The James Hutton Institute

The Centre for Sustainable Cropping

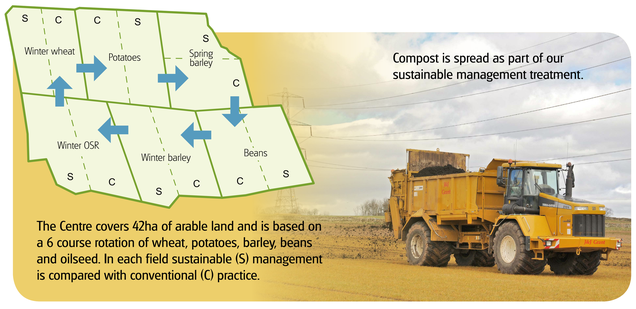
A long term experimental platform for research on the sustainability of arable ecosystems

Intensification of crop production has led to erosion of biodiversity and degredation of arable habitats. This raises serious concerns about sustainability and long term food security.

Sustainable management must achieve a balance between

- **producing high yields of good quality food**
- **conserving biodiversity**
- **maintaining a healthy ecosystem**

The centre aims to develop management practices and crop varieties to optimise these conflicting goals.



The Centre covers 42ha of arable land and is based on a 6 course rotation of wheat, potatoes, barley, beans and oilseed. In each field sustainable (S) management is compared with conventional (C) practice.

Our sustainable management treatment

Goal	Method
Improved soil fertility to maintain yield at lower NPK inputs	Compost addition & straw incorporation Minimium tillage Legume undersowing
Pests and disease control to reduce chemical inputs	Biocontrol/IPM Forecasting and threshold applications
Enhanced biodiversity to maintain healthy foodwebs and processes	Weed management for enhanced in field dicot populations Wildflower margins Overwinter stubbles
High quality crops and high yields to maintain productivity under reduced inputs	Crop varieties for Enhanced resource use efficiency Pest and disease resistance Weed suppression

At the CSC we are measuring the effect of our 'sustainable' management on the key components of arable systems:

Soil

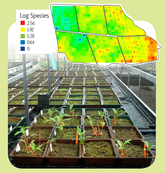
Sustainable management should improve soil physical structure and the ability of crop plants to take up water and nutrients efficiently. We are measuring soil strength and root penetration of crops under sustainable and conventional management.

Soil pH, carbon and plant nutrients are measured as standard from all soil samples collected from the CSC. These are used in calculations of nutrient availability and carbon flows.

We are monitoring the impact of sustainable management on the diversity of soil microbial communities which are essential for driving processes such as nutrient cycling.

Weeds

The arable weed seedbank is the basis for above-ground arable biodiversity in annually disturbed fields and is assessed across the CSC every year to track changes in abundance and species richness.



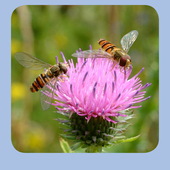
Weeds are an essential component of arable biodiversity. The functional diversity, species abundance and biomass of within-field arable weeds in all fields are assessed throughout the growing season.

Crops

The sustainable treatment aims to achieve high yields and yield quality without environmental degradation. Crop yields are used to assess the costs and benefits of sustainable and conventional management. Harvested material is also analysed for quality and nutritional value.

Foodwebs

Pollinators play an essential role in the maintenance of biodiversity within the arable ecosystem and are an important indicator group for measuring the environmental health of agricultural ecosystems.



Predators and parasitoids are an essential component of the arable foodweb, functioning as a natural biocontrol of insect pests within fields. We predict greater predation rates under sustainable management where alternative resources are more abundant.

Crop pests and pathogens can cause significant yield loss, particularly in crop monocultures. We are comparing pest populations under sustainable management with conventional practice and will explore associations between pest population density and plant diversity.

The distribution of wood mice is being monitored across the CSC. Wood mice are a useful indicator species because their abundance patterns indicate active choices about habitat quality.

The CSC is a 42ha block of 6 fields to the south-east of Balruddery Farm near Dundee, Scotland

We are studying how changes in the soil, weeds, crops and foodwebs affect the ecosystem services provided by arable habitats:

Biological nitrogen fixation by legumes is an alternative source of nitrogen input to the cropping system. Enhanced nitrogen fixation will allow reductions in non-renewable fertiliser use.

Economic sustainability may be calculated using input costs offset against income from yield. These models will be used to assess the actual cost or benefit of sustainable management over current conventional practice.

Greenhouse gas emissions and nutrient leaching are measured using cover boxes and lysimeters. These data will be used to study the efficiency of nitrogen fertiliser use under conventional and sustainable management.

Soil erosion and biodiversity loss are major issues in intensively managed fields. These maps of, seedbanks and erosion rates suggest that erosion may exacerbate the loss of weed biodiversity in some areas and create weed problems in others.

Carbon turnover is being studying by tracing carbon flows through plants, soil and microbial communities. Increased soil carbon stimulates soil microbial communities which alter soil nutrients and can improve plant growth. We aim to exploit these processes to maintain crop productivity with reduced inputs.

Diverse arable foodwebs provide ecological services including nitrogen and carbon cycling, pollination, pest control and more. We will be tracking long-term changes in biodiversity and modelling the impact on these system functions.

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