All-Party Parliamentary Group on
Science and Technology in Agriculture

Notes of an Extraordinary General Meeting held on Tuesday 19 March 2019, Meeting Room Q, Portcullis House

Policy briefing: UK research shows hi-tech, intensive farming is the best way to feed the world sustainably

Present:

Members
Julian Sturdy MP (Chair)
Lord Cameron of Dillington
Baroness Rock
Lord Trees
Bill Grant MP
Viscount Ridley
Antony Bennett (pp Jo Churchill MP)

Stakeholders
Joe Brennan, nabim; Sarah Anderton, CIWEM; Kate Farmer, GO-Science; Gabrielle Laing, VPRF; Prof David Leaver, BIAC; Joe Edwards, Royal Society; Adam Speed, CPA; Teresa Dent, GWCT; Jonny Hazell, Royal Society; Daniel Kindred, ADAS; Richard Harrison, NIAB; Stuart Hammond, NFU; Andrew Marshall, British Sugar; Anthony Keeling, Elsoms Seeds; Catherine Barrett, AIC; Prof Tony Allan, Kings College London; Susan Twining, CLA; Prof Ian Boyd, Defra; Alastair Leake, GWCT; Andrew Ross, Global Garden; Carolina von der Weid, Brazilian Embassy; Helen Ferrier, NFU; Ellen Salter, Defra; Jonathan Carruthers, RSB; Daniel Pearsall, Group Co-ordinator

1. Introduction & EGM

Julian Sturdy MP (JS) welcomed Members and Stakeholders to the meeting, noting that the requirement for the Group to hold an Extraordinary General Meeting had been triggered following the recent decision by Vice-Chair Angela Smith MP to resign from the Labour Party. While Angela Smith remained an officer of the Group, compliance with APPG rules requiring at least one officer to be from the main opposition party meant that a replacement officer from the Labour Party had to be elected. JS informed the meeting that Baroness Jones of Whitchurch, Labour spokesperson on Environment, Food and Rural Affairs in the House of Lords, had been nominated for election by the Earl of Selborne. Baroness Jones' election as a new Vice-Chair of the Group was supported by all Members present.

JS briefly introduced the topic for discussion, which followed the publication last autumn in the scientific journal *Nature* of new research led by UK scientists suggesting that hi-tech, intensive agriculture may be the best way to feed the world sustainably. JS highlighted the importance of this study for policy-makers as the UK faced a once-in-a-generation opportunity to design a fit-for-purpose domestic agricultural policy, balancing demands for increased productivity with the need to conserve and enhance the environment. He welcomed the study's lead authors, Professor Andrew Balmford FRS and Professor Rhys Green, and invited them to present the findings of their research.

2. Guest speakers

[Please note that all speakers' slide presentations are available to download via the meetings section of the All-Party Group web-site at www.appg-agscience.org.uk]

Professor Andrew Balmford FRS, Professor of Conservation Science, University of Cambridge

Presenting a summary of recent research by the conservation science team at Cambridge University into how best to measure the environmental impacts of different farming systems, Andrew Balmford (AB) opened by explaining how a group of scientists primarily focused on biodiversity conservation became interested in high-yield farming (agriculture with high levels of production per unit area).

AB suggested that through both the conversion of natural habitats to farming, and the greater intensification of *existing* farmland, agriculture is by far the greatest driver of species decline and extinctions - greater than over-exploitation, greater than the spread of invasive species, greater than pollution, and greater than climate change. And with the world's population set to top 10 billion and with rising per capita expectations, AB noted that global demand for food is likely to rise dramatically over this century.

While some key steps can be taken to limit that growth in demand – eg reducing food waste and encouraging a shift in richer countries towards lower consumption of animal products, AB argued that by themselves these demand-side measures will not be enough, requiring urgent and smart solutions to reconcile increased food production with biodiversity conservation.

Broadly speaking AB considered that two divergent solutions have been put forward to seek this balance between food production and environmental conservation. The approach most commonly advocated by the conservation community is land sharing, which seeks to maintain wildlife in the places where we produce food, by retaining habitat features like copses and ponds; retaining winter stubbles, keeping patchwork landscapes with many different crops in close proximity, delating the onset of cutting for silage, and reducing chemical inputs. Land sharing has received widespread political and financial support in the EU and elsewhere, but it is an approach which also typically reduces farm yields, which is why farmers often have to be paid to adopt it.

That recognition of a trade-off between farm yield (how much food we get out of a given area of farmland) and on-farm biodiversity has in turn prompted the very different idea of land-sparing linked with high-yield farming. If sharing lowers yields, then to produce the same amount of food we need more land under farming, leaving less for natural habitats. So perhaps instead we should increase yields on existing farmland, and combine that approach with sparing or even restoring large areas of high quality habitat – in a UK context patches of 10km2 or perhaps larger - elsewhere in the region.

To find out which of these approaches - or any intermediates – would be best for nature, AB explained that his team and other scientists have spent much of the past decade estimating the impacts of different farming systems through detailed fieldwork on thousands of species, on five different continents.

