All-Party Parliamentary Group on Science and Technology in Agriculture

NetZero PLUS

Land sharing vs land sparing: What the science tells us

Professor Ian J. Bateman
OBE, FBA, US National Academy of Science

Land Environment Economics and Policy Institute (LEEP)
University of Exeter Business School

presentation to the

All-Party Parliamentary Group on Science and Technology in Agriculture Agri-Science Summit

Portcullis House, Westminster

3rd November 2025

NetZeroPlus@Exeter.ac.uk

Land-related UK Government Environmental Targets

From (some variance across Devolved Administrations): Climate Change Act 2008; 25 Year Environment Plan, 2018, 2023; Agriculture Act 2020; Environment Act 2021; Environmental Improvement Plan 2023

NON-NEGOTIABLE

Climate change and emissions

- Net zero by 2050; Reduce emissions by 68% by 2030 and 78% by 2035, compared to 1990 levels; Decarbonise electricity by 2030; Plant 30,000ha of new woodland per annum to 2050

Biodiversity and nature

- Halt species decline by 2030; Increase species abundance by 10% (wrt 2021) by 2042; From 2024 new developments must deliver ≥ 10% biodiversity net gain; Increase woodland to 16.5% of England's land area by 2050.

Water quality

- Restore 750,000ha of terrestrial and freshwater protected sites to favourable condition by 2042; Reduce harmful pollutants in sewers and minimize harmful bacteria in bathing waters by 2030; reduce damaging water abstraction.

Recreational access

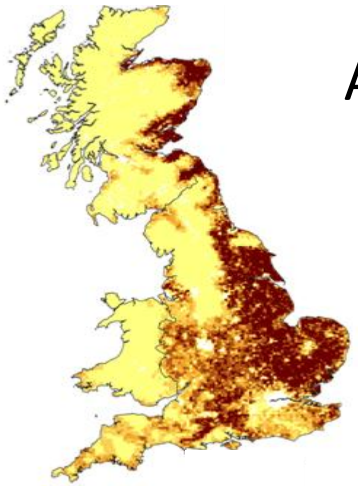
- Expand statutory rights of access; Create access for all within a 15-minute walk of home.

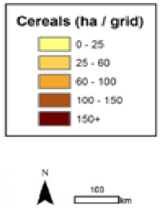
Land use change to deliver environmental targets

Land use change ← Progress toward environmental targets


Farmers Weekly

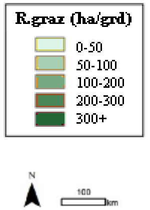
Arable

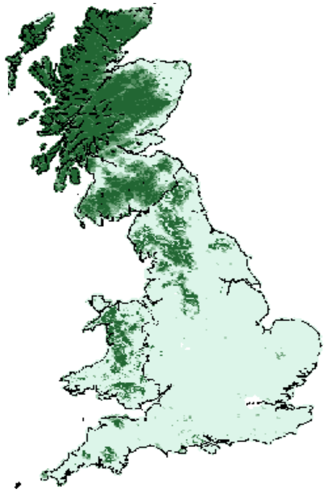





AWE

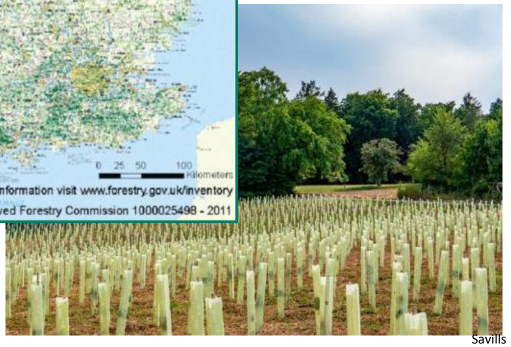
Livestock





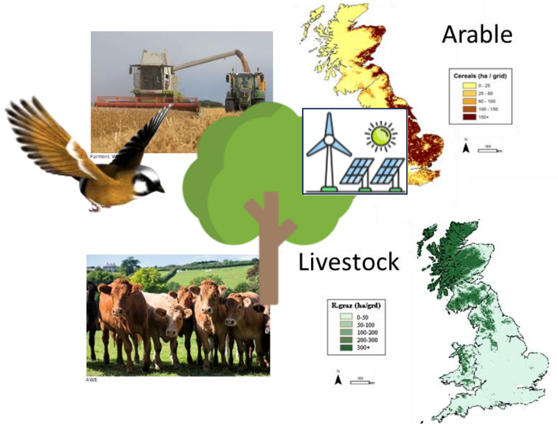

WWF

Forestry Commission

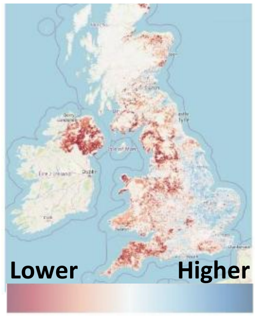

Savills

Land use change to deliver environmental targets: Externalities

Land use change



Domestic transfers of production (and impacts)



UK food output losses

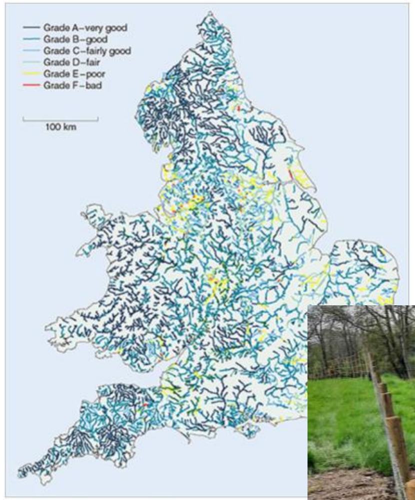
Increased imports

Overseas food output increases

Overseas carbon emissions increase

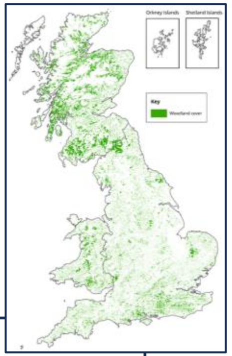
Carbon leakage

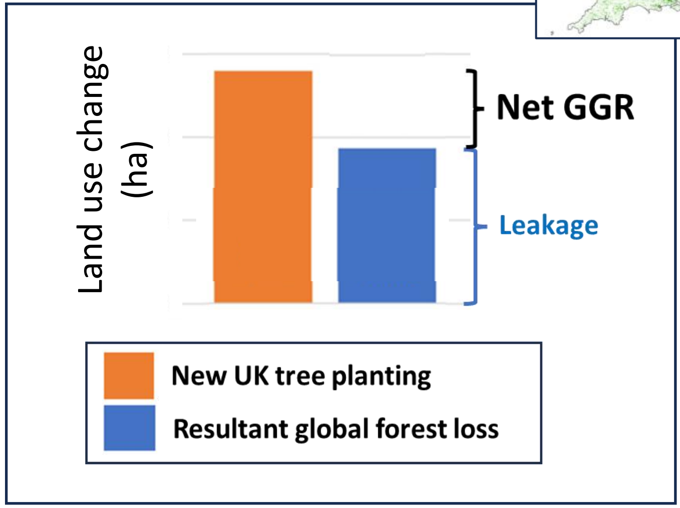
Land use change to deliver environmental targets: Externalities



Water quality & flood risk

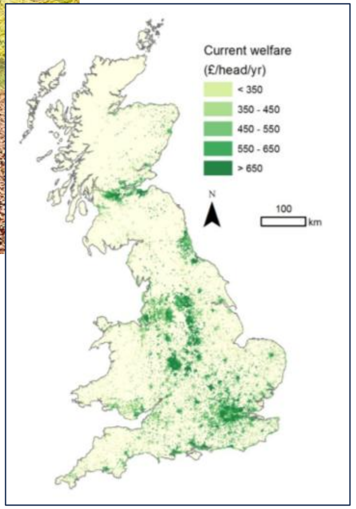
Net greenhouse gas removal adjusted for global leakage





