The Centre for Sustainable Cropping

A long-term platform for interdisciplinary research to optimise economic and environmental sustainability.

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The James Hutton Institute

Introduction

The Centre for Sustainable Cropping (CSC) is a long-term experimental platform, established in 2009 at Balruddery Farm near Dundee, Scotland. The CSC integrates cross-disciplinary research on sustainability in arable ecosystems. The platform provides an open research facility to test and demonstrate the economic, ecological and environmental trade-offs of sustainable land management.

The CSC adopts a whole-systems approach for designing a sustainable arable cropping system that optimises yields, biodiversity and ecosystem services, whilst reducing the environmental footprint of crop production.

The long-term, whole-systems approach adopted at the CSC is essential if the potential conflicts between commercial and environmental interests are to be reconciled.

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Objectives

1. Design and implement a cropping system to optimise and balance inputs and yield with environmental health, biodiversity and ecosystem processes
2. Apply a whole-systems approach to test the long-term impact on sustainability:
   - Ecological – enhanced biodiversity for provision of ecosystem services
   - Environmental – minimise losses through erosion, runoff, leaching and emissions
   - Economic – maintaining yield for economic sustainability, food security and health

The platform comprises six fields over 42 ha. Each field is divided into two halves for direct comparison of the sustainable cropping system on one half with current conventional practice on the other.

The Sustainable Cropping System:

- Green waste compost
- Straw incorporation
- Cover cropping
- Non-inversion tillage
- Legume undersowing
- Tramline management
- Reduced/tailored fertiliser application
- Threshold crop protection chemicals and IPM strategies
- Engineered riparian buffers
- Wildflower margins

Indicators of Sustainability

Key system indicators are monitored throughout each growing season. These are grouped as follows:

Economic

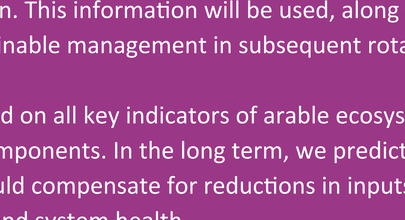
Yield , end product quality and sale price, offset against input costs , fuel use and tractor time are used to estimate financial margins .

Provisional yield data suggest little effect of sustainable crop management on yields in spring sown crops or winter oilseed rape, but a yield penalty in winter cereals.

Yield gap to be reduced by improving efficiency of crop production, reducing losses and providing alternative sources of nitrogen fertilisation of N.

Environmental

Increased soil carbon buffers the impact of non-inversion tillage on soil strength.



Losses of soil, plant nutrients and agrochemicals are mitigated by improved soil structure, engineered buffers and cover cropping

Greenhouse gas emissions, leaching and runoff, together with inputs from Biological Nitrogen Fixation and fertilisers are used to generate N budgets for both cropping systems.

Ecological

The arable weed seedbank and field margin vegetation are the basis for within-field biodiversity. Seedbanks are monitored by seedling emergence across a grid of 360 permanent sample locations.

The seedbank supports above ground invertebrate foodwebs, monitored through pitfall trapping and vortis suction sampling.

Plant, invertebrates and microbial biodiversity provides ecosystem services including predation of crop pests, pollination and decomposition.

Evaluation

The CSC platform is a long-term experimental site and results will be made available on the project website at the end of each rotation. This information will be used, along with feedback from the farming industry, to improve on the sustainable management in subsequent rotations.

Assessment of impact will be based on all key indicators of arable ecosystems and take account of the trade-offs between interacting components. In the long term, we predict an improvement in system function and resilience which should compensate for reductions in inputs of non-renewable reources, optimising both food production and system health.