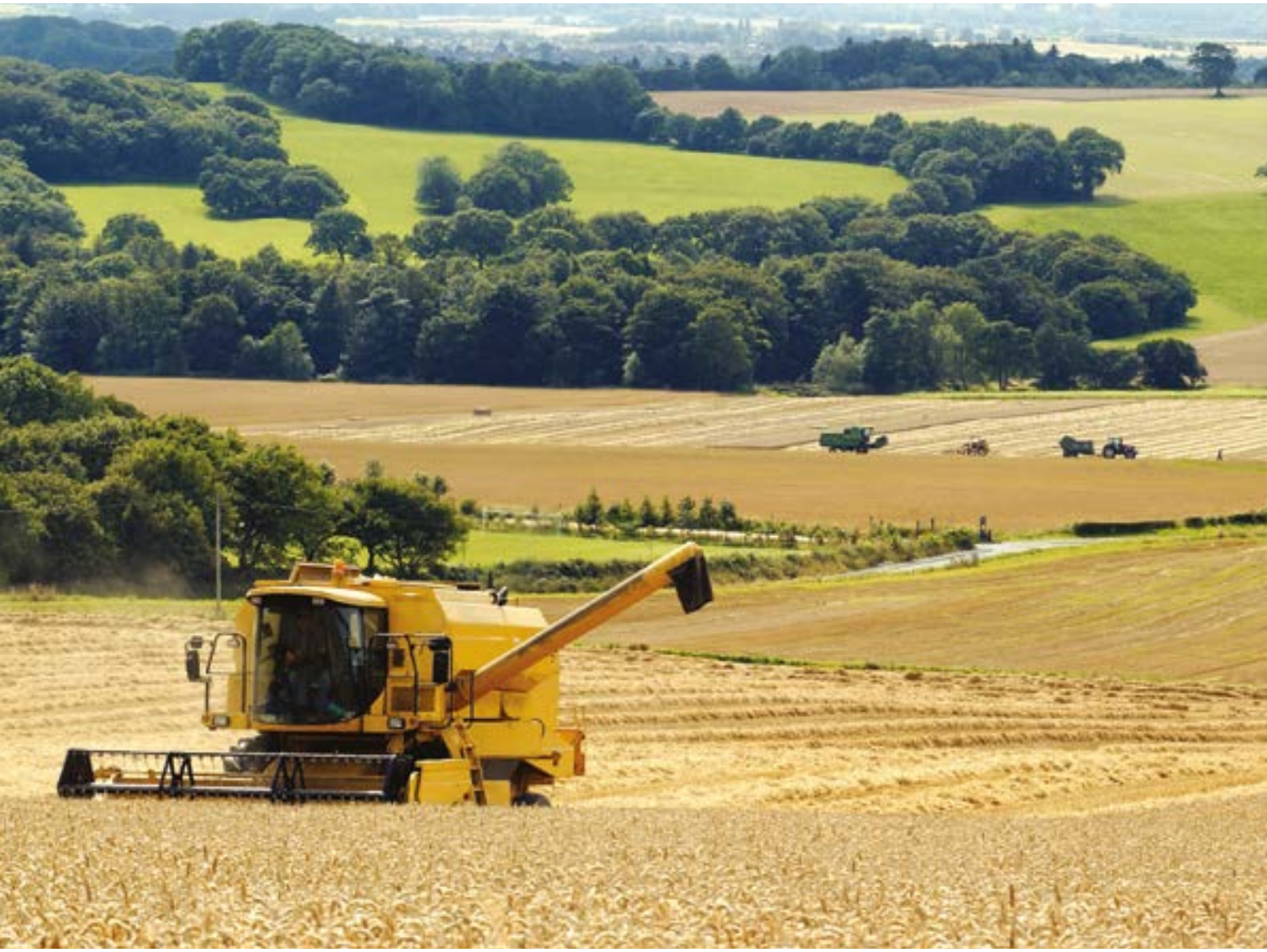
assist | Achieving Sustainable Agricultural Systems

ASSIST Future Farming: bringing together the best of nature-based and agri-tech solutions

Event Programme

Wednesday 30th March 2022
Rothamsted Conference Centre, Harpenden, Hertfordshire AL5 2JQ