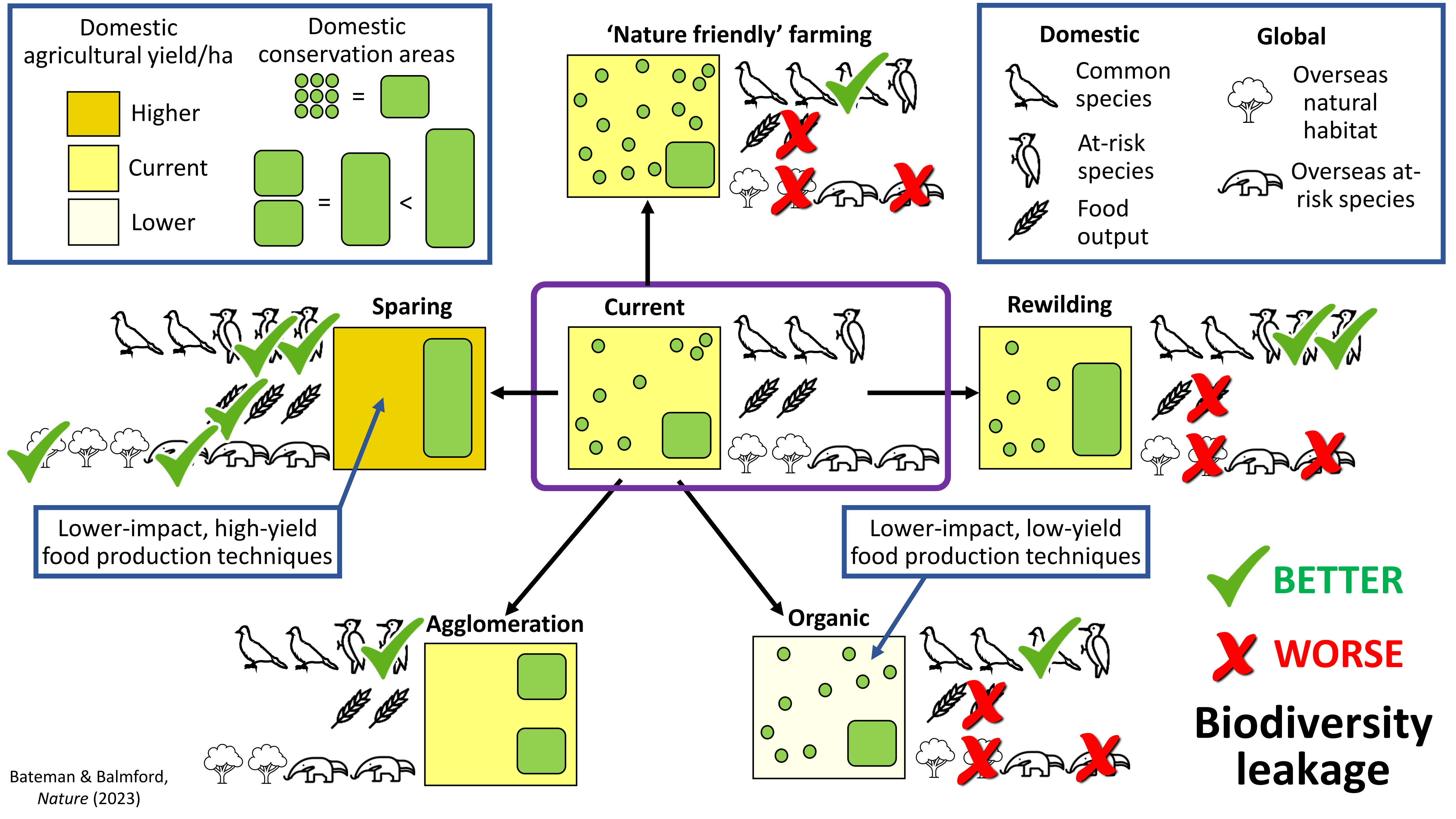
Recreation

ORVal



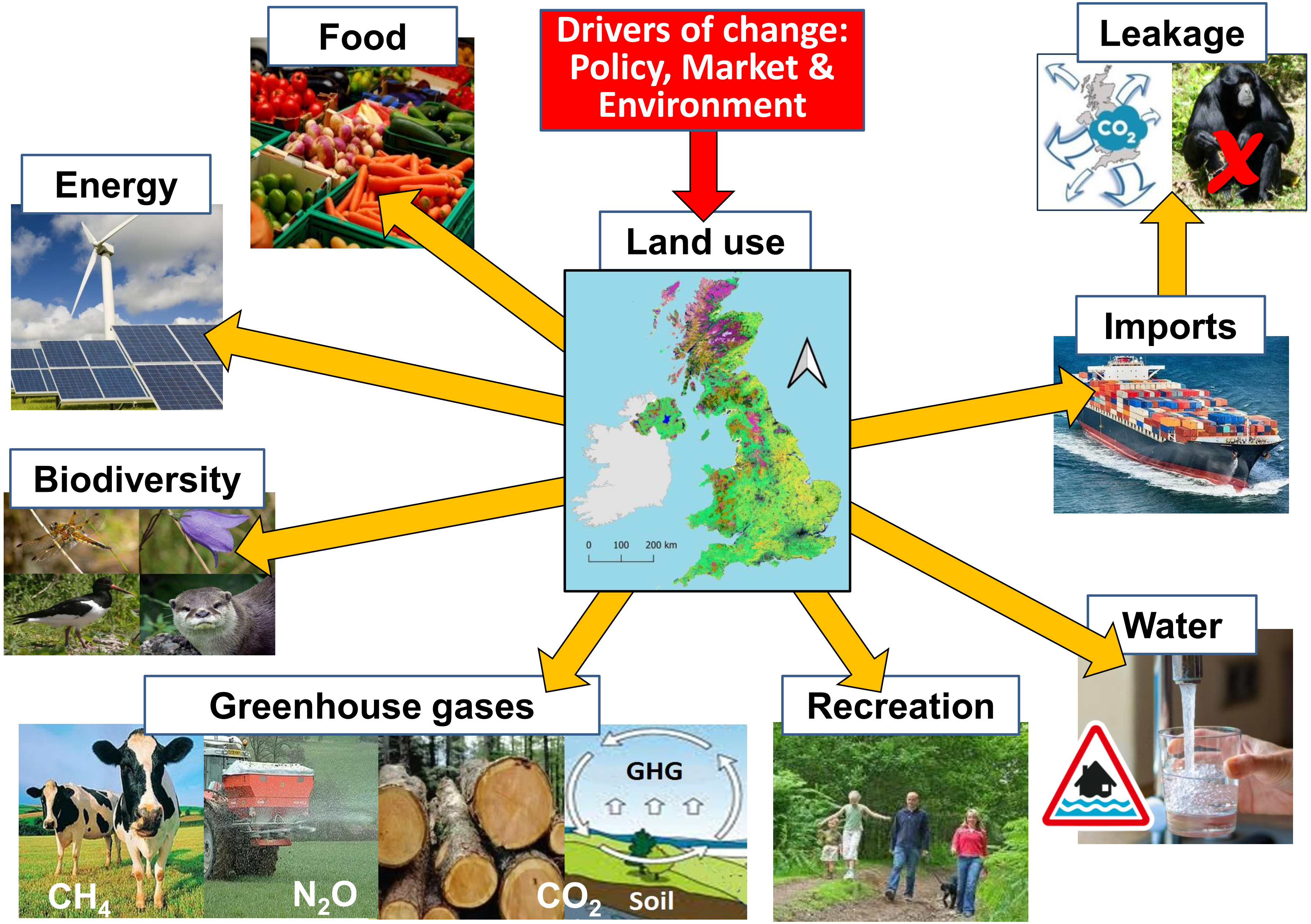
New UK tree planting

Resultant global forest loss



Domestic agricultural yield/ha
Higher
Current
Lower
Domestic conservation areas
=
=
<
'Nature friendly' farming
Domestic
Common species
At-risk species
Food output
Global
Overseas natural habitat
Overseas at-risk species
Sparing
Current
Rewilding
Lower-impact, high-yield food production techniques
Lower-impact, low-yield food production techniques
Agglomeration
Organic
BETTER
WORSE
Biodiversity leakage
Bateman & Balmford, *Nature* (2023)

Solutions: (1) Assess all the impacts of change



Solutions: (2) Do the right thing in the right place

Paying for outcomes: Planting Britain's 750,000 ha of new forests

Leave it to the market

Planting determined by:

- Subsidies
- Food production values
- Timber production values
- Ignoring non-market benefits

Benefit-cost value:

- £66million p.a.

Natural capital approach

- Subsidies
- Food production values
- Timber production values
- Net greenhouse gases
- Water quality
- Recreation

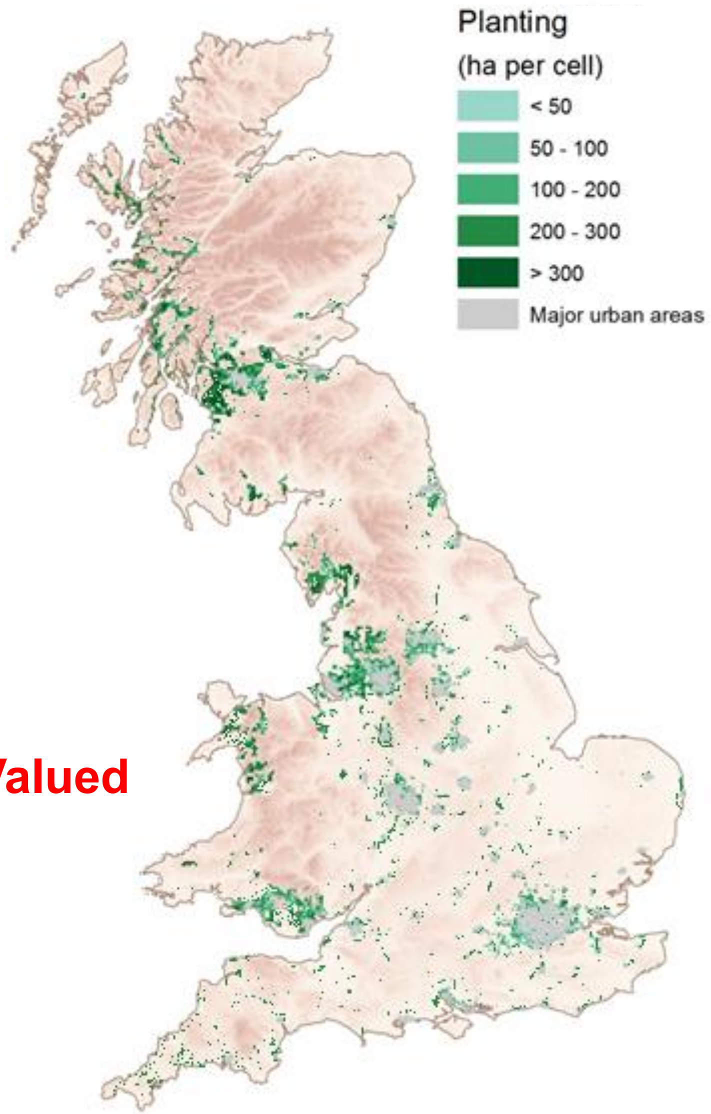
→ **Valued**

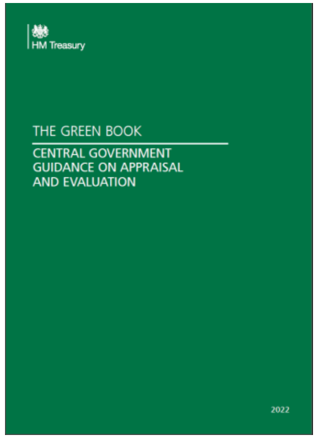
- Biodiversity

→ **NET GAIN** rule applied

Benefit-cost value:

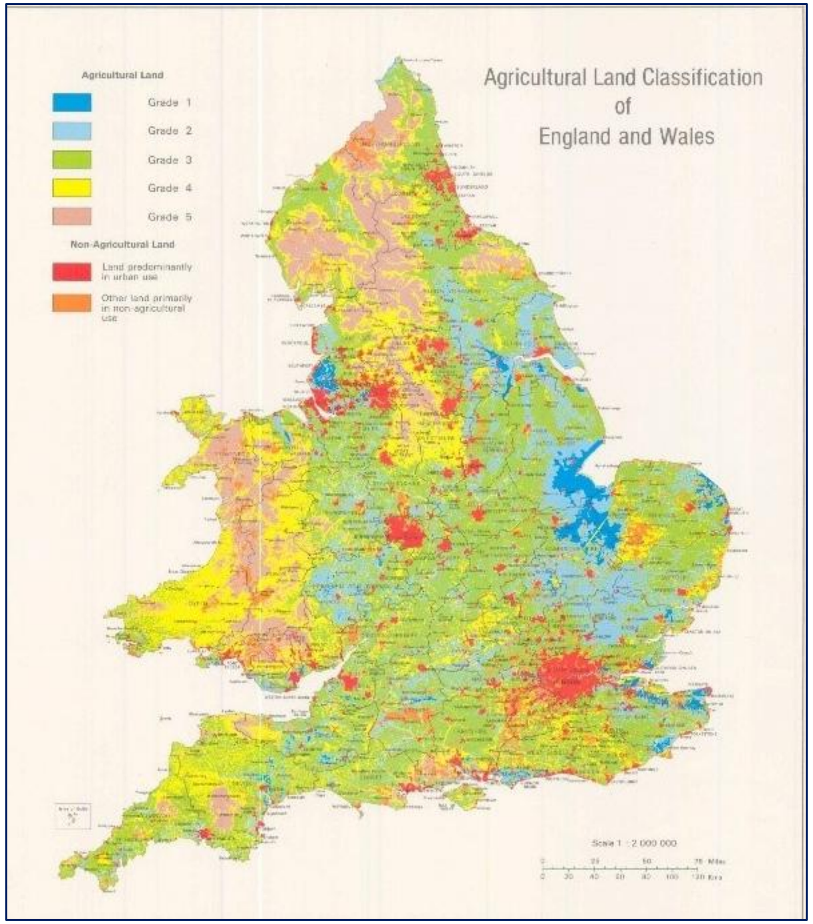
+ £546million p.a.

