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Solutions
for the farm
of the future

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Green



Section 1

Introduction

Protein crops – plants with natural occurring complex combinations of amino acids, which include peas, beans, and lentils – are consistently highlighted as a solution to the complex demands placed on UK agriculture, and yet development is slow. Currently these crops constitute just 0.8% of UK agricultural land and 0.3% of production by weight and 0.4% by value.¹ This share of UK agriculture has declined for several decades. Demand for protein crops, especially for human consumption, is almost entirely met by imports from Brazil, Canada, and the US.²

The case for greater domestic production of protein crops is strong – and growing. Under most growing conditions, pulses do not require nitrogen fertiliser, thus lowering nutrient inputs and carbon emissions, they are insect-pollinated, thus boosting wildlife and biodiversity, they are healthy sources of protein, and they could contribute to food self-sufficiency and reduce the need for imports that are rising in cost. As a non-animal protein, pulses and other protein crops also have a range of secondary benefits in displacing demand for meat protein and the well-documented impacts of animal agriculture. Studies have shown that for UK diets to change to meet the UK Government's Eatwell Guide for a healthy diet on the same budget, the largest change is an increase in bean and pulse consumption.³

There are also signs of a shift underway. The United Nations declared 2016 as the 'International Year of Pulses', putting the crop in the spotlight for many of its food and agriculture campaigns. Pulses have begun to get attention as an important part of meat-free and gluten-free diets. Even the label of 'poor man's meat' in much of the developed world is starting to be shed; reporting that Prince George was served Puy lentils at St. Thomas's school has shot demand for the product to new heights.⁴

This interest in products is not necessarily connected to UK agriculture – at least not directly. Agricultural products are highly traded and this is especially true for dry products like pulses. The Puy lentils served to Prince George were from France, and much of the products on retail shelves come from Canada. Is this situation inevitable, or could protein crops shake-up UK agriculture? What are the barriers to development and what needs to change? Is there a role for policy-making to shape the future of the industry to align with the complex and diverse objectives for UK farming? This report seeks to answer these questions in the following sections.



Section 2

The diagnosis: a broken food system in need of fixing

A broken food system

How should 'successful' be defined with respect to the food system? A 2014 report from the New Economics Foundation, *Urgent Recall*, tackled this question from a perspective of delivering wellbeing, social justice, and environmental stewardship.⁵ Using this perspective, eight criteria are defined and evaluated for the UK food system.

It is difficult to pull apart aspects of an interwoven food system, but clearly agriculture itself is at the heart of many of these issues. One worth exploring in more detail is the first indicator on environmental sustainability, as the questions explored in this report around what type of farming is conducted in the UK could have a tremendous impact.

Table 1: Indicators of a successful food system and measured UK performance

Indicator	Performance
1 Have a neutral or positive impact	It is unsustainable: we estimate the total environmental impact of the UK food system to be in the region of £5.7–7.2 billion per year, or 6.3–7.9% of the market price of food, and probably higher.
2 Be productive in its use of energy and other inputs	It is energy-intensive: the UK food system uses roughly eight calories of energy to produce every one calorie of energy from food.
3 Be diverse in species and genes	It is highly concentrated: Defra has estimated that 100 out of 130 native breeds of poultry, cattle, sheep, goats, pigs, horses, and ponies are at risk as a result of increasingly homogenous farming.
4 Support good jobs	It supports bad jobs: the UK food system employs approximately 11% of the UK labour force, but most of them are in the least well-paid jobs, with salaries of less than half the UK average.
5 Be dominated by short and simple supply changes	It is highly complex and opaque: both the decreasing share of total value going to farmers and recent events such as the horsemeat scandal testify to the extreme and increasing complexity of our UK system.
6 Be composed of assets that are controlled by a wide and inclusive set of stakeholders	It is unequal: all 17 million hectares of agricultural land is owned by about 0.25% of the UK population and the price of an acre of bare land has increased more than threefold from 2004.
7 Foster a positive and thriving food culture and the highest levels of public health	It is unhealthy: obesity is increasingly recognised as the greatest threat to public health now and in the future.
8 Make food affordable to everyone	It is volatile: Britons spend less on food than almost any other EU country, but recent price spikes have hit poor households the hardest.

Source: Adapted from Devlin et al., 2014

UK farming as a common environmental culprit

On environmental issues – from air and water pollution, to waste, to biodiversity to climate change – increased attention is now being translated into action and improvement. It is clear that all sectors and all industries must do their part to lower their environmental impact.

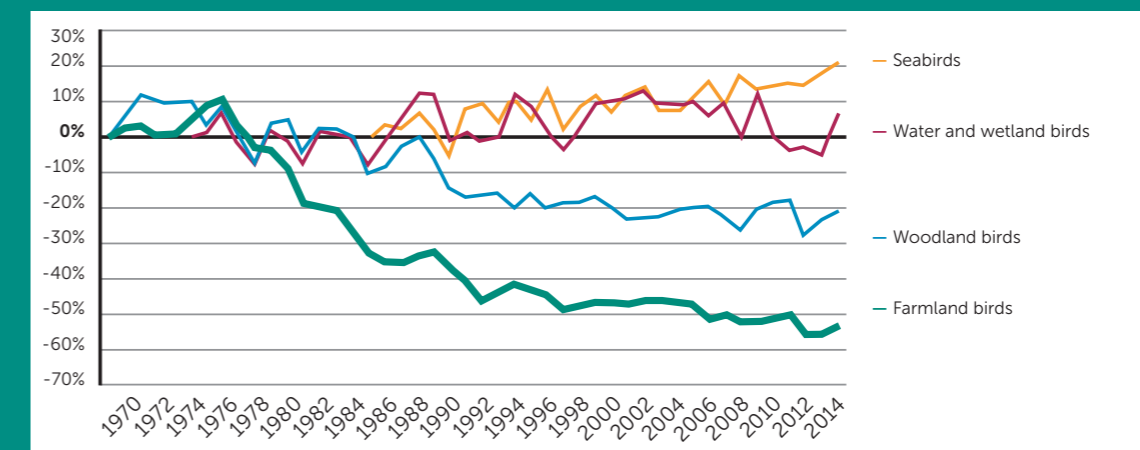
Yet a look at the evidence behind many of the more pressing environmental issues shows that consistently, and often by a large margin, it is the agricultural system that is a common culprit and frequent laggard. Of all the sectors of the economy, it is the agricultural sector that is most in need of reform, and where the most radical changes are required if progress is to be made in creating a sustainable system.

Biodiversity is decreasing most rapidly on farmland

The populations of wild birds in the UK (the most commonly used biodiversity indicator) are trending downward. By ecosystem, it is farmland birds that are decreasing at the fastest rate, and by a country mile (see Figure 1).⁶ This decline is attributed to changes in farming practices, including the increased use of pesticides over the past decades.⁷

The Mid-term review of the EU Biodiversity Strategy to 2020 (published in 2015) had similar findings, noting that while there was progress for some habitats, "there has been no measurable improvement in the status of agriculture-related habitats and species covered by the nature legislation."⁸ Intensive farming methods and the use of insecticides has been the focus of criticism on farmland biodiversity,⁹ and at a broader level, the lack of joined-up approach between agriculture and environment policy.¹⁰

Figure 1: Populations of wild birds in the UK, by habitat, 1970-2015

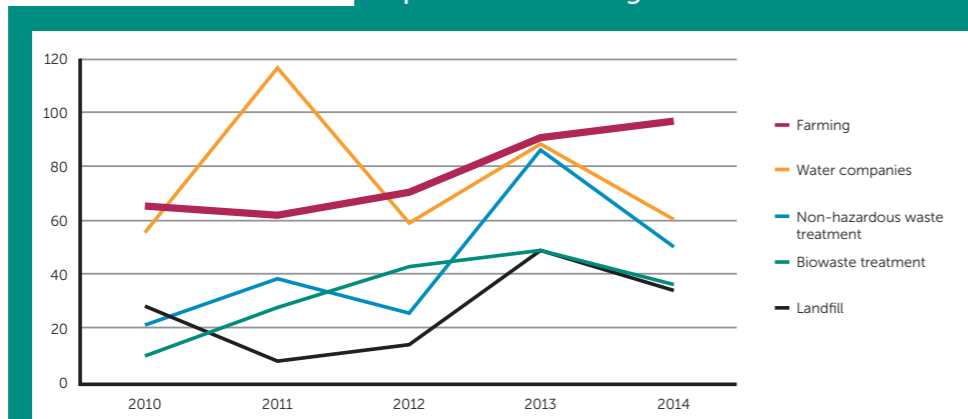


Source: Adapted from Defra, 2017, source data from the British Trust for Ornithology, Defra, Joint Nature Conservation Committee, Royal Society for the Protection of Birds

Farming is the number one sector for incidents of water pollution

While environmental awareness and public pressure has driven reductions in water pollution across many sectors, serious water pollution incidents are increasing within the farming sector – now the number one sector for recorded incidents.¹¹

Figure 2: Serious water pollution incidents: top 5 sectors in England



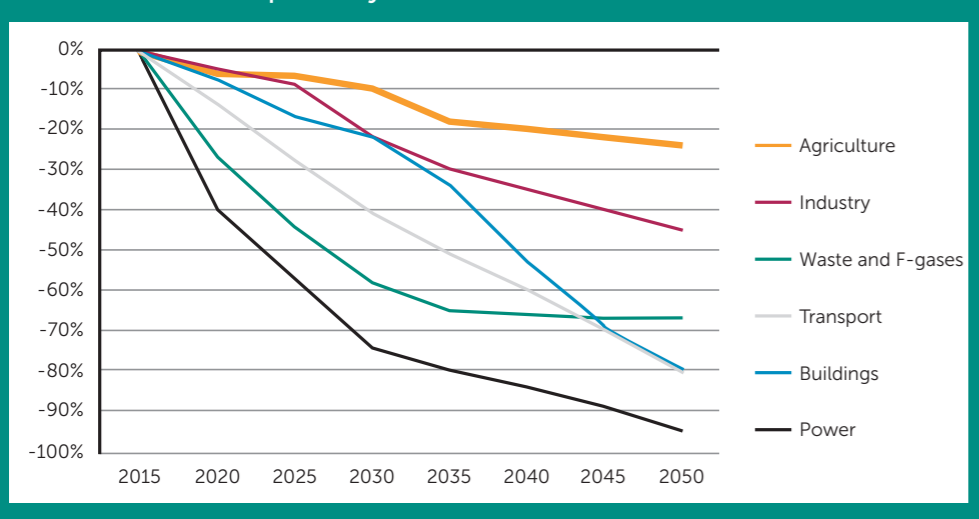
Source: Adapted from Environment Agency – Pollution incidents: 2015 evidence summary

Agriculture is not taking its share of carbon reductions

The UK's Committee on Climate Change projects that the agriculture sector will make the smallest contribution towards meeting the UK's 2050 carbon emission target of all sectors.¹²

The agricultural industry is still struggling to make any significant breakthroughs towards tackling climate change. In the last two years the UK power sector has already made the reduction in emissions (25%) that the agriculture sector is projected to make in next thirty-five.¹³

Figure 3: Committee on Climate Change emission reduction pathways to 2050



Source: Adapted from Committee on Climate Change (central scenario)

A report for the Committee on Climate Change has also analysed different types of land uses and their provision of ecosystem services.¹⁴ Here it is agricultural land that continues to stand out as the largest area of concern, undermining many of the services we rely on the natural environment to provide (see Table 2).

