# UK Food Security and What it means for the Farming Community

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By

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## Executive Summary

This is a paper about food security. It is also about farming. This paper explores the relationship between UK agriculture and UK food security. It approaches the subject by focussing on two broad questions:

1. What is the relationship between farm business decisions, their drivers and UK food security? And,
2. To what extent does UK agricultural policy contribute to food security, and if not, does it matter?

Food security is a complex issue. Ultimately, it is the responsibility of Government to ensure the UK population has access to sufficient food at all times, but for many years, the market has successfully met the daily demands of consumers, with little Government intervention or control. The future is likely to be more challenging than we have grown used to – though COVID, the recent cost-of-living crisis, and the Ukraine war are indicative of the future. Challenges in meeting food security will continue to become tougher, more frequent and multiple. Volatility in the supply of food and therefore our national food security is likely to come from the changing climate interacting with, an increasingly unsettled geopolitical arena, with the rise of protectionism and nationalism, closing borders and raising barriers.

Government needs to prepare for such events as that is not a responsibility markets willingly pay for.

British farmers account for about half of the food ingredients we consume, but as most meals involve ingredients from many places, self sufficiency is a relatively meaningless measure of our food security. Cumulatively, the actions of farmers do provide a supply of food consumed in the UK, but our food security is arguably more determined – under non-crisis conditions – by trade.

Farmers and the farming community as a whole are not responsible for food security, and UK food security will not be fulfilled by extorting UK farmers to increase their productivity. It is a farmer's job to run a business, make a profit whilst protecting the environment they are responsible for. Their prime concern should be in adapting to changing market conditions, changing demand, adapting to climate change and mitigating emissions and impacts on nature as incentivised by markets and policy.

Only the Government can enact policies that retain and improve food security. But, as key stakeholders in the food supply chain, the farming industry has a role to play in holding the Government to account on this issue.

## Contents

# 1 WHAT IS FOOD SECURITY?

## 1.1 INTRODUCTION TO THIS REPORT

The general public, politicians, and political influencers are becoming aware of our food supply, its vulnerability and factors that might threaten its security of supply in the UK. Are risks to our food security becoming greater, or is society simply more acutely aware of them? Farmers in the UK produce much of the basic ingredients of the food we eat, so what role does the farming community play in ensuring our daily food supply is secure now and potentially in the future?

## 1.2 DEFINITION OF FOOD SECURITY

"Food Security" is a term adopted by the Food and Agriculture Organization (FAO) of the United Nations (UN) and other organizations at a World Food Summit in 1996. It is defined as:

*"When all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life"* [1].

In the United Kingdom, the majority of the population is currently food secure[1]. But the definition is absolute saying "*all people*". This makes food security almost impossible to achieve. The phrase "*at all times*" makes promises about the future, something that nobody can guarantee. Food, like air and water, is a lifeline necessity that features near the start of Maslow's hierarchy of needs[2] making its regular and reliable supply critical to everybody.

## 1.3 DISCOURSES AROUND FOOD SECURITY

There will be occasions when somebody, who normally eats more or less what they want, finds their preferred food choice is not available in the shop. This could be when a celebrity chef sends scores of people buying an unusual ingredient, or even at the end of a weekend when a local butcher runs out of a stock. It could even be when seasonal food is out of season, something the consumer has lost sense of timing over. But this is not food insecurity.

Food security is far more important. It is fundamental and concerns the availability of enough food for the whole population to thrive on, always. The definition of food security above does not refer to *brands or types* of food, rather enough nutrients to sustain a healthy population. Food can be secure whether imported or

1 - *In 2022, 93 percent of households were considered food secure* [52].

2 - *Maslow a psychologist in 1943 suggested we all have a series of needs starting with physiological ones (air, water, food) followed by emotional ones (love, self esteem etc) that built on the physiological ones.*

grown in the UK, indeed, the most secure supply of food is a combination of the two, as both domestic and imported supplies can be cut off for different reasons.