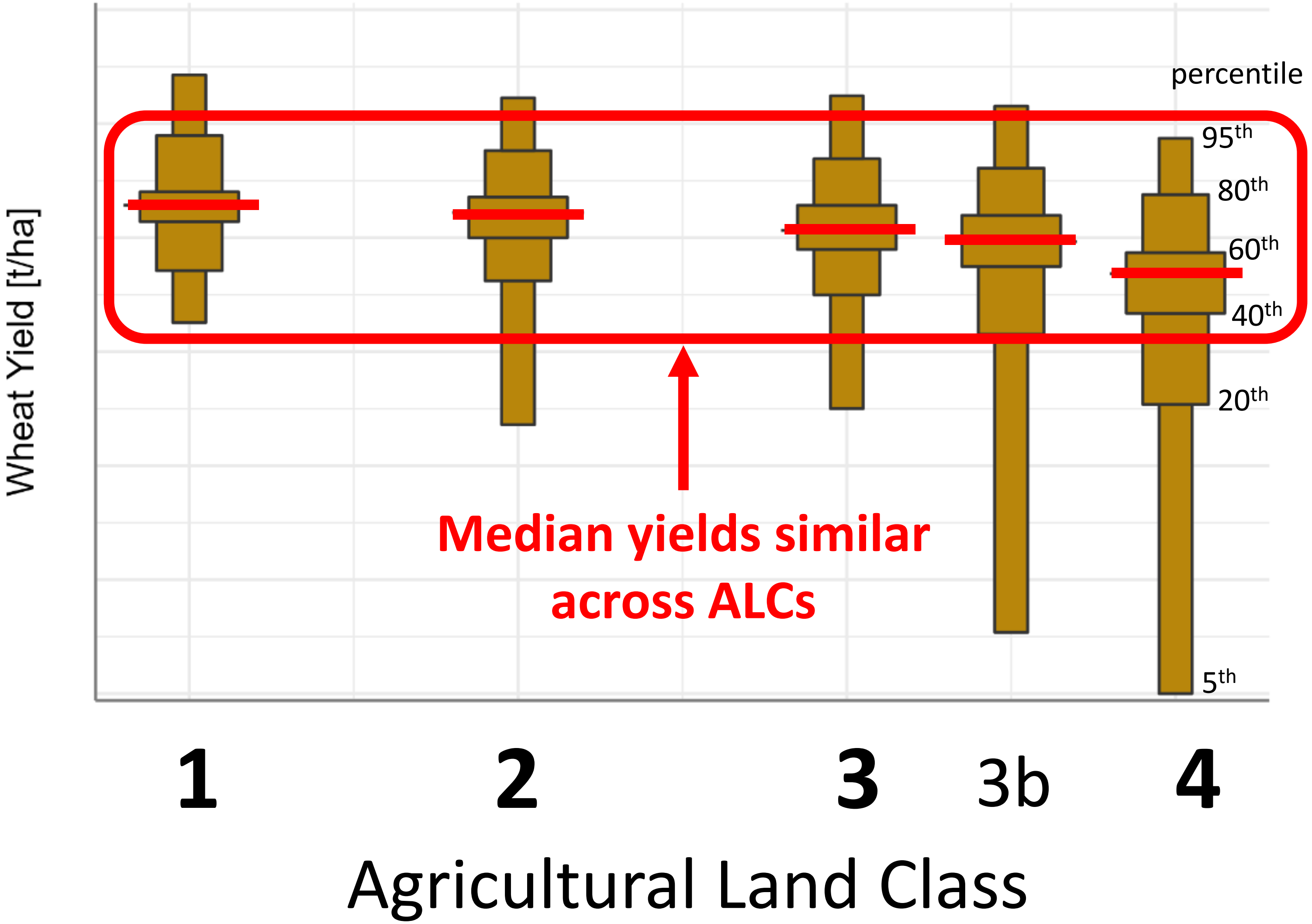




Solutions: (2) Do the right thing in the right place

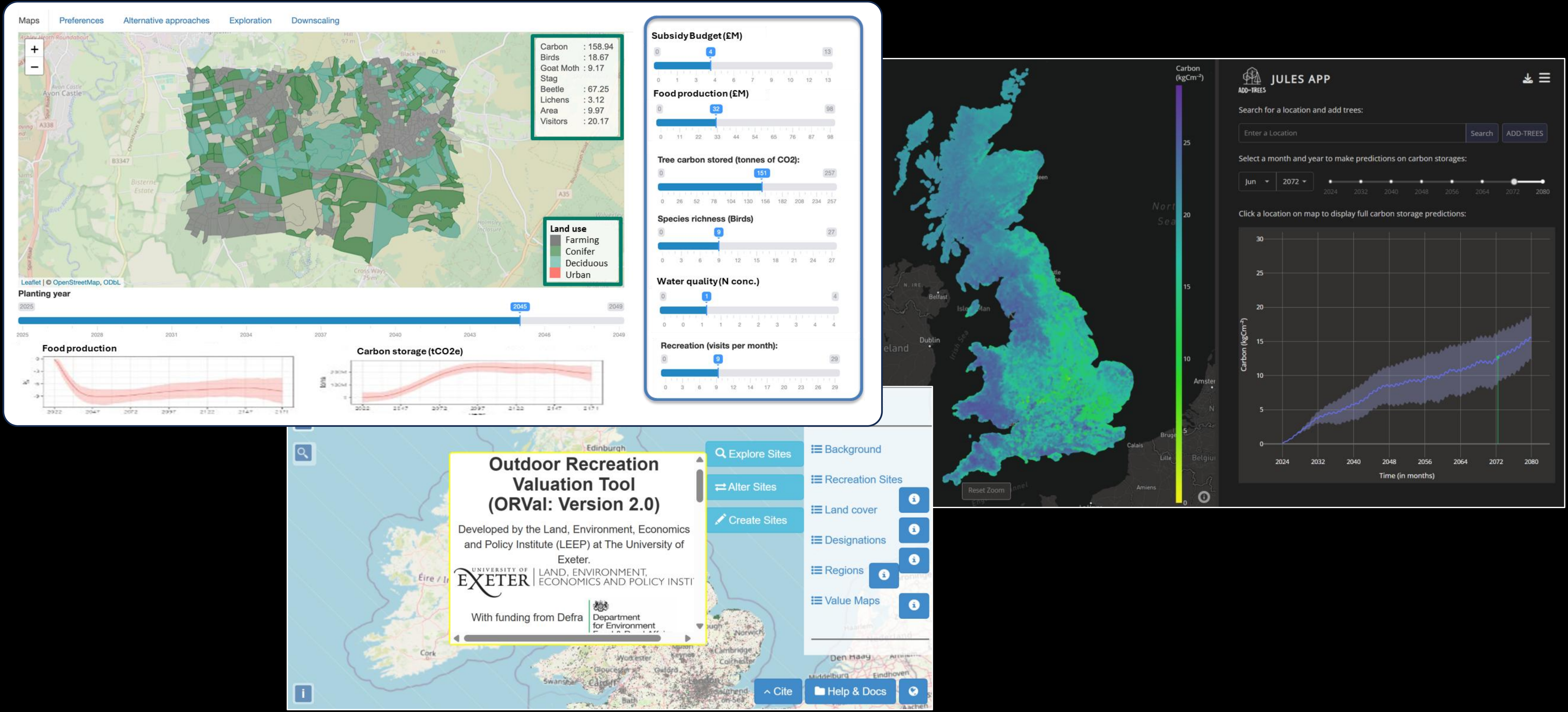
Don’t use out-of-date shortcuts such as the Agricultural Land Class to decide where to target incentives





Solutions: (2) Do the right thing in the right place

Use up to date decision support tools that examine the full effects of change



Solutions: (3) Invest in low impact high productivity technologies

- **WHAT:** Increase food productivity (i.e. higher yields per farmed hectare)

- **WHY:** To spare land for environmental improvements without reducing food production leading to national and international leakage of environmental damages

- **HOW:**

Agenda

2.30	Welcome and introduction - George Freeman MP, APPGSTA Chair
2.40	Land sharing vs land sparing: what the science tells us - Professor Ian Bateman
2.55	The contribution of genetics to sustainable crop productivity gains - Steffen Noleppa
3.10	R&D challenges for UK crop improvement - Professor Jane Langdale
3.25	The importance of genetic improvement in farmed animals - Professor Bruce Whitelaw
3.40	Closing the yield gap: the role of translational research - Dr Rosie Bryson
3.55	Break – refreshments
4.20	Farming innovations to deliver Net Zero: panel discussion - Chair Charlie Dewhirst MP; panel: Jonathan Westlake, Dr Craig Lewis and Johnny Mackey
4.50	Harnessing the power of real-time farm data - Rob Chester
5.05	Making farm assurance and data-sharing work in farmers' best interests - Hugh Broome
5.20	Summary - George Freeman MP

Low-impact increases in food productivity are vital to spare land for essential environmental improvements

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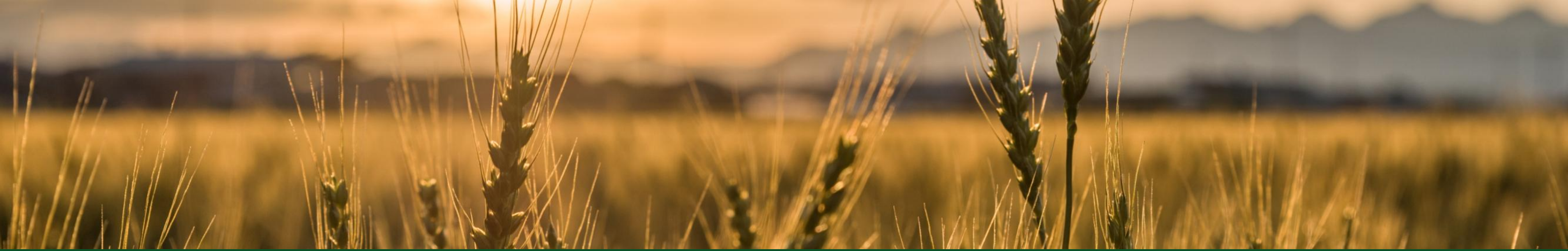

Contribution of crop genetic innovation in the UK to farm-level productivity and sustainability gains

Presentation of own research results at the
30:50:50 Agri-Science Summit, 3 November 2025,
The Attlee Suite, Portcullis House, London

HFFA RESEARCH

Content

- Examples of our research on plant breeding
- Breeding-induced productivity gains
  → real yield improvements vs. innovation-induced yield gains
  → innovation-induced yield gains vs. breeding-induced yield increases
- Related economic benefits
  → crop production and agricultural market effects
  → farm income effects
- Associated environmental benefits
  → avoided land use changes
  → subsequent GHG emission impacts
- Conclusions and recommendations

Examples of our research on plant breeding

- It started 20 years ago and has led to few peer-reviewed papers until 2015.

Agrarwirtschaft 53 (2004), Heft 5

Social rate of return to plant breeding research in Germany

Die gesamtwirtschaftliche Verzinsung der Pflanzenzüchtungsforschung in Deutschland

Harald von Witzke, Kurt Jechlitschka, Dieter Kirschke
Humboldt-Universität zu Berlin

Hermann Lotze-Campen, Steffen Noleppa
agripol - network for policy advice, Berlin

Abstract

This article focuses on the social rate of return to plant breeding investment in Germany between 1980-2000. Starting point of the analysis is the development of total factor productivity which is decomposed into the effects of factor input and research investment. Information on investment in plant breeding have been obtained via questionnaires sent to both private plant breeding companies and public research organizations. The empirical results suggest significant underinvestment in German plant breeding research, as the calculated social rate of return is in the range of 16 to 28%.

Key words

agricultural research; plant breeding investment; social rate of return

Zusammenfassung

Gegenstand der Untersuchung ist die gesamtwirtschaftliche Profitabilität der Pflanzenzüchtungsforschung in Deutschland. Ausgangspunkt der Analyse ist die Entwicklung der totalen Faktorproduktivität in Deutschland. Diese wurde mit Hilfe eines Indexzahlenansatzes dekomponiert in die Einflüsse von Faktoreinsatzveränderungen und Investitionen in die Forschung. Informationen über die Investitionen in die Pflanzenzüchtungsforschung wurden durch Befragungen privater Pflanzenzüchtungsunternehmen und Einrichtungen der öffentlichen Pflanzenzüchtungsforschung gewonnen.

Die empirische Analyse für Investitionen im Zeitraum von 1980 bis 2000 ergab eine jährliche gesamtwirtschaftliche Verzinsung von 16 % bis 28 %. Damit liegt die gesamtwirtschaftliche Verzinsung deutlich über den Opportunitätskosten der Forschungsaufwendungen. Aus gesamtwirtschaftlicher Sicht wird daher in Deutschland in die Pflanzenzüchtung unterinvestiert.

Schlüsselwörter

Agrarforschung; Pflanzenzüchtung; gesamtwirtschaftliche Verzinsung

1. Introduction

Plant breeding is a fairly sizeable agricultural industry in

social rate of return reported in the literature is in the range of 40-60%, sometimes even higher. A key critique of these results is that the analyses usually relate the productivity gains of agricultural research to the investment in public agricultural research only, while neglecting private research investment. This is due to insufficient information on agricultural research by the private sector. As a consequence, analyses typically have overestimated significantly the order of magnitude of the social rate of return to investment in agricultural research (Fox, 1985).

The analysis presented in this paper is based on information about both private and public sector investment in plant breeding. Therefore, we have been able to avoid this upward bias in our results.

2. Methodology

There are a considerable number of approaches that can be and have been used in the analysis of the social rate of return to research. Their pros and cons have been discussed in great detail by Alston et al. (1995). One type of approach is based on econometric methods. Usually, a specification such as the following has been used:

(1) $Q_t = f(X_t, Z_t, T_t, U_t)$

where

(2) $T_t = g(R_t, \ldots\ldots, R_{t-n})$

Q = quantity produced
X = vector of conventional production factors (land, labor, capital etc.)
Z = vector of pubic goods
T = technology
U = random variable
R = research investment
t = time index.

Humboldt Forum for Food and Agriculture e.V. (HFFA)

Steffen Noleppa und Harald von Witzke

Die gesellschaftliche Bedeutung der Pflanzenzüchtung in Deutschland

Einfluss auf soziale Wohlfahrt, Ernährungssicherung, Klima- und Ressourcenschutz

hffa

HFFA Working Paper 02/2013

ELSEVIER

Agricultural Systems
Volume 136, June 2015, Pages 79-84

Science for food, climate protection and welfare: An economic analysis of plant breeding research in Germany

Hermann Lotze-Campen [a b], Harald von Witzke [b], Steffen Noleppa [c], Gerald Schwarz [d]

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https://doi.org/10.1016/j.agsy.2015.02.005

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Highlights

- We analyze the economic effects of plant breeding research in Germany.
- Effects of reduced CO_2 emissions due to productivity increases are being quantified.
- Expansion of global agricultural area has been reduced by 1–1.5 million ha.
- CO_2 emissions have been reduced by 160–235 million tons.
- German plant breeding research has an economic value of 10.8–15.6 billion EUR.

hffa RESEARCH

Examples of our research on plant breeding

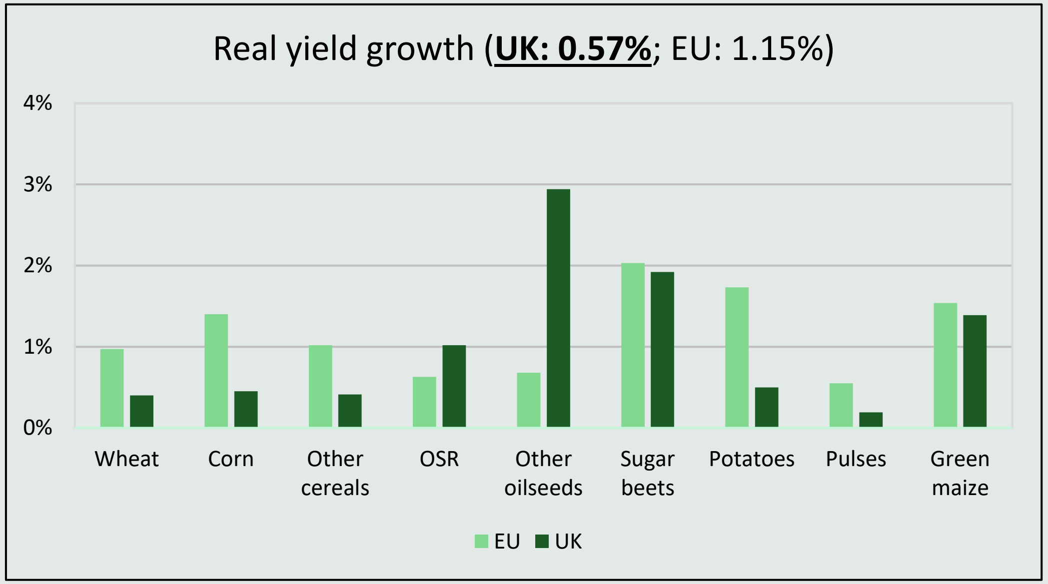
- In the past ten years, European and global foci have become important.