Table 2: Land uses and their impact on ecosystem services

Land Use (Level 1)	Built Environment (housing etc)	Provisioning Services				Regulating Services		Cultural Services	Biodiversity
		Food	Timber	Energy	Water	Air, soils and water	Climate		
Arable and Horticulture	-1	2	0	-1	-1	-1	-1	-1	-1
Improved Grassland	-1	1	0	-1	0	1	1	-1	-1
Semi Natural Grassland	0	0	1	-1	0	0	1	1	1
Woodland	0	0	1	0	0	1	2	1	1
Montane, Moor, Heath	0	0	0	0	0	0	1	1	1
Coastal	0	0	0	0	0	0	0	1	1
Urban/Developed	2	0	0	0	0	0	0	0	0

Key: Cells are scored from -2 (land use has strong negative impact on services) to +2 (land use has a strong impact on services); a score of 0 means no effect.

Source: Committee on Climate Change

Agricultural land does perform well in providing food, which is clearly an important ecosystem service, but is it worth it at the expensive of nearly all other ecosystem services? And must it be that way?

An industry shaped and directed by subsidies

Just as the agricultural sector is unique in its contribution to and slow progress on environmental issues, the sector is also unique in its functioning as an industry. Whereas in most sectors the bulk of income is constituted by sales of goods and services in the market, for the farming sector, 55% of total income comes from subsidies.¹⁵ These subsidies constitute 40% of the EU budget.¹⁶

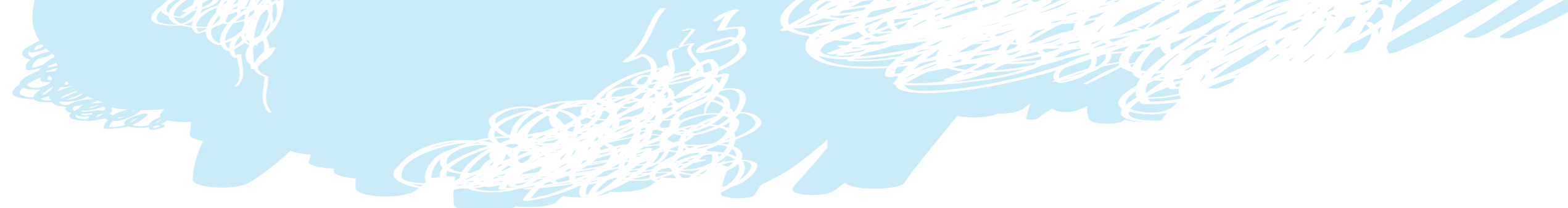
With over half of farming income coming from public subsidies, it is clear that how these subsidies are designed has a large impact. To date, these subsidies have been designed through a 'productionist' mentality, a legacy of the second world war and the drive to feed the world.

The potential for protein crops

Protein crops are a general category of plants with naturally occurring complex amino acids. These include legumes and pulses (e.g. beans, peas, lentils), some nuts and seeds (e.g. chia, hemp, flax, sunflower, quinoa) as well as grains (e.g. spelt, teff, millet). The Vegan Society's Grow Green report included case studies on hemp and fava beans for their potential to increase production in the UK and substitute for animal products.

This report will expand on these protein crop case studies, with a particular focus on pulses – edible seeds that grow inside pods. Pulses are part of the legume family (Fabaceae), but refer only to the dried seed. Common pulses consumed in the UK include:¹⁵

- * baked beans
- * red, green, yellow, and brown lentils
- * chickpeas (chana or garbanzo beans)
- * garden peas
- * black-eyed peas
- * runner beans
- * broad beans (fava or faba beans)
- * kidney beans, butter beans (Lima beans), haricots, cannellini beans, flageolet beans, pinto beans, and borlotti beans



Where statistical figures are provided in this report, the (most limited) classification of protein crops used in the 2013 EU study The Environmental Role of Protein Crops in the New Common Agricultural Policy are used.

The benefits

Protein crops, and pulses in particular, are of interest because they provide a solution to many of the problems identified in a broken food system.

Low resource use and environmental impact

Pulses are nitrogen-fixing crops, taking their nitrogen from the air and storing it in their roots. This feature provides pulses with the tremendous benefit of not requiring nitrogen fertiliser in most growing conditions, unlike most crops. Avoiding the use of nitrogen fertiliser, which involves significant greenhouse gas emissions in production, also reduces nitrous oxide emissions, one of the worst greenhouse gases, and can drastically reduce nitrate leaching into the water table.¹⁸

Improving soil quality and cropping systems

Not only avoiding the use of nitrogen fertilisers, pulses even have positive impacts on the environment by increasing soil microbial activity. The different biochemical composition of pulses has the effect of increasing the number and diversity of soil microbes.¹⁹

When used in intercropping systems, pulses have also been shown to reduce pests, diseases, and weeds.^{20,21} Studies on the use of protein crops as pre-crops for rapeseed showed average yield increases of 15%, owing to improved soil quality.^{22,23} These positive implications have led some researchers to suggest that pulses and other nitrogen-fixing crops could replace fertiliser use across the farming system.²⁴

The climate resilient nature of protein crops like quinoa has also been highlighted as having an important benefit.²⁵

Nutritious and affordable

For consumers, pulses can contribute to a healthy diet through their high protein content, with pulses recording around 8-20g of protein

per 100g of product. This is roughly double the amount of protein in cereal crops.²⁸ Pulses are also a good source of iron and can add important fibre to a diet. This combination of high nutrition and low environmental impact has put protein crops at the centre of the emerging field of 'environmental nutrition'.²⁹

This nutritious content also comes at a low financial cost to consumers, often lower than sources of animal protein.³⁰ A 2016 study in the British Medical Journal analysed how UK diets would need to change to meet the UK Government's Eatwell Guide for a healthy diet on the same budget. The researchers found that of the changes required across the 26 selected food groups, the largest change is an increase in bean and pulse consumption (by 90%, and -78% change in red meat consumption at the other end of the spectrum).³¹

These health benefits, as well as the environmental benefits can be translated into economic benefits. A 2016 study in the Proceedings of the National Academy of Sciences found that transitioning to plant-based diets in line with dietary guidelines could reduce global mortality by 6-10% and food-related greenhouse gas emissions by 29-70%, resulting in economic benefits of 1-31 trillion US dollars (0.4-13% of GDP).³²

Potential substitute for animal protein

To the extent that protein crops substitute for animal proteins, there are a whole group of secondary benefits from the reduced impacts of animal agriculture.

A 2014 study in the journal of Public Health Nutrition, *The environmental cost of protein food choices*, compared the land, water, fuel, fertiliser, and pesticide use for different plant and animal protein sources. Kidney beans performed best, while beef performed worst, with a difference of 9-18x across the environmental metrics. The authors conclude that "the substitution of beef with beans in meal patterns will significantly reduce the environmental footprint worldwide and should also be encouraged to reduce the prevalence of non-communicable chronic diseases."³³ Other studies on the environmental impacts of different diets have reached similar conclusions: in almost all cases, the environmental impact of plant proteins have a

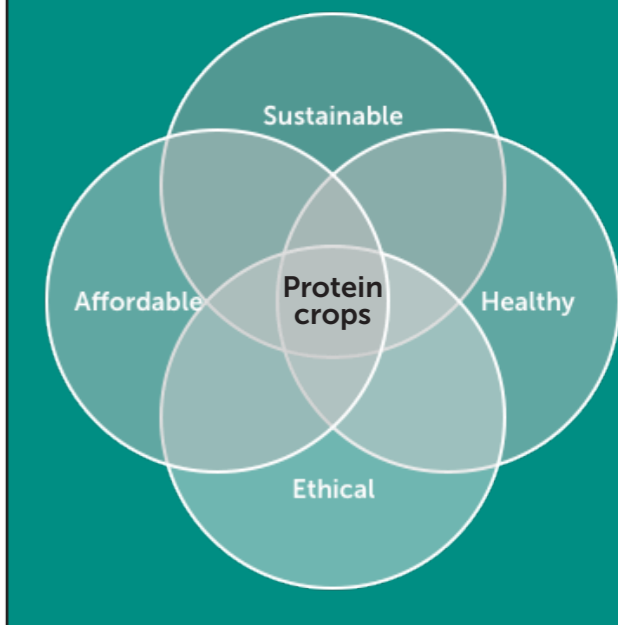
much smaller impact than animal proteins.^{34,35} This also scales up to the level of individual diets, where the less animal protein, the smaller the environmental impact.^{36,37,38,39,40}

By requiring less land,^{41,42} a transition from animal to plant protein can also free up land for other purposes or to expand production to increase UK farm production and self-sufficiency. A report for the UK Committee on Climate Change has modelled the changes to land use and greenhouse gas emissions associated with different meat reduction scenarios.⁴³

Protein crops as a key part of a reformed UK food system

Returning to the evaluation of the broken UK food system, protein crops offer the potential to address several of the most problematic issues. If UK diets are to be sustainable, healthy, affordable, and ethical, it is clear from this section that protein crops represent a win-win-win-win. These crops are truly 'superfoods' in this wider context of what the food system should be delivering and very deserving of policy support. As the EU Parliament report on pulse crops concludes: "Our assessment of the resource and environmental effects of protein crops indicates that public policy intervention to increase their production in Europe is justified."

Figure 4: The win-win-win-win role of protein crops in UK diets



While switching from meat to vegetable proteins among consumers has a clear path of action, this is a complicated transition on the production side, and not one often discussed. Yet for a whole food system to be sustainable, changes must be made to both production and consumption. The following sections detail the barriers and potential policy reforms to support this transition in the UK agricultural sector.

