THE NEED FOR A NEW VISION FOR UK AGRICULURAL RESEARCH AND DEVELOPMENT

The continuing decline in agricultural R&D is reducing the competitiveness of the UK agricultural industry[1] and putting food security at risk. A new vision is urgently required to develop innovative agricultural systems that are competitive, which reduce reliance on food imports but which also deliver the required environmental benefits.

The Commercial Farmers Group[2]

1.0 Executive Summary

1.1 Global population growth and the rising consumption of animal food products in emerging economies are putting increasing demands on global food supplies. In addition the land area devoted to biofuel production is reducing the area of land available to produce food crops. Collectively, these demands will continue to put upward pressure on food prices and focus attention on land and water use globally. The impacts of climate change will put even greater pressure on these scarce resources.

1.2 Agriculture is the key UK industry in this agenda providing not only food security as a buffer against the unpredictability of global food supplies and prices, but also contributing to the energy, water and environmental security of this country. All of this however is under threat if the industry fails to be innovative and competitive.

1.3 There is ample evidence that since the mid-1980's there has been a significant decline in the rate of growth of UK agricultural productivity, in its competitiveness with other countries, and as a consequence in food self-sufficiency. This period of decline has coincided with reductions in public sector funding support for agricultural R&D, and undoubtedly this has been a significant influence.

1.4 Government policies for R&D (across all sectors) have focused on producing world-class basic scientific research in universities and research institutes, but the successes here have been at the expense of applied R&D aimed at improving industry productivity and competitiveness.

1.5 The impact on agricultural R&D has been a major erosion of research infrastructure and expertise in both universities and research institutes. A vacuum has been created between basic scientific research and practice. This vacuum has not only reduced the ability of new science to be translated successfully into practice, it has also stifled innovation at the applied level.

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[1] In this paper 'agricultural industry' includes both agriculture and horticulture.

[2] The Commercial Farmers Group is a group of farmers and academics supporting the competitive development of the UK agricultural industry. It has recently highlighted how food security poses considerable risks to the future wellbeing of the agricultural industry and the nation.

1.6 The agricultural industry has suffered more from these policies than most sectors due to its uniqueness in being made up almost entirely of micro-businesses, and although the levy bodies carry out their responsibility for supporting industry R&D, the amounts spent annually are small (less than 0.25% of agricultural GDP).
1.7 Of greatest concern is the loss of any career opportunities in either universities or research institutes to attract young people interested in agricultural R&D, and there is very little provision of PhD training for future scientists in applied research. Consequently the number of scientists who are conversant with the needs of the industry and are capable of translating science into practice are getting fewer and older.
1.8 The simplistic view that intellectual challenge and innovation reside mainly in blue sky basic science is flawed. Innovation and knowledge exchange occur at all stages of the R&D chain. The loss of applied R&D removes an important element of innovation and the ability to exploit advances in basic scientific knowledge into practice.
1.9 The vacuum created by the loss of applied R&D will not be bridged simply by increasing the funding for 'knowledge transfer' aimed at translating basic science into practice. This fails to replace innovation and the close connectivity between science and practice provided by applied scientists.
1.10 The Commercial Farmers Group believes strongly that agriculture is key to the future sustainable development of this country, and it is the responsibility of government and industry together to ensure that an effective R&D chain is in operation. The 'market failure' in the provision of agricultural R&D which is a direct result of government R&D funding policies over a 20 year period must be addressed urgently.
1.11 The Group has no wish to see a return to the agricultural R&D infrastructures of the past. It would like to see positive change with new approaches including:

- Action by the higher education councils and BBSRC to elevate the status of applied R&D in appropriate agricultural university departments and research institutes together with the provision of career opportunities and rewards comparable with other scientists.
- Provision of studentships for PhD training in applied agricultural research.
- A re-balancing of existing research budgets in universities and research institutes with an increasing proportion of the total directed towards applied research.
- Government and the agricultural industry seeking to develop additional agricultural research funding streams from both public and private sources.
- The Agriculture and Horticulture Development Board taking a leadership role on behalf of the industry in addressing the 'market failure' in agricultural R&D, with the objective of establishing a fully functional and integrated R&D chain.

2. A competitive agriculture is an essential component of UK sustainable development

2.1 It is abundantly clear that the growing demand for food driven by global population growth and the increase in animal food product consumption in emerging economies will continue to put upward pressure on food prices and focus attention on land and water use globally. The impacts of climate change and of land producing biofuel rather than food crops will put additional pressures on these resources.