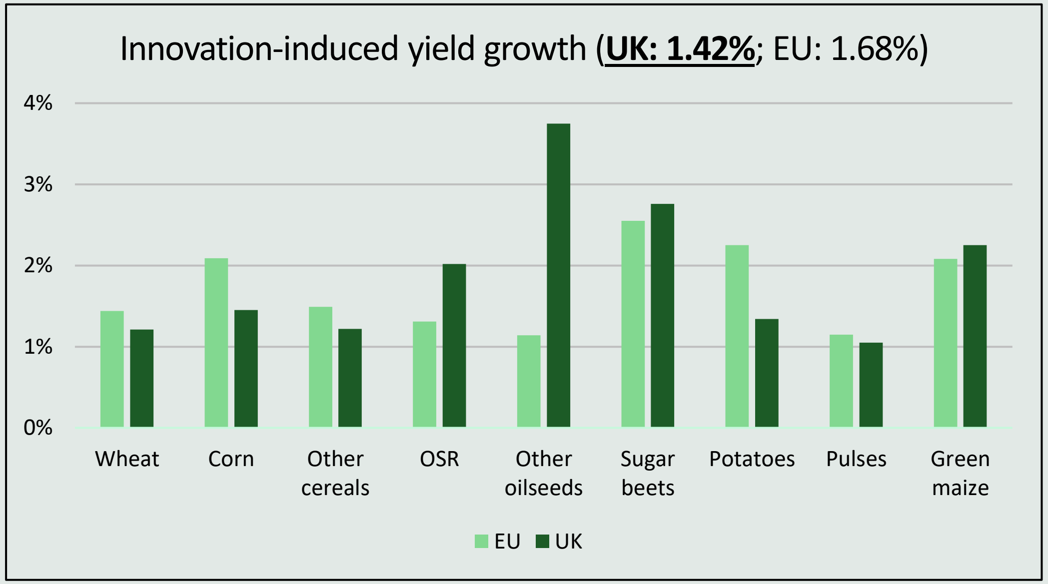
Breeding-induced productivity gains & benefits

- The following is based on data related to the first two decades post the millennium.
- Accordingly, the research findings refer to the EU at the end of that time horizon, including the UK.
  → UK results will be highlighted and partly contrasted with the EU.
- Major data sources:
  → official (publicly available) statistics
  → scientific (peer-reviewed) papers and additional expert judgements
- Sophisticated methods of agricultural and environmental economics were used to analyse the various primary and secondary effects.

Breeding-induced productivity gains

- From real yield improvements to innovation-induced yield gains
  → Yield changes – function of the quantity and quality of inputs.
  → Changes in input intensity must properly be subtracted from yield changes.

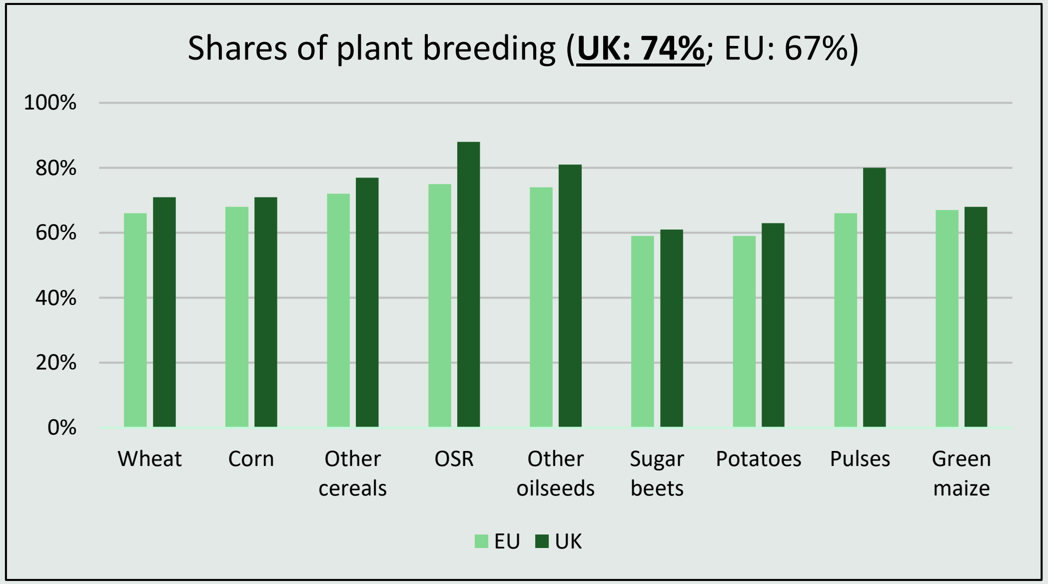


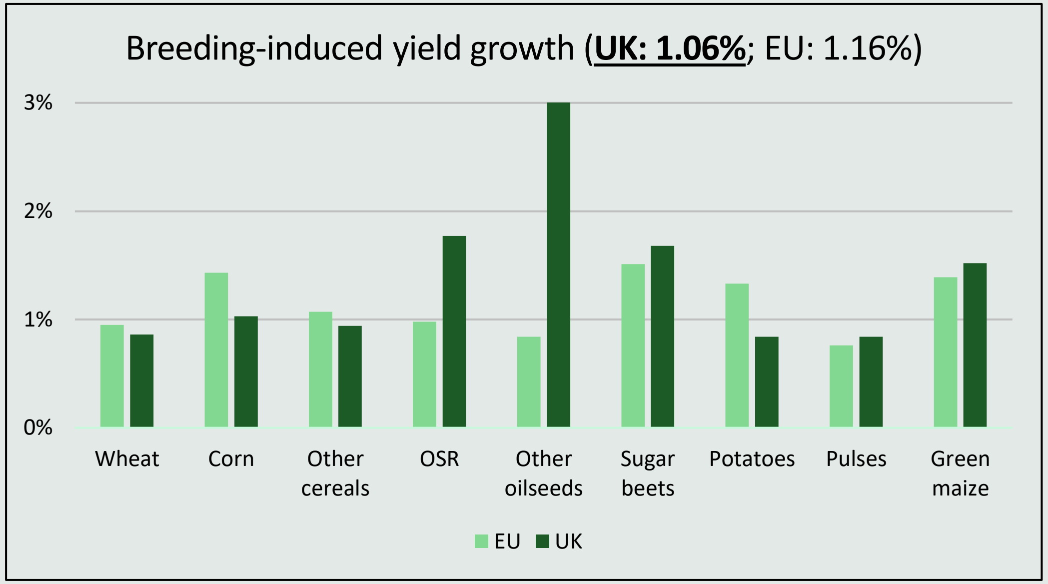


- Innovation-induced yield gains are higher than real yield increases since arable farming in the EU and even more in the UK already face extensification.

Breeding-induced productivity gains

- From innovation-induced yield gains to breeding-induced yield increases
  → Definition of the shares of plant breeding in innovation-induced yield growth (based on almost 400 data points from 113 scientific papers and expert judgements)

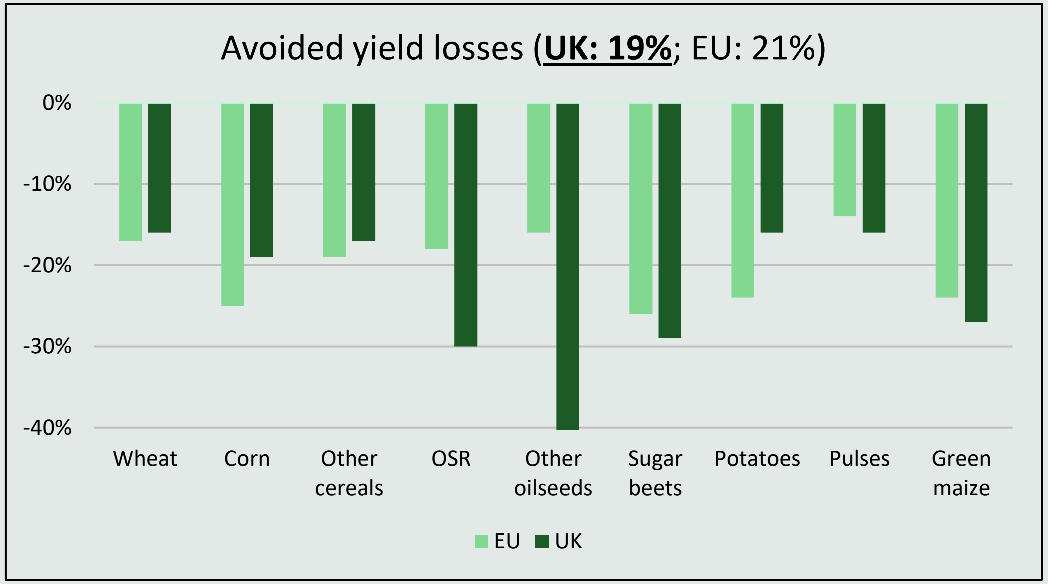




- Plant breeding can be considered to play a – if not the – major part in generating innovation leading to annual yield growth rates of more than 1% in the UK.

Related economic benefits

- Avoided yield losses over time and (current) additional market supply from domestic (UK) resources with 20 years of plant breeding progress

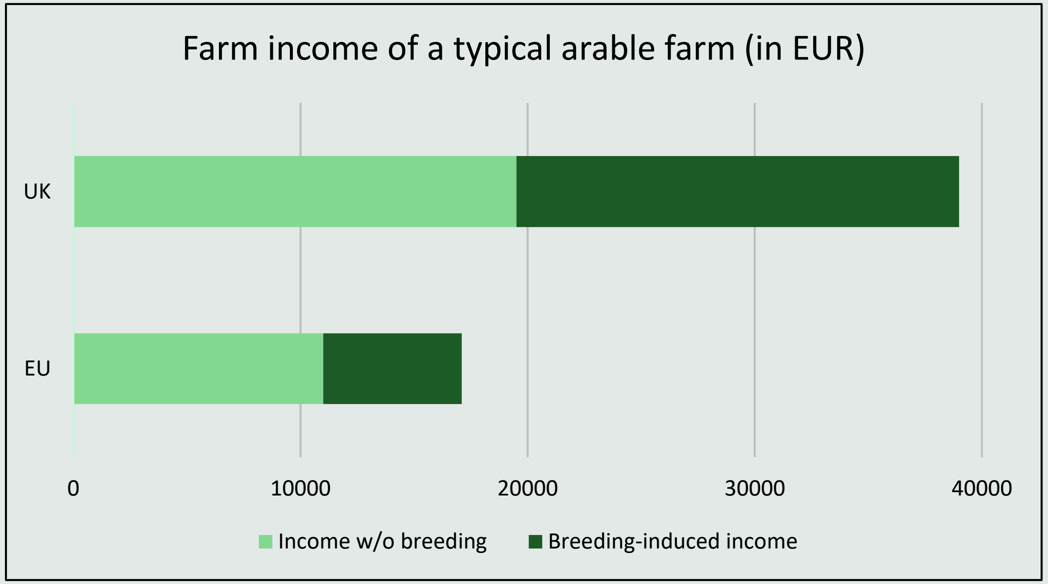


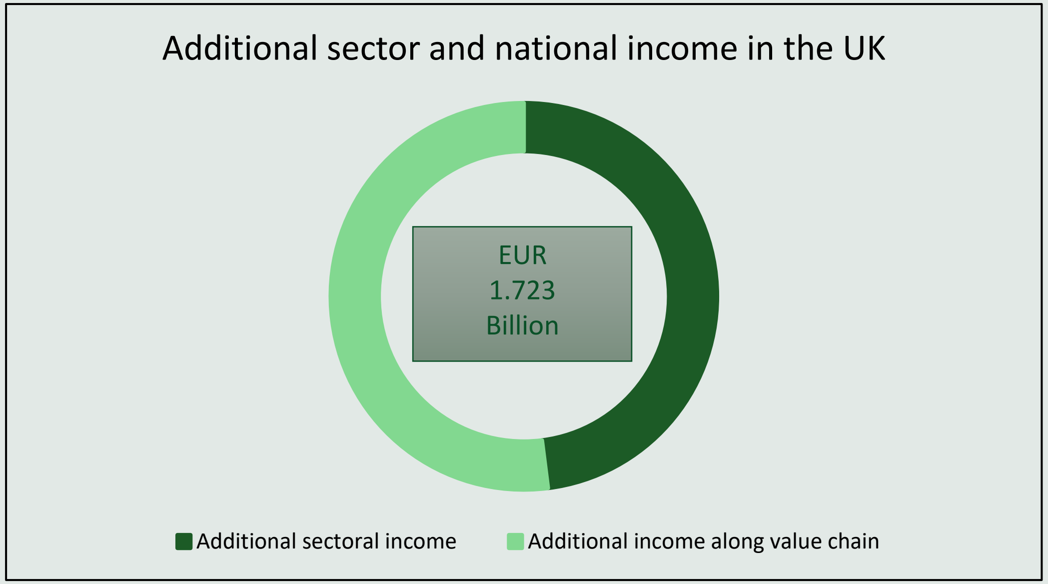
Wheat:	2.2 million tons
Corn:	0.1 million tons
Other cereals:	1.0 million tons
OSR:	0.6 million tons
Other oilseeds:	0.1 million tons
Raw sugar:	0.4 million tons
Potatoes:	0.8 million tons
Pulses:	0.2 million tons

- Social sustainability: the additional market supply in the UK enables the provision of food for up to 13 million people at lower and more stable market prices.