The literature reveals a number of major discourses or sets of conversations around food security:

1. A generic global context about "feeding the world". This is especially within two clusters of debate, one regarding development goals and ensuring food security in low and middle income countries, and the other as a global, productionist, discussion ensuring enough food supply to meet demand across the planet.
2. Food security within the UK in terms of equitable access to affordable food. This came to the fore with COVID, followed by the cost-of-living crisis and the affordability of food being an important issue for the increasing proportion of economically marginalised population.
3. Food security as part of national security. If there is a crisis, is there enough food to ensure the population is fed? Sudden loss of access to food (whether from supply issues or price issues) is a potent driver of civil unrest and could arise from any number of causes of acute supply chain disruption. For longer term, chronic disruption, population health requires not just "food" (in the sense of fuel or calories) but good nutrition. Thus food security – just as energy security following the start of the Ukraine war – as part of national security, requires a strategic and planned approach to minimise the risks of disruption to UK supply.
4. Food security in a generic "food supply" way. Are the supermarket shelves full of the normal sort of (affordable) products customers would expect and are happy to eat? Is free-market economic demand being met by supply, irrespective of the actual population needs?
5. Food security from a long term perspective, consistent with the agreed definition. *"When all people at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life"* can be interpreted as requiring access to affordable, nutritious and sustainably produced food if "*all people at all times*" includes everyone today, but also future generations for whom food supply might be harmed by today's unsustainable practices.

Food security is also inherently about our food system, and emerges in response to its success or failure (Box 1), which is a complex system depending on supply (domestic, trade) and demand, on intricate supply chains underpinning manufacturing and so on. Food security is therefore not intrinsically about agriculture. This has a number of important corollaries:

- UK agricultural production does not map onto UK food consumption for two principal reasons. First, not all agriculture provides food for direct human consumption (indeed a significant proportion is about feed production). Second, even where it does, it is generally simply as an ingredient into a

product that requires other, imported ingredients in order to be manufactured into the food consumed. Food security is therefore not about maximising UK agricultural productivity. It is also not about maximising UK self-sufficiency because of the proportion of necessary imports (including agricultural inputs like seeds, fertiliser, pesticides, and the amount of ingredients and whole food that we import because we don't produce it domestically).

- The five discourses around food security reveal tensions between them, indicating underlying trade-offs. For example, "sustainable and nutritious" food is often regarded as expensive, often because it might be more produced through agro-ecological and extensive farming systems with lower productivity per unit area of land and eaten as "whole foods". Whereas more affordable food is often more intensively produced, with a typically larger environmental footprint, and intensively processed and perhaps unhealthier. Thus, there is an inherent trade-off between the sustainability, quality, and price of foods. Food security in the sense of ensuring "sustainable and resilient food supply" implies increasing costs and potentially undermines food security in the sense of ensuring access to food from the most marginalised.

**Box 1. Defining a 'food system'**

The term '**food system**' encompasses the entirety of the production, transport, manufacturing, retailing, consumption and waste of food. It includes impacts on nutrition, human health and well-being, the economy and the environment. Food security is a function of variations in the food system in any given location, and is influenced by a range of sociopolitical factors affecting price, availability and access. While there is an overall global food system (encompassing the totality of global production and consumption), there are also many subsystems within it. Each location's individual food system is unique, and is defined by that location's mix of food produced locally, nationally, regionally or globally.

For each product consumed there is a **supply chain**, which describes the way food and its ingredients get to consumers. The term **value chain** describes the mechanisms through which the value of a product is increased by transport, processing and packaging along the supply chain. The term 'food system' includes all supply chains (and, implicitly, value chains) as well as their impacts on the environment and people. Food systems inherently incorporate feedback, leading to direct and indirect effects; in turn, this can create feedback loops wherein the system responds in unexpected ways to small changes in the forces acting on it. Food systems are therefore dynamically changing systems; thinking only about supply chains and value chains is unhelpful both analytically and for policymaking, as it avoids consideration of wider system dynamics.

All activities within a food system – whether production, processing, retail or cooking – have impacts on the environment. For example, land under agriculture is disturbed from its natural state, which affects soils, water, biodiversity and even local microclimates. Processing, transport and retail require energy, water, infrastructure (e.g. roads) and other inputs – e.g. packaging. Throughout, externalities come from chemical usage and disposal (e.g. from fertilizers, pesticides, industrial processes and greenhouse gas (GHG) emissions), as well as from the disposal of waste, including plastics and other packaging.