Section 3

UK context

Studies have demonstrated that various protein crops can be grown viably in the UK, including lentils, white lupins, fava beans and various types of pea.^{44,45,46} Climate, geography, and technical capacity is a challenge, but not a limitation. Already the UK is one of the top three bean exporters globally and a leading exporter of some lower-protein crops like marrowfat peas.⁴⁷

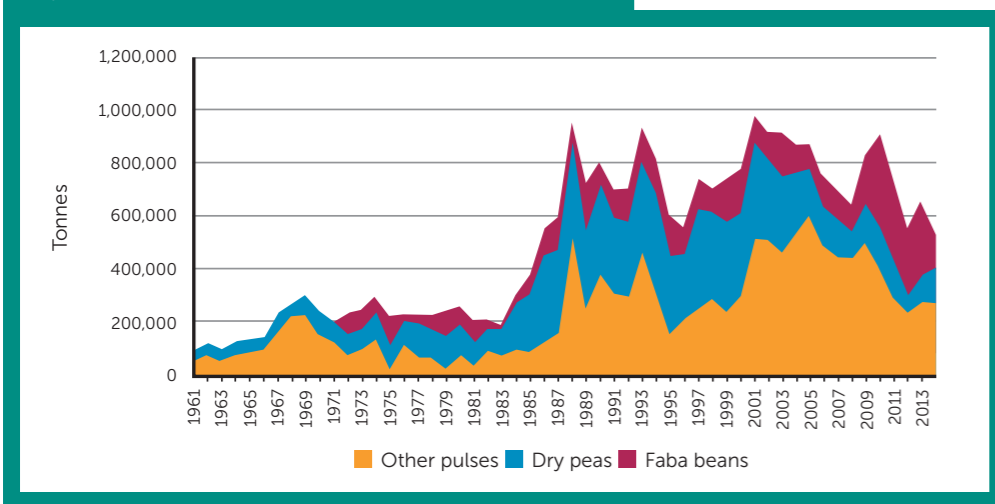
Timid production

Despite this potential and the wide array of health and environmental benefits of pulses detailed in the last section, the growing of protein crops has been very marginal over the past few decades in the UK. Protein crops were grown more before WWII, but the post-war agricultural revolution led to increasing specialisation within European agriculture. Production systems were encouraged to become more and more specialised to ensure the best short-term profitability, which led to the geographical separation of livestock from plant production and increasingly short rotations. The use of synthetic nitrogen fertilisers, available at attractive prices, was encouraged and supported by agronomic research, and the role of legumes as a fertiliser in rotations has since diminished.⁴⁸ The role of EU-grown protein crops in livestock feed has also diminished because of increasing reliance on imported protein crop commodities like soya bean.⁴⁹ On the consumption side, as incomes rose and the price of animal products reduced over the twentieth century, people substituted protein crops for animal protein.

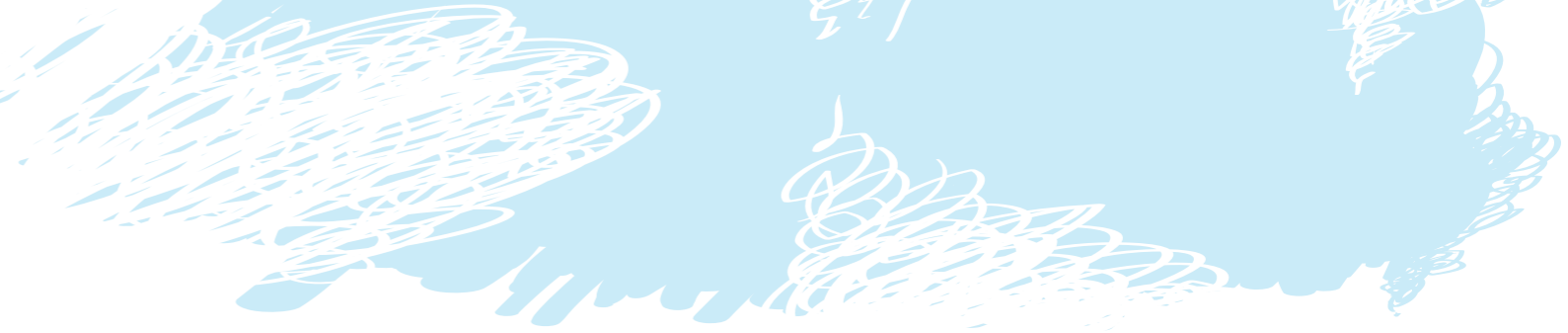
In the 1980s, there was a short-lived boom in the growing of protein crops in the UK, coinciding with various support measures for protein crops in the Common Agricultural Policy. Most importantly, price supports were used for soybean (1974) and pea, faba bean and lupin (1978). Area payments were introduced for chick pea, lentil and vetch (1989).

In the reform of the Common Agricultural Policy in 1992, price support was reduced and replaced with area payments based on crop type – with soybean receiving less than other protein crops. In the 2003 reform, such area payments were dropped in the creation of the Single Payment Scheme. A Protein Crop Premium within the Single Payment Scheme ran until 2012 in 17 member states. Under this premium, field beans, peas and sweet lupins received a €55.57 per hectare payment to a maximum of 1.648 million hectares (after which payments are reduced).⁵⁰

Figure 5: UK production of protein crops



Source: FAOSTAT

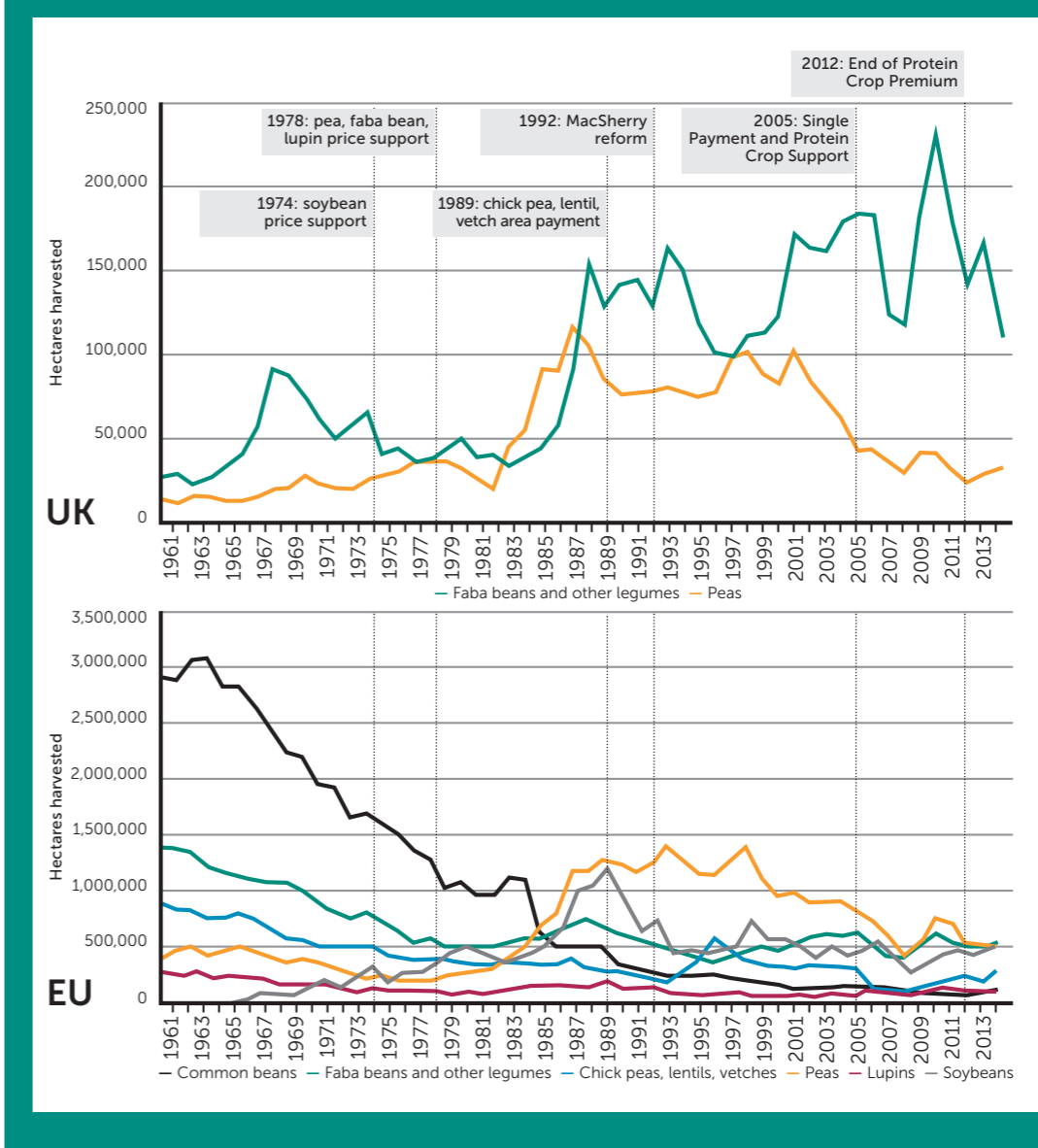


The 2013 'greening' requirements of the CAP that encourage crop diversification have also been cited as a key factor for the bump in protein crops in some EU member states.^{51,52}

Figure 6 illustrates these key policy dates again with the evolution of protein crops, here shown as hectares under protein crop production. These

measures have supported some protein crops, often with a lag of around a decade as new investments were gradually made. These support means did not halt the decline of common beans (*Phaseolus vulgaris*), which were the largest, leading to an overall decline in protein crops from 4.7% of EU arable land in 1961 to 1.4%.⁵³ The worldwide figure is 14.5%.⁵⁴

Figure 6: Production area of protein crops in the UK and EU-27 with key policy events

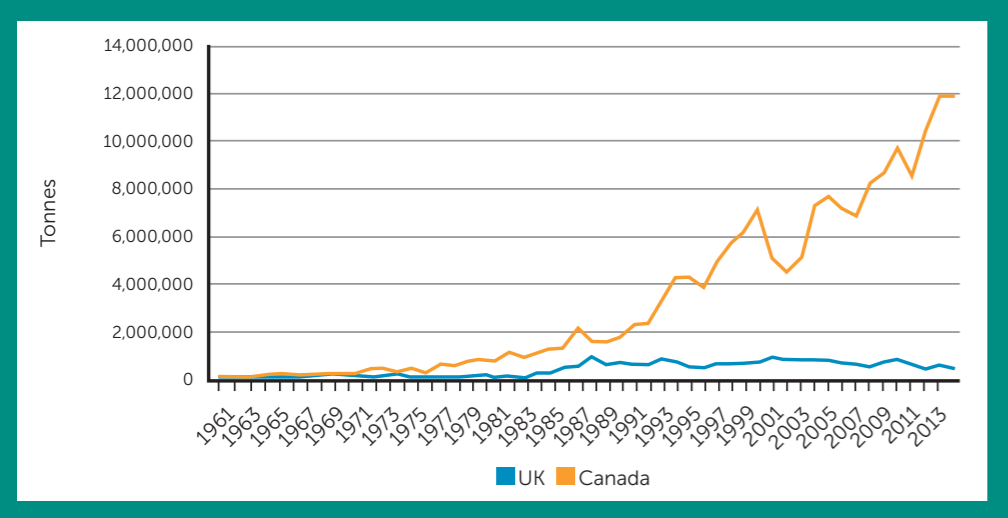




A case study of Canada

In contrast to the experience within Europe where policy reforms have led to boom and bust cycles, but little overall change in production, Canada has experienced rapid expansion in the growing of protein crops over the same period. Whereas in 1970, Canada and the UK both produced around 0.3 million tonnes of protein crop, Canada now produces 11.9 million tonnes compared to 0.5 million tonnes in the UK.