UK Centre for Ecology & Hydrology

ROTHAMSTED RESEARCH

BGS British Geological Survey

UKRI Natural Environment Research Council

UKRI Biotechnology and Biological Sciences Research Council

AGENDA

TIME	SESSION
10:00	Registration and tea/coffee
10:30	**Welcome and opening remarks** Angela Karp (Centre Director, RRes) The ASSIST programme and order of the day: Richard Pywell (UKCEH) and Jonathan Storkey (RRes)
10:50	**SESSION 1: Improving the efficiency and resilience of food production** Exploring the key environmental drivers explaining variability in crop yield and the importance of semi-natural habitats for increasing resilience of yield to environmental shocks. Speakers: Ian Shield (RRes), Andy Tye (BGS) and Emily Upcott (UKCEH)
11:15	**SESSION 2: Managing the impacts of farming on the environment** Measuring the impacts of agricultural practices on biodiversity, greenhouse gas emissions and water pollution. Speakers: Susan Jarvis (UKCEH), Helen Metcalfe (RRes), Vicky Bell (UKCEH) and Niall McNamara (UKCEH)
11:45	**SESSION 3: Integrating nature-based and agri-tech solutions on the ASSIST commercial farm network** Large-scale experiments investigating the impacts of novel farmer-led practices, including in-field flower strips, herbal leys and cell grazing, on agronomic and environmental outcomes. Speakers: Sam Cook (RRes), Ben Woodcock (UKCEH) and Jordana Rivero (RRes)
12:10	**SESSION 4: Discussion session**
12:30	Lunch
13:40	**SESSION 5: How has ASSIST helped me? A Farmer perspective** The relevance and value of the ASSIST programme to farmers and the farming industry. Speaker: Julian Gold (East Hendred Estate)
14:00	**SESSION 6: Designing future farmed landscapes** Demonstrating the integration of the knowledge gained in ASSIST into new digital tools to support farmer decisions and explore future land management scenarios. Speakers: Tom August (UKCEH), John Redhead (UKCEH) and Alice Milne (RRes)
14:25	**SESSION 7: ASSIST impacts and what's next** Speakers: Claire Carvell (UKCEH), Richard Pywell and Jonathan Storkey
14:45	**SESSION 8: Discussion session**
15:05	**Closing remarks from the Centre Directors** Karen Hanghøj (BGS) and Mark Bailey (UKCEH)
15:15	**Networking and PhD poster session** (including light refreshments)
17:00	End of event

Welcome

Welcome to the ASSIST Future Farming event 2022

The Achieving Sustainable Agricultural Systems (ASSIST) programme has united the expertise of NERC and BBSRC research institutes to address the challenge of efficient and resilient food production alongside clean air and water, healthy soils and a biodiverse countryside. To do this we have created a community of farmers and researchers to test alternative approaches to farming more sustainably and develop digital tools to help farmers implement good practice. The project has provided a network of commercial study farms for testing 'nature-based' approaches to crop and livestock production, including multi-species pastures and in-field flowering strips. This network has generated new knowledge on how understanding the environment a farm is in can help improve the efficiency of agricultural inputs. Our data is being made available through digital tools designed to monitor soil moisture, target nature-based solutions on the farm and measure the outcomes of habitat creation. By engaging with farmers and taking the bottom-up approach of demonstrating the benefits of more sustainable practices on the ground, ASSIST has played an important role in facilitating positive change that will be beneficial to farmers and wider society

Today's event will allow delegates to learn more about the outputs and outcomes of the programme over the last 6 years, and engage with researchers through the discussion sessions.

We invite you to share your own experience and participate in the conversations and available demonstrations throughout the day. We also invite you to join in on Twitter #ASSISTagri.

Finally, we would like to thank our funders and stakeholders, and everyone who has helped organise, deliver and participate in this event. We are also extremely grateful to the participating farmers and our respective research teams for the hours of hard work and dedication they have shown to make ASSIST such a success.