Food security on a national level, is about planning for the future and potential interruptions in supply. Currently, food is available to most people, and there is sufficient in the UK to feed everybody, comfortably. And in a calm, cooperative and stable world, any interruption of supply (domestically and overseas) might have little consequence, as trade would fill any gaps, within efficient markets. However, the last decade or two has been one of continuous challenge – from weather or wars or pandemics or economic shocks. There is now, more conflict, more contestation and more potential for supply chain issues looking ahead than perhaps our systems currently expect or were designed to cope with. The problem is that we do not know for sure *what* will change in the future or *how* or *when*.

Ensuring food security therefore has to be about preparing for all eventualities, many of which are probably not happening now, or at least not severely enough to restrict the nation's food supply. Those events that are occurring now might be experiencing gradual changes that we do not notice on a daily basis.

Should food supply be suddenly, without notice, cut off in an acute manner, the urgency would be to secure mainly calories, energy. However, over a longer period, a more chronic form of food supply shortage would occur, other, more nutrient-rich foods such as vegetables, salads and fruits would become more important. Different foods would have different levels of urgency, but in a chronic situation both are equally important.

The breadth of issues is large, so here we focus on two key issues and questions in this report:

1. Food security in the sense of ensuring an adequate supply of food for the population is part of national security, and a important policy area for public planning. This leads to the question: **how should policy consider food security?**
2. The agricultural sector and markets are driven by a range of factors but farming is conducted by individual businesses, making business decisions based on markets and farmers' values/attitudes. This leads to the question: **how should farmers consider food security**?

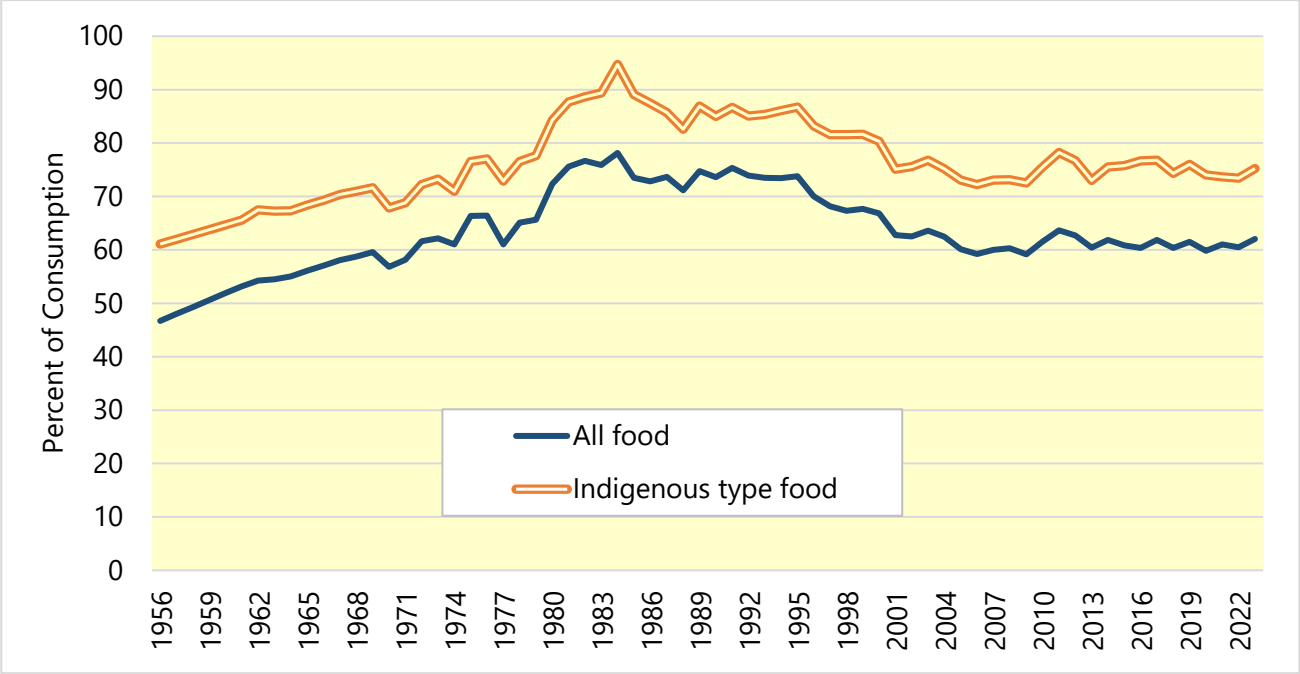
Before we address these key issues in Sections 5 and 6, we overview the structure of UK agriculture in Section 2 and discuss the policy and market drivers shaping it in Section 3 and how it might respond in Section 4. We draw together some conclusions in Section 7. Following Section 7 is an annex containing a range of information.