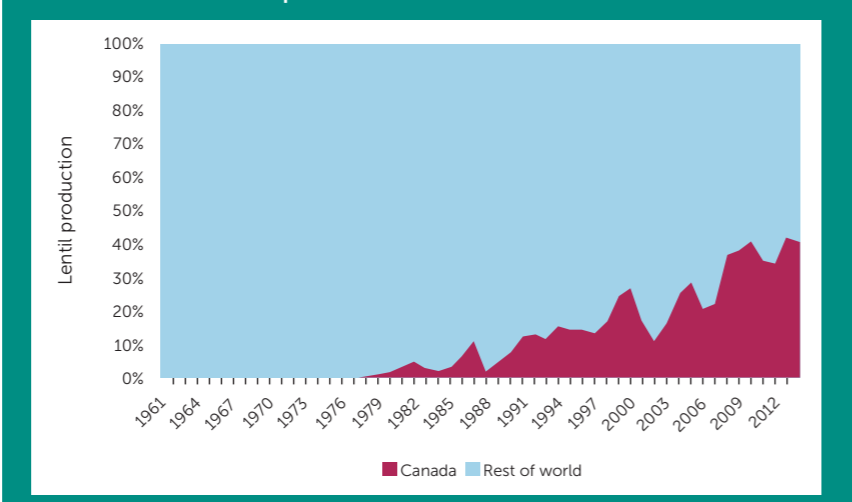
Figure 7: Production of protein crops in Canada and the UK



Source: FAOSTAT

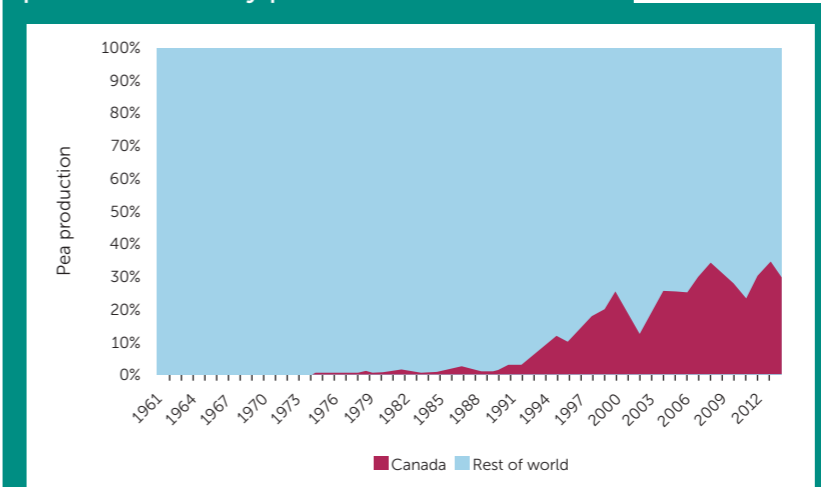
This impressive growth did not come about by accident, but by some active planning, mixed with some fortuitous timing. For two protein crops, lentils and dry peas, Canada is now the world's largest grower and exporter, yielding 41% and 31% of global production respectively. More than 10,000 farms in Canada now grow pulse crops.⁵⁵ All of this pulse production is free from genetic modification.

Figure 8a: Canadian share of global production of lentils



Source: FAOSTAT

Figure 8b: Canadian share of global production of dry peas



Source: FAOSTAT

In the 1970s, when the price for wheat and barley was low, policymakers from the Canadian government and the province of Saskatchewan began searching for new crops to diversify the main holding. As a result, the Crop Research Center was formed with the goal of increasing the production of lentils and other pulses, mostly for export. Then, following the model of the Washington State Pulse Growers Association in the US, the newly formed Saskatchewan Pulse Growers Association introduced a 1% non-refundable levy to support R&D.⁵⁶

Research support has also been provided by the government of Canada through Agriculture and Agri-Food Canada (AAFC) which houses 57 researchers across the country and has developed the majority of new pulse varieties through public breeding programs.⁵⁷ These developments are funded through private-public-producer check offs and in exchange the pulse varieties that are developed are made available for royalty-free access.⁵⁸ In Canada, subsidies play a relatively small role in agricultural development (around 14% of farmed income).⁵⁹

Over the coming decades, R&D and increased revenues worked in a positive feedback loop. Scientists and producers worked in close collaboration to develop new agronomic practices such as reduced summer fallow, longer crop rotations, continuous cropping, direct seeding, and optimised nitrogen fixation cycles.⁶⁰ It took a full two decades, but the normalisation of pulses in crop rotations and expansion over

fallow fields established Canada as one of the dominant pulse producers just as the market was expanding in Asia and other countries focused on higher-yield crops.

The significance of Brexit

Of all sectors of the economy, the farming sector is one that is potentially most impacted by Brexit. The use of farm labour, the application of tariffs in UK-EU trade, and the potential to change subsidies and farming regulations are all highlighted as potential issues.⁶¹

In the context of protein crops, changes to the subsidies regime could radically transform the incentives to growing protein crops and thus the decision-making of farmers and potential entrants.

The cultivation of protein crops may also have implications for tariffs and trade to the extent that they disrupt current trade flows. The ability of protein crops to provide 'import substitution' buffers some of the impact of the depreciation in sterling and the rising food prices that have resulted.⁶²

The shortage of farm labour is an issue across all sectors and would no doubt impact the cultivation of protein crops, although labour intensity is higher in horticulture and several animal farming sectors, so there may be a comparative advantage to the cultivation of protein crops.

These issues are explored in more detail in the following sections.

Section 4

Barriers

The failure of protein crops to spark interest from UK farmers can be traced to a number of barriers. This section describes twelve such barriers, some of which have been informed from a survey conducted of European farmers.⁶⁵

The farm-based barriers to protein crop production are:

- * environmental challenges and low yields;
- * the high-risk nature of protein crops;
- * technological lock-in and existing capital;
- * consumer stigmatisation;
- * undirected subsidies; and
- * the existence of more profitable alternatives.

These barriers are related to the financial decision-making of UK farmers, influencing gross profit margins by pushing revenues down and/or increasing costs. Other barriers to protein crop production are:

- * limited post-farmgate infrastructure;
- * limited research interest;
- * limited producer knowledge;
- * limited consumer knowledge
- * farming culture and tradition; and
- * entrenched interests and power structures.

Many of these barriers are larger forces that tend to create lock-in and discourage the development of new products and growing practices.

Environmental challenges and low yields

Protein crops are particularly vulnerable to environmental conditions. Their yield is affected by hot dry spells, standing water, and they are not very competitive to weeds. This makes it difficult to achieve consistently high returns. Pea crops in particular are susceptible to lodging (collapse of stems so the crop lies on the soil), drought stress, and pests and diseases, including the build-up of soil-borne diseases such as aphanomyces root rot (for which reportedly no protection exists).^{64,65}

In general, the slow rate of germination and often upright growth pattern of protein crops mean that they are poor competitors against weeds.⁶⁶ Weeds can quickly choke a crop and even wipe it out,

meaning that weed control is essential, especially on organic farms.^{67,68}

One paper suggests that the performance of individual legume crops is unprofitable compared to other crops in most regions due to their low yields and resulting low gross margins, which in some cases were more than 50% lower than cereals in their European case studies.

These estimates do not generally account for the savings of nitrogen fertilisers and pesticides used in subsequent crops, and the higher yields of those crops. These savings from the inclusion of protein crops as a 'break' or 'cover' crop to add nitrogen in the soil during crop rotation can total £4.27 per tonne of the following crop of wheat or £38.40 per hectare (at 9 tonnes per hectare).

Lastly, various features of the UK natural environment pose barriers to protein-crop production. For example, all cultivated lupins are sensitive to alkaline soils, restricting the extent of cultivation in the UK.⁶⁹

There is a danger, however, in assuming too much rigidity. Recent lab studies have shown, for example, that lupins could in fact be grown in the UK.^{70,71} The Grow Green report told the story of Hodmedod's, a Norfolk-based pulse trading company that is leading the way in the production of UK pulses. Co-founder Josiah Meldrum explains that they too were worried about environmental factors but have been pleased with the results:

*"We'd always wanted to grow lentils but were repeatedly told it just wasn't possible. Then we met some inspiring German lentil farmers who told us to just plant them and see what happened. We did and it turns out lentils grow well here, the trick is keeping them weed-free and harvesting them – skills we've been learning over the last few years."*⁷²

The high-risk nature of protein crops

Not only are yields from protein crops lower, they are also more variable from year to year compared to cereals. This variability is caused by climatic factors and the high susceptibility of legumes to those, affecting growth and harvest losses due to lodging and fungal infections.⁷⁷ One study of the variation in crop gross profit margins in East Anglia found higher coefficients

of variation (ratio of the standard deviation to the mean) for faba beans (36) and peas (31) than wheat (23) and barley (21), although rapeseed had the highest coefficient (49).⁷⁸

It has also been shown, however, that investments in research and breeding can increase yields and improve stabilisation by 1-2% annually.⁷⁹

Technological lock-in and existing capital

The concept of technological lock-in describes situations where, even though technology judged more effective does exist, the technology originally selected remains the standard because the entire system was organised around it, which makes it seem difficult to change. Although the benefits of developing legumes are widely evidenced and reported, the crops remain marginal because production systems, processing industries and sectors were progressively organised, then strengthened, without them.⁷⁵

This also ties into the issue of large sunk costs for farmers who already farm livestock, where they may have made significant investments in non-transferable equipment. Moving towards more protein crop production would require storage facilities that manage the slow-drying and quality separation issues common to these crops.⁷⁶

Many of the other barriers beyond financial decision-making of UK farmers relate back to this concept of lock-in as it extends to many political, market, and cultural dynamics.

Consumer stigmatisation

The rigid tastes of UK consumers are often highlighted as a major barrier to the development of protein crops in the UK for domestic consumption. Protein crops such as fava beans have been dismissed in the UK market as having a distinctive flavour that "may not be to the taste of the UK consumer"⁸⁰ and as suffering a stigma of 'what poor people eat'.⁸¹

Here, again, the story of Hodmedod's proves inspirational. Before launching their pulse trading company, the company's founders carried out a number of taste tests in British markets and found much more interest in pulses than expected. The company's growth shows no sign of slowing and in September 2017 won the award for Best Food Producer at the BBC Food & Farming Awards.⁸²

It is also the case that some production could simply replace imported pulses, for example if baked beans, which currently use Navy beans and cannot be grown in the UK, are replaced with faba beans, which are currently grown across the UK and exported.⁸³

These encouraging developments and the potential for expansion are explored further in Section 5.

Undirected subsidies

The production, use and trade in protein crops have been the subject of support measures in the Common Agricultural Policy since the 1970s. Key protein crop support mechanisms used in the past included the price support for soya bean, pea, lupins and faba beans, and area payments for some other grain legumes. However, changes over time to the CAP mean that today, legumes are supported in the CAP under voluntary direct support measures and agro-environment schemes, which are more short-term in nature and hamper long-term investment.

One paper that explores the history of plant protein in France found that price support from the CAP led to an increase in the production of protein rich plants in the 1980s, but the 1992 decoupling of subsidies to agricultural producers brought about the end to this kind of support.⁸⁴

Under the new 2015 CAP policy, 30% of a farmer's Basic Payment is allocated to 'Greening', a set of new rules farmers have to comply with. 'Greening' includes crop diversification rules and introduces 'ecological focus areas' (EFA), both of which support the cropping of protein crops. While this is unlikely to lead to a large uptake in protein crops as the main crop grown, it will support farmers to learn more about the growing and marketing of protein crops and possibly increase their appeal in future years. However, in Scotland, the 'ecological focus areas' regulations mean that growers need to grow two varieties of pulses to claim the EFA, which could be a barrier to farmers specialising in one protein crop commercially.⁸⁵

There is the opportunity for member states to specifically promote protein crops through Voluntary Coupled Support (VCS). Under VCS, Member States may grant support to types of farming/specific sectors that are particularly important for economic/social/environmental reasons and undergo certain difficulties – including protein crops.⁸⁶ Of EU member states, 24 out of 28 have VCS for protein crops.

