

## **Response from the Royal Society of Biology to Defra’s consultation on “Health and Harmony: the future for food, farming and the environment in a Green Brexit”**

**May 2018**

*The Royal Society of Biology (RSB) is a single unified voice, representing a diverse membership of individuals, learned societies and other organisations. We are committed to ensuring that we provide Government and other policymakers, including funders of biological education and research, with a distinct point of access to authoritative, independent, and evidence-based opinion, representative of the widest range of bioscience disciplines.*

The Royal Society of Biology welcomes this consultation and is pleased to provide summary comments informed by our membership of individuals and organisations with expert interests across the biosciences:

### **Summary**

1. The proposed development of a land management system that places environmental resources at its core is particularly welcomed. The notion of public goods and services hinges on the recognition of the impact of agriculture on the wider environment, particularly on biodiversity, from which humans derive multiple ecosystem services, including health benefits and risks.
2. To be successful, Government’s policies must consider the proposed agricultural and environmental outcomes comprehensively, as part of a complex and interrelated system. To this end, biodiversity must be considered at all levels, including that of the microbiome.
3. In addition to environmental outcomes, Government’s focus on plant health, and animal health and welfare is crucial and can yield concrete advances through research, the use of innovative technologies, and better-informed consumers. The importance of well-informed policy in these areas for optimum public health and wellbeing cannot be understated.

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4. Government must meet future challenges for biosecurity by maintaining a key role in oversight of issues of plant and animal health, in collaboration with authorities in Europe and the rest of the world.
5. Knowledge transfer and the upskilling of the workforce are key for realising Government's ambitions to enable agricultural development. The delivery of professionally qualified and independent expert advice on a number of biologically relevant areas should be integrated with experience, local knowledge and the creative enterprise of farmers and land managers.
6. Government can further support the upskilling of the workforce by focusing on defined education priorities, closing existing and emerging skills gaps and by supporting quality standards across the sector through accreditation of all relevant education and training routes, and continuing professional development through the promotion of professional registers.
7. Areas of agricultural research and development in need of support are highlighted in detail in our full response, as is the need for a whole-systems approach that tackles different interconnected phenomena and a long-term vision for how science in this area is funded. Fundamental, 'blue skies' research plays a central role in driving innovation. Concomitantly, direct support by Government and levy-funded bodies to applied and translational research can overcome the barriers to innovation in farming and the adoption of new technologies and solutions.
8. The delivery of a new Agriculture Bill and the review of relevant regulatory frameworks can enable the realization of the full potential of the proposed measures.

## Reform of the current CAP, stewardship, direct payments and the agricultural transition period

1. Many of the points made in our position statement in response to reform of the Common Agricultural Policy (CAP) in April 2011 are still relevant today<sup>1</sup>.
2. A renewed land management system must achieve a balance, where sufficient land is used predominantly to generate agricultural commodities, aiming at improved outputs, care for animal welfare, minimal pollution, and lower inputs; and land is also managed to provide a greater range of public goods. We agree with the Convention on Biological Diversity, which requires that “[i]ncentives, including subsidies, harmful to biodiversity should be eliminated, phased out or reformed”.<sup>2</sup> When implementing measures to avoid harm to biodiversity, we should also aim to avoid harm to the evolutionary potential and productive capacity associated with biodiversity.
3. Below, we analyse several factors that contribute to the complexities of the current, and future UK land management system. Government may want to consider these, and the supporting evidence we provide, while shaping its vision for the future of agriculture in the UK. Considering the wide variety of needs across society, expert and up-to-date data will be vital. Sound evidence of attribution and expert assessment will be needed to underpin any principles in action, and their inevitable challenge, in a concerted manner with the relevant farming communities. It is vital that there is a continuous and robust determination to ensure research and expert consultation is undertaken to extend the evidence base for policy, implementation and assessment.<sup>3</sup>

### *One measure will not fit all:*

4. There is a variety of existing farm types and sizes, rural settings and potential alternative production models available. To support the diverse use of resources, Government should consider the opportunity to adjust to a more sustainable mode of land management, e.g. related to the delivery of biodiversity and the development and support of sustainable, locally-adapted systems of production. In formulating future income policies, recognition should be given to the importance of rewarding and supporting outputs related to the type of farming, and the associated estimated economic impact and in terms of public health and environmental resources – also referred to as public goods in the Defra command paper.
5. Despite the level of variation between farms, our members generally agree that a reformed CAP system should enable farm-level support, based on the following points:

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<sup>1</sup> Society of Biology, April (2011). Position Statement on Reform of the Common Agricultural Policy (CAP). URL: <https://www.rsb.org.uk/images/6sb-cap-briefing-paper.pdf>

<sup>2</sup> Derived from the Royal Society of Biology, then Society of Biology, April 2011. Position Statement on Reform of the Common Agricultural Policy (CAP). URL: <https://www.rsb.org.uk/images/6sb-cap-briefing-paper.pdf>

<sup>3</sup> Response from the Royal Society of Biology to the Environmental Audit Committee inquiry into the Government's 25 Year Plan for the Environment, February 2018; URL: [https://www.rsb.org.uk/images/RSB\\_response\\_25\\_Year\\_Environment\\_Plan\\_inquiry\\_Submitted.pdf](https://www.rsb.org.uk/images/RSB_response_25_Year_Environment_Plan_inquiry_Submitted.pdf)

- 5.1. Within food production, farmers have the greatest direct environmental interaction; their decisions are key to effective environmental measures.
- 5.2. A sudden shift of subsidies to a different model of food production may lead to unintended consequences.
- 5.3. The UK National Ecosystem Assessment Follow-on (UK NEAFO) has shown that ‘the most effective response options in agriculture are those that develop and disseminate knowledge, technology and practice because these appear to support the delivery of ecosystem services under all scenarios, to a greater or lesser extent. Such response options include appropriate agri-environment schemes or payments for ecosystem services (PES) schemes’<sup>4</sup>.

### **Public money for public goods**

#### *Public goods in general:*

6. Agriculture should supply a wide range of goods and services beyond the production of food and non-food commodities. These include social benefits such as employment, social and cultural benefits, and environmental benefits including landscape management, increased biodiversity, water purification, flood protection, the maintenance of fertile soils and carbon storage, avoidance of environmental toxins, provision of a health-supporting environment, among others.

#### *Financing and governance mechanisms:*

7. There are many opportunities for the UK to deliver environmental benefits through its own mechanisms, for instance through food chain governance, where a principle of ‘public money for public goods’ could be beneficial or by direct support to producers providing higher value food products – for example through Stewardship Payments for higher welfare standards. In addition, the ‘polluter pays’ principle, with an emphasis on an ‘extended producer responsibility’ strategy could provide an effective and fair underpinning for future policymaking, and, combined with a greater emphasis on consumer responsibility, could deliver environmental benefits.
8. Additionally, intervention on the consumers’ side will require cooperation within the agriculture sector to develop information and labelling schemes to improve consumers’ ability to identify higher quality products – with higher quality related to best practice in environmental welfare, conservation and environmental preservation through the supply chain.

#### *Key environmental outcomes are interrelated:*

9. A new environmental land management scheme should tackle all the proposed key

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<sup>4</sup> UK National Ecosystem Assessment Follow-on (2014): Synthesis of the Key Findings. UNEP-WCMC, LWEC, UK. Page 45. URL: <http://uknea.unep-wcmc.org/LinkClick.aspx?fileticket=5L6%2fu%2b%2frKKA%3d&tabid=82>

environmental objectives holistically, as part of an interrelated system, regardless of complexity. Soil health, water quality, air quality, biodiversity, climate change mitigation and engagement with the natural environment are all important, and would all benefit from potential management schemes as anticipated in the Government's 25 Year Environment Plan<sup>5</sup>.

10. For example, the preservation of soil health should entail careful control of inputs (i.e. fertilisers and pesticides) and balanced land management, through maintaining water quality by reducing run-off of these chemicals from the land into water courses. Furthermore, increased biodiversity (in addition to environmental protection) is directly related to habitat restoration – as it has been noted that “the most important direct drivers of biodiversity loss and ecosystem service changes are habitat change (such as land use changes, physical modification of rivers or water withdrawal from rivers [...]), climate change, invasive alien species, overexploitation, and pollution”<sup>6</sup>.

*Synergy across sectors:*

11. We also advise that nutritional security (an alternative descriptive measure for food security, and with relation to minimising waste in food production and consumption) should be considered as a public good, particularly in the case of staple goods, which should be affordable across society.<sup>7</sup> If considered a public good, nutritional security would “be non-rival, non-excludable and valued by the individual”<sup>8</sup>.
12. The UN sustainable development goals (SDGs)<sup>9</sup> include improving food security, nutrition and water quality whilst protecting ecosystems on land and in water. Intrinsicly linked to this there is a need to realign the goals of food and agricultural policy in light of the changing patterns of dietary habits, choice and requirements, and the evidence of proven links between nutrition and many of the most common human diseases. As a member state of the WHO European Region, the UK has agreed on the WHO Health 2020 common policy framework<sup>10</sup>, which frames human health and wellbeing as core public goods, and aims to “significantly improve the health and wellbeing of populations, reduce health inequalities, strengthen public health and ensure people-centred health systems that are universal, equitable, sustainable and of high quality”.

<sup>5</sup> Department for Environment, Food and Rural Affairs, (2018). 25 Year Environment Plan. Page 37. URL:

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/693158/25-year-environment-plan.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/693158/25-year-environment-plan.pdf)

<sup>6</sup> Millennium Ecosystem Assessment (2005a) Ecosystems and Human Well-being: Biodiversity Synthesis. World Resources Institute, Washington, DC. Available online at <https://www.millenniumassessment.org/documents/document.354.aspx.pdf>

<sup>7</sup> As signatory to the *International Covenant on Economic, Social and Cultural Rights (ICESCR 1966)*<sup>7</sup>, Britain guarantees a right to food. The document also includes an obligation for countries “to improve methods of production, conservation and distribution of food by making full use of technical and scientific knowledge, by disseminating knowledge of the principles of nutrition and by developing or reforming agrarian systems in such a way as to achieve the most efficient development and utilization of natural resources.” As such, food availability should be supported by Government as a fundamental public good, whose provision is a public obligation.

<sup>8</sup> Burrell (2011) Evaluating Policies for Delivering Agri-environmental Public Goods. OECD Workshop on the Evaluation of Agri-environmental Policies, Braunschweig, Germany, 20th June 2011. Available online at <https://www.oecd.org/tad/sustainable-agriculture/48185525.pdf>

<sup>9</sup> UN Sustainable Development Goals Knowledge Platform; Website URL: <https://sustainabledevelopment.un.org/?menu=1300>

<sup>10</sup> World Health Organization – Europe (2015). Report: Health 2020: Agriculture and health through food safety and nutrition. URL:

[http://www.euro.who.int/\\_data/assets/pdf\\_file/0016/324610/Health-2020-Agriculture-and-health-through-food-safety-and-nutrition-en.pdf?ua=1](http://www.euro.who.int/_data/assets/pdf_file/0016/324610/Health-2020-Agriculture-and-health-through-food-safety-and-nutrition-en.pdf?ua=1);  
Website: <http://www.euro.who.int/en/health-topics/health-policy/health-2020-the-european-policy-for-health-and-well-being>

The framework holds particular focus on decreasing disease related to unhealthy diets in European populations (such as “cardiovascular disease, cancer, diabetes and chronic respiratory diseases and their behavioural risk factors”<sup>11</sup>) and on tackling new and re-emerging infectious diseases, including those related to the issue of antimicrobial resistance, through synergy between agriculture and public health sectors, enabling food safety and nutrition.

