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Symposium on 'Food supply and quality in a climate-changed world'

Session 2
Informing food policy: balancing the evidence

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The paper considers some of the reasons why governments develop food policies, gives examples of what is in food policies at the Scottish and UK levels and explores ways of effectively providing balanced evidence for policy development. It discusses the challenges of exchanging knowledge between the science and policy communities, given their different languages and cultures, highlighting the need for greater mutual understanding of roles and responsibilities. It draws on experience in the Scottish Government of developing the government's 'Recipe for Success – Scotland's National Food and Drink Policy' through engagement with stakeholders, scientists and analysts and touches on the more complex nature of the Department for International Development's contribution to meeting the first Millennium Development Goal. It compares the need for collation and analysis of existing evidence during the development of policy, with the desirability of providing policy direction for longer-term strategic research and the challenges of connecting the policy expectations with researchable questions. The paper concludes by emphasising the need to focus research in the short-term on *mitigation* of climate change through decreasing greenhouse gas emissions associated with the production of food, while also taking an account of economic, health and broader environmental sustainability objectives. A further challenge is to communicate complexity and uncertainty in ways which enable decision-makers from the consumer to policy-makers to make informed choices. Longer-term research needs to focus on the opportunities and risks associated with *adapting* to climate change.

Food policy: Food security: Science–policy boundary

The rationale for public-sector involvement in food demand and supply

Food is essential for life, yet too much can be damaging for health. It is a balanced diet, consumed in moderation, which promotes good health. Historically, the main challenge for the government was to ensure a reliable supply of food for its population. It was Thomas Malthus in 'An essay of the principle of population' published in 1798[1] who first wrote about the potential for divergence between the geometric rate of increase in population (demand), compared to the arithmetic increase in supply of food. Malthus, however, could not have foreseen the scientific and technological advances which enabled the production of food at a global level to outpace population growth[2].

This growth in supply did not, however, ensure that malnutrition was consigned to history and even though there is an increasing problem of obesity in developing countries[3], malnutrition is still with us. There is an increasing concern about the accessibility of nutritious food to all people in developed countries[4], and despite the fact that 'there was comfortably enough food globally'

Abbreviation: DFID, Department for International Development (UK); MDG, Millennium Development Goal.

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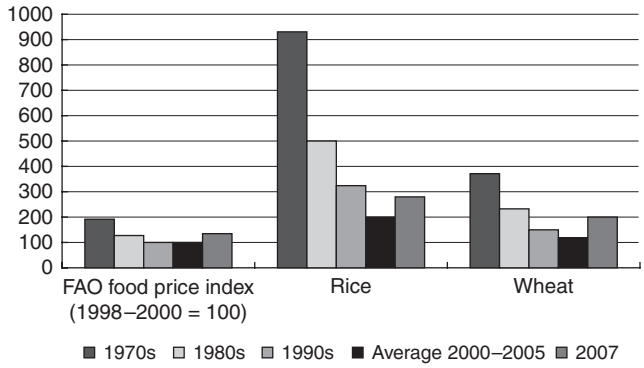

Fig. 1. Trends in real commodity prices (from FAO[9], base year 2000).

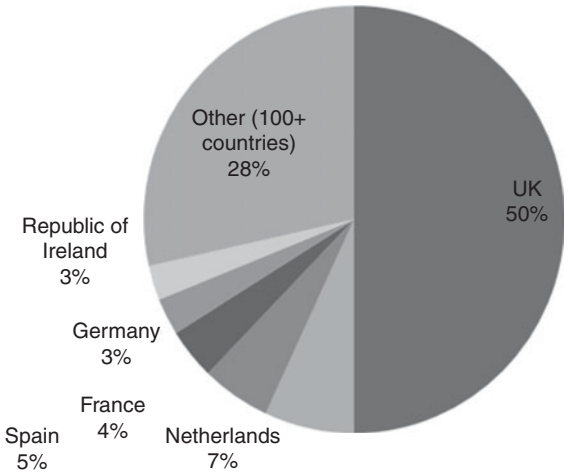

Fig. 2. Origins of food produced in the UK by unprocessed value, 2007. (▒), Republic of Ireland; (■), Germany; (■), France; (■), Spain; (▒) and Netherlands. (From Defra[11].)

in 2008[5] to feed the population of about 6·7 billion, over 1 billion people were estimated to be malnourished in 2009[6].