France is the largest, with €443 of support, while Ireland is an interesting case that chooses to only support protein crops through its VCS (€3 million). The UK is one of the four member states that has chosen not to support protein crops.⁸⁷

The existence of more profitable alternatives

Although protein crops in the UK may be technically feasible and even commercially feasible, the issue in the minds of many farmers is commercial optimality – what products and methods will maximise profitability. Many farmers consider that the profitability of protein crops is lower than their competitor crops, which is supported by some empirical evidence.⁸⁸ (Issues outside of direct financial are considered in the next set of barriers.)

A review of protein crops in the EU found that per hectare gross profit margins were 55-622€/ha less than cereals and oilcrops. This lower profitability cannot be completely offset by the protein premium of 57€/ha paid in many EU member states, although it can compensate for the use of protein crops used in rotational systems where gross margins were reported to be just 40€/ha less.⁸⁹ Some research has also pointed to lower productivity gains in legumes compared to those observed in major cereals.⁹⁰ Section 5 explores whether this is the appropriate structure of economic comparison of protein crops given their potential use as a pre-crop.

Cheap, imported protein crops

There are also issues in trade policy that have limited the economic competitiveness of UK protein crops. As soya bean is classified as an oilseed, there are no import tariffs. The ready availability of soya bean at low cost on the world market is a major factor behind the decline of legume cultivation in Europe and the dependence of animal production in the EU on imported vegetable proteins.⁹¹

Strong subsidies for other crops

Support measures for protein crops must also be seen in the context of support policies for all crops, some of which have given other crops a comparative advantage. One of the most significant support measures influencing planting decisions is the biofuels blending mandate that has provided substantial subsidies for oilseed rape.

Layered subsidy for animal farming

Animal farming is also subject to area-based payments under the CAP. To the extent that these animals are fed with grains from EU member states, they are subsidised twice: once for the area and once for the subsidised feed. This system design could amount to extremely large subsidies per animal product given the large amounts of feed used in animal farming. There have not been any studies to date estimating the total amount. This 'layered subsidy' or 'double subsidy' keeps the profitability of animal farming high and prevents farmers looking to other alternatives, including the growing of protein crops.

There is also subsidy support for animal farming in the form of commodity support (border tariffs and safety net arrangement), aid for modernisation, agri-environmental and organic support schemes, aid for consuming animal products, and specific coupled payments (only in Scotland in the UK).⁹²

Limited post-farmgate infrastructure

The existence of supply chains for further processing and sale is a barrier that cannot be overlooked. Especially as protein crops are being considered here for final human consumption, it is necessary that infrastructure exists between farms, the milling industry, and often further processing into final food products, such as pulse flours. Studies in the UK have pointed to a lack of milling capacity and storage as the most significant infrastructure challenges. This infrastructure will likely only follow once a sizable market has been proven.⁹³

Limited research investment

A report by The Andersons Centre about opportunities and barriers to growing peas and beans in the UK argues that decreasing incentives for commercial investment and research in the crops is a result of the declining area of UK peas and beans cultivated.⁹⁴ This is because agrochemical manufacturers spend millions of pounds creating new plant protection products and this cost is rising. These firms are therefore increasingly unlikely to invest in creating a new product solely to treat a crop that covers only a few thousand hectares.⁹⁵ The cyclical nature of this problem is another manifestation of the problem of lock-in.

This lack of investment and research is best exemplified in the difference between protein-crops and cereals in Europe.⁹⁶ While the yield of protein crops and cereals is similar in some places, e.g. the US, in Europe, wheat yields have increased steadily and are now double that of soya bean (the yield of which is closely aligned to other protein crops in Europe).⁹⁷ This change in yield of cereals is due to plant breeding progress combined with increased use of nitrogen fertilisers and pesticides – at least in part driven by high levels of research and investment.^{98,99} In Germany, only one breeding company has a full breeding programme for faba beans and peas, compared to 16 full breeding programmes for winter wheat.¹⁰⁰ EU research funding into protein crops is perceived as ad hoc and limited.

Targeted research on seed quality traits like improving resistance to disease and pests, and retaining benefits to the consumer like taste and texture, is important to build the grower base.¹⁰¹

Limited consumer knowledge

While a lack of consumer demand has been highlighted as a barrier by keeping prices low, a similar, though distinct, barrier is a lack of consumer knowledge about protein crops. Many consumers report concern about their health and diet and a willingness to make improvements, many are unaware that protein crops could contribute to this change. There are also substantial environmental benefits from consumers increasing the amount of protein crops in their diet, especially if this substitutes for meat consumption – as detailed in Section 2.

In addition to a lack of awareness about the benefits of protein crops, there are also indications that many consumers are unfamiliar with pulses and other protein crops at even the most basic level. Surveys have revealed that 13% of people cite not knowing how to cook pulses as a reason for their low consumption (second only to the 16% who cited preparation time/convenience).¹⁰²

Limited producer knowledge

Another factor the report highlights as a barrier is the limited availability of publicly available data about protein crop yield, area and price. Lupin growth, for example, is not measured by Defra or recorded in official statistics making it a 'hidden' crop.¹⁰³ Traders, who need reliable information

about the crop-size in order to know how much of a crop to sell, barely use Defra data, as it is not sufficiently timely or accurate, depending instead on their own figures.¹⁰⁴

"Before farmers consider cultivating a crop, they require an idea of the likely returns for planning and budgeting purposes. They will need guidance on likely yields and prices, but price information is sparse. Indeed, the only publically available information on pulse prices is that which is published by the Farmers Weekly, listing feed beans, feed peas and, in a regional market price box, micronizing peas. It has no information regarding forward prices, historic data or other datasets that are publically kept."¹⁰⁵

A report on French farms found that due to a decline in growth of protein crops and limited political and economic support, the government ceased officially recording the production of these crops of human consumption, leading to another data gap.¹⁰⁶

This data gap compounds the problem that farmers often underestimate the benefits of pulse contributions to soil quality and yields.¹⁰⁷

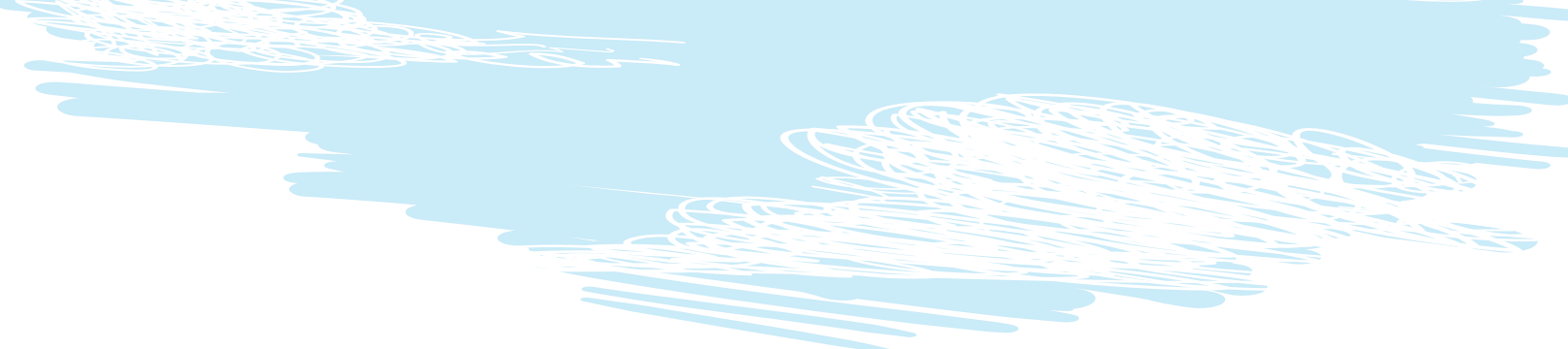
Farming culture and tradition

Because yields of protein crops are risky, knowledge and experience are important to maximise yield.¹⁰⁸ However, many farmers have insufficient knowledge of optimal cultivation and storage practices to ensure the maximum value return from peas and beans.¹⁰⁹

One report suggests that the knowledge exchange process between farmers on how to achieve high yields could be improved. Issues like how to benefit from improved habitat for pollinator species, improved timing of pest control, harvest timing of peas and correct seed bed preparation are good examples that are not fully understood by all growers.¹¹⁰

Entrenched interests and power structures

The farming business is a distant thought for many people in the UK, and increasingly so as cities and towns increase in size. However, the industry continues to be positively received, as demonstrated by the support of MPs for the 'Back British Farming' campaign or the use of



farming imagery on many food products. One consequence, however, is that supporting British farms can mean supporting existing farms and supply chains rather than a new potential farming business. This presents a barrier for the expansion of protein crops, especially as targeted as a replacement for animal proteins in the UK food system.

Market dynamics

Animal agriculture is now firmly entrenched in existing supply chains and whether for market or political reasons, this has resulted in support for animal agriculture over a transition to plant-based alternatives. An interesting case of this dynamic is when Marks & Spencer was criticised by the Royal Society for the Prevention of Cruelty to Animals (RSPCA) for the treatment of dairy cows by one of their suppliers and responded that despite potentially getting the “delicate financial and moral equilibrium between farmers, retailers and consumers” off, at the end of the day the dairy sector should be supported:

“But there is a wider issue at play. British farming is in a precarious position. The number of dairy producers in England and Wales has fallen dramatically and yet the UK dairy industry accounts for around 18% of UK agricultural production by value. As a British retailer, it is right that we support this vital sector.”¹¹¹

Research bodies

This defence of existing producers has also impacted the power structure of research bodies (in addition to the lack of interest in protein crop farming highlighted earlier). One of the major research bodies in the UK is the Agriculture and Horticulture Development Board (AHDB). The AHDB combines both research and promotion for its six farming industries it covers: Beef & Lamb, Cereals & Oilseeds, Dairy, Horticulture, Pork, and Potatoes.

Again, recent campaigns highlighting issues with dairy farming has illuminated an existing barrier for plant proteins. When Go Vegan World and other vegan campaigns launched a campaign criticising several ethical issues associated with dairy production in early 2017, the AHDB Dairy has responded with a £1.2 campaign to support the dairy industry.

While this is not related to research, it is using research funding. There were calls from the dairy industry, specifically the Royal Association of British Dairy Farmers (RABDF), to take funding from the AHDB budget and reallocate to the Dairy Council, a subsidiary of Dairy UK for more direct promotion.¹¹² The AHDB responded that they were already doing direct promotion, but this call from the industry may have laid the groundwork for the AHDB launching a counter-vegan campaign as a way of defending their own budget.

Farming representation

Another example of entrenched interests in UK farming is in the sector’s external representation in political decision-making and the media. In these arenas, the voice of the UK farming is typically represented by the National Farmers’ Union (NFU) in the press and in political decision-making. The NFU brands itself in its external communications as ‘the voice of British farming’. This branding has been extremely effective in the marketing of the organisation, but there are several problems with having a sole voice for a group as diverse as UK farmers.