AB reported that the results of all that effort have been remarkably and surprisingly consistent. For very different groups of animals and plants, and regardless of whether the question is asked in India, or Ghana, Uganda, Kazakhstan, Mexico, Poland, Brazil or the UK, most species would fare least badly under land sparing rather than land sharing, provided high yield production is linked to restoring large tracts of habitat elsewhere in the region.

But AB noted that high-yield agriculture is often linked with many other environmental issues, eg in terms of greenhouse gas emissions, soil loss, water use, nutrient run-off and so on – what economists term externalities. His research therefore also sought to examine whether high yield farming systems also impose unacceptable environmental costs in other ways.

AB explained that comparing externalities across higher- and lower-yielding systems involved an inherent challenge, which is that most studies compare those impacts per unit area of farmland. However, if the systems compared differ in yields, this approach will inevitably overestimate the environmental costs of high-yielding systems which need less land to produce the same amount of food. He suggested instead that to compare different systems properly it made sense to compare total, life-cycle costs not per unit of farm area but per unit of farm production.

If popular wisdom is correct, AB suggested that we would expect higher-yielding systems with lower land costs to be associated with greater externality costs per unit of production, so that producing a tonne of milk on a small area of land should create more nutrient run-off, for example, than producing it at lower yield on a larger area.

However, AB suggested that the pattern is more complex, revealing some really undesirable systems with both high land and high externality costs, and some systems offering low land costs at a low environmental price.

AB explained that his group assembled a team of agriculture and externality experts to extract the available data on how the generation of key externalities varies with land costs across different ways of producing the same commodities in the same place, in two UK and two international farm sectors.

AB noted that data sets measuring yield and externalities are relatively thin on the ground, and for arable systems the patterns are quite variable. But for Brazilian beef production and UK dairy production there is a clear and consistent relationship between high yield systems and reduced environmental impacts.

In summary, AB noted the following key points. First, faced with rising demand for agricultural products it seems most wild species, in every part of the world that has been thoroughly investigated, would fare less badly by adopting high-yield production methods provided these are linked to sparing or restoring remaining habitats for nature. Through this approach, high-yield farming can be key to delivering biodiversity conservation.

Second, high-yield production raises important societal concerns in terms of other environmental impacts. To assess these will require information on different systems describing environmental impacts per unit production – but unfortunately these data are few and far between.

However, AB suggested that the data currently available suggest that high-yield farming, which is essential to make space for biodiversity, may not be as ubiquitously associated with higher environmental costs as is sometimes perceived. Comparing environmental costs per unit of production should provide the norm both in terms of policy development and impact assessment and in R&D to develop yardsticks against which to evaluate future technological developments.

Professor Rhys Green, Honorary Professor of Conservation Science, University of Cambridge

Rhys Green (RG) noted that while the conservation research group's interest in high-yield farming was first concerned with its potential importance for biodiversity, the framework

developed could also be applied to trade-offs between agriculture and other outcomes, such as greenhouse gas emissions.

RG explained that under the Climate Change Act 2008 it is the duty of the Secretary of State to ensure that the net UK carbon account for the year 2050 is at least 80% lower than the 1990 baseline, measured in terms of the aggregate of net emissions of CO2 and net emissions of other greenhouse gases. This 80% reduction applies to all sectors, one of which is agriculture, which is responsible for roughly one tenth of all UK GHG emissions.

RG noted that in 2011, the Royal Society concluded that this 80% reduction target was largely impossible through feasible changes in on-farm practice like more efficient tractors, less fertiliser, and so on. Could land sparing - yield increases on farmed land combined with habitat restoration elsewhere - help to close the gap?

He outlined research, led by research student at the time Anthony Lamb and published in Nature Climate Change in 2016, which posed a different question to that asked by the Royal Society report. Instead of investigating whether changes in on-farm practice could achieve the GHG reduction, this study asked whether it could do so when combined with off-farm action, eg through sequestration of carbon growing non-crop vegetation like woodland and wetlands on land not being farmed that is spared because of the adoption of high-yielding agriculture.

RG explained that the first step was to project UK food demand in 2050 based on expected changes in population (increase of 26%) and changing per capita demand for individual products. This indicated a 38% increase in the production of farm products (including biofuels) between 2010 and 2050.

Drawing together a team of experts on agriculture and greenhouse gas emissions indicsated that even in the UK there is very substantial scope for further increasing arable yields, and increasing how efficiently livestock convert feed into meat and dairy. A reasonable upper bound estimate, based on existing knowledge, is that production per unit area could increase by a total of 52% by 2050 compared 2010 across all products - equivalent to an increase of 1.3% per year - although obviously the actual outcomes would depend on the rate of innovation and the effects of investment and regulation..

In this case increasing yield has the potential to greatly reduce on-farm emissions in large part because more efficient feed conversion means less methane is emitted per kilo of meat or litre of milk produced. But even more strikingly, the yield gains would rule out the need for land conversion, even while meeting the increased demand for agricultural products. If yield could be increased enough this would allow sufficient land to be taken out of production to reverse the land use conversion effect by allowing forest and wetland cover to increase from ~13% to ~30% of the UK countryside – close to the figure for Germany.