## 2 UK FOOD SYSTEM: SUPPLY AND DEMAND

### 2.1 UK FOOD SYSTEM: DOMESTIC PRODUCTION

The raw materials of the food we eat in the UK, are sourced from all over the world, but a significant amount is sourced domestically.

*Figure 1 - UK Food production to supply ratio, 1956-2023*




*Source: DEFRA*

Figure 1 demonstrates the ratio between production and consumption of basic (unprocessed) agricultural food products in the UK by value. It shows that for the last 25 years, the amount of unprocessed ex-farm food goods the UK has produced is equivalent to just over 60 percent of the total amount we eat [2] . Some UK production is exported though, so of the food we eat, 46 percent is imported and 54 percent is from the UK [3]. Approximately 5 percent of this is supplied by fishing, meaning that farming itself provides about 49 percent of what we eat in the UK [4]. It is therefore the most important component of the UK diet at just under half by value according to this measure.

However, whilst UK farming might produce some half of the ingredients we eat, this figure is difficult to interpret meaningfully in the context of food security. To understand the nuance, take the example of a processed food item that might have the majority of its ingredients sourced domestically, but nonetheless a proportion come from overseas. In the event of supply chain disruption, manufacturing of the food may be completely impossible, and therefore from a food security perspective the food will not be available. Sentences like "UK agriculture provides 60% of the food we eat" really means "60% of the ingredients we eat".

The chart tracks farmgate production and its use. Thus, when an already processed item such as a pie is imported or exported, it is not picked up in this data making this chart only an estimate of the actual food that ends up on our plate. Technically every meat item has been processed before consumption (slaughter is a process), the 2024 UK food security report confirms *some* meat imports are not picked up by this measure. The trend is more accurate than the actual figure.

This calculation measures the outputs from agriculture destined for human food (as whole foods or ingredients like starch, flour, oil, sugar), and not the feed grown to be then fed back into other (livestock) farming systems. It therefore includes meat production rather than the feed grown to feed the animals, so is not a reflection of how much the UK *could* feed itself in an extreme situation, rather the percentage of food produced in total by the domestic food industry.

The UK has a high population density (especially when removing the sparse uplands from the equation). Our population is roughly similar to that of France, but with a quarter of the space. Most other agricultural countries like Canada and New Zealand have far more space per inhabitant. With that in mind, it is an achievement that the UK produces as much agricultural produce as it does.