A 2013 report by Ethical Consumer examined the issue of how the NFU presents itself and whether that is reflective of its membership. The study found that the NFU is enormously powerful, especially at the political level, tallying more meetings with the Department of Environment, Food and Rural Affairs than any other organisation.¹¹³ This power also extends to media coverage, where the NFU has positioned itself as the ‘go to’ source for a farming perspective.

The Ethical Consumer report also questioned whether the organisation is really national (given its focus on England), is really about farmers (given its campaigns with retailers), and is really a union (given its orientation towards farm owners rather than farm workers).

A survey of farmers revealed a substantial split in opinion by the size of farming, with large-scale farms feeling well-represented by the organisation and small-scale farms feeling left behind.¹¹⁴ The report also echoed many of the environmental criticisms raised in high-profile critiques of the NFU from commentators such as George Monbiot and Guy Watson of Riverford Organics. Recently alternative organisations have begun to take

shape, including the Landworkers’ Alliance who have also criticised the biases in NFU lobbying.¹¹⁵

These findings suggest a potential barrier for the development of protein crops as protein crops are small-scale at this point and are supported by environmental objectives above financial objectives alone. Another potential issue is the livestock-oriented focus of much of the NFU management. The top levels of management all have a background in livestock production or trade, such as Terry Jones, NFU Director General, Meurig Raymond, NFU President, and Minette Batters, NFU Deputy President.¹¹⁶

This orientation towards livestock production and sale may impact the positions and activities of the NFU, as recent campaigns from organisations to promote alternatives to animal products have been met with resistance by the NFU, either explicitly in their dismissal of these campaigns or implicitly through campaigns for ‘dairy ice cream’.^{117,118} This is despite the fact that a change in consumer diets away from livestock and/or dairy and towards plant-based alternatives would simply shift sales between NFU members, so it is not clear whether NFU membership would be financially better or worse off. Beyond a lack of interest, the NFU may be acting in outright opposition to the development of protein crops for human consumption.

Lastly, even if the NFU were perfectly representative, there is an inherent problem in that representation is focused on the here and now. This issue applies across nearly all membership organisations but the consequence is that an alternative activity, such as the farming of protein crops, will not be advocated as it could almost be characterised as ‘unrepresentative’. This constitutes another form of lock-in.

Section 5

Discussion

Alongside these barriers, there are a number of trends and recent developments in agriculture and consumer markets that should be considered in the context of how the development of protein crops can be supported in the UK.

The economics of planting decisions

As noted in the previous section, protein crops are in many cases a less profitable option for UK farmers than other alternatives. This is true in a very general sense, but there are three major considerations that should be kept in mind.

Financially viable pre-crops

For some farmers, the relevant decision is not between protein crops and other alternatives, but whether to add protein crops as part of their rotation. Here, the results for protein crops are much more competitive.

A recent article in the journal *Field Crops Research* reviewed case studies around Europe and found that in most occasions the inclusion of protein crops gave a more profitable advantage to the following crop.¹¹⁹ This included studies from East Anglia (impact of -39 to -17 €/ha) and Eastern Scotland (+45 to +57 €/ha). The authors conclude that, "Expanding profitability measures to consider pre-crop effects substantially increases the number of situations where grain legumes can compete with cereals, and has a small positive effect on their competitiveness with alternative break crops."

Changing economics

There are also indications that differences in profitability between protein crops and alternatives may quickly be changing. One study has even pointed to Scotland as a location where protein crops already have competitive profit margins.¹²⁰

Protein crops have also been under-researched to date and thus their true potential is still largely unknown. Studies have also pointed to knowledge transfer as an important opportunity to overcome several of the economic barriers from Section 4. In Canada, yield increases from protein crops of up to 50% were achievable by incorporating pollinators in the bean fields during flowering; a technique that has been replicated in Australia.¹²¹

There are also a number of economic drivers that show positive signs for the development of protein crops. Prices for protein crops have in recent years increased slightly faster than cereal prices. Fertiliser prices, which are very unstable, are not a required input to production for protein crops. Imported soya, which competes with UK-grown protein crops, is also prone to price spikes.^{122,123}

The narrow lens of financial profitability

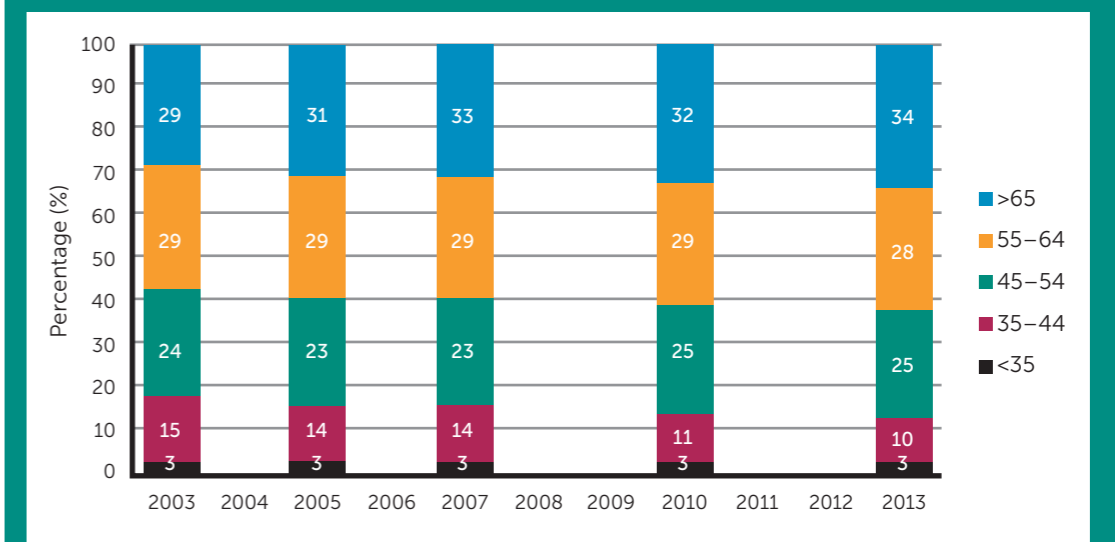
Lastly, it is important to put the discussion of financial profitability in the correct context. Agricultural policy is not simply about uncovering and supporting the most profitable crops and alternatives. If that were the case, agricultural policy would be much easier and simply rely on processes of discovery by UK farmers in the global market. Instead, farming policy addresses a wide range of objectives beyond financial profitability. Profitability is important because it is a near necessity for farmers to continue operation, but it should not be confused as the ends rather than the means.

This distinction is particularly important for protein crops given their wide range of environmental and health benefits. As one study of grain legumes noted: "markets fail to translate external effects of legumes such as biodiversity enhancement, reduction in emissions, of up to 50% in N₂O, and soil improvements into economic benefits"¹²³

Demographic and labour issues in UK farming are impossible to ignore

For the past several decades, UK farming has been characterised by an ageing workforce and the problem continues to become more extreme. According to the most recent survey, only 13% of UK farm holders are under the age of 45, while 34% are above the age of 65.¹²⁵ The number of farmers in each end of the age distribution is gradually diverging even further apart.

Figure 9: The age composition of UK farmers



Source: Defra – *Agriculture in the United Kingdom 2017*

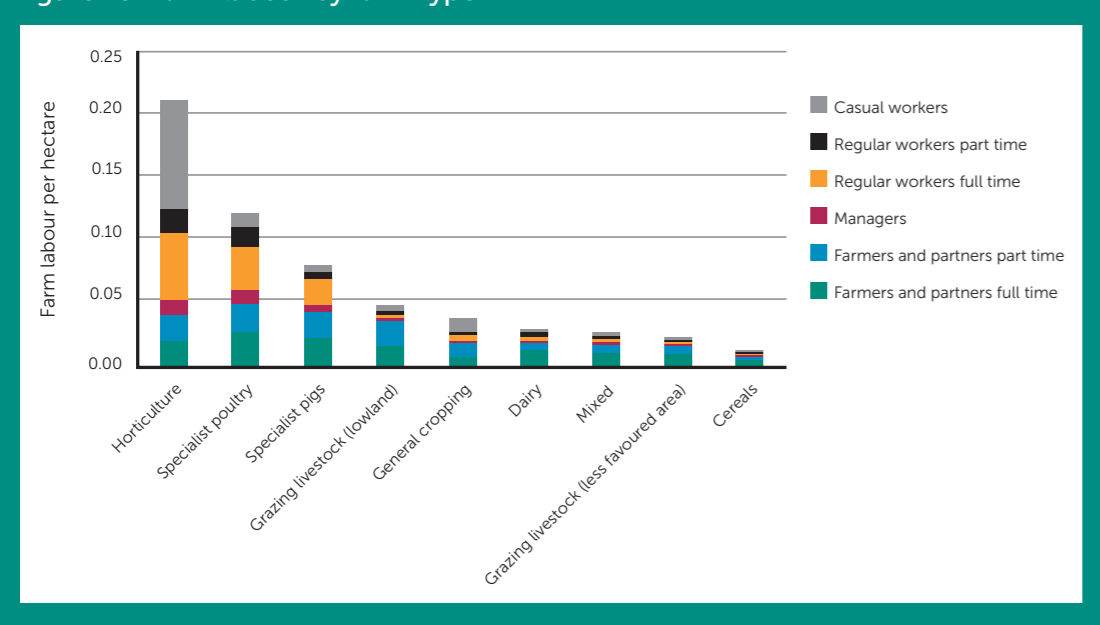
The total amount of UK farm labour is also in decline, and the UK has the lowest jobs per hectare (and conversely the highest labour productivity) in the EU.¹²⁶ This is despite a large increase in the number of migrant workers, mostly from other EU member states, into the industry.¹²⁷

Much of the change is due to technical innovations, but it is also the case that farmers have reported experiencing labour shortages and are sometimes employing fewer people than they would otherwise like to.¹²⁸ Reasons cited include not enough people interested in farming, the remote locations, unsociable hours, and the seasonal aspect of many vacancies.¹²⁹ The impact

of Brexit on labour shortages is very worrying for many farmers.

Information is not available on demographics, labour shortages or EU labour by farm type, but it is clear that demographics and labour are impossible to ignore. If labour cannot be found at a wage capable of returning a profit, these farms may seek alternatives. The National Pig Association has concluded that "one in five farms and businesses connected to the pig industry would struggle to survive without migrant labour".¹³⁰ The Royal Association of British Dairy Farmers has stated that the dairy sector's current reliance on EU labour would mean an almost "catastrophic failure" should short term access to overseas workers not be maintained

Figure 10: Farm labour by farm type



Source: Defra - Structure of the agricultural industry in England and the UK at June

post-Brexit.¹³¹ The extent to which labour issues undermine future business viability is likely to hit some farming types more intensely than others. Farm labour per hectare is over 13 times higher in horticulture than it is in cereal production.¹³²

Data is not currently categorised by protein crops, but it can be expected to approximate 'general cropping'. As such, there is potentially scope for labour issues to support a change from some farming types, including horticulture, specialist poultry farming, specialist pig farming, and lowland livestock farming, to protein crops.