13. The RSB recommends that the future Agriculture Bill should aim to align with this integrated policy approach to incentivise sustainable food systems that deliver nutritional security of direct benefit to the health and welfare of current and future human populations<sup>12</sup>. The biosciences are central to at least half of the SDGs, including ensuring health and access to food security<sup>13</sup> and the SDGs could provide a guiding principle for the future Agriculture Bill, setting out pathways to progress for national and global impact. This progress should be measured and monitored.<sup>14</sup> Maintaining links with international efforts, such as the WHO Health 2020 policy framework, which promote collaboration in tackling the SDGs, should act to further strengthen efforts in England and the UK in general, through facilitating exchange of current expertise and best practice<sup>15</sup>.

*An approach that takes account of ecosystem services:*

14. The extended economic and societal value of environmental outcomes stems from the fact that they provide us with ecosystem services - “the benefits people obtain from ecosystems”<sup>16</sup>. They are also major components of a country’s natural capital. Natural capital is another term for “the stock of renewable and non-renewable resources (e.g. plants, animals, air, water, soils, and minerals) that combine to yield a flow of benefits to people”<sup>17</sup>.
15. In light of the ecosystem services they provide, we emphasize that:
- 15.1. Biodiversity is critically important for human survival and well-being. Decline and loss in biodiversity is considered among the biggest threats to our species, because of the way biodiversity affects the properties of ecosystems, on which humans critically rely<sup>18,19</sup>. We highlight threats to biodiversity – for different species, e.g. microorganisms, insects or

<sup>11</sup> World Health Organization – Europe (2015). Report: Health 2020: Agriculture and health through food safety and nutrition. URL: [http://www.euro.who.int/\\_data/assets/pdf\\_file/0016/324610/Health-2020-Agriculture-and-health-through-food-safety-and-nutrition-en.pdf?ua=1](http://www.euro.who.int/_data/assets/pdf_file/0016/324610/Health-2020-Agriculture-and-health-through-food-safety-and-nutrition-en.pdf?ua=1); Website: <http://www.euro.who.int/en/health-topics/health-policy/health-2020-the-european-policy-for-health-and-well-being>

<sup>12</sup> Response from the Royal Society of Biology to the Environmental Audit Committee inquiry into the Government’s 25 Year Plan for the Environment, February 2018; URL: [https://www.rsb.org.uk/images/RSB\\_response\\_25\\_Year\\_Environment\\_Plan\\_inquiry\\_Submitted.pdf](https://www.rsb.org.uk/images/RSB_response_25_Year_Environment_Plan_inquiry_Submitted.pdf)

<sup>13</sup> El-Chichakli 2016. Five cornerstones of a global bioeconomy. Nature 535: 221-223.

<sup>14</sup> Royal Society of Biology response to the BEIS consultation on the UK Bioeconomy January 2017; URL

[https://www.rsb.org.uk/images/RSB\\_response\\_to\\_the\\_BEIS\\_Bioeconomy\\_consultation\\_Final\\_response.pdf](https://www.rsb.org.uk/images/RSB_response_to_the_BEIS_Bioeconomy_consultation_Final_response.pdf)

<sup>15</sup> Royal Society of Biology, 2018. [RSB response to the Science and Technology Committee of the Commons Brexit science and innovation Summit inquiry](#)

<sup>16</sup> Millennium Ecosystem Assessment (2005a) Ecosystems and Human Well-being: Biodiversity Synthesis. World Resources Institute, Washington, DC. Available online at <https://www.millenniumassessment.org/documents/document.354.aspx.pdf>

<sup>17</sup> Natural Capital Coalition, What is natural capital? Available online at <https://naturalcapitalcoalition.org/natural-capital/>

<sup>18</sup> Diaz, S. et al. (2006). Biodiversity Loss Threatens Human Well-Being. PLoS Biol 4(8), pp. 1300-1305. URL:

<http://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.0040277>

<sup>19</sup> Sandifer, P.A. et al. (2015). Exploring connections among nature, biodiversity, ecosystem services, and human health and well-being: Opportunities to enhance health and biodiversity conservation. Ecosystem Services 12, pp. 1-15. URL:

<https://www.sciencedirect.com/science/article/pii/S2212041614001648>

vertebrates – at several points in our response and point out its potential economic impact in paragraphs 27 to 29.

- 15.2. Aspects of the landscape, such as hedgerows, and complex existing ecosystems, such as those in ancient woodland, should be included in a broad definition of public goods, which affords them maximum protection through appropriate policies. Natural stable ecosystems help to provide “a healthy physical environment, such as clean air and water” or “protection against natural and human induced disasters”<sup>20</sup>, by stabilising soil and preventing erosion.
- 15.3. Ensuring beneficial outcomes of dwelling and business developments for local people and biota could bring real efficiency in ordinary times and mitigate damage in extraordinary circumstances such as unusual weather when temperature and water management are key health concerns.
- 15.4. Humans benefit from these elements of the landscape in terms of both culture, and well-being. Benefits of nature on health and wellbeing range from reduction in stress and stress-related physiological parameters to positive effects on mood, immunity, psychological wellbeing, and the promotion of a more physically active lifestyle. The effectiveness of natural environments in promoting health and wellbeing has important implications for a wide range of sectors, including public health, health and social care, environmental conservation and management, and urban design<sup>21</sup>. Defra has also recently taken into consideration the implications of using the natural environment to promote good health and wellbeing for current and future policy and delivery<sup>22</sup>.

*The impact of agriculture on biodiversity must be considered at all levels, including that of the microbiome:*

16. Biodiversity loss<sup>23</sup> is projected to reach 38-46% by 2050. The strongest drivers of biodiversity loss to date have been agriculture, followed by forestry, infrastructure, urban encroachment and climate change. In the 2020-2050 period, climate change, crop agriculture and infrastructure development are expected to be the drivers of biodiversity loss with the greatest projected increase<sup>24</sup>. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), which comprises of 129 member governments and provides policymakers with objective scientific assessments about the state of knowledge regarding the planet’s biodiversity, has recently published a regional assessment of biodiversity and ecosystem services for Europe and Central Asia. Their report states: “the biodiversity of Europe

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<sup>20</sup> JNCC, Ecosystem Services, Available online at <http://jncc.defra.gov.uk/default.aspx?page=6382>

<sup>21</sup> The Wildlife Trusts and University of Exeter, (2015). Wellbeing benefits from natural environments rich in wildlife. URL: <https://www.wildlifetrusts.org/sites/default/files/wellbeing-benefits-fr-nat-env-report-290915-final-lo.pdf>

<sup>22</sup> Defra evidence statement on the links between natural environments and human health, (2017). URL: <https://beyondgreenspace.net/2017/03/09/defra-evidence-statement-on-the-links-between-natural-environments-and-human-health/>

<sup>23</sup> For global figures about the threat of extinction we refer to the IUCN Red List of Threatened Species. Their website states that ‘biodiversity is declining. Currently there are more than 79,800 species on The IUCN Red List, and more than 23,000 are threatened with extinction, including 41% of amphibians, 34% of conifers, 33% of reef building corals, 25% of mammals and 13% of birds’. URL: <https://www.iucn.org/theme/species/our-work/iucn-red-list-threatened-species>

<sup>24</sup> Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), (2018). Worsening Worldwide Land Degradation Now ‘Critical’, Undermining Well-Being of 3.2 Billion People [Press Release]. URL: <https://www.ipbes.net/news/media-release-worsening-worldwide-land-degradation-now-%E2%80%98critical%E2%80%99-undermining-well-being-32>

and Central Asia is in continuous strong decline. The extent of natural ecosystems has declined, e.g., wetland extent has declined by 50 per cent since 1970 and natural and semi-natural grasslands, peatlands and coastal marine habitats have been degraded. Ecosystems have considerably declined in terms of species diversity. Of the assessed species living exclusively in Europe and Central Asia, 28 % are threatened. Among all the assessed groups of species living in the region, particularly threatened are mosses and liverworts (50 %), freshwater fish (37 %), freshwater snails (33 %), vascular plants (33 %) and amphibians (23 %). Landscapes and seascapes have become more uniform in their species composition and thus their diversity has declined”<sup>25</sup>. Agriculture critically relies on biodiversity and ecosystem services, as well as influencing them. The same report by IPBES remarks that “land-use change is the major direct driver of the loss of both biodiversity and ecosystem services in Europe and Central Asia. Production-based subsidies have led to intensification in agriculture and forestry, and, together with urban development, have led to biodiversity decline. Increasing intensity often impinges on traditional land use. Ceasing traditional land use has reduced semi-natural habitats of high conservation value and associated indigenous and local knowledge, practices and culture across the region. Although protected areas have expanded in the region, protected areas alone cannot prevent biodiversity loss. Only where protected areas are managed effectively can they contribute to the prevention of biodiversity loss”<sup>26</sup>. Therefore, the future of farming in the UK should ensure that biodiversity and ecosystem services at all levels are safeguarded, economic as well as practice measures will be determining.

17. Further to this, microorganisms (e.g. bacteria, fungi and viruses) in soil, water and the air represent one of the most abundant and diverse groups of organisms on Earth. One gram of soil has been estimated to contain 1 billion bacteria cells, representing 10,000s of different types. These organisms help shape surrounding ecosystems<sup>27</sup>, and have a significant impact on crop productivity through factors such as: cycling nutrients (e.g. nitrogen and phosphate), which are essential for plant growth and 'fixing' (capturing) atmospheric carbon dioxide; and beneficial interactions with plants to enhance uptake of minerals and resist pests.

18. Intensive agricultural processes and other industrial activities significantly affect these microbial communities. Heavy metals from industrial waste and pesticide/fungicide residues can persist in the environment and have been shown to negatively impact the health and

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<sup>25</sup> Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), (2018). Summary for policymakers of the regional assessment report on biodiversity and ecosystem services for Europe and Central Asia of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. Page 2. URL:

[https://www.ipbes.net/sites/default/files/downloads/spm\\_eca\\_unedited\\_advance\\_28march2018.pdf](https://www.ipbes.net/sites/default/files/downloads/spm_eca_unedited_advance_28march2018.pdf)

<sup>26</sup> Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), (2018). Summary for policymakers of the regional assessment report on biodiversity and ecosystem services for Europe and Central Asia of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. Page 3. URL:

[https://www.ipbes.net/sites/default/files/downloads/spm\\_eca\\_unedited\\_advance\\_28march2018.pdf](https://www.ipbes.net/sites/default/files/downloads/spm_eca_unedited_advance_28march2018.pdf)

<sup>27</sup> Bardgett, R.D. and van der Putten, W.H. (2014). Belowground biodiversity and ecosystem functioning. *Nature* 515, pp. 505–511. URL: <https://www.nature.com/articles/nature13855>



function of soil microbes (although biopesticide use may be one way forward)<sup>28,29</sup>. Measuring and maintaining a soil ecosystem rich in microbial diversity is therefore integral to supporting local ecosystems and to sustainable, productive agriculture.