Richard Pywell
(UK Centre for Ecology & Hydrology) and

Jonathan Storkey
(Rothamsted Research)

Useful links to ASSIST E-tools and outputs:

UKCEH Land Cover® plus: https://www.ceh.ac.uk/services/ceh-land-cover-plus-crops-2015

ASSIST Scenario Exploration Tool (ASSET): https://assist.ceh.ac.uk/asset-v2

ASSIST Environmental Planner (E-planner): https://assist-e-planner.ceh.ac.uk/About

ASSIST Environmental Surveyor (E-surveyor): https://assist.ceh.ac.uk/e-surveyor

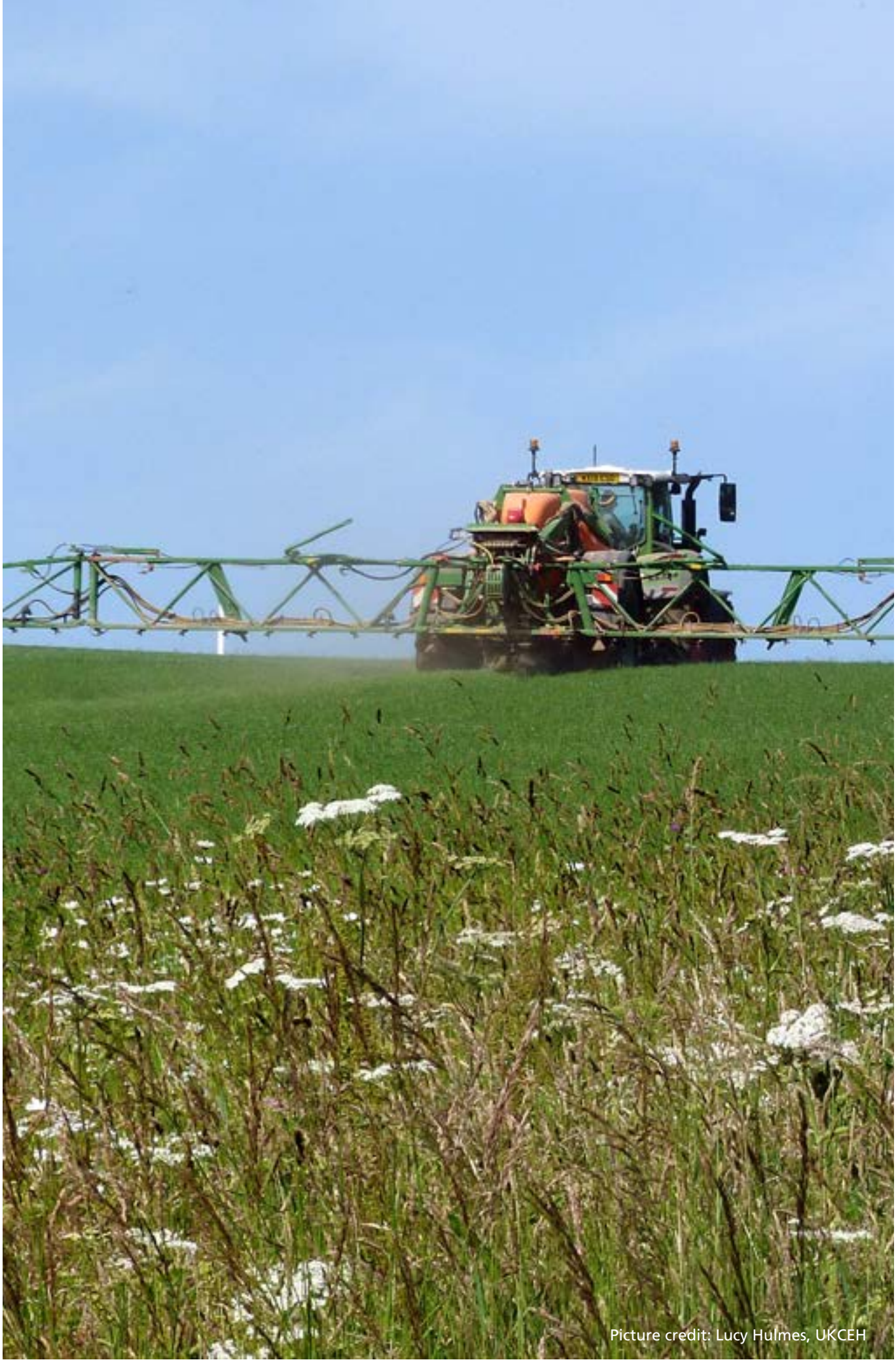
Hydrological Outlook UK Current Conditions: https://hydoutuk.net/current-conditions