The causes underlying the 2007/08 food price spikes included low stocks : use ratios, the rapid increase in energy prices, a weakening of the US dollar and export restrictions in some countries[5]. Even though the 2007/08 spike in real commodity prices was considerably smaller than those experienced in the 1970s (Fig. 1), this led to a resurgence in awareness of the potential risk of food insecurity, even in developed countries. Although it is the private sector that supplies food, government policies have a major influence on the resilience of food chains and it was governments and international organisations who took responsibility for analysing and addressing the issues in 2007 and 2008[5,7,8].

This threat of food insecurity was undoubtedly a factor in the development of national food policies in the UK, but at the same time it was well recognised that our dependence on global trade in food meant that the solution could not be found in simply increasing local food supply. Food security has been defined as 'when all people, at all times have physical and economic access to sufficiently safe and nutritious food to meet their dietary needs and food preferences for an active healthy life'[10]. Governments aim to achieve this by both facilitating efficient (biological and economic) production of foods appropriate to local conditions and by economic success enabling the purchase of preferred foods which can be grown and/or processed more efficiently elsewhere. In 2007, the UK and five other European countries accounted for about 71% of the total UK food supply (Fig. 2).

In the UK context, food preferences include quite a number of foods in our supermarkets and shops that cannot be grown in the UK. The food group for which the UK has the largest trade deficit is fruit and vegetables. In 2007, the value of imports was $£6.4 \times 10^9$ giving a trade gap in fruit and vegetables of $£5.8 \times 10^9$. Not all of the foods imported, however, are those that cannot be grown in the UK. In 2007, the UK was only 73% sufficient in those foods which could be grown; for example, dairy and eggs were the top import from EU countries, but in 2008 accounted for only 24% of imports from other countries in the EU15 (i.e. Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and UK). Other foods imported from the EU15 included unprocessed pork (carcass meat and cuts, both bone-in and boneless; mainly from Denmark) and unprocessed beef/veal carcass meat and cuts, both bone-in and boneless (mainly from the Republic of Ireland).

The importation of foods which we can grow in the UK illustrates the power of global markets in relation to keeping prices down and thus contributing to maintaining physical and economic access. Between 1987 and 2006, UK food prices fell in real terms by over 20%[5]. The average UK household now devotes about 11% of its expenditure to food, down from 16% in 1984. For low-income households, food accounts for 15·9% of all household expenditure. In Scotland, meat (including both unprocessed and processed products) formed the largest expenditure on a single food product at 20% followed by bread, flour and cereals (including unprocessed and processed products) at 12% in 2007. Fish (including fresh fish and fish products) formed only 4% of expenditure.

Trends in consumption are subject to multiple drivers (price, income, taste, attitudes and advertising) many of which are market driven. Yet, markets do not always deliver efficient levels of food production and market failure refers to a situation where the market cannot of itself be expected to deliver an efficient level of output. For example, markets should be competitive and open, but agricultural subsidies distort the market for food supply. Another example of market failure is where consumers do not have information on, or access to, nutritious food. A principal rationale for food policies is to correct for market failures to drive towards national food security as defined above, i.e. ensuring physical and economic access for all, to nutritious food.

What do we mean by 'policy' and what is the role of evidence?

Policy is a word which is freely used by many people but undoubtedly interpreted in different ways by, for example,

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scientists compared to those in government. As professionals who have worked in both communities, we explain policy in the context of national government as meaning the guidelines which governments use to deliver their commitments to their electorates through regulation and spending review (investment) decisions. In a later section of this paper, we consider the development of the Scottish Government's Food and Drink Policy as an example of guidelines set within the context of a National Performance Framework for the government.

In the context of international development, relevant commitments are the Millennium Development Goals (MDG)[12]. Policies in this context include the guidelines and documents developed by governments to describe the basis for decisions on spending to achieve the desired outcomes, including the MDG. The relevant MDG is MDG1: 'Eradicate extreme poverty and hunger by halving, between 1990 and 2015, the proportion of people whose income is less than $1 a day and the proportion of people who suffer from hunger'.