*A focus on biosecurity, better animal and plant health and animal welfare:*

19. The Society supports high standards of animal health and welfare, and the protection of crops, tree, plant and bee health as fundamental public goods. We have addressed these important topics in a number of responses to previous consultation and inquiries. We will provide reference to them and summarise additional key messages below.

20. **Biosecurity:** Failure to provide adequate support and protection will have direct impact on national biosecurity for the UK and other nations, with direct impact on public health and the economy. The response from the RSB to the House of Lords EU Energy and Environment Sub-Committee call for evidence on Brexit: plant and animal biosecurity provides a summary of our recommendations in relation to this issue<sup>30</sup>. Issues highlighted included supporting research, surveillance, infrastructures and international collaborations needed to understand, track and control infectious disease risks that threaten animal health and food security and safety.<sup>31</sup> Our membership strongly contends that epidemiological issues should remain in the effective purview of the UK Government. This is because they involve strategic, crosscutting issues with a global reach (e.g. Foot and Mouth Disease outbreaks in livestock can have far-reaching economic effects, in addition to effects on animal welfare) and the potential to undermine economic, social and ecological stability. Significant disease outbreaks and potential epidemics require effective management, or at least support of their management, by Government. The surveillance, prevention and control of plant and tree pests and diseases stands to benefit from development of cohesive systems of surveillance, prevention and control. Such systems could be based on a tiered response which could involve:

- 20.1. Low-level intervention, including a digital information platform to enable publicly accessible tracking/ visualising/ surveillance of outbreaks. This could make use of the existing institutions.
- 20.2. Mid-level intervention could include support for coordinating measures among affected businesses, homes and people. This partly already exists at least for some plant diseases in form of contingency plans with Defra or the Forestry Commission.

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<sup>28</sup> Chu, D. (2018). Effects of heavy metals on soil microbial community. IOP Conf. Ser.: Earth Environ. Sci. 113 012009. URL: <http://iopscience.iop.org/article/10.1088/1755-1315/113/1/012009>

<sup>29</sup> Shao, H. and Zhang, Y. (2017). Non-target effects on soil microbial parameters of the synthetic pesticide carbendazim with the biopesticides cantharidin and norcantharidin. Scientific Reports, 7. Article number: 5521. URL: <https://www.nature.com/articles/s41598-017-05923-8>

<sup>30</sup> Please find our response to the House of Lords EU Energy and Environment Sub-Committee inquiry on Brexit: plant and animal biosecurity attached alongside our electronic submission of the RSB response to Defra's consultation on "Health and Harmony: the future for food, farming and the environment in a Green Brexit". Our response to the EU Energy and Environment Sub-Committee has been provided prior to formal publication of evidence, with the permission of the Sub-Committee.

<sup>31</sup> The Microbiology Society (a member organisation of the RSB) also provided response to the House of Lords EU Energy and Environment Sub-Committee call for evidence on Brexit: plant and animal biosecurity. In its response, the Society highlighted a number of areas of importance for the Government to promote animal and plant biosecurity in relation to infectious diseases and the global challenge of antimicrobial resistance, particularly in light of Brexit.

- 20.3. High-level intervention could include enforcement and controls of on the ground measures, including contingency plans for eradication programmes.
21. In conclusion, capabilities exist. There is potential for compiling relevant information in one single, accessible, and appropriately funded platform, to guide citizens to the necessary resources. Defra has a Plant Health Portal<sup>32</sup> that could be expanded and more widely advertised, including, for example, reference to existing advisory services.
22. Government strategy in relation to livestock and poultry disease outbreaks is currently generally effective and efficient, having relatively recently been tested and refined by Foot and Mouth Disease outbreaks in 2001 and 2007 and by the almost annual occurrence of avian influenza outbreaks in domestic poultry, linked to seasonal migration patterns in wildfowl – for example. Constant refinement of integrated systems is required in order to maintain and develop these systems as livestock production systems, disease threats- and the technology available to detect them efficiently and effectively using limited resources- all evolve.
23. Animal Health and Welfare: In the RSB response to the Defra proposed draft Animal Welfare (Sentencing and Recognition of Sentience) Bill<sup>33</sup>, we welcomed Government’s commitment to high standards of animal welfare and stressed the importance of supporting biological research in neurobiology, ethology and veterinary science, among others, to ground welfare decisions solidly on scientific evidence. Equally, we recognise the importance of public interest with regard to animal welfare. We also support the view that more should be done to inform the public about species and setting-dependent welfare needs. Additionally, we propose here that clear labelling of food – in relation to welfare standards of animal rearing, transport and slaughter – is an essential element to empower the public to make choices in support of best practice at the point of purchase, and will be instrumental to policies by which Government pays regard to public interest.
24. In relation to crop, tree, and plant health - industry, woodland owners and others who respond collaboratively to biosecurity risks and outbreaks of priority pests and diseases in trees should be supported in this role, and in their roles related to landscape recovery and enactment of biosecurity protocols in business and supply work. For example, activities in the UK related to Chalara Ash Dieback have included the genetic analysis of a disease-resistant tree. Such research is important in the development of resilient trees, which can be used to maintain the landscape, and similar programmes of research and innovation should be maintained. Additionally, the emergence of an integrated pest management (IPM) system, championed by the European Union (EU), must be followed by a more mature understanding on how different

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<sup>32</sup> <https://planthealthportal.defra.gov.uk/>

<sup>33</sup> The response from the Royal Society of Biology to the Defra consultation on the draft Animal Welfare (Sentencing and Recognition of Sentience) Bill, February 2018; URL:

[https://www.rsb.org.uk/images/RSB\\_response\\_Defra\\_draft\\_Animal\\_Welfare\\_Sentencing\\_and\\_Recognition\\_of\\_Sentience\\_Bill.pdf](https://www.rsb.org.uk/images/RSB_response_Defra_draft_Animal_Welfare_Sentencing_and_Recognition_of_Sentience_Bill.pdf)

pest management elements can be combined and optimised in a truly holistic approach – something that is not fully realised. The value of supporting basic, interdisciplinary research into IPM lies in the potential to deliver a more sustainable and resilient mode of agriculture. Interestingly, breeding programmes and the employment of new technologies for plant genetics will be a key development in this field<sup>34</sup>.

**25. Bee and pollinator biodiversity:** Insects – and especially pollinating insects – feature prominently in public awareness of biodiversity declines linked to agriculture. While agriculture poses a threat to some insect populations, it also benefits from the ecosystem services provided by insect biodiversity, for instance in the pollination of some crops, and in pest control by predatory, parasitic and competing insects<sup>35</sup>. The economic value of crop pollination in the UK is estimated at around £690 million per year<sup>36</sup>. As well as increasing the quality, quantity and value of crop production, pollination is vital to maintain the diversity of foods necessary for healthy diets, given that crop plants that depend on pollinators provide large proportions of the vitamins and other nutrients in human diets<sup>37</sup>. However, recent research has revealed astonishing reductions in flying insect biomass in Germany<sup>38</sup> (a seasonal decline of 76% in flying insect biomass and a mid-summer decline in 82% over the past 27 years) and substantial declines in bee species richness in the UK and the Netherlands<sup>39</sup>. While these declines are potentially linked to the effects of neonicotinoid and other pesticides<sup>40</sup>, pollinators and other insects face other, interacting threats, including reductions in and degradation of suitable habitats, causing the loss of food sources and nesting sites. Pollinator-friendly farming practices must be supported to halt and reverse these declines. The spread of invasive alien species, including pathogens, presents a further, substantial risk to pollinators and their food sources<sup>41</sup>. The UK should continue to maintain strict controls on importation of bees to minimise the risks of importing disease. However, our members stress the importance of credible bee improvement programmes established in the UK and access to a regulated import of bees. Many beekeepers rely on regular small imports of honeybee queens from science-based programmes in Denmark, for example, and the UK imports tens of thousands of bumblebee colonies annually, under licence, for crop pollination and research in commercial glasshouses and polytunnels. Therefore, a generalised ban on imports of bees should be avoided, while biosecurity protected.

<sup>34</sup> Stenberg, J.A. (2017). A conceptual framework for Integrated Pest Management. *Trends in Plant Science*, 22(9), pp. 759-769. URL: <http://dx.doi.org/10.1016/j.tplants.2017.06.010>

<sup>35</sup> Gill, R.J. et al. (2016). Protecting an ecosystem service: approaches to understanding and mitigating threats to wild insect pollinators. *Advances in Ecological Research*, 54, pp. 135-206. URL: <http://nectar.northampton.ac.uk/8428/7/Gill20168428.pdf>

<sup>36</sup> Estimate published online at [https://www.reading.ac.uk/web/files/food-security/cfs\\_case\\_studies\\_-\\_sustainable\\_pollination\\_services.pdf](https://www.reading.ac.uk/web/files/food-security/cfs_case_studies_-_sustainable_pollination_services.pdf)

<sup>37</sup> Eilers et al. (2011). Contribution of Pollinator-Mediated Crops to Nutrients in the Human Food Supply. *PLoS ONE* 6(6): e21363. <https://doi.org/10.1371/journal.pone.0021363>

<sup>38</sup> Hallmann, C.A. et al. (2017). More than 75 percent decline over 27 years in total flying insect biomass in protected areas. *Plos One*, 12(10): e0185809. URL: <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0185809>

<sup>39</sup> Biesmeijer, J.C. et al. (2006). Parallel Declines in Pollinators and Insect-Pollinated Plants in Britain and the Netherlands. *Science*, 313(5785), pp. 351-354. URL: <http://science.sciencemag.org/content/313/5785/351>

<sup>40</sup> Woodcock, B.A. et al. (2017). Country-specific effects of neonicotinoid pesticides on honeybees and wild bees. *Science*, VOL 356(6345), pp. 1393-1395. URL: <http://science.sciencemag.org/content/356/6345/1393>

<sup>41</sup> Vanbergen, A.J. et al. (2018). Risks to pollinators and pollination from invasive alien species. *Nature Ecology & Evolution*, 2, pp. 16–25. URL: <https://www.nature.com/articles/s41559-017-0412-3>

## Sustainability should be key to an environmental land management system

26. To meet Government's commitments as set out in the 25 year Environment Plan, we believe there is value in looking at the evidence for the sustainability of different types of agricultural system in different conditions.