ASSIST Data Catalogue: https://catalogue.ceh.ac.uk/assist/documents

Latest News: https://assist.ceh.ac.uk/latest-news

Contact us at ASSIST@ceh.ac.uk

#ASSISTagri
@UK_CEH
@Rothamsted
@BritGeoSurvey



Picture credit: Lucy Hulmes, UKCEH

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SESSION 1
Improving the efficiency and resilience of food production

Chair: Jonathan Storkey

Biophysical limitations to wheat yield – insights from a network of UK farms

Ian Shield[1], Richard Whalley[1] and Dan Morton[2]

Over the period 2018 – 2021, a total of 49 soil and crop variates were measured in 46 winter wheat fields across the UK. Four distinct areas were determined based on their landscape features within which fields were chosen to include both high performing and lower performing crops. More than 26,000 individual data points have been analysed to understand more about the relative importance of different bio-physical limitations on wheat yield. Early results confirm expected aspects of wheat yield formation and show the first indications of new areas to focus on.

Picture credit: Lucy Hulmes, UKCEH

Soil moisture and groundwater dynamics and their impact on wheat yield

Andy Tye[3], Sarah Collins[3], Ben Marchant[3] and Nicole Archer[3]

The impacts on wheat yield of soil moisture and shallow groundwater were investigated in a small arable catchment, on heavy clay with under-field drainage and typical of many wheat growing areas in the south of England. Combine yield maps were used to explore relationships across the catchment spatially and temporally. The key result was that yields after wet autumnal and spring periods decreased by up to 20% compared to the long-term median wheat yield across the catchment. Yields after slightly drier autumns and springs improved compared to the median yield. Resilience and weakness in this type of cropping system were identified.

Mapping and modelling cropping patterns and yields across GB

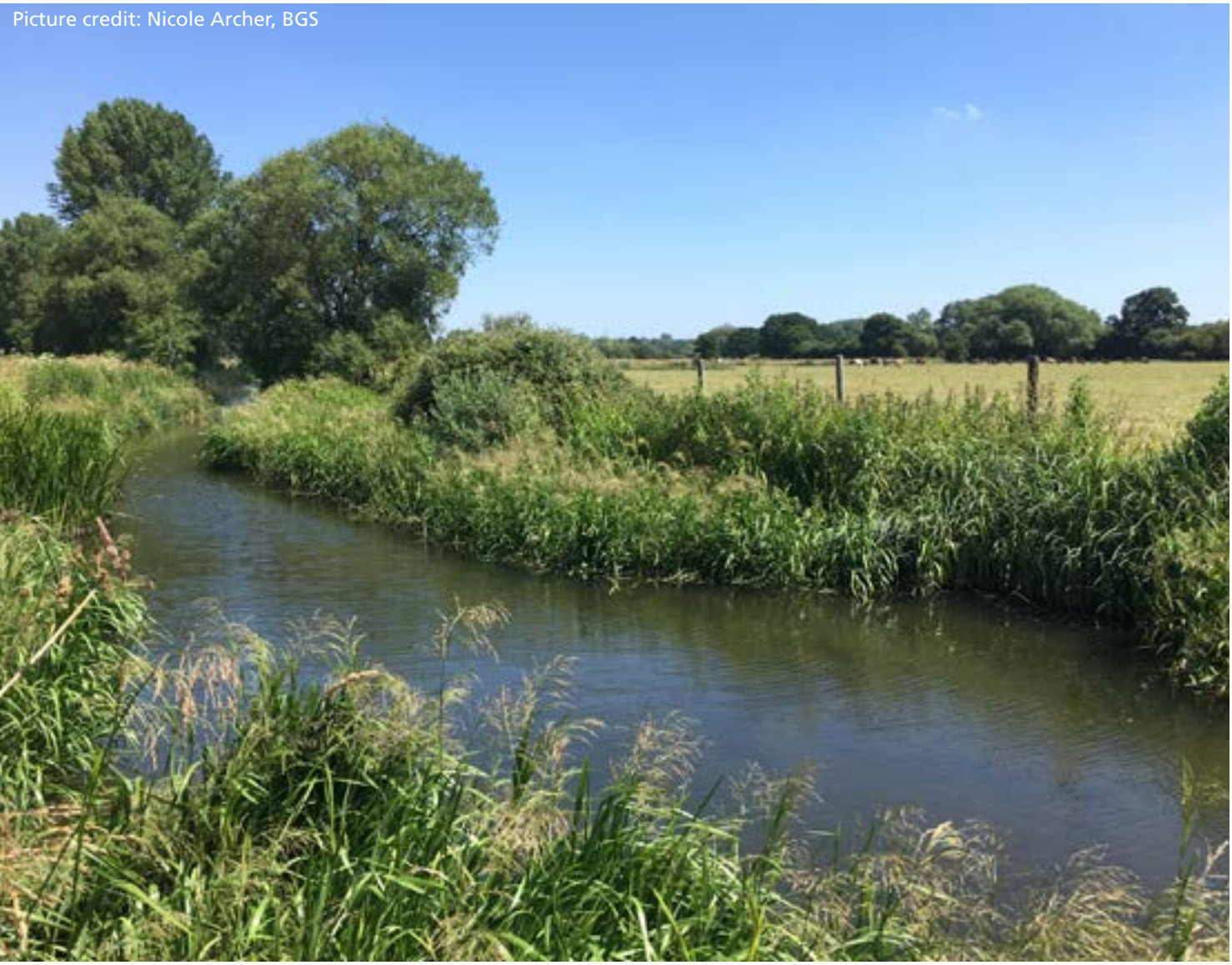
Emily Upcott[2], John Redhead[2], Will Fincham[2], Dan Morton[2] and Richard Pywell[2]

