Centre for Sustainable Cropping: long-term research platform

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Background – the global challenge

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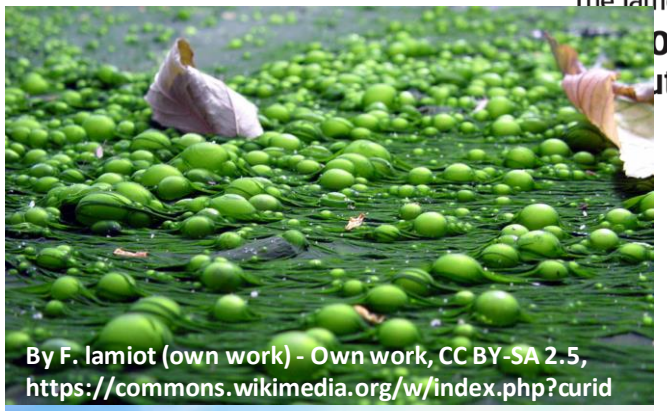
Food Security

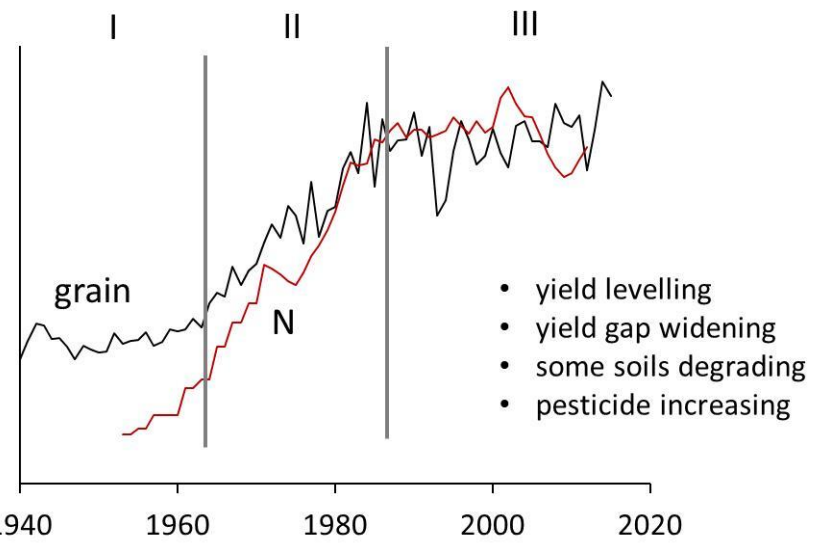
- UN predicts global population of 9.7 billion by 2050
- Food demand to increase by more than 50% (FAO)
- Crop yields plateauing since 2000
- Developing countries' net imports of cereals will more than double by 2050 (FAO)
- Undernutrition contributes to nearly half of all deaths in children under 5 worldwide

Unsustainable Agriculture

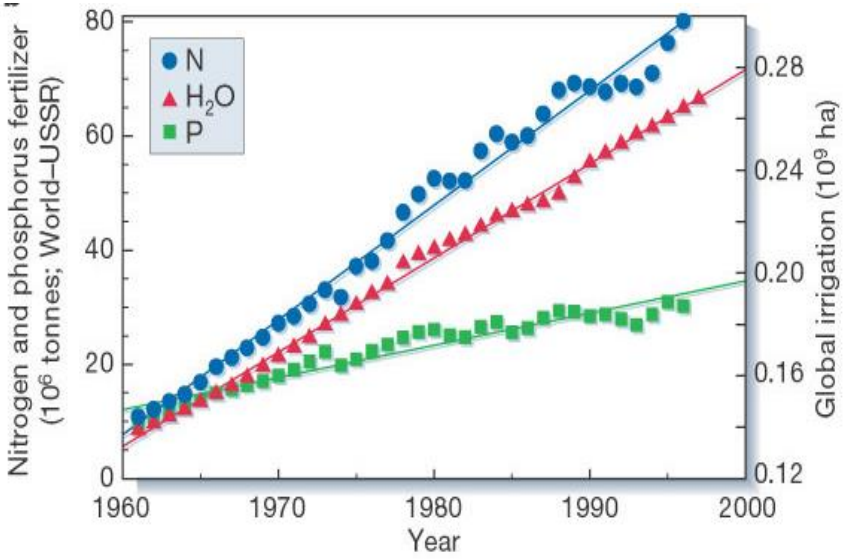
- Agriculture responsible for 2.8% of energy consumption (EU-28)
- Agriculture accounts for 19% of total greenhouse gas emissions (Scotland)
- 40% of N input remains in the environment (EU-28)
- Farmland birds declined by 50% since 1970 (UK)
- 3.24 t ha^{-1} yr^{-1} soil lost from agricultural land (EU-28)