Related economic benefits

- Higher yields and production create additional farm and sector income
  → Below visualised monetary effects are in EUR and based on 2020 market prices as well as input costs obtained from the EU Farm Accountancy Data Network.

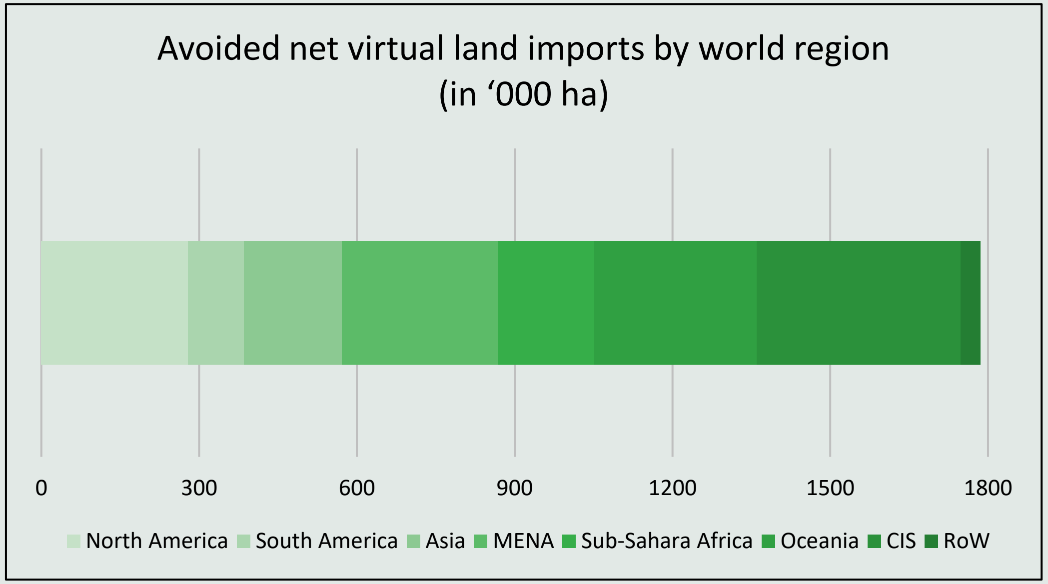




- 20 years of plant breeding in the UK can be considered an important income generator for arable farms as well as many other value chain actors.

Associated environmental benefits

- Avoided net virtual land imports at global scale with 20 years of plant breeding progress in the UK

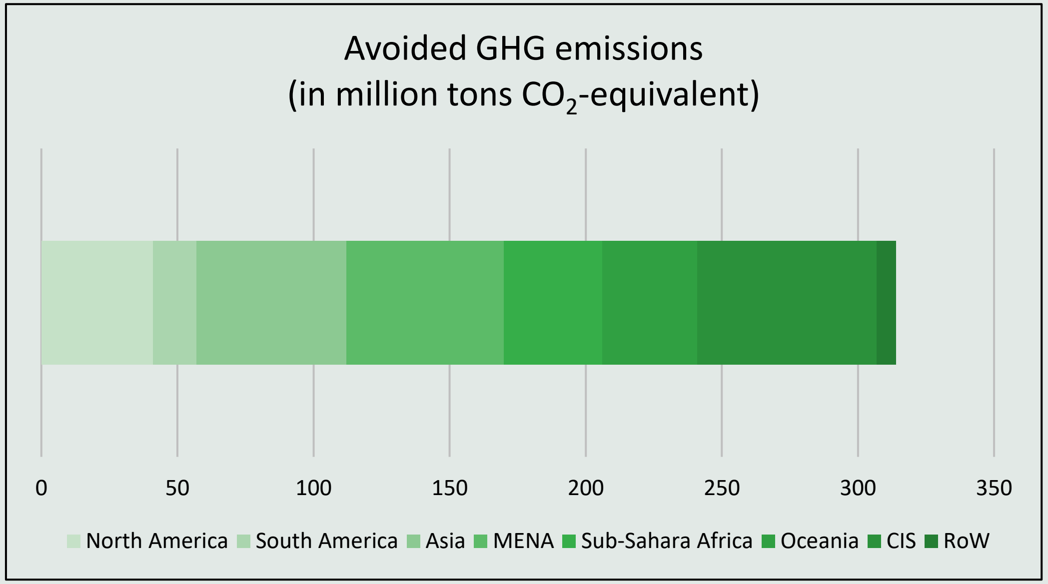


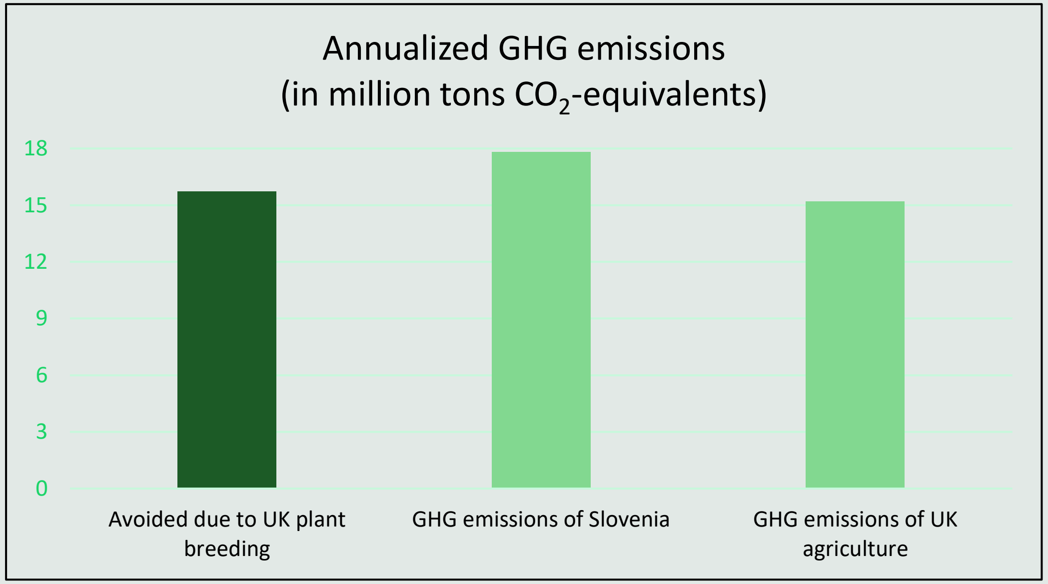
Wheat:	739 000 ha
Corn:	1 000 ha
Other cereals:	352 000 ha
OSR:	591 000 ha
Other oilseeds:	2 000 ha
Sugar crops:	24 000 ha
Potatoes:	11 000 ha
Pulses:	64 000 ha

- Avoided net virtual land imports equal the arable land globally needed extra w/o plant breeding. Land is not available per se and would have to be converted.

Related economic benefits

- Conversion of the land extra needed w/o UK plant breeding would have led to release of carbon still sequestered in natural/nature-like habitats.





- Over 20 years, more than 300 million tons of CO_2-equivalents were not emitted with plant breeding in the UK. Annualized, this equals all the UK farming emissions.

Conclusions and recommendations

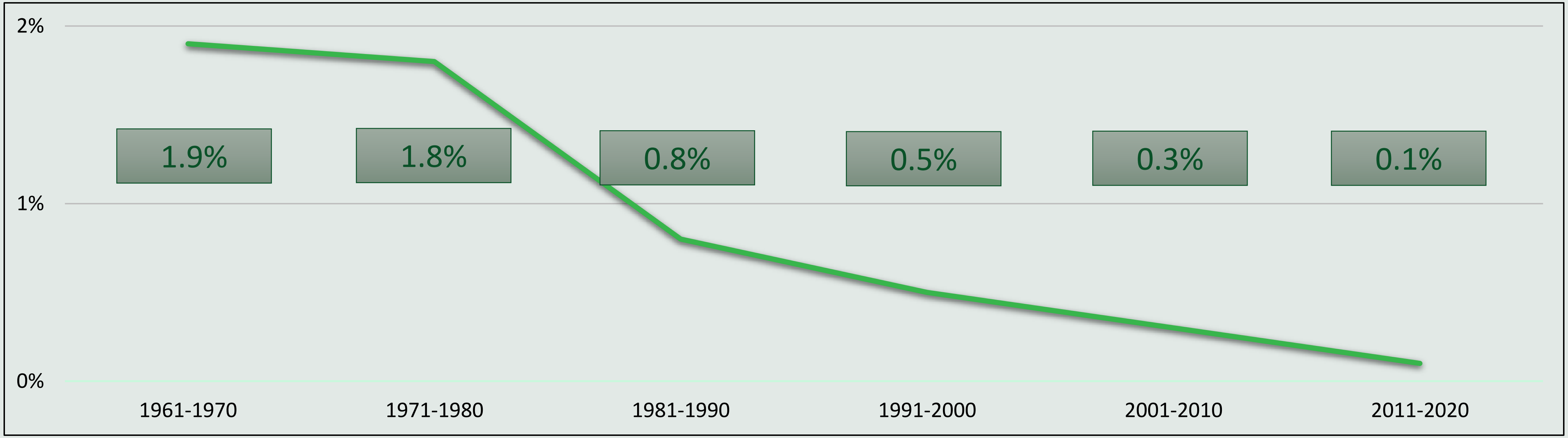
- Innovation-induced yield growth (+1.42% p.a.) in the UK is higher than real yield growth (+0.57% p.a.) indicating that better inputs matter.
- Breeding-induced yield growth (+1.06% p.a.) in the UK contributes the most (~74%) to innovation-induced yield growth.
- W/o plant breeding in the past two decades, UK crop yields would be much lower (-19%) today and food availability from own resources would shrink.
- 20 years of plant breeding in the UK considerably increased income of a typical arable farm (~19,000 EUR p.a.) and income along the value chain.
- W/o 20 years of plant breeding in the UK, more land (+1.7 million ha) still storing carbon (and preserving biodiversity) would have been needed at global scale to meet the country’s food and other agricultural demand.

Conclusions and recommendations

- The 30:50:50 agenda aims at increasing domestic food production by 30% by 2050 while reducing UK agriculture's environmental footprint by 50%.
- Our research shows that UK plant breeding has already played a major role in increasing domestic production and reducing environmental footprint.
- Plant breeding can surely further contribute to the agenda objectives.
- Plant breeding innovation needs to speed up to better cope with various challenges (food demand, climate change, crop protection issues, policies).
- Private breeders must take responsibility by investing more into innovation.
- Policy-makers must encourage and not hinder plant breeders by prioritising breeding-related R&D and enabling regulation to use new tools such as NGT.

Conclusions and recommendations

- A final eye-opener: There is no time to wait!
  Total factor (innovation-induced) productivity growth in UK agriculture has continuously decreased over past decades and may soon come to a standstill.



Source: Agnew et al. (2024)

Thank you!

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hffa RESEARCH

R&D Challenges for UK Crop Improvement

Jane Langdale

@jane.langdale
www.langdalelab.com

March 15th 2021

Why?

- community fragmentation
- limited end-user pull
- low visibility in Government

Solutions needed

- to mitigate the effects of climate change
- to ensure a sustainable & secure agri-food supply
- to protect biodiversity & enhance our environment
- to address health & wellbeing issues

The four big plant science questions

- What species should be planted where and when, and how should they be managed?
- How can yield and quality be increased with significantly reduced chemical inputs?
- How can plant health be sustainably protected?
- How can plant products be used to improve human health & environmental resilience?

Deliverables

- Landscapes that sustainably balance demands for agriculture, biodiversity, carbon sequestration, energy production and flood management.
- Resilient agricultural systems to sustainably produce safe & nutritious food.
- Significant reductions in carbon emissions from the UK agricultural sector, contributing to the UK 2050 net zero goal.
- Proactive mechanisms to monitor, contain and deter plant disease.
- Completely new plant-based production systems for food and for the manufacture of novel products including vaccines, protein feedstocks and high value chemicals.