Crop type and management are two of the key drivers of agricultural impact on the environment in Great Britain. Building a picture of production in the landscape helps us understand the relationships at play between agriculture and the surrounding environment, with a view towards sustainable intensification. There are two main data sources that enable us to explore between- and within-field cropping patterns in space and time. The satellite-derived UKCEH Land Cover® plus: Crops maps identify crop type across 2 million fields since 2015. Precision yield meters on combine harvesters capture fine-scale data, building a picture of within-field variation of crop yield.

Author affiliations:
1 Rothamsted Research
2 UK Centre for Ecology & Hydrology
3 British Geological Survey

SESSION 2
Managing the impacts of farming on the environment

Chair: Richard Pywell


Picture credit: Nicole Archer, BGS

Mapping and modelling pesticides and fertilisers in the environment

Susan Jarvis[2], John Redhead[2], Will Fincham[2], Anna Oliver[2], David Roy[2], Lindsay Newbold[2], Gloria Dos Santos Pereira[2], Ben Woodcock[2], Carolin Schultz[2], Dave Spurgeon[2] and Richard Pywell[2]

In order to support the sustainable use of pesticides and fertilisers it is important to monitor where they are applied and in what quantities, their environmental fate and their potential impacts on the environment. ASSIST has produced the first national maps of agricultural pesticide and fertiliser use. It has developed a citizen science monitoring scheme to link pesticide use to residues found in honey and potential risks to pollinators. Finally, working with the farming industry we have combined models of pesticide application, degradation and fate to produce a framework to assess risks to a range of terrestrial and freshwater indicators.

Mitigating impacts of pesticides

Helen Metcalfe[1], Richard Hull[1], Alice Milne[1], Andy Whitmore[1], James Bullock[2] and Jon Storkey[1]

Agrochemicals can have adverse effects on the environment and can negatively impact non-target organisms. We quantified these effects by looking at the combined risk of the harmful compounds persisting in the environment and the hazard to different ecological groups. Measures to reduce the use of agrochemicals can reduce their environmental impact. However key agronomic decisions, made to maintain food production under reduced agrochemical-use, may have unintended consequences and can potentially jeopardise any ecological benefits. We consider scenarios related to loss of the active ingredient glyphosate and the impact of alternative weed control options.

The contribution of agriculture to nutrient pollution in rivers

Vicky Bell[2], David Cooper[2], Ryan Sharp[1], Helen Davies[2], Andy Whitmore[1] and Alice Milne[1]

Our challenge has been to understand and quantify the environmental impacts of agricultural changes (past, present and future) to help formulate effective mitigation strategies and develop sustainable farming strategies for the future. In this short presentaion we will show how collaboration between UKCEH and Rothamsted Research modellers has enabled us to quantify the impact of historical changes in agriculture on nutrient pollution in the UK's rivers, and the likely impact of climate change over the next 30 years.

