Agroecology

First steps by British farmers towards agroecological systems

Stephanie Williamson, PAN UK
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Background

During the years 2000 to 2013, the total area of UK crops treated with pesticides increased from 59.1 to 78.2 million hectares.[1] The data indicate that the number of applications per crop per season has increased considerably, contributing to this increase in usage, rather than a spatial increase in cultivated area. The area of organically farmed cropland remains far too small (under 3%) to make a noticeable difference in overall pesticide use statistics. Upward trends in use of specific Highly Hazardous Pesticides (HHPs) or pesticide families associated with negative environmental impacts (e.g. pyrethroid and newer generation neonicotinoid insecticides, glyphosate herbicide) remain a major concern, while there has been a notable increase in fungicide use frequency in cereals, partly due to fungal pathogens becoming resistant to commonly used fungicide groups.

Leaving the European Union ('Brexit') may have many impacts on farmers and the UK economy, but it also gives the UK a once in a generation opportunity to strengthen its pesticide regulatory system to become more protective of human and environmental health and to rethink its entire food and farming policy and subsidy system. PAN UK believes that with strong political leadership from the UK Department for Food & Rural Affairs (Defra), Britain has the potential to follow the shining example of France[2] to become one of the leaders in agroecological approaches and innovation in non-chemical practices in developed countries.

First lessons from farmer experimentation with agroecology

Agroecological theory suggests that more diversified cropping can contribute to reduced weed, disease and pest pressure, as well as deliver other benefits, e.g. for pollinators and for soil health.[3] Since 2016, on-farm trials run by farmers and agronomists at different sites are generating detailed understanding of how expanded and more diverse crop rotations and/or different forms of intercropping within the same season can work in practice. In these case study summaries, we look at some early lessons from intercropping and using cover crops, with a focus on improving weed management in organic and non-organic farms.

Agroecology: Farming for the Future

Agroecology is an economically viable and socially just approach to sustainable agriculture and food systems, grounded in ecological and social principles and the integration of science with local and Indigenous knowledge and practice, emphasising farming in harmony with natural cycles and processes, and the political approach of food sovereignty — including the right to produce and access nutritious and culturally appropriate food.

By taking a holistic approach to farming, agroecology encompasses not only its biophysical and ecological, but also its social, economic, political, cultural and spiritual dimensions, where farmers, agricultural workers, community-based processors and consumers are at the centre of decisions. People and communities are thus recognised as part of the agroecosystem. Agroecology also seeks to establish system equilibrium by supporting reciprocal relationships among the agroecosystem's components, the natural world and the society in which we live.

Sowing small or awkward corners of fields with plants to attract pollinators and/or natural enemies and leaving natural flowering vegetation are valuable practices for enhancing agrobiodiversity in arable crops. Credit: Stephanie Williamson

Case study 1
Innovative Farmers' Field Lab on Intercropping in Arable Systems, 2017–2019

Established in 2015, Innovative Farmers is a network of British farmers and growers conducting on-farm trials to investigate, explore and address practical issues of concern. The network's "Field Lab" brings together farmers and researchers who assist with experimental design, and currently includes more than 50 on-farm trials and workshops, run by over 25 people, including 12 farmers. The project builds on the EU-funded DIVERSify project[4] to optimise the performance of crop species mixtures ('plant teams') to improve yield stability, reduce pest and disease damage, and enhance stress resilience in agricultural systems.

The trials and group learning activities cover:

- Sharing experiences between farmers of different 'plant teams';
- Identifying beneficial combinations and their impact on key indicators identified by farmers (yield, soil and plant health, weed burden and pest / disease) in different contexts; and
- Practical considerations, e.g. crop competition, establishment, machinery, harvest, separation and finding markets.

Group members' initial ideas for trialling are outlined in Table 1. Results in the first season (2018) have been quite mixed, which is not surprising given the huge variety of soils, weather and growing conditions at different study sites, in addition to the different plant species selected by host farmers. Some disappointing results were likely due to adverse growing seasons (too much or too little rain), making it hard to assess the effectiveness of different intercrop combinations compared with the monoculture 'control' fields.