In both of these examples, the aims of policies are specified in terms of outcomes. These outcomes cannot be delivered by government alone and thus the links between the policies and the outcomes are less predictable. Knowledge from past experience or from an understanding of the processes involved, often applied through models or the development of plausible future scenarios, can help to improve predictability. This is where analysts and scientists play a key role in providing knowledge or evidence linking potential actions with outcomes. Governments have long relied on economists, and more recently on social scientists, to provide the evidence required, but increasingly there is recognition of the benefits of natural scientists also providing evidence to inform policy decisions. While this might seem a straightforward goal to achieve, the training of natural scientists is very different from that of the other specialist disciplines and our hypothesis is that for effective evidence-based policy-making to include natural scientists, these differences need to be recognised. The following section covers a review of relevant literature and of experience gained both within the Scottish Government and the Department for International Development on some of the challenges of bringing the science and policy communities together.

Including natural science in the evidence base for policy development

There is a growing literature in technical and in-house reports and peer-reviewed journals, which explores the characteristics of effective evidence-based policy-making, going back over the last two decades or more. Most of the recent literature assumes that policy-making is

> 'by no means the rational activity that it is often held up to be in much of the standard literature. Indeed, the metaphors that have guided policy research over recent years suggest that it is actually rather messy, with outcomes occurring as a result of complicated political, social and institutional processes which are best described as 'evolutionary'[13].

The use of the word 'messy' in this context illustrates one of the first challenges of language. Many natural scientists, in particular, are accustomed to rational, detailed approaches to progress from point 'A' to point 'B' and would not be attracted to becoming involved in a 'messy' process. Yet, 'messy' in this context could also be described as 'iterative', which has a resonance with 'feed-back' loops which are common occurrences in the systems approach, popular in the ecological sciences. Thus, it is perhaps not surprising that in the Rural Economy and Land Use research programme[14], there was a faster involvement of scientists from the environmental science community than from the biological science community in a programme which was both multidisciplinary and addressing policy-relevant questions. The language used might be different, but the concept of interactions within a system would resonate with both communities.

Language is only one of the challenges to be surmounted in bringing the scientific and policy communities together. Culture is another. Lagacé *et al.*[15] noted that while 'Policymakers often do not understand how scientific knowledge is generated nor the values or traditions of understanding defended by scientists and technical experts, scientists often lack an understanding of how policymakers use scientific evidence and have often failed to understand the complexities of reaching consensus in a political arena'.

Non-scientists often consider scientific findings to be about certainty, whereas for many disciplines the scientific process is one of developing hypotheses (e.g. the world is flat) and then challenging those hypotheses until they are disproved and replaced by one founded on new knowledge (e.g. the world is round). Not all scientific progress requires hypotheses; however, some focus on a goal of designing a new invention or equation, but it is this hypothesis-driven scientific method (first described by Karl Popper[16]) that exacerbates the science–policy cultural divide. This is particularly obvious at present in the debate over whether the origins of the current period of rapid climate change are largely man made or not. While the overwhelming weight of evidence suggests that warming is human induced, it is impossible to prove absolutely that human activity is responsible for the current speed of change in our climate. This lack of absolute proof is then used to justify challenging the more contentious consequence, that only by modifying our current lifestyles to reduce our greenhouse gas emissions, can that change be slowed. Recommendations for policy-makers (e.g. the 2007 Inter-governmental Panel on Climate Change report [17]) thus rely on the considerable weight of evidence and expert opinion, built up in the case of the Inter-governmental Panel on Climate Change over 21 years, with inputs from thousands of scientists.

A similar scenario of lack of complete knowledge also applies to the evidence in support of the links between specific dietary components and health. As we learn more about genomic differences between individuals, we understand how difficult it is to make generic assumptions about the impact of specific nutrients on the health of a population, but even with the speed of the latest scientific advances we are a long way from having a complete

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understanding. Science advisers to government thus have to proceed with immediate advice on the basis of partial knowledge and learn how best to communicate uncertainty while also developing longer-term strategic research programmes to generate new knowledge. An example of involving policy-makers in designing strategic research programmes is described in a later section.

It is equally important though, in seeking to align the demand for evidence with its supply, for scientists to understand the policy context. One of the first steps for scientists to accept is that they do not have a monopoly on evidence. In a democracy, politicians will also take into account the political evidence such as public acceptability and perception of the degree of risk. A current example here is that of the role of genetically modified crops in feeding a world population of 9 billion. While public acceptability in Europe may change in future if a shortfall in supply leads to price increases, the reality is that a significant proportion of the European public remain sceptical of the net benefits[18]. This is part of the overall evidence on which politicians will base decisions.