Challenges to Implementation

People

- Education
- Training/Culture
- Collaboration
- Leadership

Funding

- Sustainability
- Connectivity
- Politics

Innovation

- Risk aversion
- Individual mindsets
- Public/private partnerships
- Regulatory issues

Challenges to Implementation

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- Connectivity
- Politics

Innovation

- Risk aversion
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Case study 1: Plant based omega 3 oils

The annual global marine harvest of ~ 1M tonnes of fish oils is worth ~ $4B

Discovery science & proof of concept

Validation & testing of elite events

Field, feed and food testing

De-regulated in US – can be grown at any scale

2000 2010 2015 2023 2025

£800K BBSRC

£900K BASF

£600K BBSRC

£1.1M BBSRC

£200K Yield10

$200K license payment to Rothamsted

Johnathan Napier

ROTHAMSTED RESEARCH

Yield10 BIOSCIENCE

nufarm

Case study 1: Plant based omega 3 oils

- Driven by an individual not an institutional/national framework
- Piecemeal funding slowed progress
- Regulatory issues have prevented adoption in the UK
- Commercialization and profits in hands of an Australian company

Johnathan Napier

ROTHAMSTED RESEARCH

Case study 2: Purple tomatoes

Health benefits of purple fruits are well supported but there are not many choices

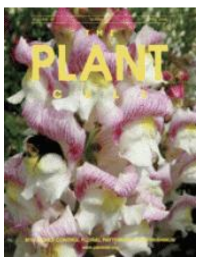
BBSRC

BBSRC/EU/
private investment

Private
investment

Investment by
major grower

2000 — 2006 — 2015 — 2020 — 2025



Discovery
research on
anthocyanin
pigments

Metabolic
engineering
of tomato

FDA safety approval 2023;
Sales of seeds to home
growers in US 2024;
Regulatory completion Canada
2025; FANZ (Australia)
deregulation expected
November 2025

Cathie
Martin

John Innes Centre

Norfolk Plant Sciences

NORFOLK
HEALTHY PRODUCE

Case study 2: Purple tomatoes

- Driven by an individual not an institutional/national framework
- Piecemeal funding slowed progress
- 6 years to deregulate in US
- Regulatory issues have prevented adoption in the UK

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NORFOLK HEALTHY PRODUCE

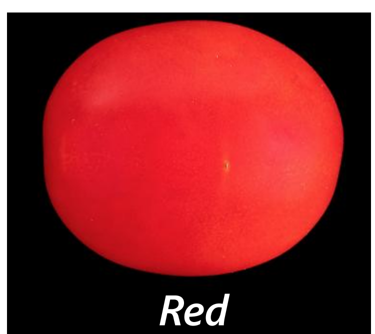
Case study 3: Vitamin D fortified tomatoes

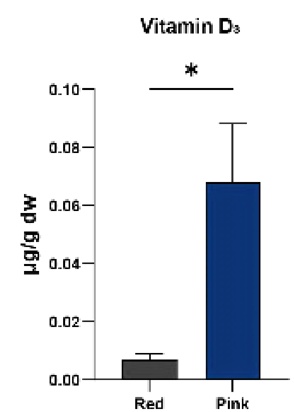
Fortified fruit for vitamin D insufficiency (63% of the UK population)

2017	2021	2022	2024	2025	2026-2029
Discovery research	Generation of provitamin D3 rich tomatoes by precision breeding, Patent filed	Approval by Defra of field trial for research Demonstration of conversion of provitamin D3 to vitamin D3 in field	Fine tuning to increase provitamin D3 accumulation & conversion to vitamin D3	Preparation for FSA approval. Consumer acceptance study	License patent on vitamin D biofortification internationally. Obtain FSA approval for commercialisation Take to market
BBSRC	BBSRC	John Innes Centre	Rank Prize Funding	BBSRC	BBSRC Follow-on Funding; Innovate UK (Farming Futures)

Cathie Martin

John Innes Centre





Case study 3: Vitamin D fortified tomatoes

- Driven by an individual not an institutional/national framework
- Rapid approval by DEFRA for field testing of research
- Just 4 years between patent filing & preparation of FSA approval submission

Cathie Martin

John Innes Centre

Going Forward

- Need national framework for delivery of novel products to farmers & consumers
- Need a funding model that incentivizes long-term collaborative projects
- Need Precision Breeding Act to be fully implemented
- Need to think beyond the existing regulatory landscape to GM products

The Importance of Genetic Improvement in Farmed Animals

Bruce Whitelaw FRSB
ex-Director of The Roslin Institute
Prof of Animal Biotechnology
University of Edinburgh

UK leading livestock player

Genetic improvement in livestock – **enormous contribution to productivity**

- will be important for future sustainability gains in livestock

Need ‘fit-for-purpose’ **innovation ecosystem**

- joined up R & D
- long-term thinking

Promote translating early stage genetic discoveries

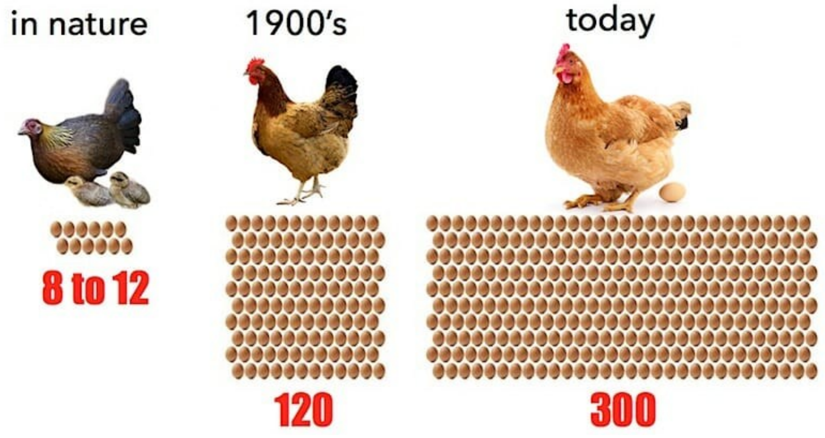
- promote **entrepreneurial activity**
- to develop enhanced breeding tools
- within **proportionate and enabling regulation** of genetic innovation

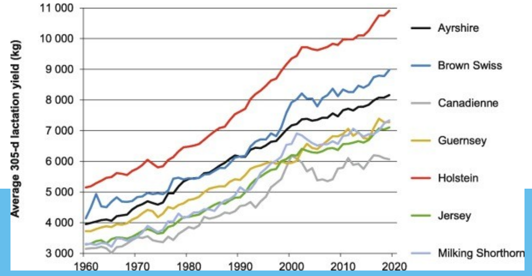
Enormous contribution of genetic improvement

Genetic improvement
= faster, cheaper, healthier, and more-efficient animal production

since 1960:

- 50% larger litter sizes in pigs
- doubling of lean pork meat / kg of feed intake
- chickens reach 2kg mass 60days quicker
- feed conversion ratio halved
- eggs / tonne of feed increased by 80%
- milk production increased by 67%