### *The hidden environmental costs of agriculture and biodiversity loss:*

27. Defra's evidence in support of the command paper highlights that agriculture uses by far the largest land area among industries<sup>42</sup>. Agricultural land use comes with significant externalities that are not adequately accounted for at present. Agricultural systems are recognised as contributing to water contamination, damage to wildlife, emissions and soil erosion, among other externalities, with food transport contributing significantly to road traffic. Recent data cited in Defra's evidence compendium gives a cost estimate of £305m for offsite soil erosion and compaction in 2010<sup>43</sup>; £3.1bn for greenhouse gas emissions<sup>44</sup> and £456m for the impact of agriculturally-produced ammonia on human health and the environment in 2015<sup>45</sup>. The continuing collection and use of these data should inform further comprehensive assessments of total externalities of UK agriculture – potentially acting as a monitoring tool during adoption of new systems and solutions. Importantly, environmental measures take time to achieve significant impact and, as a result, Government should seek to address both historic (if still relevant) and current externalities. An example of the former is the historic application of fertilisers to agricultural land, which has led to rises in nitrates in the groundwater system for many years following interventions, due to slow migration from the soil layer to the water table.<sup>46</sup> As groundwater maintains the flow of many rivers, their nitrate levels may also be affected by historical land management. It will therefore be necessary to consider and model the effects of historic pollution when monitoring progress towards cleaner waters.<sup>47</sup> It is possible that phosphorus levels may remain high in some places, even more so than nitrogen, because of the relative insolubility of phosphorus – this may not be a serious problem but it could conceivably slow the restoration of biodiversity.

28. Safeguarding of biodiversity has important economic implications, specifically because it is a key driver of a multitude of ecosystem services, such as soil erosion control, plant nutrient

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<sup>42</sup> Department for Environment, Food and Rural Affairs, (2018). The Future Farming and Environment Evidence Compendium. Page 14 URL: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/683972/future-farming-environment-evidence.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/683972/future-farming-environment-evidence.pdf)

<sup>43</sup> Department for Environment, Food and Rural Affairs, (2018). The Future Farming and Environment Evidence Compendium. Page 61 URL: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/683972/future-farming-environment-evidence.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/683972/future-farming-environment-evidence.pdf)

<sup>44</sup> Department for Environment, Food and Rural Affairs, (2018). The Future Farming and Environment Evidence Compendium. Page 63 URL: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/683972/future-farming-environment-evidence.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/683972/future-farming-environment-evidence.pdf)

<sup>45</sup> Department for Environment, Food and Rural Affairs, (2018). The Future Farming and Environment Evidence Compendium. Page 64 URL: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/683972/future-farming-environment-evidence.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/683972/future-farming-environment-evidence.pdf)

<sup>46</sup> Wang et al. 2016. The changing trend in nitrate concentrations in major aquifers due to historical nitrate loading from agricultural land across England and Wales from 1925 to 2150. <https://doi.org/10.1016/j.scitotenv.2015.10.127>

<sup>47</sup> Response from the Royal Society of Biology to the Environmental Audit Committee inquiry into the Government's 25 Year Plan for the Environment, February 2018; URL: [https://www.rsb.org.uk/images/RSB\\_response\\_25\\_Year\\_Environment\\_Plan\\_inquiry\\_Submitted.pdf](https://www.rsb.org.uk/images/RSB_response_25_Year_Environment_Plan_inquiry_Submitted.pdf)

concentration, or invasion resistance<sup>48</sup>. Studies focusing on grassland productivity show that “ecologically relevant decreases in grassland plant diversity influenced productivity at least as much as ecologically relevant changes in nitrogen, water, CO<sub>2</sub>, herbivores, drought, or fire”<sup>49</sup>.

29. If it can be implemented effectively, the principle of “environmental net gain”, as recently published in the 25 Year Environment Plan, will ensure that the full environmental impact of development projects are assessed, with overall benefits to the environment. To ensure positive environmental outcomes there should be an overarching principle of “biodiversity net gain” to run parallel to the “environmental net gain” approach, to avoid biodiversity being neglected in favour of other aspects of natural capital that could be more directly “valued” financially. This “biodiversity net gain” should also be substantially monitored taking into account the whole extent of biodiversity, and not limited to protection of individual or iconic species.<sup>50</sup> Biodiversity encompasses all areas of life, and the importance of microbial diversity for healthy terrestrial and aquatic environments should be considered, along with plans for conservation. This is likely to be of significant importance in soil quality, which is an identified priority. The recently published 25 Year Environment Plan says that biodiversity net gain will be “explored” and this should be “locally-led” (p33-34)<sup>51</sup>, but the failure to commit to adopting this approach due to the need to “avoid increased burdens on developers” could undermine these good intentions. In addition, a balanced consideration of local and national needs will be important in some decisions and will need to be accommodated.<sup>52</sup>

*The centrality of a land management focused on environmental outcomes:*

30. As discussed, the outcome-based payment approach will be vital for the establishment and development of effective environmental management systems to support markets for environmental goods and services. Alternative support could also be provided to encourage the sustainable production (with control of externalities) of other biotechnology related outputs, such as specialist crops and industrial feed-stocks.<sup>53</sup> Similarly, there are prospective benefits relating to “whole system projects” approaches, with collaboration across sectors and industries e.g. to reduce the use of metaldehyde on farms across England, as a more efficient alternative to removing this agrochemical (and others) from water courses - with potential impact UK wide. The plan for a Nature Recovery Network, as laid out in the Government’s 25 Year Environment Plan, could be a good example of this methodology. A

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<sup>48</sup> Balvanera, P. et al. (2006). Quantifying the evidence for biodiversity effects on ecosystem functioning and services. *Ecology Letters*, 9(10), pp. 1146-1156. URL: <https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1461-0248.2006.00963>.

<sup>49</sup> Tilman et al. (2012). Biodiversity impacts ecosystem productivity as much as resources, disturbance, or herbivory. *PNAS*, 109 (26), pp. 10394-10397. URL: <http://www.pnas.org/content/109/26/10394>

<sup>50</sup> Response from the Royal Society of Biology to the Environmental Audit Committee inquiry into the Government’s 25 Year Plan for the Environment, February 2018; URL: [https://www.rsb.org.uk/images/RSB\\_response\\_25\\_Year\\_Environment\\_Plan\\_inquiry\\_Submitted.pdf](https://www.rsb.org.uk/images/RSB_response_25_Year_Environment_Plan_inquiry_Submitted.pdf)

<sup>51</sup> Department for Environment, Food and Rural Affairs, (2018). 25 Year Environment Plan. Page 37. URL: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/693158/25-year-environment-plan.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/693158/25-year-environment-plan.pdf)

<sup>52</sup> Response from the Royal Society of Biology to the Environmental Audit Committee inquiry into the Government’s 25 Year Plan for the Environment, February 2018; URL: [https://www.rsb.org.uk/images/RSB\\_response\\_25\\_Year\\_Environment\\_Plan\\_inquiry\\_Submitted.pdf](https://www.rsb.org.uk/images/RSB_response_25_Year_Environment_Plan_inquiry_Submitted.pdf)

<sup>53</sup> Royal Society of Biology response to the BEIS consultation on the UK Bioeconomy  
[https://www.rsb.org.uk/images/RSB\\_response\\_to\\_the\\_BEIS\\_Bioeconomy\\_consultation\\_Final\\_response.pdf](https://www.rsb.org.uk/images/RSB_response_to_the_BEIS_Bioeconomy_consultation_Final_response.pdf)

perspective focusing on ecosystem services places these outcomes in relation to each other, as well as with socio-economic factors, and human health and well-being. These outcomes are strongly interconnected, and a recurrent observation across studies is habitat loss as a driver for decline in biodiversity. Benton et al. (2003) discuss the link between habitat heterogeneity and farmland biodiversity with an emphasis on Europe. They review how a variety of agricultural measures have had an impact on habitats and show that “habitat heterogeneity is associated with higher biodiversity in the farmed landscape, whether measured at a small or large scale”<sup>54</sup>. Detailed research into land management practices - regardless of farming system – generally enables distinction between more and less environmentally friendly farms<sup>55</sup>, using current practices of management, which continue to improve and develop. Organic agriculture is frequently promoted as more environmentally sustainable than more conventional methods. However, some researchers acknowledge that “the choice of this scenario is not because organic is the only form of agricultural system that is more sustainable than current practices, but because it has a well-defined system of standards”<sup>56</sup>. This may well be the case for other systems if clear standards were defined and incentivised. Moreover, without denying the value of organic agriculture, it does not represent a unique panacea for the environmental impact of farming. Further to this, the defined positions on GM crops in organic farming can hamper introduction of further environmentally sustainable practices. Similarly, Reganold and Wachter's very positive 2016 review of organic agriculture<sup>57</sup> concludes that sustainable agriculture will require not conventional or organic agriculture, but rather a “blend of organic and other innovative farming systems”. Current greening measures<sup>58</sup> should be optimised based on current research. For example, nectar flower mixes are a prominent measure, with some clear environmental and biodiversity benefits<sup>59</sup>. The same study shows that: (1) current sown wildflower strips mainly benefit common insect species; (2) different types of strips provide for different species; (3) interactions with adjacent habitats are unclear; and (4) research indicates the strips' role in pest control, which could also be further assessed. There is clear potential for evidence-based improvement of this greening measure and an incentive for further research.

31. To accomplish the difficult task of valuing many elements of the natural environment, there must be comparable metrics for valuing natural capital, with robust mechanisms<sup>60</sup> in place for monitoring and implementation in order to make the most informed decisions. Without this, there is a risk that one aspect of the natural environment could be prioritised in terms of financial benefit, while neglecting other areas with less direct economic impact but equal importance, for example, for the protection of biological diversity or societal wellbeing.

<sup>54</sup> Benton et al. (2003). Farmland biodiversity: is habitat heterogeneity the key? *Trends in Ecology & Evolution*, 18(4), pp. 182-188. URL: <https://www.sciencedirect.com/science/article/pii/S0169534703000119>

<sup>55</sup> Trewavas (2004) A critical assessment of organic farming-and-food assertions with particular respect to the UK and the potential environmental benefits of no-till agriculture. *Crop Protection* 23, 757–781.

<sup>56</sup> Pretty et al. (2005). Farm costs and food miles: An assessment of the full cost of the UK weekly food basket. *Food Policy* 30, 1–19.

<sup>57</sup> Reganold and Wachter (2016) Organic agriculture in the twenty-first century. *Nature Plants* 2, 1-8.

<sup>58</sup> Greening, European Commission - Agriculture and rural development page at [https://ec.europa.eu/agriculture/direct-support/greening\\_en](https://ec.europa.eu/agriculture/direct-support/greening_en)

<sup>59</sup> Haaland et al. (2011) Sown wildflower strips for insect conservation: a review. *Insect Conservation and Diversity* 4 (1), 60-80.