Carbon sequestration on that spared land, coupled with the reduction in on-farm emissions, could potentially bring total emissions from agriculture down to ~20% of 1990 levels, alongside having other major benefits - for biodiversity, for flood control, and so on.

Returning to the results presented earlier by AB on externality costs per tonne of product in relation to land cost (area required per tonne), RG noted that including the effects of land use on emissions transforms the previously mixed patterns to strongly and universally positive for high-yield cost options in terms of GHG cost per tonne of product.

In conclusion, RG noted that high-yield farming could potentially meet increased UK demand for agricultural products and spare land to grow unharvested non-crop plants (such as trees) that would sequester carbon long-term.

Modelling indicates that projected yield increases for UK crops and livestock could allow net GHG emissions from agriculture to decline by 80% between 1990 and 2050, as required by the Climate Change Act 2008. This would require land sparing for non-crop vegetation and yield increases by 2050 near the top end of the plausible range.

Taking into account the potential for establishing or conserving carbon sequestering non-crop vegetation on land spared by high-yield farming has a marked effect on net GHG emissions per tonne of product in favour of high-yield farming methods. Even without this effect, high-yield farming methods do not always have high environmental costs per tonne of product.

RG added that linking the promotion of high-yield but low-externality cost farming to large-scale establishment of non-crop vegetation on other land could deliver the benefits of land sparing, but this would require policy mechanisms not yet in existence.

Viscount Ridley, House of Lords

Matt Ridley (MR) indicated that he had been following the sustainable intensification debate between land sparing and land sharing for some time, and was particularly struck by this landmark publication and research. MR suggested it makes eminent sense in global terms to be as productive as possible on the land we use to spare land for wildlife, he acknowledged that this approach goes against the grain of conventional wisdom and would not be an easy sell to environmentalists.

Taken to its extreme, MR observed that if we could grow all our food indoors using LED lighting – replicating the Japanese systems growing lettuce heads at 300 times the density of outdoor farms, with lower water use, less pesticides etc – then the entire world could be fed from a farm the size of Wales, leaving the rest of the land for wildlife reserves and recreation.

Put another way, between 1960 and 2010, averaged across all crops according to how much they contribute to diet, MR noted that the amount of land needed to produce a given amount of food reduced by 68%, an incredible change in the density of food production – achieved over a period in which famine largely disappeared except where it was caused by politicians, and nature reserves grew in size – and despite a doubling of the world's human population.

Today we are using around 38% of the world's land surface for farming – if we were still producing at the average yields of 1960 it would require over 80% of the land to produce the same amount of food. MR suggested that advanced farming techniques and innovative technologies are clearly contributing to this reduced demand for land. Farming without GM crops, for example, would require another 762,000ha under the plough.

To add to this concept these latest research findings that the externalities of higher yielding farming systems are better or at least not worse, and that the spared land could be used for carbon sequestration, really swings this long-running debate in favour of land sparing.

MR noted that one of the challenges facing politicians and policy-makers at a national level would be to understand and establish the scale at which land sparing would be practicable in the UK, and also how integrate it into policy to ensure spared land is used to best effect. For example, a recent paper he had produced for the Institute of Economic Affairs with a colleague David Hill had discussed the specific concept of environment banking, effectively providing a licence to double yields in one area by rewilding land somewhere else.

3. Questions and discussion

The following key points arose during questions and discussion:

The importance of conducting quantitative studies to understand how the public would appreciate the aesthetic, amenity and recreational value of the spared land, and how they want to use and enjoy the environment.

A recognition that implementing policies to generate yield increases in the UK would involve political trade-offs, eg adopting new technologies not currently in use, such as GM crops, or reversing political decisions taken on environmental grounds, such as the withdrawal of neonicotinoid seed treatments.

While the research suggests that in terms of conserving biodiversity and reducing carbon emissions it would be better to farm in blocks, the reality is that the existing landscape must also be regarded as an important externality valued by the public. Some parts of the UK may be more or less adaptable to a land sparing approach and the adoption of high input, high output production systems.

While there may be a perception that most UK farmland is already farmed intensively, the consensus among agricultural experts consulted as part of the research was that the potential exists to increase yields by 50% over the next 40 years. This could make a significant difference to conservation of biodiversity and ecosystem services such as carbon sequestration, eg enabling UK woodland cover to increase from 13% to 30%.

The need to ensure a move to promote increased yields is economically sustainable for farmers and does not simply depress prices.

The need to establish an economic model and functioning market place which values environmental goods and services in the same way as agricultural products.

The importance of understanding how a land sparing approach might affect other aspects of biodiversity, eg soil microorganisms.

Concluding the meeting, JS thanked guest speakers and attendees for their contribution to an informative and thought-provoking session on the importance of high-yielding, science-based agriculture in addressing long-term food security and sustainable development objectives, and the implications for the development of a future domestic agricultural policy.