2.2 A recent review[3] has concluded that 'world cereal and energy prices are becoming increasingly linked… since 2000, the prices of wheat and petroleum have tripled, while the prices of corn and rice have almost doubled'.

2.3 Food security like energy security is of growing importance for all countries. Agriculture is therefore a key strategic industry of the UK, quite disproportionate in significance to its direct contribution to national GDP. In addition to its role in food security, agriculture will increasingly contribute to energy security; and will continue to carry the main responsibility for stewardship of the rural environment and the sustainability of rural communities.

2.4 It is inevitable that existing agricultural land will have to produce increasing amounts of food, and the UK is fortunate in being blessed with resilient and productive soils and a temperate climate which is ideally suited for crop and livestock production. The agricultural industry therefore provides the UK with a valuable buffer against the unpredictability of global food supply and prices.

2.5 However if agriculture is to make a meaningful strategic contribution the industry will have to be increasingly innovative and competitive.

2.6 There is ample evidence that the reductions in public sector support for agricultural R&D since the mid-1980's have been associated with a decline in growth of agricultural productivity[4], and in its competitiveness with other countries[5]. This may partly explain the 1% per year decline in UK self-sufficiency in food over this period.

2.7 No industry can be competitive and progress without innovation and a confident well organised agricultural R&D chain is essential to meet future demands. Estimated returns on investment in publicly-funded agricultural R&D vary considerably but are significant (10 to over 50%). A recent UK estimate shows a marginal rate of return on R&D of about 15% after taking into account 'spillovers' from private and international R&D[6].

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[3] J. van Braun (2007) The World food Situation: New driving forces and required actions. AGM of the Consultative Group on International Agricultural Research (CGIAR). www.ifpri.org

[4] Thirtle, C. *et al.* (2004) Explaining the decline in UK agricultural productivity growth. J. Agric. Economics, 55, 343-366.

[5] Defra - Agriculture in the United Kingdom 2006. http://statistics.defra.gov.uk

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

3. Public sector policies have reduced agricultural R&D capacity to an unsustainable level

3.1 Until the mid-1980's when the government began withdrawing its support for agricultural R&D, the UK was in the 'high-level technology club' of nations (with USA, France, Netherlands, Belgium and Denmark) as measured by Total Factor Productivity (TFP) indices. Thereafter, growth in productivity in the UK fell considerably relative to the other five and the authors[7] noted that - 'It is not coincidental that the UK public sector R&D in agricultural research peaked in 1983 and by 1989 was 12.5% lower'. There are also indications that those in the 'low-level growth of technology club' (Ireland, Italy, Germany, Greece, Luxembourg) are now beginning to overtake the UK.

3.2 Government policies for R&D have focused on producing world-class basic scientific research in universities and research institutes and most indicators suggest this objective has been successfully achieved in a number of institutions. However, this success has been at the expense of applied R&D (research aimed at improved productivity of farms).

3.3 The negative impact of government policy on agricultural R&D has been hugely significant with a major erosion of research infrastructure and expertise in both universities and research institutes.

Universities

3.4 Government funding for research in universities only supports those departments which score highly for 'quality' in the Research Assessment Exercise (RAE) carried out by the university funding councils. The RAE assesses quality against a benchmark of 'world-leading in originality, significance and rigour'[8]. One outcome has been that basic science has been rated considerably higher than more applied science, and this has been one of the main drivers for university departments to move away from applied to more basic science across all sectors.

3.5 This has been a factor in the closure of some departments of agriculture in universities and to a major shift to a more basic science research agenda. An added consequence is there are now fewer academic staff in universities with industry experience and this in turn influences how subjects are taught. For many universities this loss of industry-relevant expertise has eroded the close links that formerly existed with the agricultural industry.

3.6 The colleges of higher education (Royal Agricultural College, Harper Adams University College, and Writtle College) have retained their industry links, but by remaining involved with applied research have been deprived of their core research funding from the university funding council resulting from the RAE.

3.7 In addition two colleges which have been influential on the agricultural industry in the past are no longer active. Seale Hayne College was closed subsequent to merger with the University of Plymouth, and Wye College

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

[8] Research Assessment Exercise. http://www.rae.ac.uk

has moved out of agriculture completely since merging with Imperial College.