Lagacé *et al*. are not the only authors to make the point about the need for scientists to have a greater understanding of the policy context. Cash *et al*.[19] also emphasised the benefits of two-way communication between decision-makers and researchers. They drew on a large body of work which identified the importance of 'boundary work' (defined as the interface between communities of experts and communities of decision-makers), linking the two communities of expert advisers and decision-makers. For the future, they thought further work was needed to 'learn how to harness the boundary-spanning potential of multiple individuals and organisations in ways that can most effectively bolster salience, credibility, legitimacy and the trade-offs among them'. This, again, supporting the argument for flexible and multiple linkages between policy and scientific communities.

One cultural attitude which often causes misunderstanding between decision-makers and researchers is that of time horizons. Decision-makers are usually working to very short time-horizons (weeks and months) while the time horizon for researchers differs between disciplines, but may vary from months to decades or even millennia! One suggestion[20] is that horizon scanning approaches could foster dialogue and one form of horizon scanning that of considering the impacts of various climate change scenarios has brought the policy and science communities more closely together.

In reality, those commissioning research need to commission the generation of new knowledge to cope with the medium- and long-term horizons while also facilitating access to existing knowledge to meet the immediate needs of policy-makers. An example of meeting the short-term needs is outlined in the next section while meeting the longer-term needs is considered in the following section.

National food policies in Scotland

Food is an important part of Scottish culture, with a global reputation for quality products such as Scotch whisky, Scotch beef, lamb and pork and Scottish farmed salmon. The food and drink supply chain contributes about £9×10^9 per year to the Scottish economy) and employs nearly 370 000 people in 75 000 food and drink businesses. Yet, Scotland has a high rate of obesity[21] and the diet of Scots is recognised as being poor[22]. Prior to the current administration, Scotland had not previously had a specific food policy, although agriculture and health policies were devolved in 1999.

In early 2008, the Scottish Government held a consultation (*Choosing the right ingredients*[23]) to ask the people of Scotland what they thought should be included in a food policy. This was based around the Scottish Government's vision for the food policy:

> 'Our vision for food in Scotland is that it should make the nation healthier, wealthier and smarter with production making communities stronger and consumption respecting the local and global environment.'

Over 500 individuals and organisations submitted comments highlighting diet and nutrition, local food and local economies, health promotion, the environment, education and access and affordable food as the most important issues. The next step was the setting up of a Food and Drink Leadership Forum, with five workstreams:

1. sustainable economic growth of the food and drink industry;
2. healthy and sustainable food and drink choices;
3. celebrating and safeguarding Scotland's reputation as a land of food and drink;
4. walking the talk – getting public procurement right and
5. food security, access and affordability.

Each workstream had the opportunity to request evidence from government analysts to inform their discussions and in addition two 'transient think tanks' were held. These think tanks were organised to address focused 'challenge questions' of relevance to the emerging policy discussions such as 'What could be the effect on Scotland of global forces such as world population growth, dietary transition, water and land scarcity and climate change? How should we approach the future global challenges in order to safeguard our food supply?' and experts in the selected areas (with differing disciplinary backgrounds) from across the UK were brought together to debate the issue.

The emerging findings of the workstreams were discussed at meetings of the Leadership Forum, before each workstream made a series of recommendations to the Scottish Government and Scotland's National Food and Drink Policy: '*Recipe for Success*'[24] was published in June 2009. The major objectives identified are listed in Table 1. Discussions with stakeholders are now continuing using 'logic models' to identify both the actions required delivering these objectives and who should take them. (Logic models provide a framework to articulate the way in which policy actions relate to outcomes. They describe the links between inputs, activities, outputs and outcomes. It is through the process of developing a logic model that policy outcomes are specified and the policy actions that will contribute most to those outcomes are identified.)

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Table 1. Key objectives of Scotland's National Food and Drink Policy

Support the growth of our food and drink industry
Build on our reputation as a land of food and drink
Ensure we make healthy and sustainable choices
Make our public sector an exemplar for sustainable food procurement
Ensure our food supplies are secure and resilient to change
Make food both available and affordable to all
Ensure that our people understand more about the food they eat

One of the recommendations in the policy document referred to the ongoing need to underpin future work through research. It committed the Scottish Government to both set up a specific Food Research Group to 'advise on maximising the contribution of our research outputs to aims of this policy' and also recognised the opportunity for policy to contribute to the design of the strategic (5 year) research programmes to be commissioned in 2011. Commissioning policy-relevant strategic research has proved to be a challenge in the past due in part to the differing concepts of time horizons referred to above, but enhanced discussion and interaction in a range of fora has made this more feasible.