The Agriculture & Horticulture Development Board have highlighted four possible solutions to these labour issues: "schemes to maintain the current availability of migrant labour, increasing agricultural labour productivity, increasing automation, and increasing incentives for the unemployed/economically inactive to work."¹³³ The National Farmers' Union has called for a 'student workers scheme' for agricultural students from around the world to undertake seasonal harvest work in the UK.¹³⁴ Others have focused on low wages for farm labour and the ending of Agriculture Wages Board in 2013.¹³⁵ Most of these solutions are about increasing (or in some cases

decreasing) farm labour rather than new entrants as business owners. On this issue there is a sole proposal from the Landworkers' Alliance that focuses on helping new entrants get access to land, startup costs and training.¹³⁶

Concerns about self-sufficiency

Alongside a decline in farm labour and stalling productivity, the self-sufficiency of UK agriculture is another recurring concern. The rate of self-sufficiency has declined to 61% in the latest assessment (2015)¹³⁷ and some worry that this jeopardises the ability of the UK to feed itself during times of crisis.¹³⁷ In response, Defra has pledged to reverse the self-sufficiency trend.

That self-sufficiency guards against food crisis does not naturally follow. A highly specialised nation producing only one commodity could appear self-sufficient if the quantity produced is high enough. Regardless, a transition from animal to plant proteins could increase self-sufficiency as animal proteins are much lower yield per area of land. This transition would also reduce import reliance as the UK is currently a net importer of protein crops.

Post-Brexit subsidies set to continue in a similar amount, but altered purpose

While much remains unknown about how Brexit will manifest, the indication is that agricultural subsidies post-Brexit will continue in similar amounts. Farming minister George Eustice has even claimed that farm subsidies could increase post-Brexit.¹⁴⁰

These subsidies are not expected to stay in the same form, however. In the early years of CAP, subsidies were production-based, which then incentivised overproduction and led to high environmental impacts and dumping. For the last two decades, subsidies were area-based, which then led to high land prices and slower productivity growth. Now, the near unanimous view for post-Brexit subsidies, including the view of Minister Eustice, is that the overarching principle should be 'public funds for public benefits' (sometimes termed 'public goods').^{141,142,143} These public benefits are intended to refer to externalities, not simply the fact that food is desirable,¹⁴⁴ a feature shared by many industries.

Protein crops are not often featured in these high level agricultural sessions, but they will be hugely impacted by decisions made on the type of subsidy regime going forward. In a subsidy regime based on 'public benefit', protein crops have the potential to expand significantly based on the win-win-win-win contributions outlined in Section 2.

Dietary trends show promise for protein crop demand

Further to the changing economics, there is a strong potential for consumer demand for protein crops to increase. Vegan, vegetarian, flexitarian and other diets are increasing in popularity and involve a switch from animal to vegetable proteins.

Another growing segment of the consumer market is the 'free-from' market. Pulses are free from gluten and are not nuts or peanuts so circumvent many people's allergies and preferences to avoid certain foodstuffs. They could therefore find a market in the vastly expanding free-from market, for example,

milled pulse flour can be incorporated into breads to provide more protein, flavour or simply remove gluten.¹⁴⁵

There is also the potential for protein crops to capitalise on high-protein diets and an increasing interest in fitness. The policy implications here are much more uncertain as if anything there is an overconsumption of protein at the moment rather than an undersupply. Tom Sanders, professor emeritus of nutrition and dietetics at King's College London, has noted that many of the protein campaigns are a way for the dairy industry to remarket whey protein, which is a waste product, at a high price.¹⁴⁶

There is no direct link between UK production and UK consumption

The benefits of protein crops described in Section 3 are split between health benefits for consumers and a reduction of environmental and animal impacts on the production side. However, the global nature of food markets means that an increase in UK production may not end up changing the plates of UK consumers. There are certainly positive economic implications of the export potential, and a report from the Andersons Centre notes that "existing markets could sustain a doubling in the size and value of the UK pea and bean industry in the coming five years,"¹⁴⁷ but there should also be recognition of how to get plant proteins into the UK food system to realise the health benefits.

Without wider reform, protein crops could complement animal proteins rather than substitute them

A similar issue to that of exporting is that an increase in the cultivation of protein crops would not have many of the desired effects if it simply feeds the livestock industry and entrenches this system. All else being equal, there is a worrying expectation that increased production of UK protein crops could lead to more available and potentially cheaper feed for UK (and other) animal farming.

Considerations of the expansion of protein crops needs to account for this, especially given the focus of some proponents of protein crop

Policy recommendations

expansion as a means of 'import substitution'. It is no surprise that the livestock industry has thus far welcomed the prospect of increasing the production of UK protein crops.^{148,149}

The importance of publicly supported research

A necessary function

Farming is the archetypal example of a sector in which diffusion is the dominant spread of a new technology. Farms are simply too small (relative to the size of the market) to perform their own R&D and are unable to rapidly expand their market share.¹⁵⁰

Agricultural R&D is also considered a public good as breakthroughs can be easily replicated for a nominal cost (non-rivalrous) and can be easily shared among farmers (non-excludable). In other cases, research provision can be provided through a particular group for their membership (a club good), or patented and excluded (toll good).¹⁵¹ While such cases are increasing with developments in intellectual property law, these cases remain the exception to the rule.¹⁵²

It is important to understand this funding model as there is sometimes a mistaken belief that private sector finance can take the place of public research. This does not fit the diffuse nature of agricultural R&D and is also not true empirically. Rather than substitutes, public and private research more often operate as complements to each other. A 2003 report for Defra, *The Productivity of UK agriculture: Causes and constraints*, noted that "the private sector has not responded to the withdrawal of the public sector from 'productivity enhancing' and 'near market' research as the proponents of these changes had originally expected."¹⁵³

This is problematic, as the decline in public research funding in the UK and the modest uptick in private funding has left a substantial gap to be filled.¹⁵⁴ This lack of public R&D has been highlighted as a cause of the UK's lack of improvement in total factor productivity (TFP – the portion of output not explained by the amount of inputs used in production), and a vicious cycle of low profits and low investments.¹⁵⁵

There has also been a change in its composition of public research funding, with the Department for International Development (DfID) representing

a much larger share of the research budget over time. While there may be other objectives achieved through this funding, it is not currently geared toward the production of UK protein crops for consumption.¹⁵⁶

A desirable opportunity

This research funding gap should be seized by the UK Government. The most comprehensive studies on rates of return show that despite the perception of agriculture as 'old' or 'established', investment in agriculture typically yields returns in 20-80% range, putting agricultural research at the top end of potential returns from public investment.^{157,158,159} The inevitable conclusion is that the UK, as well as the world, is continuing to underinvest in agricultural R&D.

Although this research has spillover effects to agricultural sectors in other countries, there is little evidence of a 'free-rider problem', especially given the applied nature of much of the agriculture research. In addition, studies from the US still find substantial rates of return to agricultural R&D within the state of investment.¹⁶⁰

Pulse research in particular requires research investment given the early stages of development. Investment in pulse research in Canada has shown an annual rate of return of around 20%, although there was a longer delay to the returns, possibly due to early stages of the industry under the period of analysis.¹⁶¹

Despite the large number of barriers to the development of protein crops in the UK (Section 4), it is clear from the discussion that with the right policies the development is possible (Section 5) just as it is desirable (Section 2). As the EU Parliament Report on protein crops concluded, "agricultural policy has not realised its potential to mitigate the decline in protein crop production, and several policies have even played a role in driving these changes."¹⁶²

This section outlines what policy changes could be made in the UK to support the development of protein crops. These policy recommendations require action on subsidies, taxes, research, entry, public procurement, and decision-making processes.

Subsidies: Create a Protein Aid Scheme

One of the most direct ways to target the development of protein crops is through a direct payment scheme for their development. Ireland provides an interesting case study, as protein crops are the only crop in Ireland that receives voluntary coupled support (VCS).¹⁶³ Under the CAP, member states may use the VCS to grant funding to types of farming/specific sectors that are particularly important for economic/social/environmental reasons and undergo certain difficulties.

Under the Irish €3m Protein Aid Scheme, introduced in 2015, protein crops are eligible for €250-280 per hectare. This support is available to "provide a more consistent supply of Irish grown protein," according to agricultural minister Simon Coveney.¹⁶⁴ In the first year of implementation, this scheme resulted in a 300% increase in the production of protein crops.¹⁶⁵ This progress in Ireland is encouraging as both the UK and Ireland have areas with heavy soil that limit, but do not prohibit, the cultivation of protein crops.

The UK could, at the very least, meet the support levels for protein crops used in other EU member states like Ireland. Under a new subsidy scheme, the UK could even exceed the EU ceiling level on VCS funding (although this is limited by WTO considerations).¹⁶⁶ This support could be justified using environmental considerations, for example as part of a soil erosion reduction or nitrogen reduction plan for certain areas. To encourage large-scale transition and investment, it is important that this scheme is guaranteed for

at least a ten-year period.

Given the tremendous win-win-win-win potential of protein crops on sustainable, ethical, healthy, and affordable (Section 2), this subsidy support fits well within a new subsidies framework of 'public funds for public benefits'.

Recommendation: Create a designated Protein Aid Scheme of support for the growing of protein crops in the UK.

Entry: Make protein crops a focus of a new farm entry scheme

The fall in the number of farms and farmers in the UK is well-documented. In just ten years, one third of UK farms have been lost, most of which are small-scale.¹⁶⁷ This trend has been highlighted by many organisations, as well as the government, as one of the biggest issues in UK agriculture to address.

Fortunately, the Scottish Government can provide a model here. In 2007 the government asked the Tenant Farming Forum to investigate barriers to new entrants, which resulted in a report on barriers and recommendations.¹⁷⁰ In response, a number of schemes for new entrants were included in the Scottish Rural Development Programme – schemes that have been deemed successful and could be replicated throughout the UK. These schemes provide start-up aid for farmers starting an agricultural business (Young Farmers Start-Up Grant Scheme), for new entrants to farming (New Entrants Start-Up Grant Scheme), and for new entrants to continue boosting their business (New Entrants Capital Grant Scheme). There is also a one-to-one specialist consultancy advice and mentoring from experienced farmers.¹⁷¹

A similar scheme for new entry offers an exciting potential to address 'new blood' into the farming system. The relatively unexplored potential of protein crops could attract a new generation of entrepreneurs who are lured in both by the financial support as well as the appeal of farming in the pursuit of environmental and ethical benefits. As much as possible, a new entrants scheme should be paired with the Protein Aid Scheme for ease of application.

While the NFU opposes financial schemes for new entrants and instead calls for temporary worker

visas and automation, it is important to note that new entry (owners, not just labourers) is likely not in the interest of their existing membership.¹⁷² (This positioning is not the case for NFU Scotland.¹⁷³) The Landworkers' Alliance, on the other hand, released a briefing on August 2017 on what they see as the three pillars of supporting new entrants into farming: increase access to land, aid startup cost, and support training schemes.