3.8 The university funding councils have attempted to overcome this loss of industry contact through the introduction of the Higher Education Innovation Fund (HEIF) totalling £112m (2008-09) across all subjects (only a small proportion of which will be allocated to support the agricultural industry).This funding is to support knowledge transfer (KT) activities between universities and industry, but the funding has not replaced the innovative developments lost from applied R&D, and it remains unclear how effective it has been in translating basic scientific research into practice.

Research Institutes

3.9 The influence of government research policy on Research Councils was exemplified by the change of name and policy of the Agricultural and Food Research Council (which primarily funded research institutes involved in agricultural research and to a lesser extent research projects in universities) when it was assimilated into the Biotechnology and Biological Sciences Research Council (BBSRC) in 1994. This change was associated with a greater emphasis on basic science in the remaining institutes, and a continuing move away from industry-relevant activities and staff skills.

3.10 In addition, since 1985 there have been a large number of closures of research institutes associated with agriculture[9], although in some cases there was a transfer of some of the resources into other institutions.

3.11 Research institutes like universities have a remit to carry out KT activities. However the funding for this activity represents a small proportion of the total resource, and involvement in KT work does not bring the same career rewards or status associated with basic science activities.

3.12 Rationalisation of research institutes is continuing and there is now a policy to move research institutes into university control[10] where the driver of the RAE is likely to further enhance the concentration of effort into basic science at the expense of applied research.

Agricultural extension and demonstration

3.13 The privatisation of the advisory service ADAS resulted in its demonstration farms which had provided an important component of KT, becoming more remote from farmers and some have now been closed. An uncoordinated assemblage of demonstration farms now continues these activities. They include the remaining ADAS sites; Defra organised sites (following the recommendations of the Curry Commission); LEAF Demonstration Farms; and the Soil Association Demonstration Farm Network.

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[9] Letcombe Laboratory 1885; National Institute for Research in Dairying 1986; Weed Research Organisation 1986; Hill Farming Research Organisation 1987; Plant Breeding Institute 1987; Grassland Research Institute 1992; Long Ashton Research Station 2003; Silsoe Research Institute 2006; Hannah Research Institute 2007.

[10] HRI Wellesbourne became part of the University of Warwick in 2004; IGER will become part of the University of Aberystwyth in 2008.

3.14 At present it is neither clear to what extent these demonstration farms make a contribution to KT, nor whether this disaggregation of demonstration activities has resulted in a further loss of efficiency in the R&D chain.

Outcome for the agricultural industry

3.15 The result of losing much of the applied R&D infrastructure and scientists with knowledge of the industry is that a vacuum has been produced between basic scientific research and practice. This vacuum has not only reduced the ability of new science to be translated successfully into practice, but has also stifled innovation at the applied level.

3.16 These impacts have been greater for the agricultural industry than for others due to its uniqueness in being made up almost entirely of micro-businesses. The industry is less able to take over full responsibility for funding applied R&D, because although it might be assumed that the levy bodies (funded by farmers but regulated by government) carry a responsibility for supporting R&D in their own sectors, the amounts they spend annually on R&D are relatively small (about £15-20m or less than 0.25% of agricultural GDP).

3.17 Of greatest concern is the loss of any career opportunities and training in agricultural R&D in either universities or research institutes for young people interested in applied agricultural research. It is not surprising therefore that the few PhD scholarships that do become available are mainly taken up by overseas applicants.

3.18 Those still employed in applied R&D work are consequently getting older and fewer. A recent survey of agronomy specialists[11] showed that in ten specialist technical areas the proportion of individuals under 40 years of age ranged from 9 to 44% with an average of 24%. The loss of this expertise in applied science will not be reversed quickly.

3.19 The position is probably worse in England and Wales than in Scotland or Northern Ireland. In Scotland, SAC continues to be involved in applied R&D and has an associated extension service. In addition there are four Scottish research institutes[12] involved in agricultural research also supported by the Scottish Government. In Northern Ireland the newly-formed Agri-Food and Biosciences Institute[13] operates on seven sites with basic, strategic and applied R&D activities relating to agriculture, and the provision of training and specialist advice.

3.20 Whilst most countries in the developed world have continued to reduce expenditure on publicly-funded agricultural R&D[14], none appear to have followed the extreme approach of the UK. The average public agricultural R&D spend for developed countries is about 2.3% of agricultural GDP representing about 46% of total agricultural R&D spend (with 54% privately

[11] Scientific skills for knowledge transfer in arable agriculture in England: a survey. Report to the Board of the Rothamsted Research Association by Mark Tatchell (2005). http://www.rothra.org

[12] Macaulay Land Use Research Institute; Moredun Research Institute; Rowett Research Institute; Scottish Crop Research Institute.

