Achieving Sustainable Agricultural Systems (ASSIST)
Ensuring future food security without causing unacceptable environmental damage is one of the greatest threats facing humanity.

The science underpinning the concept of SI is incomplete and requires an immediate and bold investment.

Aim: to develop innovative farming systems that increase crop productivity & resilience to future perturbations, while reducing the environmental & ecological footprint of agriculture.
A: maintain yields while reducing environ. impact
B: increase yields while reducing environ. impact
C: increase yields without negative environ. impact
Wider science context

• **Unites BBSRC and NERC-funded science**
  – essential for UK leadership in SI research

• **Builds on current shorter-term and narrower-focus investments e.g.**
  – existing policies / practice (Defra), or
  – single/few components of the agro-ecosystem (RCUK)

• **Our focus is distinct in aiming to**
  – quantify effectiveness and robustness of novel *far-horizon whole-systems* agricultural and technologies

• **Core to delivering SDGs**
Opportunities for strategic partnerships

- Opportunities for new partnerships to address critical knowledge gaps (e.g. the socio-economic barriers to uptake)
- Community workshops to share plans in greater detail; consider how to build on ASSIST to deliver more excellent science
- A community platform providing opportunity for research, training & dissemination (including access to existing RRes & CEH Farms - North Wyke, Hillesden)
- Access to data via new technology (e.g. national sensor networks; Sentinel etc.)
WP1: Limitations on crop productivity

WP2: Environmental impacts of agriculture

WP3: Sustainable solutions (agri-tech + nature based)

WP4: Synthesis modelling: Optimisation of future agriculture

WP5: Agri-informatics & tools

Model validation

Refinement of management solutions

External data: Agrimetrics, SIP, SARISA etc.

Project co-ordination
WP1: Biophysical limitations on crop productivity

- Innovative remote sensing products mapping of crop type, health and productivity at national scale
- Attribution of spatial constraints on crop yield & resilience through time
- Quantification of limits on current and future crop yield
- 3D models of water connectivity at the farm and catchment scale: integrating surface and sub-surface processes in relation to farm productivity
WP2: Environmental impacts of future agriculture

- Predicting the effects of agricultural management on water quality and nutrient loss by adapting & extending the LTLS model
- Impacts of agricultural management on soil carbon and GHG fluxes
- Enhancing biological resilience of agro-ecosystems through parameterisation & analysis of response and effects traits of key species
WP3: Sustainable solutions

- Core to ASSIST will be a statistically robust multi-site experiment infrastructure
- 10-20 commercial arable and grassland farms
- Test field-scale combinations of innovative nature-based and agri-tech farming systems:

  **Nature-based**: enhance natural processes associated with crop production (so-called ‘ecological intensification’), in particular soil function, and biodiversity-mediated pollination and pest-control services

  **Agri-tech approaches**: best-practice agronomy to improve resource-use efficiency and pest management to either maintain or increase yields while reducing the negative environmental impacts (e.g. precision farming, smart rotations etc.)
Eco-intensification of agriculture

- 6 year experiment on 1,000ha commercial farm
- Removed 3% to 8% of low-yielding land from cropping
- Created habitats for beneficial species (pollinators, pest predators)
- Yield of some crops increased by 35%, not net loss of yield for others
- First evidence of sustainable intensification
WP3: Farm experiment network

- **a) Business as usual (Control)**
- **b) Agri-tech solutions** (e.g. pesticide & fertiliser placement, crop varieties & N inhibitors)
- **c) Nature-based solutions** (e.g. 1yr fallow & in field strips)
- **d) Agri-tech + Nature-based solutions**

Design of a factorial experiment testing nature-based and agri-tech farming systems against a business as usual control

- **Powerful factorial design**
- **Farms along the trade-off continuum of environmental services vs. productivity**
- **Will consider interaction with landscape**
- **Treatments defined at stakeholder workshops (building on existing best practice) – ‘community-led solutions’**
- **Increase yield, reduce inputs & costs, lower environmental footprint, enhance natural processes**
WP4: Synthesis: optimisation of future agriculture

• Using the InVEST model to synthesise the knowledge gained on:
  
  ➢ where to intensify/extensify production (WP1),
  ➢ the impacts of changed agricultural management on natural capital and biodiversity (WP2), and
  ➢ the application of intervention measures to mitigate/enhance these effects (WP3)
  ➢ build resilience future agro-ecosystems

Schematic showing how ASSIST will be used to identify and manage conflicts for planning future multi-functional agricultural landscapes
WP5: Agri-informatics and tools

- Develop a new national **Land Water Information System for Agro-ecology** bringing together CEH/BGS/RRes data with that of Defra & the farming industry (via Agrimetrics)
- Create value added (modelled) products, and make data fully discoverable, interoperable and scalable
- Provide novel decision support tools to inform land management decisions and testing scenarios of intensification

![Data infrastructure](image)

**Intensification scenarios**
- National: land cover transitions
  - **Land Cover Map**
- Landscape: crop pattern & rotation
  - **Land Cover Map Plus**
- Field: crop inputs
  - Industry data
  - Pesticide & Fertiliser Surveys

**Biodiversity & natural capital**
- National base data sets (examples):
  - RRes/CEH Water quality
  - BGS Soil carbon
  - CEH GHG maps
  - RRes Insect Trap
  - BRC Biodiversity indicators
  - CEH Pollination service
  - CEH Pest control
  - Defra Agri-environment
  - Defra Farm Business
  - Defra Crops

**Risks and conflicts identified**
- Overlay & visualisation tool

*Fig. 7. Intensification Risk Mapping Tool*
Getting involved

- This novel cross-council investment is an opportunity to coalesce and enable research ideas in this area for future funding (e.g. Newton, SPAG etc.)
- Kick-off meeting summer 2016
- Community workshops
- Project Advisory Group
- Project web pages
- Data portal & tools

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ASSIST will provide the long-term, large-scale strategic underpinning for a community-led transformation of agriculture.