It is important to note how changes to the framework for subsidies may affect access to land. The current area-based subsidy regime incentivises hoarding of land for its income stream of subsidy payments. The system also unnecessarily discriminates against the smallest farms (under 5 hectares).¹⁷⁴ Under a new regime of land for public benefits, the price of some types of farm land, particularly idle land (unless it can be shown that it is delivering public benefits), should fall in price. This abrupt change, alongside the housing crisis, presents an additional reason for the government to pursue a land trust or land bank – a quasi-governmental entity to manage and repurpose underused or abandoned land/property trust. These bodies assemble land for a particular purpose, like protein crop cultivation, and then release it back to the market through sale or lease.¹⁷⁶

Recommendation: Create a New Entrants Scheme that targets access to land, startup costs, and training. This scheme should be easily paired with the Protein Aid Scheme for ease of application.

Research: Create a funded programme for pulse research and expand data collection

The role of research in supporting the development of protein crops cannot be overstated. The UK would be wise to replicate the success of Canada where research into pulses paved the way for Canada to become the world's largest producer.

The quantity of research funding is clearly important, but so too is how it is conducted and how it is perceived as a public good. The government must recognise that applied research

in agriculture is a responsibility of the public sector as well as a private sector responsibility. This recognition should be reflected not only in funding policies, but also in the career opportunities, recognition and reward for scientists in the public sector.¹⁷⁸

Research funding into protein crops could immediately build on an existing infrastructure of scientific institutions and research organisations. The Processors and Growers Research Organisation (PGRO), a charity paid through a voluntary levy by pulse, vegetable and legume growers, already carries out several research and support schemes. Through the PGRO, public funding for protein crops could be supported in these early stages of development by match funding from the government over a certain period, eventually replaced by a mandatory levy, replicating the successes observed in Canada.

An option to be explored is to shift the PGRO structure towards an additional Agriculture and Horticulture Development Board (AHDB) that exists for other crop and animal farming categories in the UK. Utilising the role of the AHDB would require a refocusing of the board towards research, particularly farmer-led research and large-scale trials that are easily accessible (see Section 4).

The commercial and consumer side of the industry is represented by the British Edible Pulses Association (BEPA), also funded through a voluntary levy system to promote pulses. Together the PGRO and BEPA are well-equipped to put research funding into the cultivation and sale of protein crops into action.

With this new focus on pulses, there is also a need to change data collection procedures so that pulses appear alongside the other major farming types. The only concern here is if there are so few producers at this stage that reporting financial data would breach confidentiality.

Recommendation: Match fund the protein crop industry levy over a ten-year plan of research support. Start collecting and publishing data on pulses alongside the other farming types in Defra datasets.

Taxes: Deduct farm subsidies to account for externalities in animal farming

For the full potential of protein crops to be unlocked, support for their development would need to be paired with measures to curb the production and consumption of animal protein. This is to ensure that protein crops act in the food system as a substitute rather than as a complement for animal agriculture.

A 'meat tax' has been commonly proposed in recent years as a solution here and is a straight forward case of significant externalities that are not being priced and therefore meat is being overconsumed in relation to its 'true cost'. Here, cost is most often defined by environmental and/or health impacts. As Dean Baker of the Center for Economic and Policy Research argues, "it seems reasonable to say there's externalities associated with farm animals, so why don't we incorporate those into the cost of the product."¹⁷⁹

Using taxation is especially popular among economists as fiscal incentives have proven effective in inducing behaviour change – the 5p plastic bag levy being a particularly stark change.

Three dimensions for consideration

In considering a farmed animal tax there are three main dimensions that determine the final form that is taken. The first issue is where the tax is levied: whether the tax is levied on the producer (i.e. a tax per head of cattle) or on the consumer (i.e. a percentage of the item price). In terms of bearing the burden of tax, whether the tax is levied on the producer or the consumer makes little difference, as the prices throughout the meat supply chain will adjust depending on market power and elasticities, so both versions approximate the same outcome. The main differences are in how exports and imports would be taxed and administrative simplicity. One administratively simple proposal is to apply VAT to all meat products.¹⁸⁰ Under this proposal animal products would need to be classed as 'luxury products' due to their particular externalities for nutritional content that can be gained from plant proteins.¹⁸¹

The second issue is how the tax is calculated: whether animals/animal products are taxed similarly or differentiated by environmental, health and/or other impact. Most of the meat tax

proposals are differentiated by impact, but these estimations can vary as much by farming method as by product. There is thus a significant amount of impression in the estimates of harm. None of these proposals attempt to price the intrinsic value of animal life into their estimates of harm. Often taxes (e.g. the sugar levy) are levied in bands for administrative simplicity.

The third issue is what becomes of the tax revenues: whether they become part of the government coffer or are used for a particular purpose through 'revenue-recycling'. Hypothecated taxes, those with ring-fenced revenues, are used in the UK for policies from health care to national insurance to public broadcasting. They can have the advantage of political acceptability and transparency, but also reduce flexibility.

Opposition is overblown

Resistance to taxes on animal products is generally on the grounds that they are politically unpopular and may be regressive (a larger proportional impact on the least well off in society). There are reasons to be sceptical. On political acceptability, studies of focus groups by Chatham House and the University of Glasgow have shown that people are much more likely to accept a tax if they understand why it is being implemented and agree with the intended objective.¹⁸² Laura Wellesley, lead author of the accompanying study, explained that:

"The idea that interventions like this are too politically sensitive and too difficult to implement is unjustified. Our focus groups show people expect governments to lead action on issues that are for the global good. Our research indicates any backlash to unpopular policies would likely be short-lived as long as the rationale for action was strong."¹⁸³

This framing has recently been used by the government in the introduction of the Soft Drinks Industry Levy. It is also the case that VAT is already levied on food products from ice cream to raisins,¹⁸⁴ so taxing food is not new policy terrain.

On the regressive nature of product taxes, this is true to an extent, although it applies to hundreds of levies already in existence from parking fines to tobacco duties to the TV licence. In constructing a progressive society, it is more important to analyse the effect of a government's policies

taken as a whole than each individual line item. Going further, if there is a concern about social justice it seems very indirect to pick the price of meat as the point of resistance. In his defence of 'sin taxes' on harmful products, economist Tim Harford explains that:

*"There are better ways to deal with inequality than by cutting sin taxes. People on low incomes need support but that help is better provided through tax credits, child benefit or good public services rather than cheap booze, sweets and tobacco. We are all free to buy vodka and cigarettes. Yet trying to make them cheaper would be a strange way to address social justice."*¹⁸⁵

The 'revenue-recycling' aspect of a farmed animal tax could also be used to address either or both objections. Revenues could be used to explicitly address the regressive nature of the tax, for example Dean Baker's idea of increasing tax credits/tax-free Personal Allowance to offset the regressive impacts.¹⁸⁶ Research has shown that public acceptability for product-specific taxes increases if revenues are used on supporting the social safety net.¹⁸⁷

Alternatively, the revenue from such a tax could be used to fund protein crop subsidies or other important aspects of the food system so as to keep the funds 'contained'. Surveys have shown a greater level of support for carbon taxes when revenues are contained for project related to the issue being taxed.¹⁸⁸

A 'net' approach to public costs and benefits

An alternative to a farmed animal tax is to take a 'net' approach to subsidies, and simply reducing or eliminating the subsidies for animal agriculture instead of levying a tax on the producer. Although the end result is identical to keeping subsidies and instituting a new tax, it may be more politically acceptable – and potentially more straight-forward – to simply deduct subsidies at whatever rate the tax would be applied at. Even if this approach to 'net' subsidies is not used, the remaining subsidies specifically for animal agriculture (e.g. support to beef and sheep farming in Scotland that is coupled to production) should be removed and integrated into the same support system.

Given that the CAP system of subsidies is already being reformed, this approach may have the potential to create a coherent approach to the consideration of public benefits and costs

associated with agriculture. Under this version of an animal product tax there would be no additional revenues, but small farm payments.

Recommendation: Levy a farmed animal tax on UK farmers that accounts for the environmental, health and intrinsic losses from animal farming. This tax could be deducted from subsidies under a new subsidy regime post-Brexit.

Public procurement: Encourage the serving of plant proteins in public sector canteens

An avenue for reform that is frequently overlooked is the use of public procurement – the purchases of goods and services made by government departments and local authorities. In Denmark, using public procurement as central pillar to promote organic food, with a target of 60% usage of organic products in public canteens by 2020.¹⁸⁹

In the UK, public procurement could be enhanced by further developing the Government Buying Standards. There are already calls to improve these standards for environmental reasons or to promote British produce.¹⁹⁰ UK-produced protein crops could be promoted under either or both considerations.

Recommendation: Encourage government departments and local authorities to use UK-grown plant proteins as a staple meal in their canteens.

Decision-making processes: Consult on farming policy with a wider range of stakeholders

The research in this report has revealed that it is not only UK agricultural policy that needs to change, but also the policy-making process. In particular, there are issues around how the National Farmers' Union positions itself as 'the voice of British farming', particularly given their response to the potential replacement of animal

protein with plant protein.

Decision-making processes should be proactive in consulting a wider range of stakeholders to prevent one particular view on farming, especially one that protects existing interests, from dominating the political discourse. This consultation could include newer groups representing farmers including the Landworkers' Alliance and the Family Farmers Association, as well as supporting networks including Community Supported Agriculture UK and the Real Farming Trust. Wherever possible, this involvement should go beyond consultation and search for ways to empower these stakeholders.

Still, there remains a problem that future protein crop farmers do not yet have a voice. The forthcoming Agriculture Bill, including the white paper due in March 2018, represents the first major chance to get this balance right.

Recommendation: Policy-making bodies should consult from a wider range of stakeholder views and consider the views of groups not formally represented.

Section 7

Conclusion

The case for a shift from animal to protein diets is clear. Many reports have documented the health, environmental, and ethical benefits from doing so but stop short of explaining why this transition has failed to take place and what policies could spark that change.

This report tackles the question of 'how' by analysing the barriers to producing protein crops in the UK. These barriers are complex, interwoven, and exist at different levels of the food system, or sometimes run through it altogether.

From these barriers, a set of policy recommendations emerge in six different areas, specifically:

- * **Subsidies:** Create a Protein Aid Scheme
- * **Entry:** Make protein crops a focus of a new farm entry scheme
- * **Research:** Designate funding to boost the yields and profitability of protein crops
- * **Taxes:** Implement a farmed animal tax
- * **Public procurement:** Encourage the serving of plant proteins in public canteens
- * **Decision-making processes:** Consult on policy with a wider range of stakeholders

These policies should be supported by a Defra vision document outlining the goals for the expansion of protein crop cultivation and consumption in the UK with targets attached to the major policy aims.

Besides promoting protein crops, these policies also have the potential to address a number of pressing issues in UK agriculture at present. An increase in research funding is linked to productivity growth, which has stalled in the UK. An entry scheme can help address the decline in the number of farms and farm labour. Implementing a farmed animal tax would lower the net government contribution to agriculture and help create a more sustainable funding model. Public procurement can help inform consumers and connect them to their food, while a wider stakeholder consultation process can be coupled with efforts to address the lack of power and agency felt in many rural communities. This shift from animal to plant proteins would also have secondary effects of reducing import reliance and increasing self-sufficiency.

Many of these proposals are bold and would put the UK at the forefront of countries leading the way for sustainable food systems. By embracing this boldness, the Government can show that rather than Brexit creating a race to the bottom in standards, the UK will act as a role model in this space for other countries to follow.

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