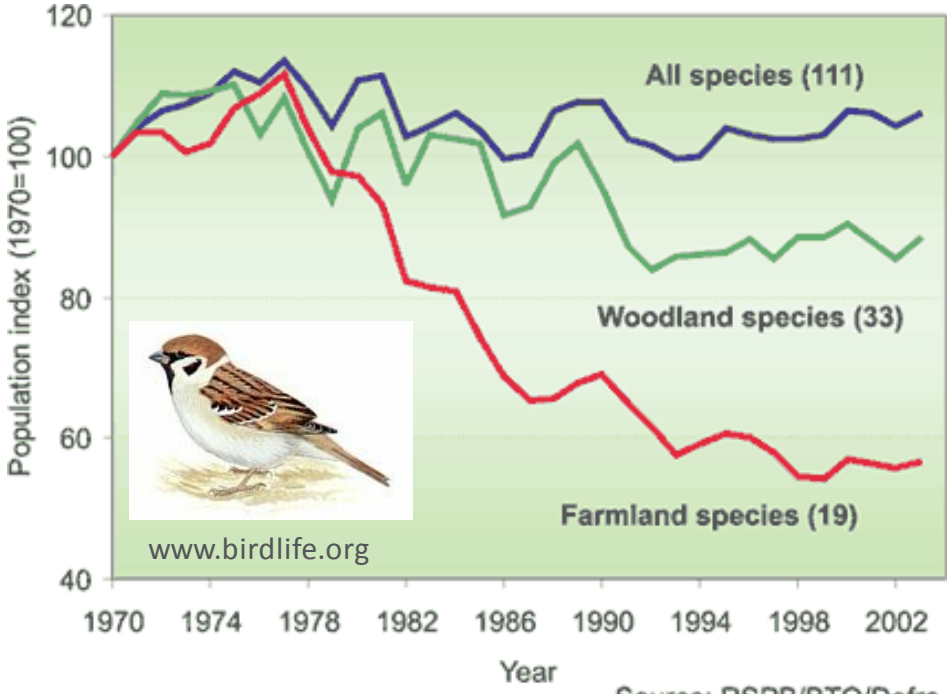


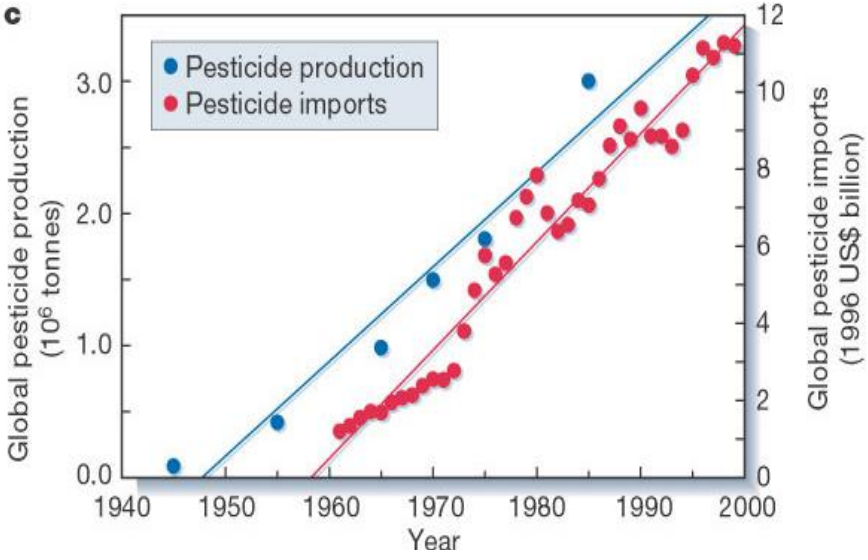
While national yields flat-line…



- yield levelling
- yield gap widening
- some soils degrading
- pesticide increasing