<sup>60</sup> Response from the Royal Society of Biology to the Environmental Audit Committee inquiry into the Government's 25 Year Plan for the Environment, February 2018; URL: [https://www.rsb.org.uk/images/RSB\\_response\\_25\\_Year\\_Environment\\_Plan\\_inquiry\\_Submitted.pdf](https://www.rsb.org.uk/images/RSB_response_25_Year_Environment_Plan_inquiry_Submitted.pdf)

*Balanced assessment of alternative approaches:*

32. The ecosystem services approach has also gained traction in recent years as a means for more sustainable agriculture. A framework by which farmers will be remunerated based on the provision of ecosystem services, in place of CAP subsidies, has been suggested by Government to form the basis for future UK agricultural policy contained in its 25 Year Environment Plan. Among the suggested benefits of this market-based approach, in which “environmental goods and services are purchased directly from those best placed to provide them”, there are diversification and easier entry into the sector<sup>61</sup>. Still, several points must be considered: (1) The approach would partially address the environmental impact of farming. Separate measures are needed for agricultural research, technological development, extension work, food safety, animal health and welfare, biosecurity, and invasive species. These are areas of fundamental importance to agricultural policy that are not properly accounted for in the ecosystem service framework. (2) Most ecosystem services are not well understood, and the ecosystem services approach has not been fully operationalised in agriculture - only implemented locally in case studies, for selected ecosystem services. Some even argue that the approach is still being conceptualised<sup>62</sup>. Given the impact on farmers, there is need for the creation of a new institutional framework – with related capacity and financing issues – and provision for extension services during the transition phase; a careful impact assessment must accompany the development of new policies.

### **Improving the system of knowledge transfer to and from farmers and land managers**

33. We recognise the importance of incentivising farmers’ access to existing education opportunities and professionally qualified, unbiased, independent advice, as some other EU countries have implemented<sup>63</sup>. Sustainable farming depends on management practices more crucially than a particular farming system<sup>64</sup>. Therefore, a skilled, well-advised and informed farming sector will be an effective driving force for change. Advice from experts across fields including agricultural, ecological and health researchers, behavioural economists and experts in agricultural practice will be central to the integrity of this process. In general, more support is required to encourage knowledge-exchange links between agricultural workers and academic researchers. These links may be facilitated by the cooperation of industry, from Government directly and through the Research Councils under UK Research and Innovation (UKRI). Many other European countries enable state-owned or state-affiliated research institutes to provide long-term, locally tailored, free and reliable agricultural advice publicly. The benefits of knowledge-exchange are twofold:

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<sup>61</sup> Gawith and Hodge (2017) Policy Brief on an alternative approach to rural land policy after Brexit. Cambridge. Available online at <http://www.csap.cam.ac.uk/media/uploads/files/1/besp-policy-brief---15-5-17.pdf>

<sup>62</sup> Seppelt et al. (2011) A quantitative review of ecosystem service studies: approaches, shortcomings and the road ahead. *Journal of Applied Ecology* 48, 630–636.

<sup>63</sup> “Under the rural development pillar of the CAP, a measure on advisory services is already available for possible uptake by Member States, according to Article 15 of Regulation 1305/2013 (for various types of advice) and to Article 28 (for advice in relation to agri-environment-climate commitments)” extract from ‘Precision Agriculture in Europe: legal, social and ethical considerations’, (2017). European Parliamentary Research Service. URL [http://www.europarl.europa.eu/RegData/etudes/STUD/2017/603207/EPRS\\_STU\(2017\)603207\\_EN.pdf](http://www.europarl.europa.eu/RegData/etudes/STUD/2017/603207/EPRS_STU(2017)603207_EN.pdf)

<sup>64</sup> Trewavas (2004) A critical assessment of organic farming-and-food assertions with particular respect to the UK and the potential environmental benefits of no-till agriculture. *Crop Protection* 23, 757–781.

- 33.1. To improve farmers' understanding of the evidence base behind the policies and interventions that affect agricultural practices.
- 33.2. Agricultural workers can communicate their needs to researchers, who in turn may use this context to apply their science more effectively. For example, livestock farmers play an important role in tackling the issue of antibiotic drug-resistance, through the responsible use of veterinary medicines. Organisations such as the Responsible Use of Medicines in Agriculture Alliance (RUMA) promote best practice in the British livestock industry, supported by academic researchers within an independent scientific group.<sup>1</sup>
34. Government should ensure, perhaps through legislative and regulatory practices, a process of benchmarking and a set of quality standards approved by the widest community of stakeholders.
35. Additionally, reward could be provided for farmers and land managers, and for those who provide them with independent professional advice, who participate in Continuing Professional Development (CPD) and certification programmes, such as those enabling chartered status. We expand on the role that independent, professional bodies can play in upskilling the workforce in the following section. Among the huge variety of biological topics that will be of relevance to farming practice, we would like to specifically highlight ecology, including microbial ecology, microbiomes<sup>65,66</sup>, and biodiversity. Development of skills should be incentivised and rewarded in relation to required non-core farm investments.
36. Government should ensure that the experience, local knowledge and creative enterprise of farmers and land managers is integrated into the development and implementation of policy and research agendas. The value of a grass-roots approach to landscape management – as demonstrated in a number of praised farmer-lead, performance-based schemes<sup>67</sup> – should be reconciled with technical advances and the opinion of third-party experts. In addition, bolstering public understanding of, and therefore support for, best farming practice and production, and the professional development this entails, will also be important in maintaining uptake.

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<sup>65</sup> Unlocking the Microbiome, opportunities and challenges of microbiome related research for health, agriculture, environment and technology; a report published by the Microbiology Society; URL: <https://microbiologysociety.org/policy/microbiome-policy-project/unlocking-the-microbiome-report.html>

<sup>66</sup> Food Security from the Soil Microbiome; a briefing published by the Microbiology Society; URL: <https://microbiologysociety.org/uploads/assets/uploaded/142eda0c-4d8a-448d-8cdc5d45a45d7165.pdf>

<sup>67</sup> The Burren Programme. Available at <https://www.agriculture.gov.ie/media/migration/farmingschemesandpayments/locallyledschemes/TermsConditionsBurrenSchemeTrancheIV2061016.pdf>



## Maintaining and growing the skilled workforce: resilience in the face of labour demand

37. The Royal Society of Biology has provided responses to Government's consultations on the future T-levels<sup>68</sup>, the quality of apprenticeships and skills training<sup>69</sup> and has set education priorities for the next five years<sup>70</sup>, with a spotlight on links between agriculture, biochemistry, plant science, nutrition, aerobiology, agroecology, sustainable agriculture, bioinformatics - and accompanying case studies<sup>71</sup>.
38. The land-based disciplines, such as farming and forestry, face difficulties in recruiting technical and professional personnel. Our members have identified that this issue is partly to do with the very low profile of land-based jobs among school-leavers making their study choices. Anecdotally, some of our members observe that secondary school students do not see modern agriculture as high-tech, and the field does not appear as an esteemed opportunity for future careers.
39. Before setting out specific recommendations, we would like to highlight the important point that the increasing support for the formulation of environmental management policies at a landscape scale, together with the adoption of new approaches to agriculture which harness the power of data-mining, robotics and new genetic and agronomic techniques - will be met by a significant skills gap in several disciplines. In earlier collaborative work with BBSRC and MRC<sup>72</sup>, we identified the following areas of vulnerability in skills and capabilities in the UK biosciences, which are relevant to this consultation: interdisciplinarity, maths, statistics, computation, microbiology, agriculture, food security – to which disciplines dealing with ecosystem function and landscape ecology should likely be added. Specifically, skills shortages within plant sciences – a strategically important capability for UK agriculture – are concentrated around plant physiology, plant pathology, field studies, horticultural science, crop science, taxonomy and identification<sup>73</sup>. More information about skills gaps in STEMM and our recommendations to address them can be found in the Royal Society of Biology's response to the House of Commons Science and Technology Committee inquiry into closing the STEMM skills gap<sup>74,75</sup>.

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<sup>68</sup> Royal Society of Biology, (2018). Response from the Royal Society of Biology to the Department for Education's consultation on 'Implementation of T level programmes'. 8 February. URL:

[http://www.rsb.org.uk/images/RSB\\_T\\_level\\_consultation\\_response\\_6\\_February\\_2018.pdf](http://www.rsb.org.uk/images/RSB_T_level_consultation_response_6_February_2018.pdf)

<sup>69</sup> Royal Society of Biology, (2018). Response from the Royal Society of Biology to the Education Select Committee inquiry into the quality of apprenticeships and skills training. 5 January. URL:

[http://www.rsb.org.uk/images/RSB\\_Quality\\_of\\_apprenticeships\\_and\\_skills\\_training\\_response\\_5\\_Jan.pdf](http://www.rsb.org.uk/images/RSB_Quality_of_apprenticeships_and_skills_training_response_5_Jan.pdf)

<sup>70</sup> Royal Society of Biology, (2017). Education priorities 2017-2022. URL: [https://www.rsb.org.uk/images/RSB\\_Education\\_Priorities\\_2017\\_20.06.pdf](https://www.rsb.org.uk/images/RSB_Education_Priorities_2017_20.06.pdf)

<sup>71</sup> Royal Society of Biology, (2018). Spotlight on the life sciences – a guide to biology careers. URL:

[https://www.rsb.org.uk/images/Spotlight\\_on\\_the\\_Life\\_Sciences\\_-\\_A\\_Guide\\_to\\_Biology\\_Careers.pdf](https://www.rsb.org.uk/images/Spotlight_on_the_Life_Sciences_-_A_Guide_to_Biology_Careers.pdf)

<sup>72</sup> BBSRC and MRC review of vulnerable skills and capabilities. <https://www.mrc.ac.uk/documents/pdf/review-of-vulnerable-skills-and-capabilities/>

<sup>73</sup> UK Plant Science: Current status & future challenges. [https://www.rsb.org.uk/images/pdf/UK\\_Plant\\_Science-](https://www.rsb.org.uk/images/pdf/UK_Plant_Science-Current_status_and_future_challenges.pdf)

[Current\\_status\\_and\\_future\\_challenges.pdf](https://www.rsb.org.uk/images/pdf/UK_Plant_Science-Current_status_and_future_challenges.pdf)

<sup>74</sup> The Royal Society of Biology response to an inquiry into closing the STEM skills gap.