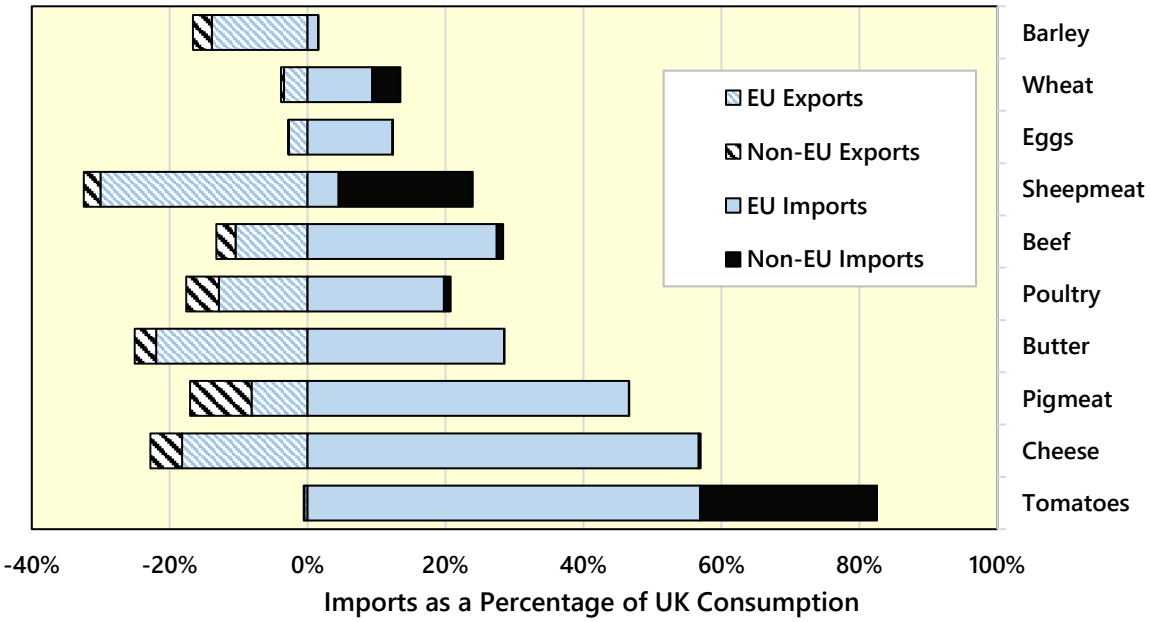
The national statistics (those shown in Figure 1) show very steady supply of domestically produced food by value even in the light of the national population rising 17 percent since 2001 and therefore reflecting more food being required over the period. Averages of annual national statistics hide a lot of detail, such as availability of particular foodstuffs, or at specific times of the year.

### 2.2 UK Food Security and UK Capacity to Produce

The domestic supply of agricultural produce is clearly an important component of the UK food system. The UK production to supply ratio above poses the question which farm goods can (or cannot) be produced domestically. In other words, what products are indigenous to the UK? It is easiest to start at the extremes, such as citrus fruits like oranges that are very difficult to produce in the British climate and certainly not competitively. Other products, are very suitable such as grass-based outputs like milk. Between the two extremes, are many other farming goods we produce. Technically, any crop can be produced in the UK given the right environmental conditions, which in many cases would mean growing them in greenhouses or similar. Thus, to determine whether we *should* consider something as indigenous, we compare our financial competitiveness with imports. This is effectively what the market silently does. Whilst the UK is unlikely to be the cheapest origin of production for many goods, we should be able to support businesses and trade to produce them. Figure 2 below shows the balance of trade for a number of goods, most considered indigenous. It shows at the bottom that tomatoes are not particularly indigenous unless they are housed and heated. On the flipside, barley, wheat, eggs and grazing livestock are goods we should be considering as

indigenous. When consulted for this report, Defra was unable to state *what* crops it considers indigenous making the information in Figure 1 yet more unclear.

*Figure 2 ~ UK Food Self-Sufficiency & Trade*




*Source: Defra – Agriculture in the UK.*

## 2.3 SELF SUFFICIENCY

Self-sufficiency is a term that is often misinterpreted as food security. Self-sufficiency is the degree to which a population can produce enough to meet its own consumption. Self-sufficiency does not imply any level of food security. To illustrate this, a country that is 100% self-sufficient but experiences harvest failure would be food insecure (e.g. North Korea); just as without any domestic agriculture a country can be food secure based on international trade (e.g. Singapore).

The debate on UK's self-sufficiency is often naive, focussing on a trivial measure (e.g. calorie supply), missing out the need to consider the international imports of agricultural inputs (fertiliser, seed – see Annex 10). Whilst some countries (such as Argentina, and New Zealand) might be described as self-sufficient, they still import foods and ingredients. Being able to provide many times more meat and grains (therefore calories) than a population requires for example, and therefore export much of it to other countries, does not compensate for the need for other food categories such as fresh vegetables or spices, meaning trade is necessary for a broad and complete and healthy larder of food ingredients for good nutrition. No country is totally self-sufficient, even those that are net exporters of food goods (by value or calorie count).