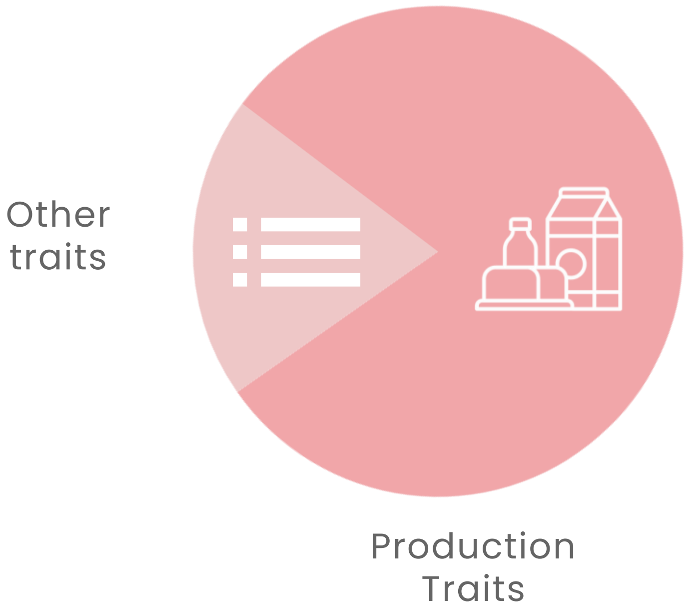




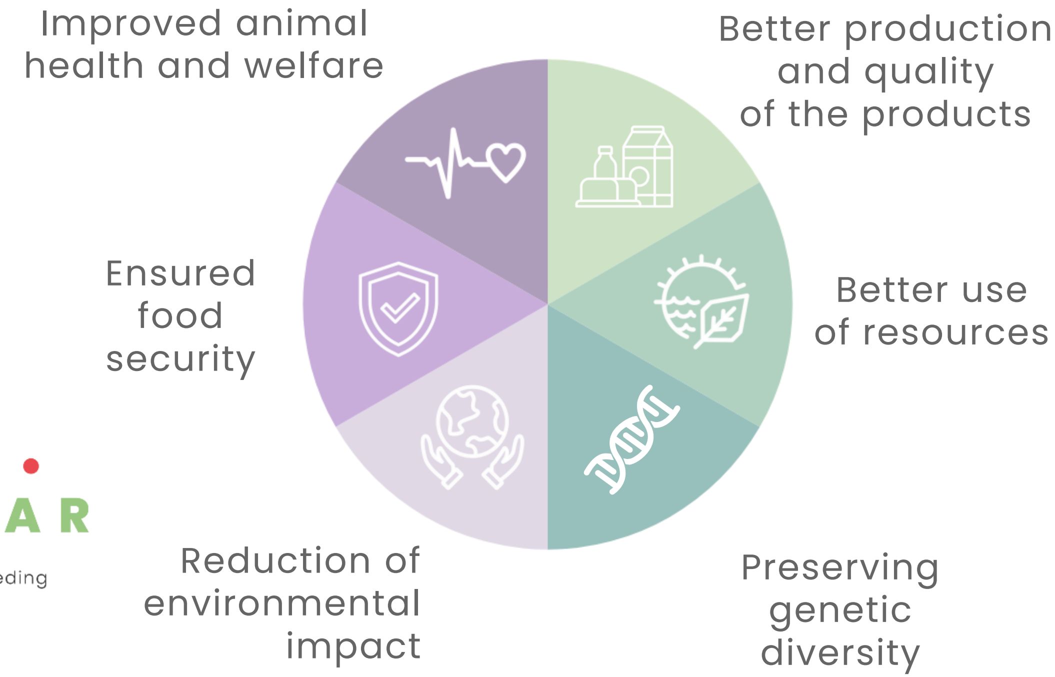
doi.org/10.1016/j.animal.2021.100292

Productivity + health, welfare, environment

1980



Today

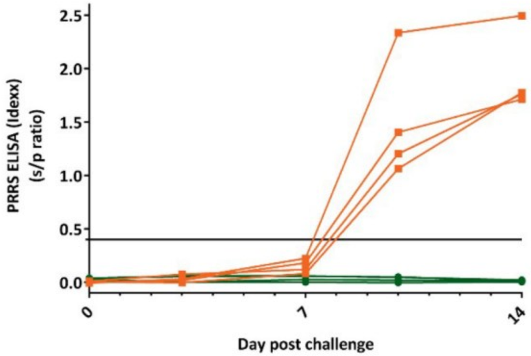


CODE • EFABAR
The commitment to responsible breeding

Responsible & Balanced Breeding

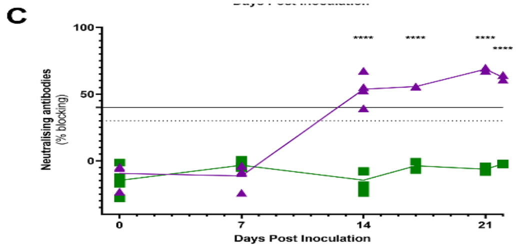
New technologies – genome editing

PRRSV-resistant pigs doi: 10.1128/JVI.00415-18



academic-industry research partnership

POC animals	2018
FDA approval	2025



CSF-resistant pigs
doi: 10.1016/j.tibtech.2025.09.008

ROSLIN

Keep the UK leading agriculture productivity

Genetic improvement in livestock

- **has and will contribute to productive & sustainable agriculture**

Need ‘fit-for-purpose’ regulatory policy and research priorities

- **long-term thinking for joined up R & D**

Promote research translation into early stage genetic discoverie

- **entrepreneurial ecosystem**
- **proportionate and enabling legislation**

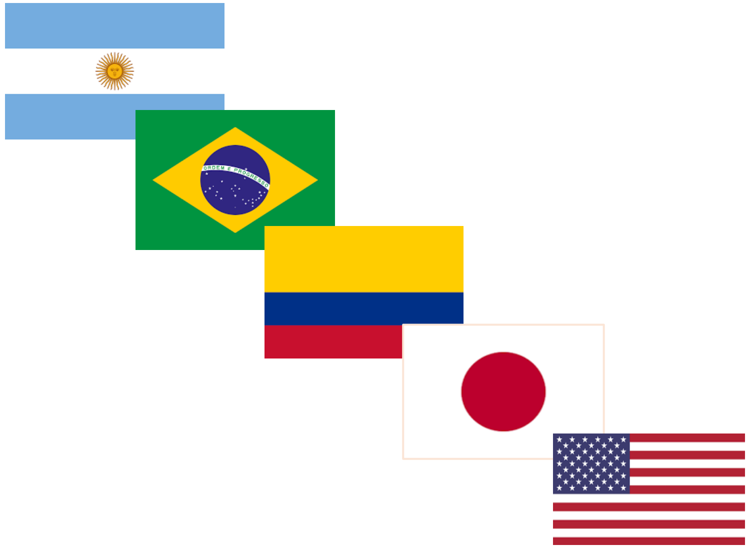
CHARLES III

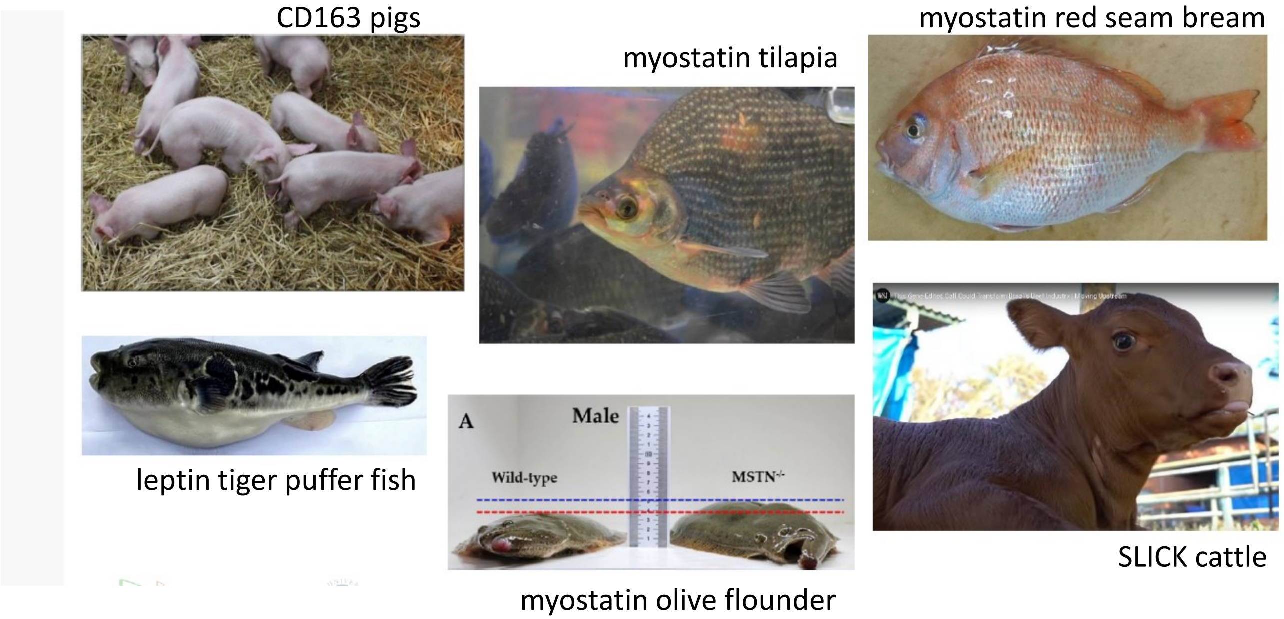
Genetic Technology (Precision Breeding) Act 2023

“to be the leader”

30% increase in agricultural production
50% reduction in environmental footprint per unit of output
50% improvement in land, water, and emissions efficiency

Edited animals approved elsewhere





CHARLES III

Genetic Technology (Precision Breeding) Act 2023

Secondary Legislation (plants) predicted November 2025

***** keep up momentum on <u>animal legislation</u> *****





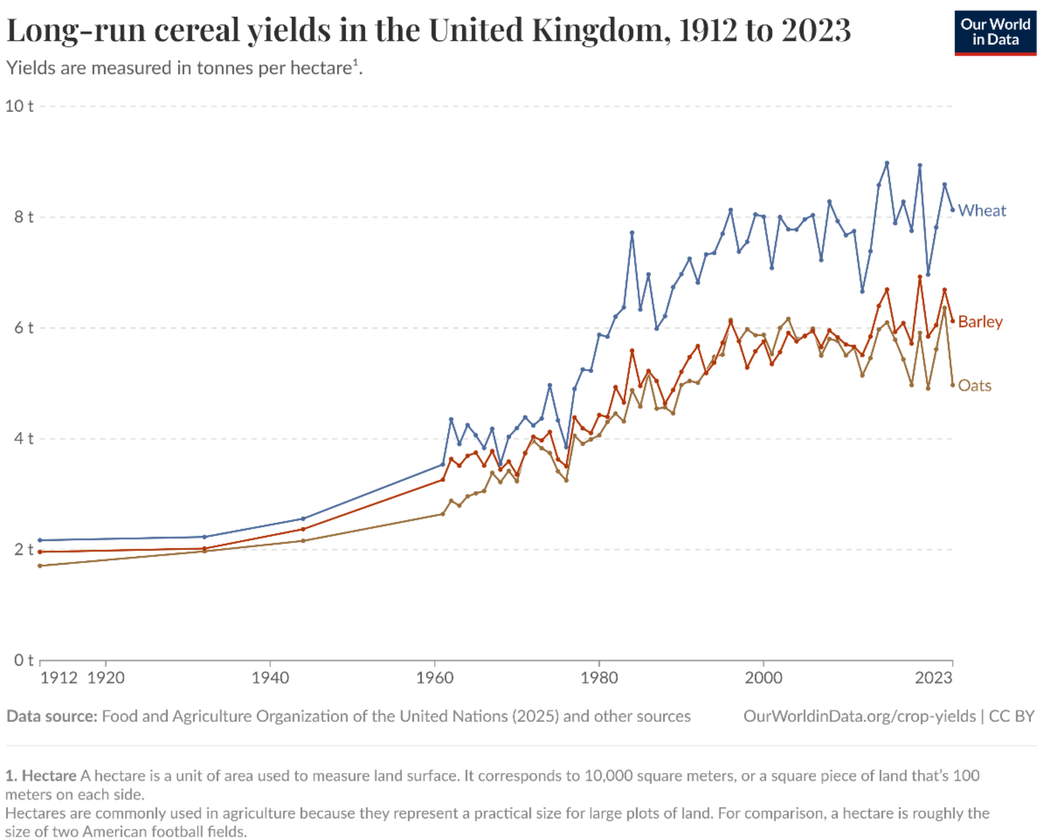
Closing the yield gap: the role of translational research to effect real change

Dr Rosie Bryson, Research Director
ADAS Sustainable Agricultural Systems

APPG meeting – 3rd Nov. 2025

www.adas.uk

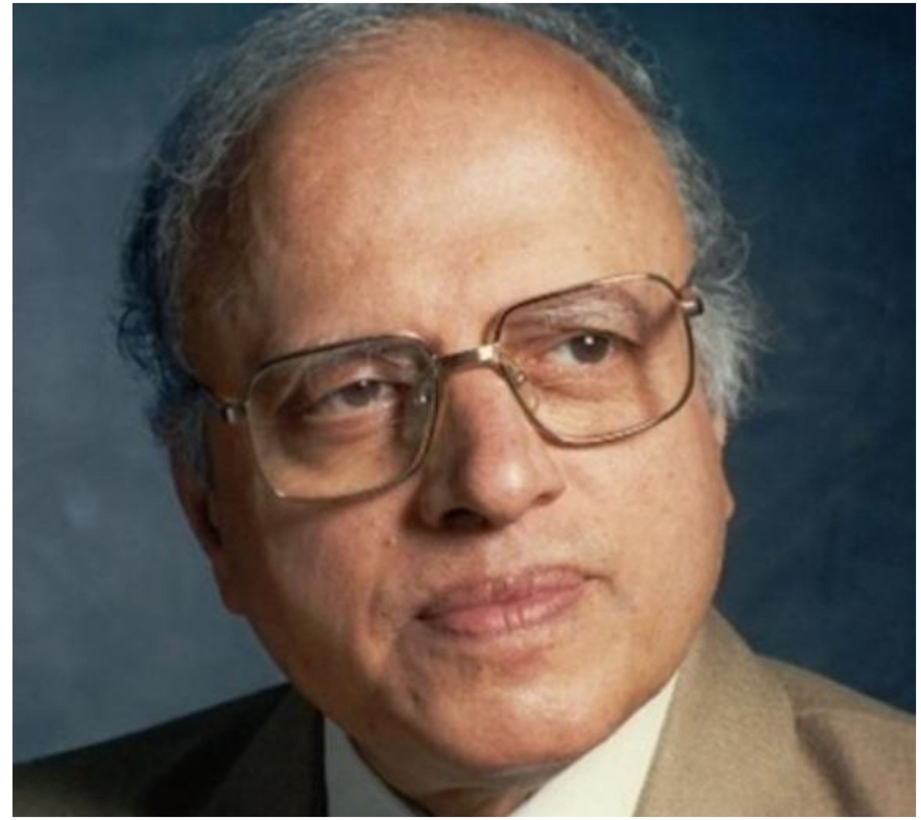
The Green Revolution filled the early Yield Gap (1940s-1980s)



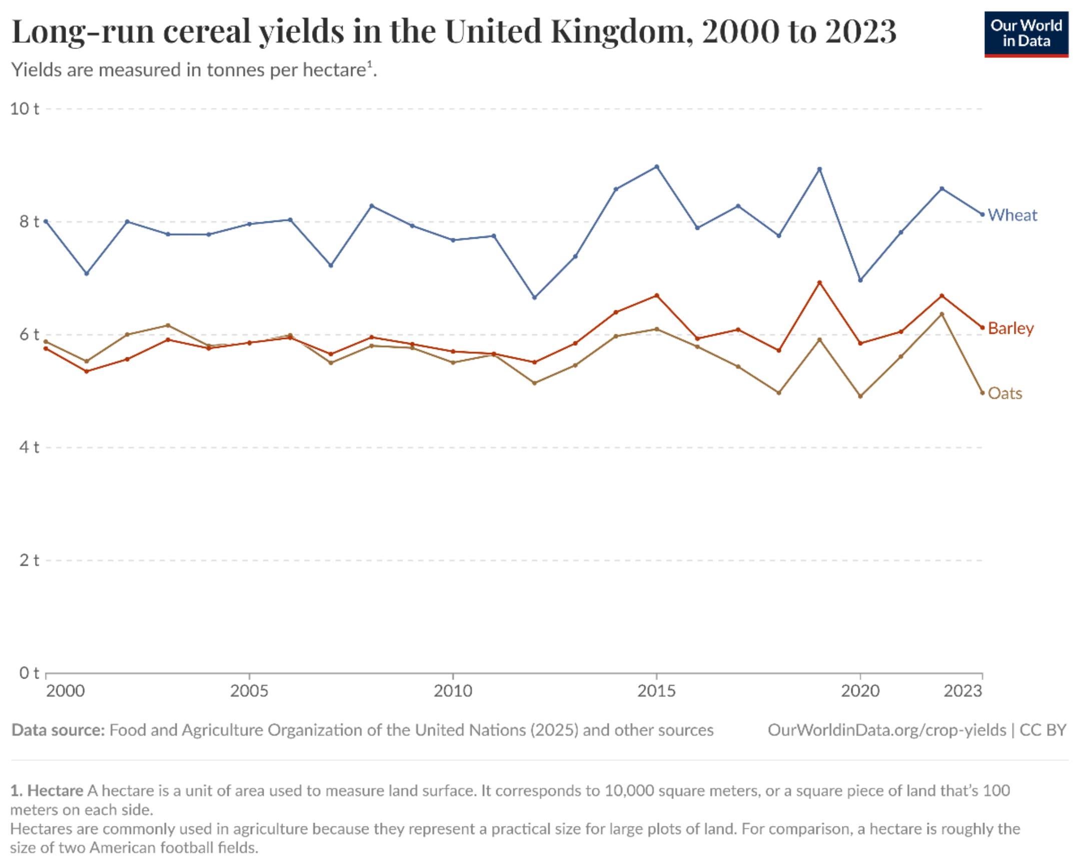
- **Yield Gap** – difference between **potential yield** (under ideal conditions) and **actual yield** (on farm)
- **Green Revolution** – from 1940s- 1980s driven by major advances in **plant breeding, agronomy** and **farm inputs**
- **Norman Borlaug** won the **Nobel Peace prize in 1970**
- **Global cereal** production **doubled** between **1960-2000** – **Global population** also **doubled**
- **Mankombu Swaminathan** instrumental in **implementing Green Revolution** in India

M.S. Swaminathan was the Father of the Green Revolution in India

- Why did **Mankombu S. Swaminathan** **NOT** get the Nobel Peace Prize ?
- His role was seen as "**implementation and adaption**" the difference was Discovery v's Implementation.
- M. S. Swaminathan provided the **policy leadership** to ensure that the Green Revolution actually happened
- His leadership paved the way for the **Green Revolution** to be **implemented Globally**