<http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/science-and-technology-committee/closing-the-stem-skills-gap/written/45123.pdf>

<sup>75</sup> RSB response to the House of Lords Select Committee on Science and Technology inquiry into Life Sciences and the Industrial Strategy;

[https://www.rsb.org.uk/images/RSB\\_response\\_Life\\_Sciences\\_Industrial\\_Strategy\\_inquiry\\_submitted.pdf](https://www.rsb.org.uk/images/RSB_response_Life_Sciences_Industrial_Strategy_inquiry_submitted.pdf)

40. A summary of some of the key messages from our previous responses is relevant here, given their relationship to agriculture, and we suggest some additional actions to improve perceptions of careers in farming and land management. Many of these recommendations align with benchmarks provided by the Gatsby foundation in their 2014 'Good Career Guidance'<sup>76</sup> and more recent supplemented publications<sup>77,78</sup> i.e. learning from career and labour market information, experience of workplaces, and linking curriculum learning to careers.
41. We recommend that Government works to:
- 41.1. Raise the profile of agriculture-related careers to secondary school students: this can be facilitated by school curricula that include technological food production methods, advances in agriculture research and development (R&D), and careers in the field. Additionally, implementing materials for career advice (in this and other fields) into integrated curriculum teaching materials (of STEMM-related subjects, for example) would prove beneficial.
  - 41.2. Promote the role of farmers as landscape and environmental stewards: the promotion of careers in farming and land-management should publicly shine a positive light on the importance of these jobs in the sustainable production of food for balanced diets for society, for protection of the environment, for wildlife conservation, and for a sustainable leisure industry.
  - 41.3. Push-pull interaction between schools and employers: improvements are needed in both the 'push' from schools in providing quality careers guidance and the 'pull' from employers by providing greater visibility and interaction with relevant and varied sectors<sup>79</sup>.
  - 41.4. Greater interactions with experienced STEM ambassadors and employers: would give students first-hand information about current career prospects and useful mentoring, which would help them in their choices<sup>80</sup>. A recently published Careers strategy<sup>81</sup> contains specific guidance, which states that some of the frequent (and at least annual) encounters year 7 to year 13 students should have with future employers must be within STEM. Paragraphs 40 – 47 of the strategy set out other STEM priorities including work experience, STEM encounters, and a toolkit on proven developments.
  - 41.5. Increase visibility of the sector among students as they consider their post-16 choices (including for A-Levels and relevant T-Levels). Members of the public may be

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<sup>76</sup> Holman, J. (2014). The Good Career Guidance. Report by the Gatsby Charitable Foundation. URL:

<http://www.gatsby.org.uk/uploads/education/reports/pdf/gatsby-sir-john-holman-good-career-guidance-2014.pdf>

<sup>77</sup> Holman, J. (2018). The Good Career Guidance. Benchmarks for schools (updated). URL: <http://www.gatsby.org.uk/uploads/education/gatsby-careers-4-pager-updated.pdf>

<sup>78</sup> Holman, J. (2018). The Good Career Guidance. Benchmarks for young people in colleges (updated). URL: <http://www.gatsby.org.uk/uploads/education/final-0099-qcg-college-booklet-a5-4pp-rgb-aw1.pdf>

<sup>79</sup> Holman, J. (2014). The Good Career Guidance. Report by the Gatsby Charitable Foundation available at <http://www.gatsby.org.uk/uploads/education/reports/pdf/gatsby-sir-john-holman-good-career-guidance-2014.pdf>

<sup>80</sup> Holman, J. (2014). The Good Career Guidance. Report by the Gatsby Charitable Foundation. Page 47 and Recommendation 7&8 at page 11. URL: <http://www.gatsby.org.uk/uploads/education/reports/pdf/gatsby-sir-john-holman-good-career-guidance-2014.pdf>

<sup>81</sup> Royal Society of Biology response to the BEIS consultation on the UK Bioeconomy [https://www.rsb.org.uk/images/RSB\\_response\\_to\\_the\\_BEIS\\_Bioeconomy\\_consultation\\_Final\\_response.pdf](https://www.rsb.org.uk/images/RSB_response_to_the_BEIS_Bioeconomy_consultation_Final_response.pdf)

<sup>81</sup> Royal Society of Biology, (2018). Response from the Royal Society of Biology to the Education Select Committee inquiry into the quality of apprenticeships and skills training. 5 January. Page: 2. URL: [http://www.rsb.org.uk/images/RSB\\_Quality\\_of\\_apprenticeships\\_and\\_skills\\_training\\_response\\_5\\_Jan.pdf](http://www.rsb.org.uk/images/RSB_Quality_of_apprenticeships_and_skills_training_response_5_Jan.pdf)

aware of farming per se, but not necessarily of the vocations related to agriculture, for example the roles for plant breeders, food analysts, etc. Knowledge on the training for and working life involved in these and other specific lines of work within the sector, in addition to greater understanding of the technological advances related to their work, is not readily accessible to those outside of these specific fields. More should be done to make these career routes clear to the public and those looking to move into the sector. Related to this, the Department of Education is currently recruiting for panel members on the Agriculture, Environmental and Animal Care T-level route. This includes two pathways, “Animal Care and Management” and “Agriculture Land Management and Production”. We recommend that future panels are given the opportunity to carefully consider whether their pathway includes the expected breadth of skilled occupations at all levels, and that students have the opportunity to consolidate the underpinning science knowledge required for their chosen occupation. We would hope to engage with those representing bioscience on this panel when appointed.

41.6. Advanced apprenticeships may prove to be a real opportunity to address the recruitment shortfall.<sup>82</sup> Higher level and degree apprenticeships have been welcomed as a route with the potential to produce highly skilled people to support STEM industries, which include those in the agriculture and food production sectors. Employers should recognise equal qualifications equally, regardless of whether they were gained through a technical or academic route<sup>83</sup>. We recommended that all T-level training provides the appropriate footing for apprenticeship training, as well as other types of training<sup>84</sup>. A focus on maths and communication skills is appropriate for the technical training route, but core subject knowledge must be stressed for progression to further study, and students must be prepared for critical thinking as well as practical skills to aid this. For example, students could be asked to generate, analyse and critique data.

41.7. Upscaling the standards of apprenticeships and skills training through accreditation: accreditation by the Royal Society of Biology recognises and supports the advancement of skills and education in the biosciences, throughout the UK and internationally. Graduates from accredited degree programmes are equipped with well-rounded knowledge and skill sets, making them highly employable both within and beyond their chosen field. Technical and vocational routes at all levels would benefit from a similar external accreditation review. Initial work is being conducted by the Society in this area, however the support of Government funds for the accreditation of FE bioscience programmes would enable accreditation processes to launch on a greater scale and have a wider impact<sup>85</sup>.

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<sup>82</sup> Royal Society of Biology response to the BEIS consultation on the UK Bioeconomy  
[https://www.rsb.org.uk/images/RSB\\_response\\_to\\_the\\_BEIS\\_Bioeconomy\\_consultation\\_Final\\_response.pdf](https://www.rsb.org.uk/images/RSB_response_to_the_BEIS_Bioeconomy_consultation_Final_response.pdf)

<sup>83</sup> Royal Society of Biology, (2018). Response from the Royal Society of Biology to the Education Select Committee inquiry into the quality of apprenticeships and skills training. 5 January. Page: 2. URL:  
[http://www.rsb.org.uk/images/RSB\\_Quality\\_of\\_apprenticeships\\_and\\_skills\\_training\\_response\\_5\\_Jan.pdf](http://www.rsb.org.uk/images/RSB_Quality_of_apprenticeships_and_skills_training_response_5_Jan.pdf)

<sup>84</sup> Royal Society of Biology, (2018). Response from the Royal Society of Biology to the Education Select Committee inquiry into the quality of apprenticeships and skills training. 5 January. Page: 3. URL:  
[http://www.rsb.org.uk/images/RSB\\_Quality\\_of\\_apprenticeships\\_and\\_skills\\_training\\_response\\_5\\_Jan.pdf](http://www.rsb.org.uk/images/RSB_Quality_of_apprenticeships_and_skills_training_response_5_Jan.pdf)

<sup>85</sup> Royal Society of Biology, (2018). Response from the Royal Society of Biology to the Education Select Committee inquiry into the quality of apprenticeships and skills training. 5 January. Page: 2. URL:  
[http://www.rsb.org.uk/images/RSB\\_Quality\\_of\\_apprenticeships\\_and\\_skills\\_training\\_response\\_5\\_Jan.pdf](http://www.rsb.org.uk/images/RSB_Quality_of_apprenticeships_and_skills_training_response_5_Jan.pdf)

- 41.8. Ongoing training and upskilling of the current workforce through professional registration: Employers should be encouraging employees at all levels to work towards professional registration, allowing them to demonstrate continuing professional development. The RSB, licensed by the Science Council, offers Registered Science Technician (RSciTech) status, which offers recognition for the technical profession and demonstrates individuals meet and maintain the high standards expected of our organisation as a professional body. The RSB also provides routes to progression to higher awards through Registered Scientist (RSci), Chartered Scientist (CSci), and our own professional register Chartered Biologist (CBiol).
- 41.9. Encourage trainees to consider careers in agriculture and related research through studentships and awards: providing relevant training opportunities can help to encourage trainees to consider careers in agriculture and related research. With support from Defra, the Royal Society of Biology runs the Plant Health Undergraduate Studentships (PHUGS) scheme<sup>86</sup> to raise awareness of plant health research among undergraduate bioscience students. Additionally, The Young Innovators' Forum helps young scientists and farmers understand each other's work and can encourage farmers in further education and scientists working in crops and agriculture<sup>87</sup>; while the Chartered Institute of Horticulture (CIH) has a very active 'Young Horticulturist of the Year programme'<sup>88</sup>.
- 41.10. Co-supervision by field practitioners and academic professionals: some of our members have highlighted the value of supervision by field practitioners, alongside academic work, during advanced training for technologists. This is particularly relevant.
- 41.11. Promote careers in farming and food production from an early stage in education, while simultaneously educating the public about the origin of their food: for example, the associations Linking Environment And Farming (LEAF) and Farming and Countryside Education (FACE) have merged and run several schemes<sup>89</sup>.

42. On a final and important note in relation to skills and labour for UK agriculture, the UK relies heavily on workers from the EEA in the agricultural sector. The effects of Brexit on this labour force are already being felt. Work permits and visa schemes allowing seasonal working and semi-permanent employment arrangements may help to mitigate this pressure. Concerns for a shortage of skilled and indispensable labour force in the agriculture sector are experienced at all levels, from research to farming<sup>90</sup>. For example, active researchers have recruited assistants from other EU countries for labour-intensive periods of field work, as it proved

<sup>86</sup> Please see <https://www.rsb.org.uk/get-involved/grants/plant-health-ug-studentships>

<sup>87</sup> <https://www.agritech-east.co.uk/category/young-innovators-forum-yif/>

<sup>88</sup> Information about the award available at <https://www.horticulture.org.uk/awards-ci-h/>

<sup>89</sup> LEAF and FACE schemes include: *The FaceTime/ Skype a Farmer scheme*: <https://leafuk.org/eating-and-living/facetime-a-farmer>; *Teacher training*: <https://www.face-online.org.uk/>; *The Countryside Educational Visits Accreditation Scheme*: <http://www.visitmyfarm.org/cevas-farmer-training>; *Countryside classroom*: <http://www.countrysideclassroom.org.uk/>

<sup>90</sup> Please find our response to the House of Lords EU Energy and Environment Sub-Committee inquiry on Brexit: plant and animal biosecurity attached alongside our electronic submission of the RSB response to Defra's consultation on "Health and Harmony: the future for food, farming and the environment in a Green Brexit". Our response to the EU Energy and Environment Sub-Committee has been provided prior to formal publication of evidence, with the permission of the Sub-Committee.

difficult to find adequately trained students in the UK, with appropriate time to spare in the required season – this short term use of international labour has clearly supported research to the benefit of UK agriculture. More senior researchers have similarly commented that they often rely on both temporary labour from overseas and highly skilled and often highly-specialised research staff: this helps balance respective shortages in the UK and keeps research projects running. Arrangement for appropriate permit and visa schemes should be a high priority for the conversations between Defra, the Home Office and other relevant Government departments.