## 2.4 UK Food Security is Also About Demand

Food security in the UK is not solely a function of the supply of food goods, or the proportion produced within the UK. It is also a function of demand. The agricultural land requirements, implications for UK agriculture and food security, of a population that is happy eating root vegetables, requires a high-meat diet or is rich in tropical fruit and vegetables are very different. To illustrate this, take the amount of food wasted:

The UK wastes 10 million tonnes of food every year[3]. That is three kilogrammes of food per person per week. At some level, food waste is economically rational, because the cost of food is cheap relative to the cost of avoiding it through better planning.

In the early days of lockdowns in 2020, the level of food waste fell by 43 percent in the household and by effectively 100 percent in the restaurant [5]. This was a reflection on our feeling of vulnerability, not the availability of food on offer. Wrap estimates that 70 percent of food waste occurs in the house, 16 percent from manufacturing and 12 percent from hospitality and 2 percent in retail. Food waste is comparatively low on farm [6], most of which is to meet the varying and demanding expectations of the consumer. This is when appetites change suddenly with weather. Couple this with the unpredictability of a natural production system, inevitably leads to mismatches between supply and demand [7].

Thus, in a crisis, food security can be met through changes in the demand side and not just through ensuring normal levels of supply (changes in diet, reduction in waste).

3 *https://www.businesswaste.co.uk/food-waste-the-facts/*

## 3 DRIVERS OF UK AGRICULTURE: PAST, PRESENT AND FUTURE

This section includes a broad discussion on the factors that shape domestic food availability through agricultural policy, trade and market conditions, and what shapes those as well. It covers

- Agricultural, agri-environmental, food and food security, environment and climate policies. Health policy might become included in future years but as yet, the political disconnect between agriculture and nutritional health is considerable.
- Production drivers, both current and past. These include productivity, labour, prices, specialisation and market factors. Future drivers including geopolitical, market and climate and their interactions are then considered.

### 3.1 POLICY AND MARKETS

The environment that shapes farmer decision-making and consequentially productivity is complex and multifaceted. Whilst Defra (and equivalents in the devolved administrations) is often taken as the principal shaper of "what farmers do" for leading on agricultural and environmental issues, farmers are arguably as influenced by trade-policy (Department of Business and Trade), fiscal policy and tax (Treasury) as well as the regulatory environment around food safety and marketing (Food Standards Agency and equivalents in the devolved administrations).

Other areas also have influence in the shorter or longer term, such as research investment and infrastructure (UKRI etc) which help determine the innovation pipeline. Clearly, some areas of policy are shaped by extra-territorial considerations and treaty obligations (examples include trade policy, UNFCCC Paris agreement) and the degree of sovereignty the UK has embedded in a global network has become evident via UK's Brexit experience.

Nonetheless, the conventional view is that governments broadly set the regulatory environment, shape it with a range of permitted incentives (such as subsidies, including research investment) and leave it to the market, especially through competition, to drive efficiency gains within the sector. Liberalising the trading environment, has led to global markets and global competition, so there is considerable "price transmission" between global commodity market prices and farm-gate prices. What farmers decide to do is very much dependent on a range of considerations, policy, market, domestic and international factors as much as on farm factors.

In broad terms, the last decades have been shaped by four inter-related trends:

- Increasing globalisation through trade liberalisation. Access to bigger markets, and consolidation of business interests, leading to global focus on smaller number of commodity crops grown and traded at scale

- Increasing intensification of agriculture to drive productivity/efficiency (including through scale and specialisation)
- Increasing homogenization of diets globally, arising from arising from ingredients sourced from a small number of commodities (starches, proteins, oils etc), with increasing consumption of very processed foods based on large-scale industrial manufacture and long supply chains
- Increasing focus on environmental protection to reflect the scale of environmental impact arising from land use change, intensification and degradation from larger scale, more industrial, specialised and productive agriculture.

The difficulty of the period we are currently in is that whilst these trends have been taken as read for 50+ years, these historic trends are weakening. Looking ahead there are a number of significant drivers that will affect agricultural markets in the UK and elsewhere:

### 3.1.1 Climate Change and its Impacts.

Within a few years the world will likely have passed 1.5°C[4] and be heading for 2°C. As a result, globally impactful extreme weather is likely to become increasingly severe and frequent (but not regular). The widespread extremes of 2023/24 might be a foretaste of this. This is likely to create disruptions in supply chains. Internationally connected supply chains might be more vulnerable with trade route risks that domestic supply lines are not exposed to. As already discussed, completely domestic supply chains are unusual.