Tilman et al (2002) Nature 418, 671-677

A systems approach for improving arable sustainability

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- *Ecological (biotic)* – enhance biodiversity for provision of ecosystem services (pollination, predation, IPM, decomposition)

- *Environmental (abiotic)* – reducing environmental footprint, improving soil physical condition for plant growth, minimise losses through erosion, runoff, leaching and GHG emissions

- *Economic (financial)* – increasing efficiency (crop varieties, mixtures, intercropping) to maintain or improve yield for economic sustainability, food security and health

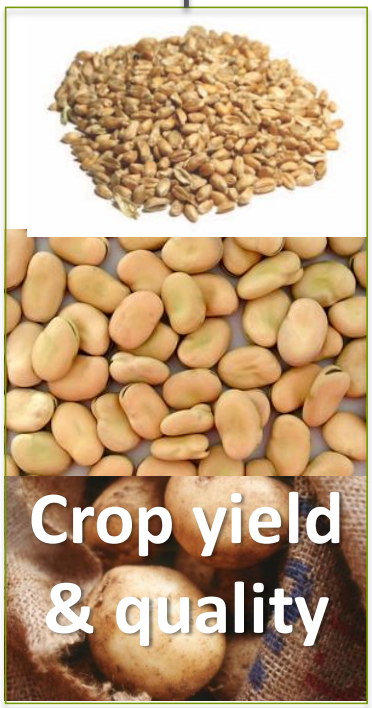
The Centre for Sustainable Cropping: putting theory into practice

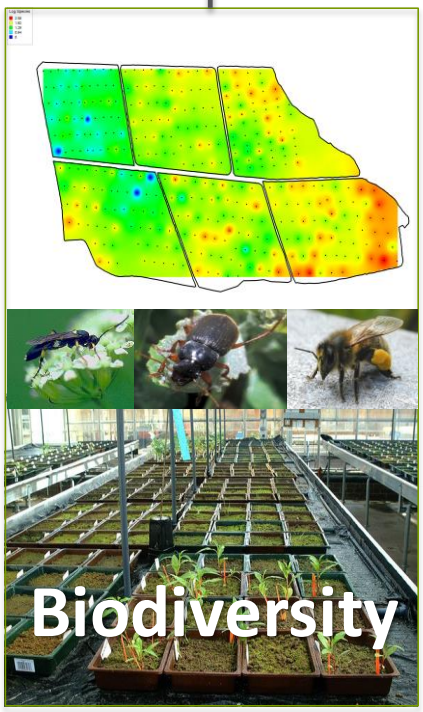
- design a more sustainable cropping system and
- establish a robust whole-system cost-benefit analysis