Author affiliations:
1 Rothamsted Research
2 UK Centre for Ecology & Hydrology
3 British Geological Survey
4 East Hendred Estate
5 Wildlife Farming Company

Measuring and mitigating cropland GHG emissions

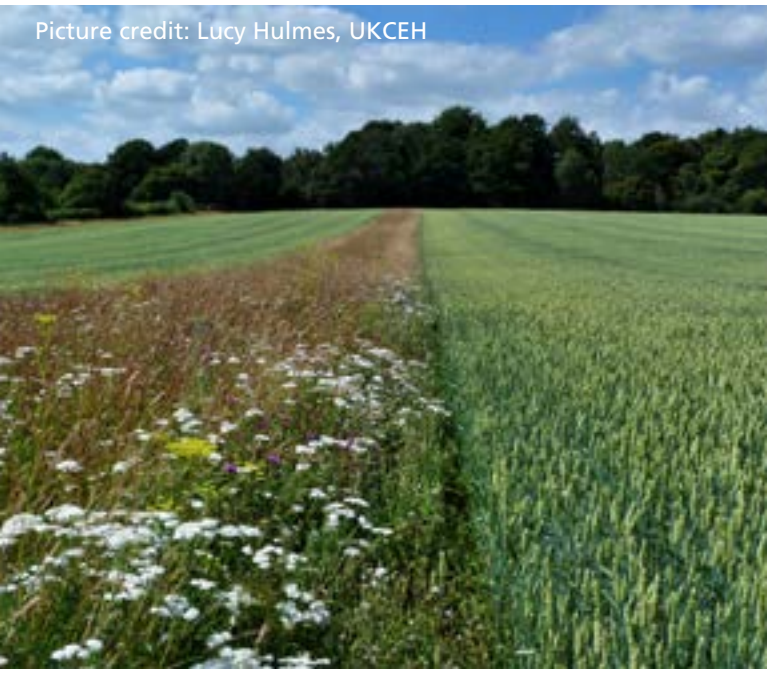
Niall McNamara[2], Dafydd Elias[2], Simon Oakley[2], Ross Morrison[2], Alex Cumming[1], Morag McCracken[1], Sarah Hulmes[1], Lucy Hulmes[1], Julian Gold[4], Marek Nowakowski[5] and Richard Pywell[2]

Agricultural soils represent one of the most difficult sectors from which to reduce greenhouse emissions (GHG's). They are major sources of nitrous oxide (N2O), due to the extensive application of nitrogen (N) fertilisers. Development of mitigating strategies requires accurate estimates of N2O emissions, which are hugely variable in space and time. Using real-time GHG measurement technology in plot-scale arable crop experiments, we evaluated N2O mitigation using manure, clover under-sowing, timing of N application, nitrification/ urease inhibitors and biochar. We discovered that reducing N application in combination clover under-sowing decreased N2O emission by 20%, whilst biochar supressed N2O emission by 50%. For both experiments crop yield was maintained. These mitigation techniques require further testing at scale in commercial farming systems and across a range of soils and climatic conditions.


Picture credit: Lucy Hulmes, UKCEH

SESSION 3
Integrating nature-based and agri-tech solutions on the ASSIST commercial farm network

Chair: Jonathan Storkey


Picture credit: Lucy Hulmes, UKCEH

The ASSIST farm network - testing sustainable intensification within real arable systems

Sam Cook[1], Ben Woodcock[2], Martin Torrance[1], Jennifer Swain[1], Jamie Hall[1], Lucy Hulmes[2], Sarah Hulmes[2], Richard Ostler[2], Marek Nowakowski[5], Matt Heard[2], Richard Pywell[2] and Jon Storkey[1]

ASSIST has established a network of 18 commercial arable study farms. This has enabled us to implement a field-scale experiment testing the benefits of management interventions to enhance ecosystem processes vital for supporting crop production. These practical interventions were co-designed with ASSIST farmers and include creation of 'green infrastructure' (sown field margins and in-field strips) to support biodiversity beneficial to crop production, and growing cover crops and adding organic matter to enhance soil functions. We describe our innovative integrated approach to monitoring the impacts of these interventions on ecosystem processes and wider biodiversity

The ASSIST farm network - can sustainable intensification support increased productivity?