### Improving investment in farming

43. Two particular barriers to new capital investment in the agricultural industry have been defined as below, by our community:

43.1. New genetic methods have significant potential to improve productivity, resilience to stressors and other bionomic traits, and to provide novel products, and novel routes to existing products. However, investment in research in this area- public and even more so private- is severely affected by the current regulatory environment for GMOs. The UK has lost the lead it once had in this area and major private-sector research has almost entirely moved overseas to areas and markets with risk assessment and regulatory systems that provide a route to market. The UK still retains a world-leading life-sciences sector, and such research could flourish again. In that situation, relatively modest public investment in plant and animal breeding and genetics, and crop and livestock health and animal welfare (question 11 within the Defra command paper<sup>91</sup>) could provide very significant returns.

43.2. In addition, the British Society for Plant Breeders (BPSB) have identified a major problem around how plant variety rights operate and generate royalty payments, which could mean that rights owners would lose their income stream in the UK post Brexit if this were not addressed. Many plant breeding companies are global and make investment decisions from outside the UK about where to place breeding programmes globally, influenced by a generally long plant breeding timescale. A similar situation applies to several major animal breeding companies (e.g. including poultry and fish for aquaculture), which are UK based and operate globally. The UK currently has a good pre-competitive environment that is attractive. However, should the ‘Brexit effect’ on variety rights not be appropriately addressed, this would be a crisis for the industry). Steps need to be taken urgently by Defra and other bodies, to give companies confidence to continue investment in breeding in the UK. Enabling related regulations to be harmonised with the EU, or at least to be similar in their creation of an environment as attractive as (or more attractive than) the EU, would be advisable.<sup>92</sup>

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<sup>91</sup> Defra “Health and Harmony” Consultation Command Paper; URL: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/684003/future-farming-environment-consult-document.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/684003/future-farming-environment-consult-document.pdf)

<sup>92</sup> Royal Society of Biology, 2018. [RSB response to the Science and Technology Committee of the Commons Brexit science and innovation Summit inquiry](#)

## **Agricultural research and development: areas in need of support**

44. The Society would like to make a general recommendation for both blue skies (fundamental) and policy or application driven research, in the context of the development of a new land management system. This should include research involving genebanks, with implications for agricultural crop development.
45. All of the research topics cited in the Defra command paper are broad, important, and interconnected. Improvements in one area may lead to improvements in another. For example, breeding and growing crops that require reduced water consumption should enable conservation of this limited resource. Likewise, reduced and more efficiently targeted use of agro-chemicals, which cause damage to microbiomes, will have a positive impact on soil health<sup>93</sup>. In all cases, a central aim of decision-making should be to attain peak performance, productivity and efficiency using limited resources and whilst enabling maintenance and improvement of animal, plant and environmental health, and animal welfare, through sustainable management practices.
46. We wish to emphasise the vital importance of supporting fundamental, ‘blue skies’ research, as well as developing research that addresses defined problems and applications. Fundamental research increases understanding of how complex ecosystems – such as those observed in human managed agricultural landscapes – respond to different biotic, climatic and anthropogenic pressures. This insight is often the source of breakthroughs that lead to innovations in ways that cannot be predicted or commissioned. Applied and translational research are also essential, and the effects are still being felt of the near-market cuts to research in agriculture and horticulture of the 1980s, with a reduced pipeline of good applied science available to industry in some fields. It is important that the portfolio of publicly-funded research achieves a balance of fundamental, translational and applied programmes.<sup>94</sup> This goal will only be achieved if researchers, farmers, land managers, consumers and food chain industries are actively involved in the debate and are empowered to inform the argument and shape the policy outcomes.
47. Short-term funding is often ill-suited to research objectives, and the availability of longer term strategies from funding bodies could bring real advantages. In agriculture and related subjects, research can take several years, as in the case of monitoring biodiversity loss, and relies on long-term curation of plant collections. Longer-term funding, for example through BBSRC Strategic Longer and Larger grants or through EPSRC’s awards<sup>95</sup> that run for 3 to 5 years, can

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<sup>93</sup> Stenberg, J.A. (2017). A conceptual framework for Integrated Pest Management. *Trends in Plant Science*, 22(9), pp. 759-769. URL: <http://dx.doi.org/10.1016/j.tplants.2017.06.010>

<sup>94</sup> RSB response to the House of Lords Select Committee on Science and Technology inquiry into Life Sciences and the Industrial Strategy; [https://www.rsb.org.uk/images/RSB\\_response\\_Life\\_Sciences\\_Industrial\\_Strategy\\_inquiry\\_submitted.pdf](https://www.rsb.org.uk/images/RSB_response_Life_Sciences_Industrial_Strategy_inquiry_submitted.pdf)

<sup>95</sup> EPSRC grants: <http://gow.epsrc.ac.uk/NGBOListSchemes.aspx>

be complemented with specific project funds which applied alone may arguably have reduced chance of success. The UK should consider investing in longer research programmes, particularly for fundamental research as highlighted above, provided that funded studies and related translational projects are continually reviewed in the light of emerging scientific evidence. Research into ecological processes of human-environment interaction and the long-term assessment of farming impacts will certainly benefit from funding programmes with longer timescales. This is particularly relevant in relation to the use of agro-chemicals and the necessary investment into monitoring their long-term effects at a landscape scale. We agree with Defra's chief scientific adviser in that there is need for the set-up a monitoring system which will involve users in data collection on a number of environmental parameters, according to preregistered designs, to unearth potential unexpected effects of the use of agro-chemicals at industrial scale over longer periods of time – akin to what is done for pharmaceutical use in humans<sup>96</sup>. This valuable dataset could be analysed to reveal sub-lethal effects of pesticides, interactions between individual components in complex mixtures, differential responses of multiple species to similar agro-chemicals in different environments, and the effects of these agents on the health of not just a single animal but on entire colonies, as has been recently reported for pollinators<sup>97</sup>. Therefore, we would like to support the adoption of appropriate funding to enable such long-term studies, which are expected to yield results that will provide essential information in the economic audit of agricultural policy of the type sought by Defra.

48. Newly generated policies should be evidence-informed and, where there is an absence of evidence of harm, bans or withdrawal should be undertaken only with consideration of the risks of action, inaction and the projected impact of available alternatives.
49. Endocrine disrupting compounds are another concern, which are not specifically mentioned in the 25 Year Environment Plan, with a substantial body of evidence linking exposure with disease in humans and other animals.<sup>98</sup> Furthermore, other medicines and chemical products, such as antimicrobials and biocides, enter the environment through human activity, with associated risks, for instance the generation of antimicrobial resistance. Further knowledge of the overall impact of these products and management of their use are called for to increase our understanding of the implications for public and ecosystem health.<sup>99</sup> The importance of more research cannot be overemphasised.

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<sup>96</sup> Woodcock, B.A. et al. (2017). Country-specific effects of neonicotinoid pesticides on honey bees and wild bees. *Science*, 356(6345), pp.1393-1395. DOI: 10.1126/science.aaa1190

<sup>98</sup> Gore et al. 2015. EDC-2: The Endocrine Society's Second Scientific Statement on Endocrine-Disrupting Chemicals. <https://doi.org/10.1210/er.2015-1010>

<sup>99</sup> Response from the Royal Society of Biology to the Environmental Audit Committee inquiry into the Government's 25 Year Plan for the Environment, February 2018; URL: [https://www.rsb.org.uk/images/RSB\\_response\\_25\\_Year\\_Environment\\_Plan\\_inquiry\\_Submitted.pdf](https://www.rsb.org.uk/images/RSB_response_25_Year_Environment_Plan_inquiry_Submitted.pdf)

## Effective implementation of agricultural R&D: the adoption of new technologies on-farm

50. Some of our members advise that if the appropriate technology becomes available at the right price and with added value, it will be adopted by farmers - something the Harper Adams case study (Defra Health and Harmony command paper, p27) appears to support. However, the adoption of new technologies and ideas is not straightforward, and farmers themselves might not always be keen to engage in trials of experimental treatments or methods, especially if reimbursement is not at 100%. As mentioned previously in this response, farmers often need information and advisory services, in order to enable them to access, contribute to and benefit from development of up-to-date scientific and business-related knowledge on their specific challenges (e.g. on-farm soil quality). Such facilities could aid farmers in making decisions efficiently about the most sustainable methods of farming available to them.
51. The implementation of the Agri-Tech Catalyst has been valuable in helping to bring products to market. Further, as the funding for the Agri-Tech Catalyst is now exhausted, a helpful source of funds to pump-prime late-stage research has disappeared. There is a need for an information service of some kind that might encourage new entry by substantial players, who can see the advantages and do not have embedded investments in traditional methods.<sup>100</sup>
52. Government and levy-funded bodies should focus on identifying and helping to overcome barriers to the uptake of new methods. As an example, genetic improvement of farm livestock (through breeding) has made huge contributions to the poultry, pig and dairy cattle sectors. Meanwhile the sheep and beef cattle sectors have generally not yet received the same benefits from private capital, which is yet to be attracted to apply the same methods to the more difficult problems in their breeding sectors. In the related field of genetic technology, Government investment through Research Councils and translational funding has sustained the UK science base but the de facto EU ban on field use of GMOs means these promising developments have had no beneficial on-farm impact. Arguably, since the EU permits importation of many GM products while preventing their cultivation, development of highly effective GM methods has been to the competitive disadvantage of UK farmers as their (non-EU) competitors can use these methods while they cannot. As a consequence of the EU regulatory/ political environment, most major private-sector players moved their relevant research to the countries where their grower markets are, i.e. outside the EU.
53. The revision of the old, problematic, process-based EU regulatory framework for GMOs in favour of a more rational, product-based, science-based risk assessment, together with the permitting/ registration of processes based on the best current understanding, will allow the UK to overcome a significant barrier to adopting new genetic technologies and ideas on-farm.

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<sup>100</sup> Royal Society of Biology response to the BEIS consultation on the UK Bioeconomy  
[https://www.rsb.org.uk/images/RSB\\_response\\_to\\_the\\_BEIS\\_Bioeconomy\\_consultation\\_Final\\_response.pdf](https://www.rsb.org.uk/images/RSB_response_to_the_BEIS_Bioeconomy_consultation_Final_response.pdf)



54. Advances to support food production technology bring the opportunity take pressure off the land, improving the sustainable use of resources across the system. A key gap for research, and one which deserves support, is to understand how best to integrate crops that produce feed-stocks for fuel and chemicals (including pharmaceuticals), with those that produce food. Developing effective crop rotations for these different commodities would mean farmers could grow industrial crops as a break crop between the years in which a field is planted with food crops, reducing pressure from pests, weeds and disease.<sup>101</sup>
55. Finally, the use of robotics, bio-sensing devices and automated detection of animal behaviour, which presents incredible opportunities but also challenges for both land managers<sup>102</sup> and animal health and welfare<sup>103</sup>, will require support to be effectively implemented and adopted on farm.