Economic: maintain yield with less non-renewable inputs

Environmental: reduce environmental footprint

Ecological: enhancing biodiversity for ecosystem services



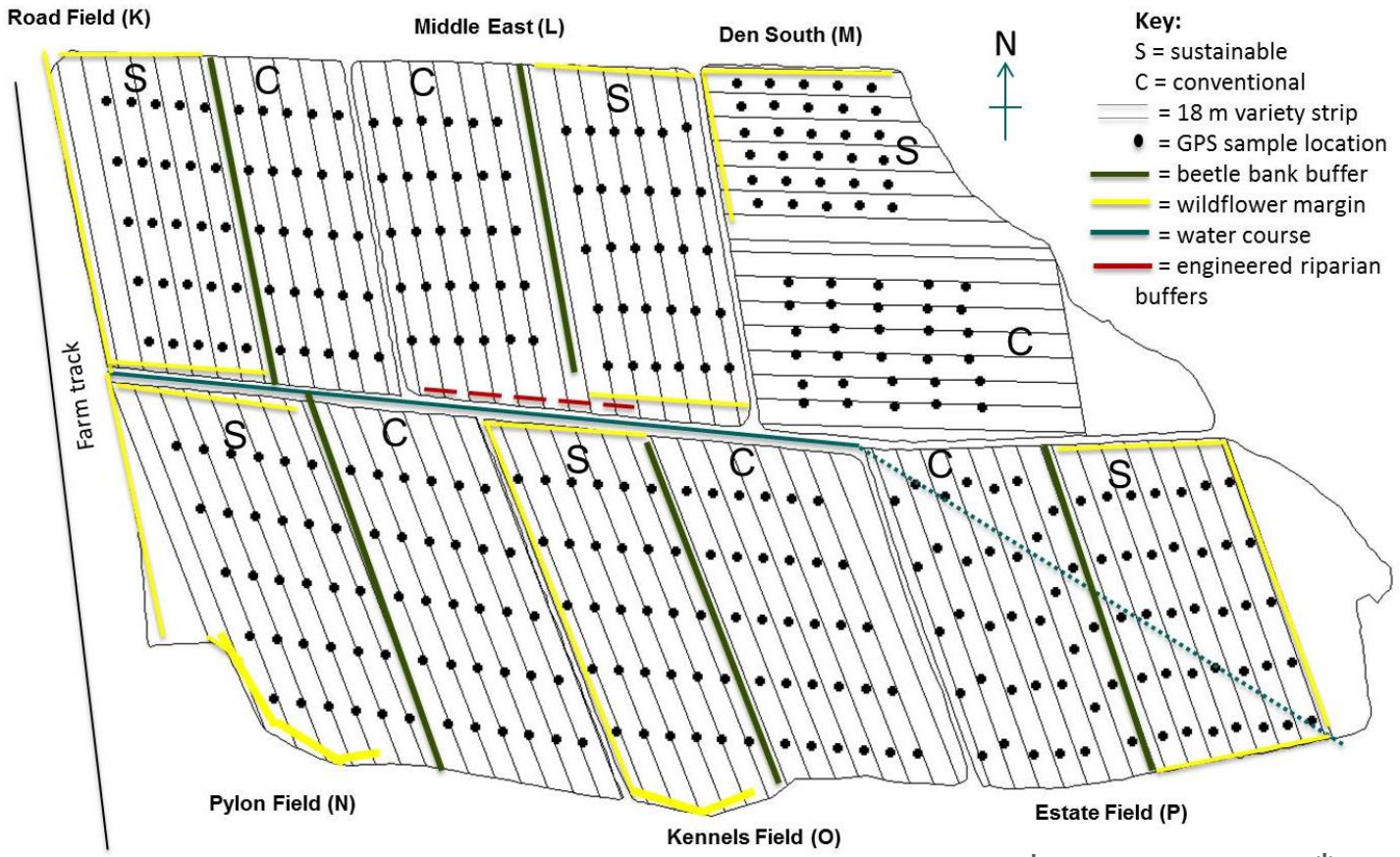


Design

- A long-term platform for research on sustainable arable systems
- 46 ha over six fields comparing an integrated cropping system with standard commercial practice

- Open access resource for collaborators:
  - field treatments
  - archived samples
  - data
- Demonstration site for industry, scientists, policy makers

Design



* → potato → winter wheat → winter barley → oilseed rape → * faba beans → * spring barley

