the gift of the research community itself. This lack of parity of esteem has profound consequences for the behaviours in the research community affecting the efficiency of the research effort in terms of public policy outcomes. Agricultural science draws on

<sup>9</sup> <http://www.eurocrop.cetiom.fr/index.php?id=11086>

the basic sciences to serve society through the bringing together and application of those sciences in frameworks serving agricultural practice and decision making. It is important that the agricultural scientific community restores a sense of purpose in supporting technical change in agricultural practice and policy development. We need to stop using agricultural species and agricultural activity to justify fundamental research which deep down is not being pursued to improve those species and activities. Research models used in an agricultural development context need to support agriculture, not the other way round.

26. Systems- and interdisciplinary-thinking are essential. Much of what passes as interdisciplinary research is in fact a loose and temporary alliance between separate disciplines – there is a lot of multi-disciplinary activity, but relatively little interdisciplinary thinking. This seems to be a particular problem in England and Wales, and is getting worse as we see the effects of the shift towards reductive science since 1990 come through. There is a scarcity of people in research who appreciate the systems or strategic context of their research and who design research programmes around the needs of the system and the needs of the research user. Likewise in research management, there is a scarcity of people who have practical experience of agricultural research and who have the wider experience required to orientate policy objectives into coherent research investment, particularly in the long-term. These skills need more nurturing and more reward.

*The need to 'invest in', instead of 'fund' research.*

27. There is a 'funding' and 'funded' mentality running right through the system. 'Funding' provides a convenient backdrop to cuts. It is much easier to cut a 'funding' programme than it is to cut an 'investment' programme. Likewise, managing 'funding' bears less responsibility than managing 'investment'. The 'funding' system has also focused researchers on securing project funding at the expense of contributing objectively to public debate on research direction, and public returns to research investment. So the words 'funder' and 'funding' are a curse to the research community in its broadest sense, especially to users – ie policy-makers, industry and farming.

28. So my last point is the need to completely change the mindset of those who finance and deliver research. The mindset in the public research community that public bodies 'fund' and researchers are 'funded' damages both. It results in a mutually harmful donor/donee relationship and mentality which does not foster a focus on returns to society. Embedding the consideration of the public financing of research as an investment would have benefits for both the researchers and the public bodies that support them. An 'investor' will consider consequences in terms of lost returns to previous investment before terminating financing or compromising a capability. The consideration of the finance as an investment would also focus financing organisations on delivering a return to society and would reinforce the need to design research portfolios accordingly. Likewise on the research provider side, the realisation that the flow of finance is an investment would focus researchers' minds on the responsibility of delivering returns.

## Conclusion

29. The recent food crisis is not a temporary phenomenon. Public agricultural research programmes need rebuilding world-wide. The research management approaches used in Government can have profound effects on the direction and effectiveness of the resulting research and the policy outcomes achieved. In considering the condition of the UK science base, the Committee might consider the effect of changes that were made to the management Defra research in recent years, in addition to consideration of the effects of cuts in investment since 1985.

Donal Murphy-Bokern,  
Lohne, Germany, 18 May 2009

Postscript: The House of Commons EFRA Report supported by this evidence is available at:  
[http://www.parliament.uk/parliamentary\\_committees/environment\\_food\\_and\\_rural\\_affairs/efra\\_food\\_policy.cfm](http://www.parliament.uk/parliamentary_committees/environment_food_and_rural_affairs/efra_food_policy.cfm)