### **Improvements to regulation, inspection and enforcement**

56. Our response focuses mainly of the regulatory framework for new genetic technologies. At present, UK regulations regarding field use of a range of technologies in agriculture are directly based on EU legislation. While these regulations are in many cases satisfactory, leaving the EU provides an opportunity to review and revise those that are not. One area of EU regulation widely regarded as unsatisfactory relates to field use of genetic technology (large-scale or commercial use; regulation of field trials is regulated at the state level, though still subject to Directive 2001/18/EC). There is wide recognition that the current European system does not function well as a whole. The registration of any GM variety for cultivation is extremely difficult, and for most practical purposes, impossible.
57. One of the conflicting consequences of the current system is that the EU allows import of a wide range of GM products, for human as well as animal food, while it does not allow similar to be cultivated in the EU. This is in part due to World Trade Organisation (WTO) cases against the EU, won on the grounds that the EU had no basis for prohibiting such imports. However, it leads directly to an invidious position for UK farmers, who cannot employ this class of methods to assist them with productivity and sustainability - but their competitors in other (non-EU) countries can. Not all UK farmers might choose to do so, and there are well-rehearsed issues in relation to co-existence, but the current situation, as it stands, reduces farmers' options.
58. Another feature of the system is that it is extremely slow and expensive, even to the extent that it cannot be navigated at all. SMEs end up excluded from this market, which is exclusively

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<sup>101</sup> Royal Society of Biology response to the BEIS consultation on the UK Bioeconomy

[https://www.rsb.org.uk/images/RSB\\_response\\_to\\_the\\_BEIS\\_Bioeconomy\\_consultation\\_Final\\_response.pdf](https://www.rsb.org.uk/images/RSB_response_to_the_BEIS_Bioeconomy_consultation_Final_response.pdf)

<sup>102</sup> John, A.L. et al. (2016). Milking robot utilization, a successful precision livestock farming evolution. *Animal*, 10(9), pp. 1484-1492. URL: <https://www.cambridge.org/core/journals/animal/article/review-milking-robot-utilization-a-successful-precision-livestock-farming-evolution/5DC59CA250E35DD009C7A67F321D58A4>

<sup>103</sup> Mottram, T. (2016). Animal board invited review: precision livestock farming for dairy cows with a focus on oestrus detection. *Animal*, 10(10), pp. 1575-1584. URL: <https://www.cambridge.org/core/journals/animal/article/div-classtitleanimal-board-invited-review-precision-livestock-farming-for-dairy-cows-with-a-focus-on-oestrus-detection/div/E1201D95AF5B9C31B623E09C8C1EF509>

accessible only by large multinational corporations. A modernised regulatory process, more aligned with current understanding of genetic technology, would have wide-reaching benefits for farmers, innovative SMEs and consumer choice.

59. The UK has now an opportunity to review the regulatory/ registration framework and produce something more adequate, while keeping in mind that leaving the EU will have substantial repercussions in the field of GMO in relation to UK import/ export to Europe and to the rest of the world. This is already testified by recent stakeholders advice on GMOs given by several Directorates General of the European Commission<sup>104,105,106</sup>.

### **Fairness and collaboration within the food supply chain**

60. As a reiteration of the recommendations made earlier in this document, related to public goods, we would advise that food related policy deserves a more direct link to health related policy in the UK. Nutrition should be a core concept in the maintenance of societal health nationally and internationally; the sustainable production and availability of a variety of nutrient rich foodstuffs is key to this.

61. Consideration should be given to both dietary choice and to the environmental impacts of different farming systems, with an ambition to incentivise healthier and more sustainable food systems. The factors involved are numerous and their interaction is often complex, and so collaboration across sectors should be wide-ranging with consultation of the available and up-to-date evidence and expertise, including consideration of societal interest.<sup>107</sup>

### **Devolution: cohesion and flexibility**

62. Agriculture and land management policy areas with shared resources that don't follow administrative boundaries will need co-ordination from the responsible institutions to implement an effective strategy. Furthermore, such shared resources may not be solely confined to the United Kingdom and as such, effective and efficient management should be considered at an international level.<sup>108</sup>

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<sup>104</sup> European Commission Directorate-General For Health And Food Safety & Directorate-General For Agriculture And Rural Development, (2018). Notice to stakeholders - withdrawal of the United Kingdom and EU food law. 1 February. URL:

[https://ec.europa.eu/food/sites/food/files/notice\\_brexit\\_eu\\_food\\_law.pdf](https://ec.europa.eu/food/sites/food/files/notice_brexit_eu_food_law.pdf)

<sup>105</sup> European Commission Directorate-General For Health And Food Safety (2018). Notice to stakeholders - withdrawal of the United Kingdom and EU rules on genetically modified food and feed and the deliberate release of genetically modified organisms into the environment. 23 January. URL:

[https://ec.europa.eu/food/sites/food/files/plant/docs/notice\\_brexit\\_gmo.pdf](https://ec.europa.eu/food/sites/food/files/plant/docs/notice_brexit_gmo.pdf)

<sup>106</sup> European Commission Directorate-General For Taxation and Customs Union et al. (2018). Notice to stakeholders - withdrawal of the United Kingdom and EU rules in the field of import/export licences for certain goods. 25 January. URL:

[https://ec.europa.eu/food/sites/food/files/notice\\_brexit\\_field\\_import\\_export\\_licences\\_certain\\_goods.pdf](https://ec.europa.eu/food/sites/food/files/notice_brexit_field_import_export_licences_certain_goods.pdf)

<sup>107</sup> Response from the Royal Society of Biology to the Environmental Audit Committee inquiry into the Government's 25 Year Plan for the Environment, February 2018; URL: [https://www.rsb.org.uk/images/RSB\\_response\\_25\\_Year\\_Environment\\_Plan\\_inquiry\\_Submitted.pdf](https://www.rsb.org.uk/images/RSB_response_25_Year_Environment_Plan_inquiry_Submitted.pdf)

<sup>108</sup> Response from the Royal Society of Biology to the Environmental Audit Committee inquiry into the Government's 25 Year Plan for the Environment, February 2018; URL: [https://www.rsb.org.uk/images/RSB\\_response\\_25\\_Year\\_Environment\\_Plan\\_inquiry\\_Submitted.pdf](https://www.rsb.org.uk/images/RSB_response_25_Year_Environment_Plan_inquiry_Submitted.pdf)

## International trade: maintenance of standards and responsibilities internationally

63. The Society would support an increased focus and priority for food, plant and animal safety as part of Government's talks on future international trade deals, this will signal intention in relation to environmental protection, food safety, agricultural productivity and animal welfare. Maintaining effective and efficient links with the European Food Safety Authority (EFSA) and other related European regulatory agencies and reference networks after Brexit will be of importance in this effort. Further to this, the EU has effective institutions to provide enforcement of its environmental legislation, ultimately via the European Commission and the European Court of Justice (ECJ). It is vital that the UK maintains communication with these and other regulation and knowledge exchange networks, in addition to developing its own effective mechanisms, to ensure environmental standards are maintained and ambitions met. Further comment on the importance of links with European networks is provided in the Royal Society of Biology's response to the 2018 Commons Science and Technology Committee Inquiry for the Brexit science and innovation summit.<sup>109,110</sup>

64. In the context of international collaboration on agricultural issues, the UK has responsibilities for a global spread of overseas territories that in different ways have their own farming issues and will undoubtedly be affected by the UK leaving the EU. For example, some territories are geographically closely associated with the territories of other member states (e.g. Montserrat (UK) and Guadeloupe (France)). A proposed solution for the issue of how best to cater for the mutual needs of EU outermost regions and overseas territories (at present including UK overseas territories) might be to develop collaborative schemes on a regional basis for their mutual benefit.

*The Society welcomes Defra's consultation on "Health and Harmony: the future for food, farming and the environment in a Green Brexit". We are pleased to offer these comments, which have been informed by specific input from our members and Member Organisations across the biological disciplines (Appendix). The RSB is pleased for this response to be publicly available.*

*For any queries, please contact the Science Policy Team at Royal Society of Biology, Charles Darwin House, 12 Roger Street, London, WC1N 2JU. Email: [policy@rsb.org.uk](mailto:policy@rsb.org.uk)*

## Appendix: Member Organisations of the Royal Society of Biology (following page)

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<sup>109</sup> Royal Society of Biology, 2018. [RSB response to the Science and Technology Committee of the Commons Brexit science and innovation Summit inquiry](#)

<sup>110</sup> Response from the Royal Society of Biology to the Environmental Audit Committee inquiry into the Government's 25 Year Plan for the Environment, February 2018; URL: [https://www.rsb.org.uk/images/RSB\\_response\\_25\\_Year\\_Environment\\_Plan\\_inquiry\\_Submitted.pdf](https://www.rsb.org.uk/images/RSB_response_25_Year_Environment_Plan_inquiry_Submitted.pdf)

### Full Organisational Members

Academy for Healthcare Science  
Agriculture and Horticulture Development Board  
Amateur Entomologists' Society  
Anatomical Society  
Association for the Study of Animal Behaviour  
Association of Applied Biologists  
Bat Conservation Trust  
Biochemical Society  
British Andrology Society  
British Association for Lung Research  
British Association for Psychopharmacology  
British Biophysical Society  
British Ecological Society  
British Lichen Society  
British Microcirculation Society  
British Mycological Society  
British Neuroscience Association  
British Pharmacological Society  
British Phycological Society  
British Society for Cell Biology  
British Society for Developmental Biology  
British Society for Gene and Cell Therapy  
British Society for Immunology  
British Society for Matrix Biology  
British Society for Medical Mycology  
British Society for Nanomedicine  
British Society for Neuroendocrinology  
British Society for Parasitology  
British Society of Plant Breeders  
British Society for Plant Pathology  
British Society for Proteome Research  
British Society for Research on Ageing  
British Society of Animal Science  
British Society of Soil Science  
British Society of Toxicological Pathology  
British Toxicology Society  
Daphne Jackson Trust  
Drug Metabolism Discussion Group  
The Field Studies Council  
Fisheries Society of the British Isles  
Fondazione Guido Bernardini  
GARNet  
Gatsby Plant Science Education Programme (incl. Science and Plants for Schools)  
Genetics Society  
Heads of University Centres of Biomedical Science  
Institute of Animal Technology  
Laboratory Animal Science Association  
Linnean Society of London

Marine Biological Association  
Microbiology Society  
MONOGRAM – Cereal and Grasses Research Community  
Network of Researchers on Horizontal Gene Transfer & Last Universal Cellular Ancestor  
Nutrition Society  
Quekett Microscopical Club  
The Rosaceae Network  
Royal Microscopical Society  
Society for Applied Microbiology  
Society for Experimental Biology  
Society for Reproduction and Fertility  
Society for the Study of Human Biology  
SCI Horticulture Group  
Systematics Association  
The Physiological Society  
Tropical Agriculture Association  
UK Environmental Mutagen Society  
UK-BRC – Brassica Research Community  
University Bioscience Managers' Association  
Zoological Society of London

### Supporting Organisational Members

Affinity Water  
Association of the British Pharmaceutical Industry (ABPI)  
AstraZeneca  
BioIndustry Association  
Biotechnology and Biological Sciences Research Council (BBSRC)  
British Science Association  
CamBioScience  
Envigo  
Ethical Medicines Industry Group  
Fera  
Institute of Physics  
Ipsen  
Medical Research Council (MRC)  
MedImmune  
Pfizer UK  
Porton Biopharma  
Procter & Gamble  
Royal Society for Public Health  
Syngenta  
Understanding Animal Research  
Unilever UK Ltd  
Wellcome Trust  
Wessex Water  
Wiley Blackwell