Despite intensive R&D investment – UK cereal yields have plateaued

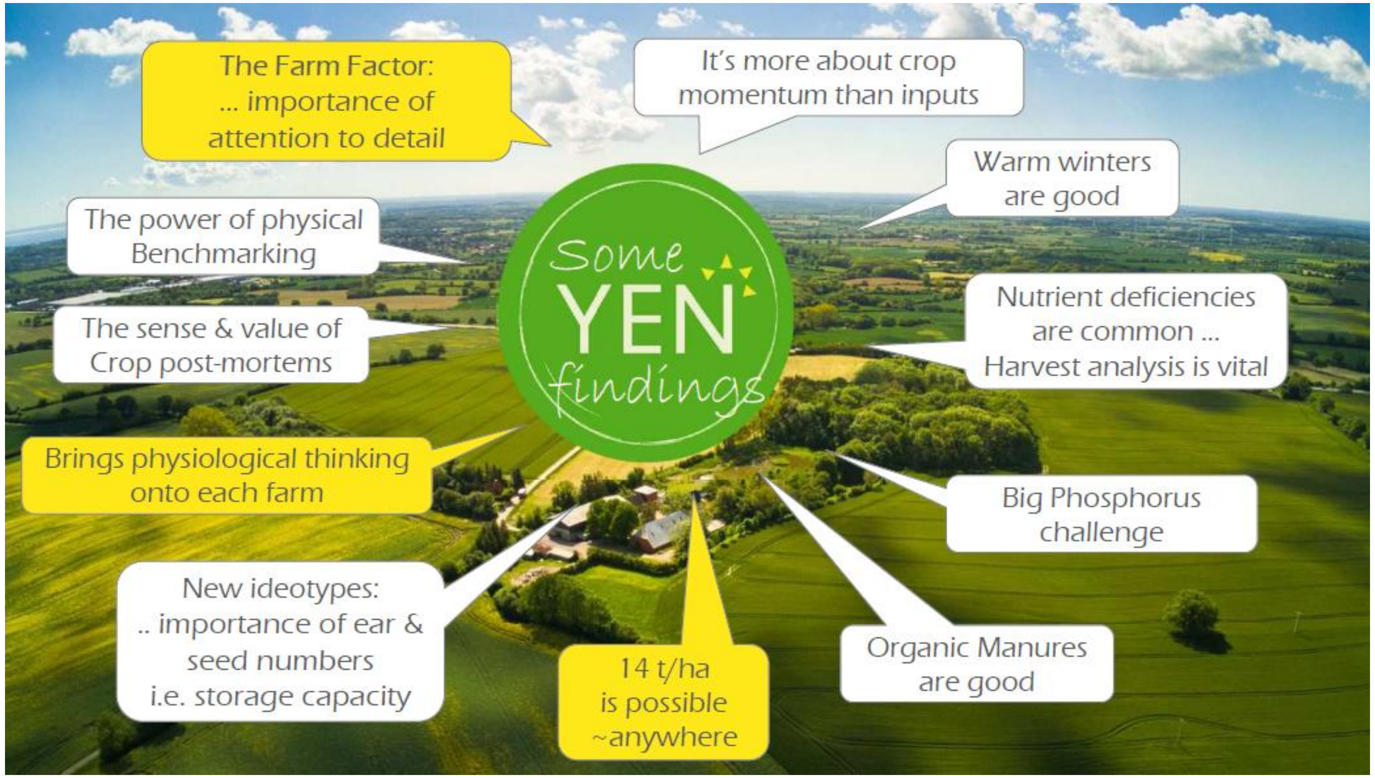


	2025 (t/ha)	2024 (t/ha)	10-year average
Wheat	7.6	7.3	8.1
Winter Barley	6.7	6.4	6.9
Spring Barley	5.8	5.7	5.8
Oats	5.2	5.4	5.5

AHDB Harvest Report 6 – Week 12 (harvest 100% complete) , 24th Sept. 2025

- Cereal yields have **flat-lined since 2000**
- Increased level of **fluctuation** since 2010
- Wheat Genetic Improvement Network **(WGIN)** received **£6.5 million** from Defra 2003-2023

ADAS Yield Enhancement Network (YEN) – over 15 years applied R&D experience



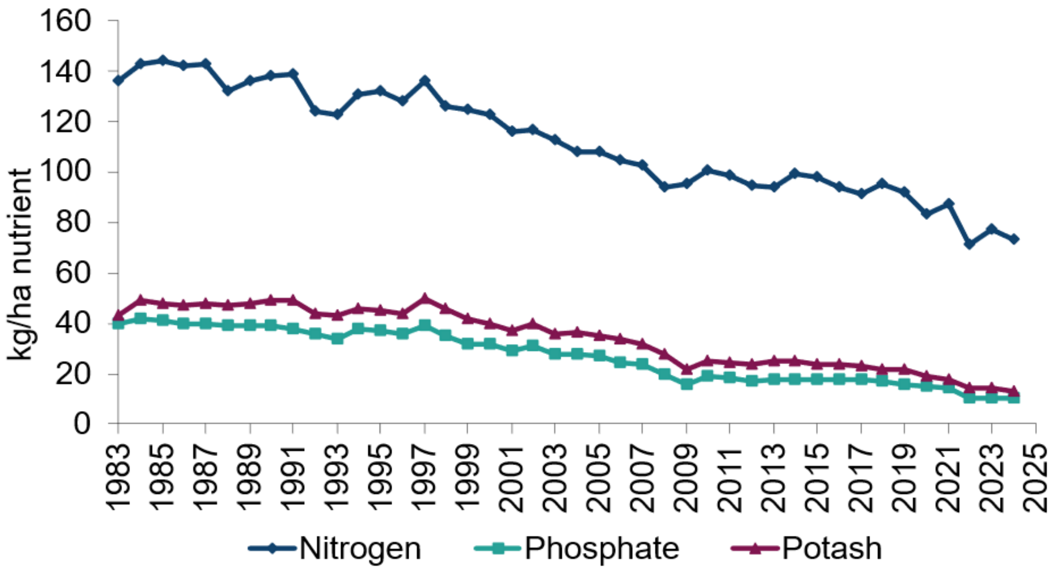
- Across YEN participants – average yield was **11 t/ha** (3 t/ha more than 10-year average)
- **Maximum yield was 16.5 t/ha**
- **Most farms** should be able to achieve **14 t/ha**

The highs and lows of 15 years of YEN - built on early work funded by Defra and AHDB (HGCA)

- **Higher yields possible on most farms** – less about what you spend … n to detail”
- **Engagement** directly **with farmers** essential to generate … and benchmark between fields and farms
- **Benchmarking** helped to identify const… new ideas and tests to improve productivity
- Significant support from acro… unded directly by farmers and agronomists and industry sponsors BUT….
- ……after 15 … or **“fatigue”** and **cash flow a challenge** for farmers and agronomis…
- **ADAS are no… eligible for BBSRC** funding and **only 50%** direct funding from **Innovate UK**

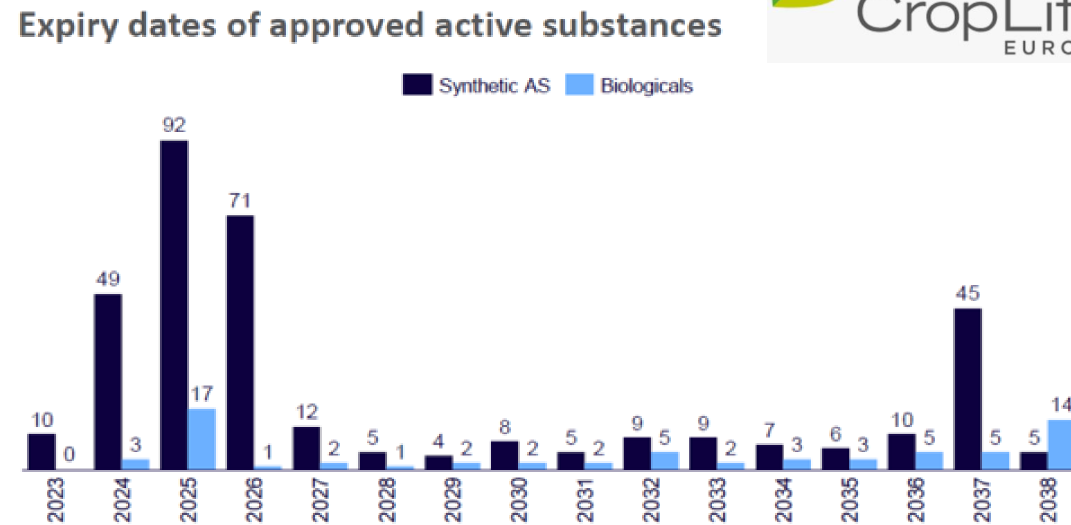
YEN to stop from 2026 in the UK

Cost and availability of inputs will impact yield now & in the future



Fertiliser use across all crops and grass (BSFP 2024)

- Nitrogen inputs at < optimal levels for yield
- P & K < soil replacement levels



- Loss of plant protection actives is a major issue going forward

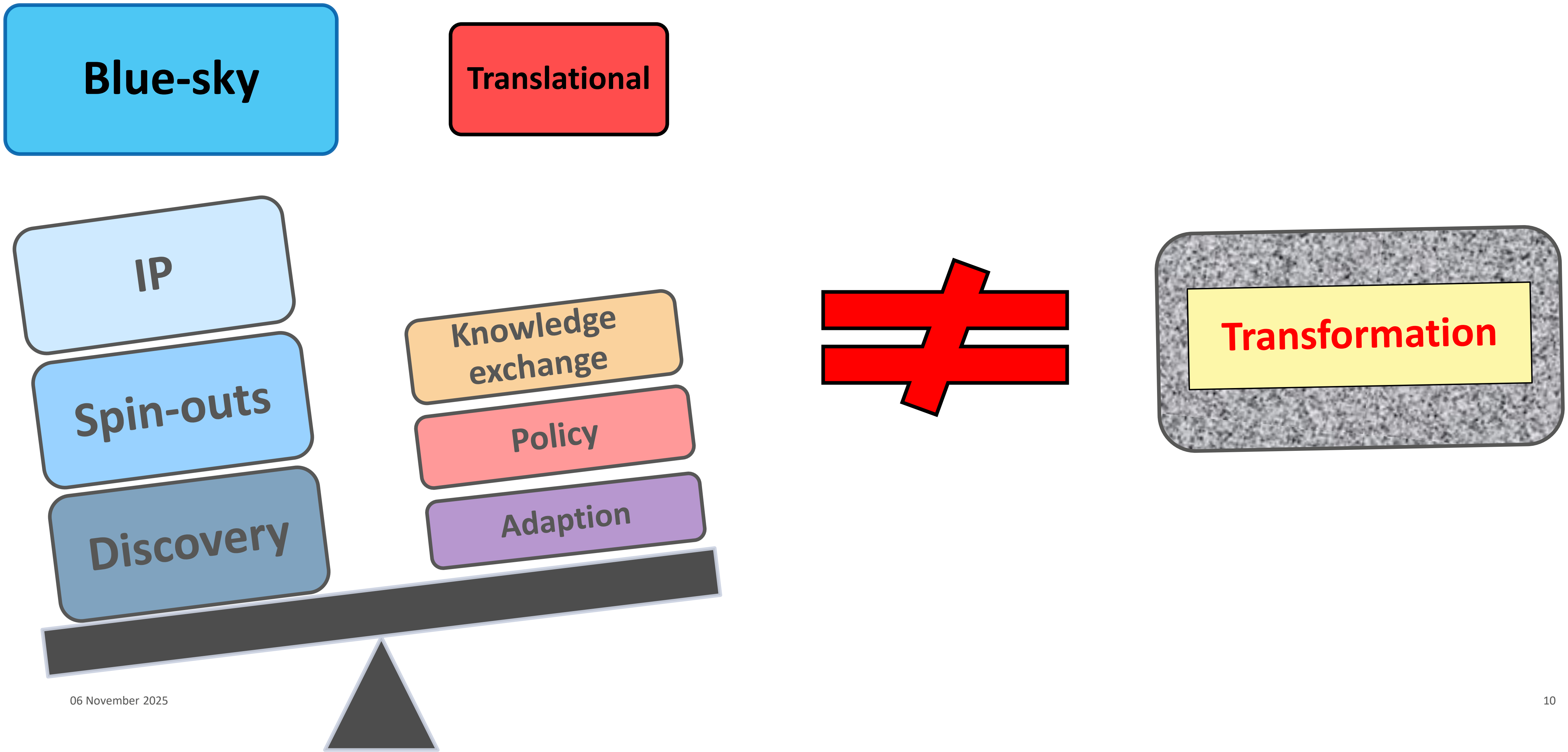
To address the Yield Gap we need a dose of reality !

- Gene edited crops will not be a silver bullet – genetic improvement is only part of the story
- Biopesticides cannot fully replace conventional plant protection products, they are less effective and require different agronomic approaches
- Bio-stimulants are not a substitute for inputs of N, P or K fertilisers needed to fill the yield gap
- New technologies such as robotics, targeted spray and weeding systems etc. require cost:benefit analysis and technical support at farm level

We need to learn from the example of M. S. Swaminathan

Innovation & Discovery **+** *Implementation & Adaption* **=** ***Transformation***

The imbalance in funding between Blue Sky and Translational research is severely limiting Transformation



Proposal for next steps

- Start with the end in mind
- Identify **real world problems** that are limiting yield, quality and production margins across crop systems
- Ensure that research is **solution driven -** tell truth to Government
- **Ring-fence R&D funding** for translational and transformative research
- Protect and develop **applied research** facilities, skills and infrastructure – once they are lost, they will be hard to get back !
- Respect and **value Translational Research** and those committed to its' delivery

ADAS