Ben Woodcock[2], Sam Cook[1], Lucy Hulmes[2], Sarah Hulmes[2], Martin Torrance[1], Jennifer Swain[1], Jamie Hall[1], Richard Ostler[2], Marek Nowakowski[5], Matt Heard[2], Jon Storkey[1] and Richard Pywell[2]

The ASSIST arable farm experimental network has allowed us to test whether novel management interventions to enhance ecosystem processes result in measurable benefits to arable crop yields. To investigate this we measured the yield of a range of crops at multiple scales on the commercial farm network using a range of ground- and satellite-based approaches. We will explore the link between measures of yield and the underlying ecosystem processes, including pest control, pollination and enhanced soil function.

Managing multi-functional grassland systems

M. Jordana Rivero[1], Deborah Beaumont[1], Suzanne Demirkaya[1], Martin Blackwell[1], Sam Cook[1] and Jon Storkey[1]

Our aim was to develop innovative grazing livestock systems which minimise inputs while maximising yield and build resilience to future environmental change. Newly established herbal lays were found to provide good animal performance and grassland productivity, particularly when managed in a rotational grazing system. They also supported higher biodiversity (e.g pollinators abundance) when the botanical diversity was sustained. However, the number of plants species decreased over time. We believe it is necessary to adjust the grazing management (e.g. rotation length) to improve the persistence of sown species and extend the time over which these ecosystems services can be delivered.

SESSION 5
How has ASSIST helped me? A Farmer perspective

Chair: Richard Pywell

Julian Gold[4]

Julian has spent 34 years managing farms and large estates in the UK and overseas, with a commitment to producing food in an efficient and environmentally sustainable manner. Julian is often featured in the farming press and is a frequent speaker at farming conferences.

He is keen to improve the flow of knowledge between farmers and the scientific community.

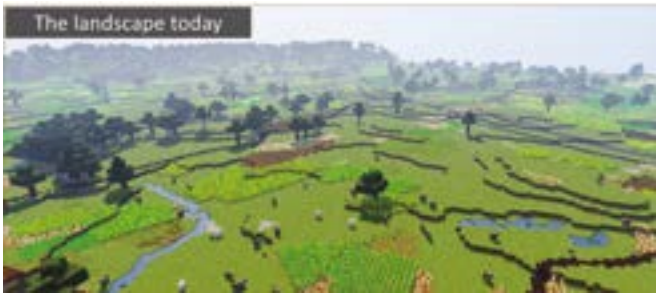
Julian was one of the first AHDB Monitor Farms designated by the Agriculture and Horticulture Development Board for sharing knowledge and best practice solutions. He plays a key role in the ASSIST programme as one of our study farm network and by hosting our detailed greenhouse gas monitoring studies. He is on the committee of SEESOIL (South East England branch of the British Society of Soil Scientists) and was awarded Soil Farmer of the Year in 2019.

Picture credit: Claire Carvell, UKCEH

Author affiliations:
1 Rothamsted Research
2 UK Centre for Ecology & Hydrology
3 British Geological Survey
4 East Hendred Estate
5 Wildlife Farming Company

SESSION 6
Designing future farmed landscapes

Chair: Richard Pywell



Tools supporting farmer-led decision making and monitoring

Tom August[2], John Redhead[2], Vicky Bell[2] and Richard Pywell[2]

ASSIST has produced many valuable datasets that can be used to help farmers make informed decisions about how to manage their land. This talk presents a range of tools that have been developed to make it easy to access, explore, and act on these datasets. Using maps, apps, artificial intelligence and virtual reality these tools explore how novel technologies can be used to improve the accessibility of ASSIST science and the usability of ASSIST datasets.