Commissioning policy-relevant strategic research

Over the years, the UK funding community in the agricultural sciences has evolved such that the Research Councils fund more upstream research (with the questions framed by the researchers), with government departments, such as the Department for the Environment Food and Rural Affairs, funding research which answers questions framed by policy colleagues. There has been a lack of funding from the industry side, leading to a gap in the funding of applied science which analysis concludes as having contributed to the decrease in productivity of UK agriculture[25]. In Scotland, we have been more fortunate in having retained funding to commission agricultural and biological research from the strategic through to the applied and Scottish scientists were recently rated first in the world for citations in the agricultural sciences[26]. In the broader disciplines of plant and animal sciences, the UK was also recently rated as world leading[27]. An undoubted contribution to this dominance is the existence of research institutes across the UK which have maintained a focus on plant and animal science during a period when many of the facilities for such work have disappeared from universities, during recent decades when food security was not recognised as being a priority issue for government funding. These institutes have a strategic focus, with the benefit of having Directors in a position to direct research towards specified 'missions'. In Scotland, our institutes are well positioned to act as key players in both mining the more basic science within universities which may be of most relevance to policy and to translate the policy context into questions which can be addressed by science (Fig. 3).

Part of the benefit to Scottish policy of having research institutes directly funded by Government, has been the opportunity to create multidisciplinary teams, which have been able to embed the social and economic aspects into the design of the natural science research, helping to enhance its relevance to the policy community and indeed the ability of the scientists in those organisations to exchange knowledge with the policy community. This is not to say that excellent exchanges between scientists in the wider academic community and policy colleagues do not take place, the benefit is one of critical mass in that more scientists within institutes are interested in fulfilling this function than is the case within universities.

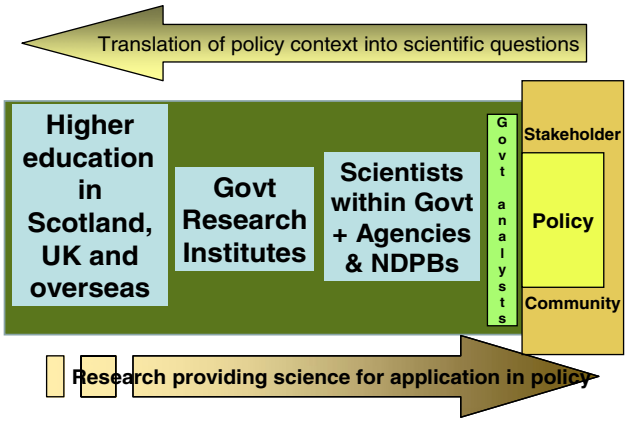

Fig. 3. Science and Policy communities in the Scottish context. Govt, Government; NDPBs, non-departmental public bodies.

The Scottish Government (like the Research Councils at a UK level) is therefore continuing to fund research institutes outside the university sector, through provision of long-term funding to maintain the expertise. In the case of the Scottish Government, this takes the form of long-term (5 year) strategic research programmes in areas of policy relevant to the Scottish Government. From the start of the next strategy (which runs from 2011 to 2016) the specification for the research to be commissioned has been developed in consultation with policy colleagues and wider stakeholders from the farming and environmental sectors in a highly iterative process over a number of years. This has led to two programmes including themes framed in the language of outcomes (e.g. 'resilient food supply systems' and 'vibrant rural communities'), while the researchable questions proposed to underpin these outcomes are being framed by scientists. One consequence of posing outcome-oriented questions is the need for collaboration between disciplines to deliver more integrated outputs. Mimicking funding in the higher-education sector, a dual funding system is also being introduced, whereby programme funding will be complemented by a separate funding stream to encourage maintenance of depth of expertise in areas of key policy relevance such as animal, plant and soil health. This additional funding stream also enables policy colleagues to tap into the platform of expertise generated by the strategic research to get answers to specific questions requiring more immediate answers. This strategic research platform also provides underpinning research which has relevance to answering questions related to global food security.

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International commitment on food

The example given above refers to policy needs at a national level, where the same funder is responsible for funding applied through to strategic research. As discussed earlier, at UK level, the Research and Funding Councils are responsible for funding largely basic research, with government departments funding research to meet specific objectives. In the past, this distinction has been perceived as detracting from the potential impact of UK research both on the economy and quality of life. Recent initiatives that have sought to increase impact, include the cross-government research programmes such as Living with Environmental Change[28] and Global Food Security[29]. These collaborations bring together the main UK research funders who share common goals. The UK Government's Department for International Development (DFID) is a partner in both initiatives, providing the global dimension, particularly for research on global food security, where it is developing countries that are most at risk from food insecurity.