[13] http://afbini.gov.uk

[14] Pardey, PG, Beintema, N and Wood, S (2006) Agricultural research. A growing divide? http://www.ifpri.org

funded). Whilst the total spend on R&D by Defra and BBSRC far exceeds these proportions, it is difficult to assess that which is allocated to agricultural R&D aimed directly at benefiting the industry.

4. A better understanding is needed of how the agricultural R&D chain works

4.1 A successful R&D chain works with new ideas and experimentation taking place at basic, strategic and applied research levels, as well as in the process of demonstration and practical implementation on farms. KT exists throughout this continuum with ideas and discoveries stimulating thought and innovation throughout the chain moving from basic science into development and practice, and knowledge from practice being passed back to basic science (Fig 1). The lack of continuum and connectivity is now acute in UK agriculture.

4.2 The vacuum created by an overemphasis on support for basic science at the expense of applied science not only blocks the translation of science into practice, it also removes innovation at the applied level and breaks the contact with industry (Fig 2).

4.3 The government concept of the R&D chain appears to be a linear one-way model with the opportunity for innovation only emerging from 'blue sky' basic science. This linear conceptual approach is not helpful in developing new technologies for agricultural systems which are complex and function under economic, environmental and social constraints.

4.4 The concept that the purpose of funding R&D is primarily to develop new saleable products with intellectual property rights derived from basic research is well illustrated by the National Audit Office review of Defra research in agriculture in 2003[15]. This review was concerned with 'reaping the rewards of agricultural research' but concentrated its analysis almost entirely on the financial receipts from intellectual property. Increasing the efficiency and competitiveness of agriculture did not appear to be a consideration in the review indicating a lack of appreciation about how the acquisition of scientific knowledge impacts on the agricultural sector.

4.5 The attempts by government to solve the problems of translating science into practice have focused on the provision of KT funding, but this policy has also been formulated to operate within the linear R&D model. It continues to neglect the role of applied research in innovation and does not solve the problem of scientists involved in basic research being remote from industry needs.

5. A new vision is required for agricultural R&D

5.1 The CFG considers that industries such as agriculture are key to the future sustainable development of this country, and it is the joint responsibility of government and industry to ensure that a fully integrated R&D chain is operating effectively. There is a clear 'market failure' in the

[15] Reaping the rewards of agricultural research (2003) Report by the Comptroller and Auditor General. London, the Stationary Office.

provision of agricultural R&D resulting directly from government R&D funding policies over a 20 year period, and this must urgently be addressed.

5.2 The importance of future R&D has been emphasized in a recent review of the world food situation[16] which concluded that 'to combat rising food prices, national and international research systems … should be positioned to invest more heavily in agricultural science and technology to increase agricultural production on a global level'. The UK Government Chief Scientific Adviser commenting on the global food supply and demand situation has also recently called for more agricultural research.

5.3 This should not be seen as a requirement to return to the past agricultural R&D infrastructure - a new way forward is needed. Fundamental is the requirement for career opportunities for young people in agricultural applied R&D (including KT) to be re-established in appropriate universities and research institutes, with required staffing levels, staff training (including PhD's) and infrastructural support.

5.4 The damaging effects of the RAE on applied R&D in universities need to be recognized and addressed. The present third stream strategy (for business and community activities) in universities provides a useful vehicle to fill the vacuum between basic science and practice, but to achieve this will require a change of strategy including financial support for applied R&D and the development of appropriate career opportunities for staff. Such a strategy will only deliver success however, if the necessary resources are made available and most importantly if the work is accorded a high enough priority and status by universities to attract and reward talented staff.

5.5 The present remits of Defra and BBSRC do not appear to be the problem. What is needed is for their stated objectives to be fulfilled. The overarching aim of Defra is 'to promote a competitive and efficient farming and food sector which protects and enhances our countryside and wider environment, and contributes to the health and prosperity of all our communities'[17]. Similarly, the mission statement of BBSRC[18] includes a responsibility for 'basic, strategic and applied research' and to promote and support the exploitation of research outcomes' also to 'provide trained scientists and engineers which meet the needs of users and beneficiaries … including the agricultural (and other) industries'.

5.6 Current total funding of R&D is significant. Defra spends over £300m per year on research, monitoring and surveillance activities although research funding has been in decline in recent years. BBSRC spends over £400m per year, although it is unclear in either organisation how much of this is directed towards supporting a competitive agricultural industry. What is needed is a change in the balance of this funding between basic, strategic and applied R&D.