* cover crop



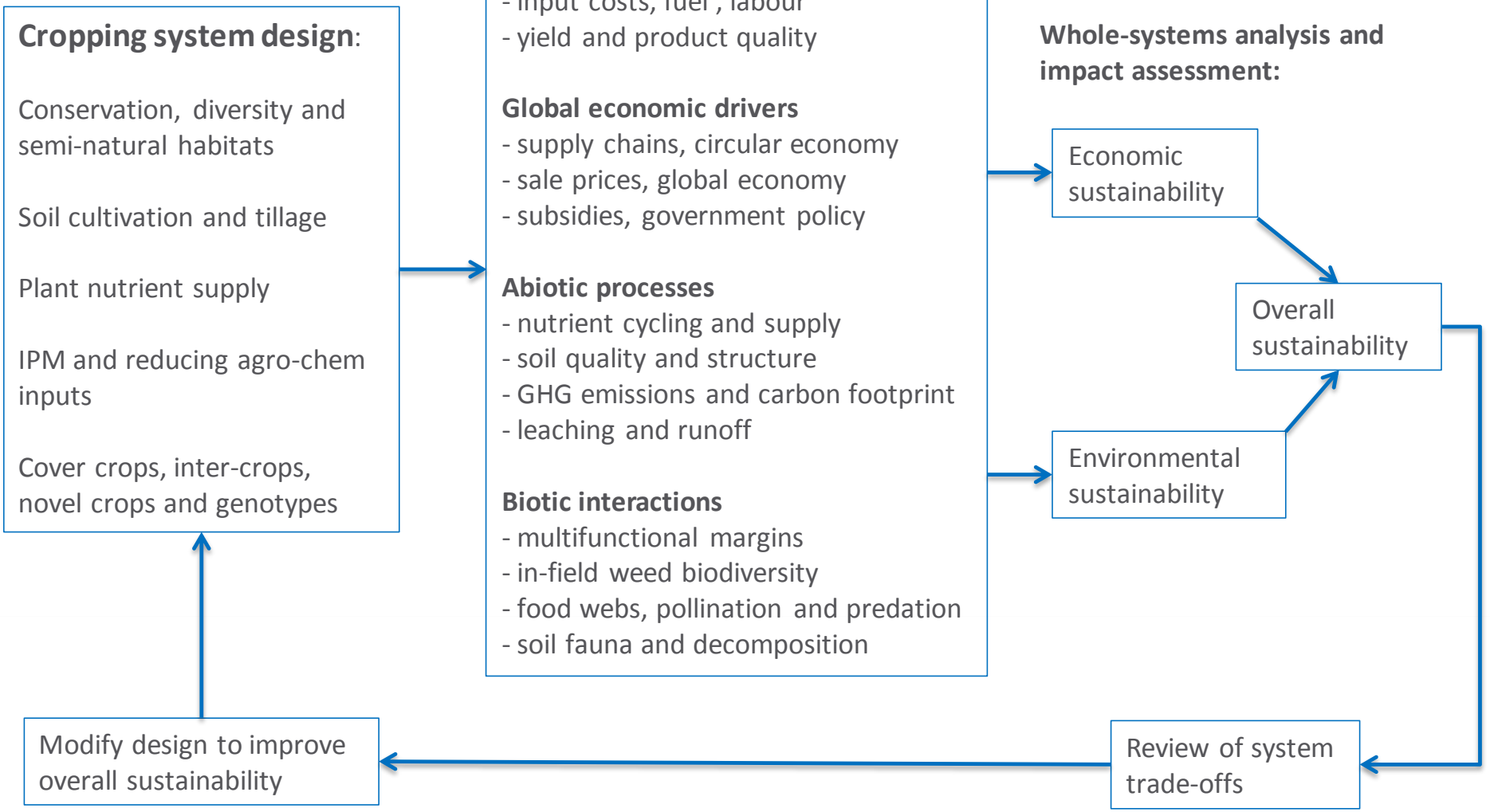



Integrated cropping system

- **Improve soil structure for better plant rooting and to minimise erosion/run-off losses:**
  - conservation tillage (non-inversion, moving to direct drill/no-till)
  - increase soil carbon (green waste compost, straw incorporation)
  - cover cropping over winter
  - tied-ridging in potatoes
- **Sustainable supply of plant nutrients:**
  - under-sowing and inter-cropping legumes for BNF
  - renewable sources of nutrients, e.g. digestates, urea (under investigation)
  - reduced rates of mineral fertiliser (moving to replacement)
- **Enhancing arable biodiversity for ecosystem services:**
  - targeted weed control to allow dicot weed understorey
  - IPM options (e.g. blight forecasting) to reduce crop protection inputs
  - wildflower margins to support populations of pollinators and natural enemies

Whole systems approach

(Hawes et al. 2016)



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(Hawes et al. 2016)