DFID played a key role in the development of the UN MDG and the MDG form the starting point for the DFID 2009 White Paper '*Eliminating World Poverty: Building our Common Future*'[30]. DFID is committed to playing its part in reaching the MDG and recognises that this includes actions 'to create, share and apply knowledge and ideas'. DFID's research strategy is part of the planned activity and focused on ensuring that 'research makes a greater impact on policy and practice in partner countries and internationally'.

For the Global Food Security initiative this creates a very diverse range of users and consequently requires a huge amount of evidence. As a result, it requires international effort to even approach a balanced and integrated collation of evidence. The Integrated Assessment of Agricultural Knowledge, Science and Technology[31], did just that and reported in 2008, but the report was completed before there was time for analysis of the food price spikes of 2007/08 and two other initiatives undertaken since then are also highly relevant[32,33].

The Integrated Assessment of Agricultural Knowledge, Science and Technology involved multiple disciplines and multiple stakeholders in analysing the issues. It drew out five key messages for decision-makers in North America and Europe[31], including the need for 'a paradigm shift which accords increased importance to the multifunctionality of agriculture and adapts to local environmental and sociopolitical contexts'. Other key messages referred to the need to intensify the 'focus on nutrition, health and food quality' and to the need for public investment 'to support public goods and reshape agricultural knowledge systems'.

The paper by Godfray *et al.*[32] also picked up the need for radical change referring to the need for a 'revolution in the social and natural sciences' if society is to meet the challenge of feeding 9 billion people in a sustainable manner. The report commissioned by the Royal Society[33] puts a monetary value of $£2 \times 10^9$ over 10 years on the requirement for research to meet the challenge of global food crop security. The Global Food Security initiative is part of the government response to all of this evidence, but it is clear that there is much more to be done and in a time of declining public sector spending, innovative partnerships are needed on how to achieve success. All three reports recognise the importance of people working together; natural and social scientists, researchers and decision-makers from those individual farmers who take decisions about which crops to grow through to world leaders who take decisions on global agreements such as on reducing greenhouse gas emissions.

Conclusions

Food policy has a global dimension even when being developed by the government of a single country, due to the extent of global trade in food products. The advances of recent decades in the natural and social sciences, engineering and technology provide exciting opportunities to provide innovative options for policy and radical innovation will be essential if 9 billion people are to have access to nutritious food, produced in a sustainable way in 2050 in the face of climate change challenging yields in some parts of the world.

Radical innovation is only possible though, if there is a robust evidence base with which to explore likely consequences, both intended and unintended of adopting new practices. This requires a much greater strategic and co-ordinated approach to setting research agendas between funders to ensure that the evidence base is balanced, between potentially competing interests. It also requires greater mutual understanding between researchers and decision-makers to ensure that the outputs of research lead to the outcomes prioritised by society.

In the short-term food production systems in the UK at least, will need to respond to climate change policies and decrease the greenhouse gases associated with each kJ of energy and gram of protein offered to consumers. As highlighted in the food policies referred to above, this has to be achieved, without compromising the potential growth of the Scottish and UK food industries and without compromising health policies or other environmental quality objectives. Evidence, particularly in relation to the trade-offs between these sectors, is far from complete, with key gaps identified in the UK Cross-Government Food Research and Innovation Strategy which was published in January 2010[34]. Filling these gaps requires a more holistic approach to both the commissioning and implementation of research. There is also a challenge in communicating these complexities and uncertainty in ways that adequately inform decision-makers from consumers to policy-makers.

Longer-term research on crop, livestock and aquaculture production needs to focus on the areas of greatest opportunity for managing the risks to global food security. Production in some countries will be adversely affected by climate change, while others will have new opportunities. New advances in science and technology will be essential to meeting the challenges of evidence provision in a rapidly changing world.

Accumulating a robust and balanced profile of evidence on health, environmental, economic and social issues requires both the collation of existing knowledge and the

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commissioning of new knowledge generation to meet future needs. A prerequisite for the effective provision of evidence for policy is closer dialogue between the scientific and policy communities, recognising the need to break down the barriers of language and cultural differences.

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