Intercropping and crop rotation are key agroecological strategies to maximize nutrient efficiency, improve soil health, reduce weed pressure and manage pests. Credit: PAN-Germany

Table 2 summarises some of the key findings from intercrop combinations tested so far.[5] Positive or encouraging results have been obtained by most farmers, as indicated by triallists' quotes from reflections on the first season:

> "We actually saw slightly lower bean yields where we intercropped but this was more than made up for by the wheat. Crucially, we saw 64% less weed biomass in the intercropped plots. With far fewer weeds, we should have a much cleaner field next year."

Table 1: Inter-cropping research questions

Intercrop	Main crop	Aims/considerations
Clover	Cereal	suppress weeds; improve soil health, yield, water infiltration and soil structure
Beans	Oilseed rape (OSR)	increase yield / these two crops are easy to separate and have similar harvest dates
Clover	with any cash crop	improve soil health; reduce chemical usage
Beans	Wheat	reduce weeds in bean crop / the wheat should not outcompete the beans
Legumes	Buckwheat	suppress weeds; improve soil health and mineral availability
Vetch (legume)	Ryegrass	increase diversity on farm; spread risks in poor growing seasons
Linseed (flax)	Peas	
Yellow trefoil	Spring barley	
Beans	Oilseed rape	reduce pest risk in OSR
Barley or Legumes	Oilseed rape	reduce fleabeetle damage in OSR

Table 2: Preliminary results from first season inter-cropping trials

Intercrop combination	Key findings
Beans with wheat	• Overall good result with intercrop; generates useful biomass to combat weeds. • 50%:50% mix is not best for weed suppression. Will try wheat at 33% of normal seed rate in next season trial.
Beans with wheat	• Late sowing led to poor establishment of beans in both plots. • Need to adjust sowing date, seeding rate and bean variety.
Peas with triticale	• 30% triticale mix had visibly less lodging problems than monocrop • no significant difference in yield
Peas with barley Faba bean with wheat	• higher yield in mixtures as peas yielded better than in monoculture • variety used is very important • difficult to split pulses from cereal at harvest so only useful on mixed farms using this for animal fodder

> "This is our first foray into intercropping and we are convinced it was worthwhile. Having the extra biomass in the form of a wheat crop—rather than weeds—is hugely beneficial. Next year, we'll probably drop the wheat rate to around a third to try and boost our bean yield while still suppressing the weeds."

Other Field Labs are exploring the potential to introduce agro-ecological methods into arable and horticulture crops and mixed farming. Examples include: studying impacts of compost tea on crop health and yield and on soil microbiological communities; biological control methods for leatherjacket pests in cereals grown after pasture; and cultural methods to control blackgrass, which has developed resistance to most available herbicides.

Case study 2
Intercropping for pest and weed management and agrochemical reduction

The OK-Net Arable project, Innovative Farmers' Network and the Agricology knowledge hub all provide useful 'stories from the field' on farmer experimentation. For example, farmer Andy Howard from Kent has been working on intercropping and companion planting tactics for several years, to learn how these can help with pest management, boost crop yields and income, improve crop germination and root growth and reduce insecticide and fertiliser use. His experience is that these tactics can reduce off-farm inputs and produce up to 30% more yield.[6]

Organic beef farmer James Hares in Wiltshire wanted to reduce weed levels, especially thistles, in his beans grown for cattle feed. As an organic farmer, James has to exploit biological, rather than chemical, means to control weeds but results from his experience can be relevant for non-organic farmers too.[7] He used some spare wheat seed in his first experiment and achieved a 62% reduction in weed fresh weight and 74% reduction in dry weight when sowing wheat with the beans. Next season he plans to analyse the protein levels in the wheat to see if the nitrogen-fixing beans help improve the feed quality of the cereal.

Rotational grazing and ecological grassland management in mixed livestock-cropping systems provide nutrient-rich forage, improve soil biology and mitigate greenhouse gas emissions while supporting animal health.

Case study 3
Learning to manage weeds ecologically at Tillingham vineyard, East Sussex

Ben Walgate manages a mixed farm with grazing livestock, ancient woodland and fruit trees and recently founded Tillingham vineyard to make natural and biodynamic wines, farming without pesticides.[8] He has planted 36,000 vines of different varieties, with the first grapes to be harvested in 2021. To build soil fertility on land previously under conventional agriculture, Ben has sown a cover crop of radish, mustard, vetch and rye grass in the autumn, before direct drilling additional cover species alongside the baby vines. He hopes this will provide additional habitats for beneficial microbes to colonise the rooting zone and support the nutrition and immune responses of the vines. In 2019, he planted a wildflower cover crop mix in the field headlands, buffer strips and alleyways to prevent soil erosion, help control weeds, retain soil moisture and encourage wildlife.