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[16] Press release on 'The World Food Situation: new driving forces and required actions' by J. von Braun (2007) www.ifpri.org

[17] The Strategy for Sustainable Farming and Food. Facing the future. (2002). http://www.defra.gov.uk

[18] Biotechnology and Biological Research Council. http://www.bbsrc.ac.uk

5.7 The government and the agricultural industry should also seek new funding streams for agricultural R&D from both public and private sources.
5.8 The Defra LINK programme has successfully supported R&D in the sustainable arable, sustainable livestock, horticulture, food, and renewable materials sectors, with research funding mainly shared 50:50 between government and industry. Nevertheless the LINK programme is currently under review, and it is essential that its future is sustained and that it should put greater emphasis on developing industry competitiveness.
5.9 The newly-formed Agriculture and Horticulture Development Board (AHDB) has an important responsibility in providing leadership for the industry in finding solutions where there are market failures, and agricultural R&D is a clear example of this. Consideration should be given for a body such as the Applied Research Forum to have a wider role in promoting, extending and monitoring agricultural R&D for the benefit of the industry.
5.10 The Research Priorities Group (RPG) formed post-Curry advises Defra on strategic priorities for publicly-funded research. Its first report[19] was produced before the extent of the imbalance in global food supply and demand became fully apparent. It is timely therefore for the RPG to reconsider their research prioritization.
5.11 Other countries have invested more heavily in applied R&D than the UK, and the value of 'spillover' knowledge from other countries cannot be ignored and there is also an important role for applied R&D in adapting available global knowledge to UK conditions.

6. Conclusions

6.1 Global food supplies and prices are of growing importance in all countries, and food security in the UK can best be addressed within a global market place through having an innovative and competitive agricultural industry.
6.2 Competitiveness has been seriously damaged by successive government policies directed towards supporting basic science at the expense of applied R&D in universities and research institutes.
6.3 The role of applied R&D in developing and transferring innovative technologies, in adapting basic science into practice, and in providing a link between industry and basic science has been vastly underestimated.
6.4 This role should be re-introduced into university departments and research institutes together with appropriate support to overcome the present dysfunctional problems of the R&D chain.
6.5 It is the responsibility of government and the agricultural industry to work together to ensure that an effective agricultural R&D provision continues at a sustainable level in order to enhance the competitiveness of the agricultural industry.

[19] The First Report of the Sustainable Farming and Food Research Priorities Group (2005). http://www.defra.gov.uk/science/publications

Figure 1. A FULLY OPERATIONAL R & D CHAIN

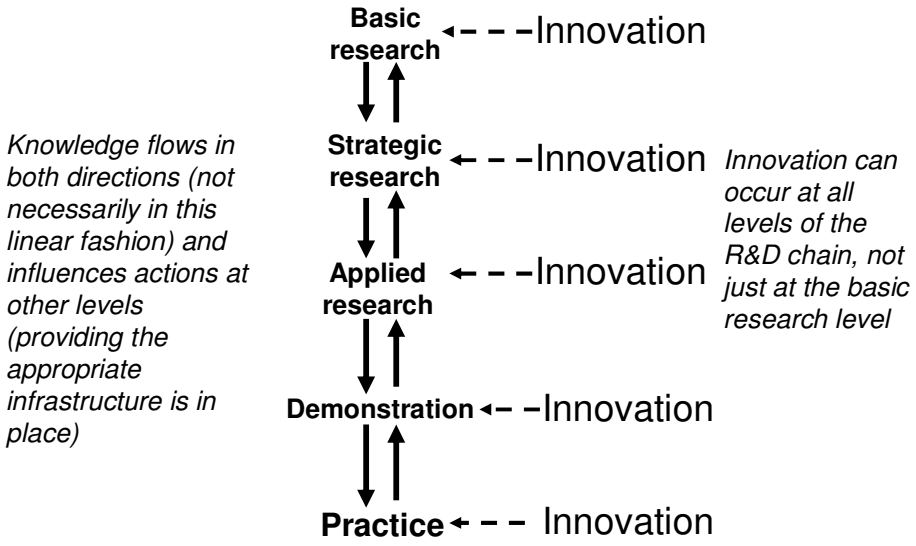

Figure 2. THE PRESENT STATE OF THE AGRICULTURAL R & D CHAIN