Tools for exploring impacts of future agricultural land use scenarios

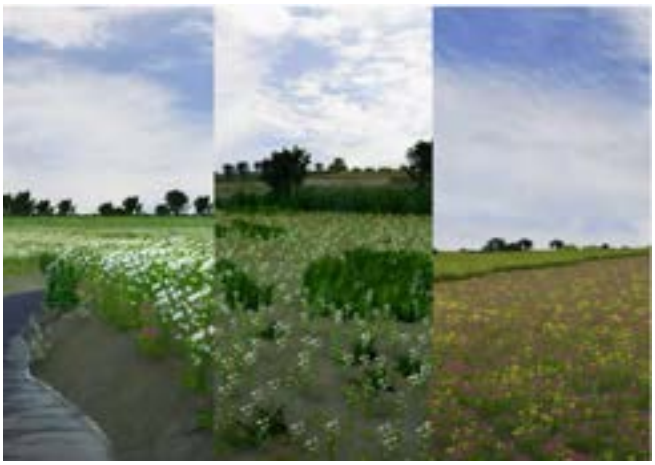
John Redhead[2], Rod Scott[2], Mike Brown[2], Gary Powney[2] and Richard Pywell[2]

Future agricultural land management needs to maximise benefits for the environment and society, whilst minimising conflicts with agricultural production. The ASSIST Scenario Exploration Tool (ASSET) is a user-friendly, online tool for exploring where potential changes in the amount and type of agricultural land might take place, and how these changes might impact on key variable indicators such as biodiversity, pollution, agricultural income and aesthetics. ASSET presents results via simple maps and plots, but is underpinned by a wealth of data and models, making it a valuable resource for both stakeholder engagement and scientific analysis.

Managing trade-offs between food production, biodiversity and the environment

Alice Milne[1], Helen Metcalfe[1], Andy Whitmore[1], James Bullock[2] and Jon Storkey[1]

Agriculture is challenged to produce food sustainably, with minimal impacts on the environment and/or biodiversity. It is difficult to make management decisions that improve on one factor without unintended consequences on another. To make informed decisions the trade-offs between different outcomes must be considered. We have developed a model that describes the impact of management on production, weed communities, nutrient losses, soil health and pesticide impacts. We explore these trade-offs in relation to policy and management scenarios.



SESSION 7
ASSIST impacts and what's next

Chair: Richard Pywell

Claire Carvell[2], Emma Bennett[2], Jonathan Storkey[1] and Richard Pywell[2]

The ASSIST programme has enabled the collection, digitisation and analysis of huge environmental datasets by teams of scientists from field surveyors to instrument technicians to data modellers. These have so far been published in or contributed to 120 peer-reviewed papers with others for submission, around 33 datasets or derived data products and over 240 articles or appearances in the farming or mainstream media. Here we celebrate these diverse outputs and impacts through a series of highlights in numbers that also demonstrate the strengths of ASSIST's collaborative partnerships with the farming community, HEIs, UKRI and beyond.

We also have great pleasure in introducing the follow-on Long Term National Capability programme funded by NERC and BBSRC: Clean, Green and Net Zero+ Agriculture.

Picture credit: Sarah Hulmes, UKCEH

POSTERS

ASSIST has made links with Universities through at least six linked PhD studentships. Posters summarising their research are displayed at the event.

- **High resolution wheat yield mapping using Sentinel-2**
  Merryn Hunt
  UK Centre for Ecology & Hydrology and Lancaster University
- **Diurnal variability of nitrous oxide (N2O) emissions from agricultural soils**
  Fred Wu
  UK Centre for Ecology & Hydrology and University of York
- **Positive effects of predator functional dissimilarity on prey suppression**
  Arran Greenop
  UK Centre for Ecology & Hydrology, Rothamsted Research and Lancaster University
- **Are pitfall traps measuring the tip of the iceberg?**
  Kelly Jowett
  Rothamsted Research and University of Reading
- **New heroes to defeat cabbage stem flea beetle**
  Patricia A.Ortega-Ramos
  Rothamsted Research and University of Reading

ACKNOWLEDGEMENTS

Thank you to the ASSIST Advisory Group:

Agrii

AHDB

BASF We create chemistry

CABI

Department for Environment Food & Rural Affairs

University of Exeter

The James Hutton Institute

The University of Manchester

Natural England

rspb

syngenta

And all organisations that have provided support throughout the programme:

agrimetrics

agrovista

DLF Seeds & Science

Emorsgate Seeds

Farmcare

Indigro

Precision Grazing

Wildlife Farming Company - Proven Wildlife Delivery -

UK Centre for Ecology & Hydrology

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