Ben Walgate applies biodynamic principles to growing organic tomatoes and other vegetables, for consumption at the farm's guesthouse and events. Credit: Benjamin Youd.

Weed management is a steep learning curve as Ben does not want to use any herbicide. He had problems in the first year as the mulch he had ordered earlier did not arrive until August, by which time the fields were over-run with weeds. He used a side-hoe to do a mechanical cultivation but it was not very effective and there was a lot of re-growth. He has found that mulch is only effective if it goes on straight after cultivation with no existing weed growth. The vineyard still has areas where certain weeds are very invasive, especially dock, fat hen and thistles, and require control via a brush cutter. Much of the 2018 vine plantings had to be hand weeded, at great expense. Ben's main weed concern this year is their excessive competition for water with the young, immature vines, so a dry summer is a threat.

Taking the longer view of managing the vineyard under biodynamic principles, Ben recognises they have a lot to learn, but his focus is to pay attention to detail, timing, monitoring and forward planning. He is keen to combine ancient farming methods with new developments and to embrace appropriate technologies that are beneficial to the environment.

Beyond specific results from individual trials and farmer experiences , these short case studies exemplify the power of agro-ecology—a place-based, problem-oriented, farmer-led approach, integrating science and local knowledge—to explore, investigate and improve the resilience and sustainability of agroecosystems.

Policy recommendations

PAN UK has advocated for more than a decade that British governments need to create a new public sector body to support the development and uptake of ecologically based IPM practices by UK farmers. One of the best ways to help fund this body's work would be a tax on pesticides, to be used to stimulate farmer innovation, training and high quality, independent advice on managing pests, diseases and weeds with reduced or zero use of synthetic active ingredients.[9] In addition to clear targets and timetables for pesticide reduction in general and phaseout of specific HHPs, other policy instruments needed to help more farmers embark on the agroecological journey are:

- Use farm support payments to reward farmers for low pesticide use and employing IPM methods;
- Increase support to the British organic sector, to increase number of farms and area under organic;
- Introduce a government procurement requirement that mandates the use of local organic and/or agroecological produce in state facilities, schools and hospitals;
- Fast-track registration of biopesticides and other less hazardous pest management products

PAN UK took an active part in Defra's public policy consultations on what the new Environmental Land Management Scheme (ELMs) should prioritise as it replaces the current EU Common Agricultural Policy (CAP) agri-environment support for British farmers. We urge that the new scheme must be designed to drive the uptake of genuine IPM approaches, under the 'umbrella' of agroecology, to make British farming more sustainable and deliver essential public goods of improved human and environmental health, ecosystem services and climate change mitigation and resilience.[10] Many agroecological practices could deliver beneficial outcomes, while helping farmers phase out reliance on HHPs. Some examples of IPM activities that should receive public support for farmers to implement include:

- At least four years' crop rotation on all arable land, including at least one legume crop and one insecticide-free flowering crop;
- Minimum 5% of each farm area devoted to non-productive features or to areas where agrochemicals are not to be used
- Good agroecosystem design, with careful and timely cultural practices for soil health and water management;
- S.A.F.E. practices for enhancing natural enemies (Shelter; Alternative Prey; Flower-rich Habitat; Environment;[11]
- Use of biorational methods (pheromones, biopesticides) with a short term (e.g. three seasons) subsidy, either for product purchase or for tailored advice on how to use these effectively

If agroecology is to become the norm, UK farmers urgently need: a knowledge hub with crop-specific guidance and experience sharing; practical experimentation by networks of farmer groups; high quality training and advice; and a monitoring and evaluation framework to assess with farmers and advisors progress on targets, environmental outcomes and socio-economic impact of agroecological and organic practices.

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PESTICIDE ACTION NETWORK UK

The Brighthelm Centre, North Road, Brighton BN1 1YD, UK
www.pan-uk.org/agroecology-resources/