These disruptions could be in imported food supplies, agricultural inputs or even packaging arising directly from climate impacts on production processes or indirectly from transport infrastructure interruptions. These disruptions could also be acute in response to extreme weather, or slower-onset (becoming chronic) changes as production of materials changes in response to climate adaptation and mitigation. Both will dynamically influence markets. At home, there is potential for climate change to amplify extreme weather through changing the jet stream positioning as a result of Arctic warming[5]. UK agriculture has been significantly hit by heat, drought and floods in 2023/24 and harvest yields have been reduced[6], as have planting patterns. It is likely that in 15 years' time, changing weather patterns will create significant structural change in the UK food system – particularly through changing trade, prices and adaptation within the UK agricultural sector. Given the UK's geographical position, changes in the Jetstream (position or waviness[7]) may affect the competitiveness of UK agriculture relative to other countries or at least the productivity of British agriculture.

4 *wmo.int/news/media-centre/global-temperature-likely-exceed-15degc-above-pre-industrial-level-temporarily-next-5-years*
5 *ncas.ac.uk/extreme-weather-in-the-uk-why-arctic-climate-change-cannot-stay-out-of-sight-out-of-mind/*
6 *ahdb.org.uk/cereals-oilseeds/gb-harvest-progress*
7 *www.nature.com/articles/s41467-022-28911-7*

Adaptive change in UK agriculture – in responding to the absolute and relative impacts of climate - may drive structural change in the sector thereby affecting production (and may or may not also mitigate emissions).

### 3.1.2 Non-Climate Changes in Global Markets.

In the last 25 years, the world has changed significantly – through events such as the 9/11, Iraq War, the financial crash of 2008, food price spikes, the Arab Spring, swine flu/SARS/MERS, COVID-19, Trump as US President, the UK's exit from the EU, Afghanistan, Ukraine, Gaza and the recent inflationary crisis. The world of 2025, compared with 2001, is one of increased geo-political tension particularly Europe versus Russia, US against China and China with Taiwan. The application of international law, and multilateral cooperation, is now noticeably weaker.

In particular, the second Trump administration is rapidly making global waves and may create more tensions in the name of protectionism (or "MAGA"), and thereby increase our need to be concerned about UK domestic food (and energy) security. It is not just in the USA, but closer to home, the rise in populist and protectionist concerns within EU Member States is a reality as indeed was the considerable swing in far-right votes in the UK election of 2024. Looking ahead over the next decades, we are as likely to see a more fragmented and volatile world as a globalised and cooperative world. Trade and market prices, as well as demand and supply, are inevitably going to change, perhaps radically. The UK food system will need to adapt, and food security – as a component of national security – may require more deliberative action . In other words, UK food security might need greater central planning and cannot simply be devolved to market actors.

### 3.1.3 Changing Consumption Patterns.

Diet is an underrated determinant of public health, worker productivity, social and health care costs. As Lord Darzi's recent report on the state of the NHS emphasised that NHS spending rose to 43 per cent of all-departmental government spending in 2023, up from 26 per cent in 1998-99[8]. Dietary ill-health is both preventable and a significant determinant of health and social care costs. Growth in NHS and social budgets needs to be constrained. Poor diets account for 10 percent of all deaths in the UK [8]. Ill-health from poor diets now outstrips that from smoking [9]. The overall costs of poor diets exceed £268 billion in the UK, far greater than the entire NHS annual budget according to a recent report by the Food, Farming and Countryside Commission [10]. Thus, the political imperative for, and space to, incentivise pro-health dietary change – as preventative healthcare – will need to emerge in the decades ahead. For these reasons, the poor diet of the typical Briton is arguably the most unsustainable component of the entire food. In a really fiscally

8 *Page 92 in https://assets.publishing.service.gov.uk/media/66e1b49e3b0c9e88544a0049/Lord-Darzi-Independent-Investigation-of-the-National-Health-Service-in-England.pdf*

constrained world, the UK may be unable to afford the low productivity and high dietary ill-health at a population level, and therefore may need to focus on dietary change as preventative health care.

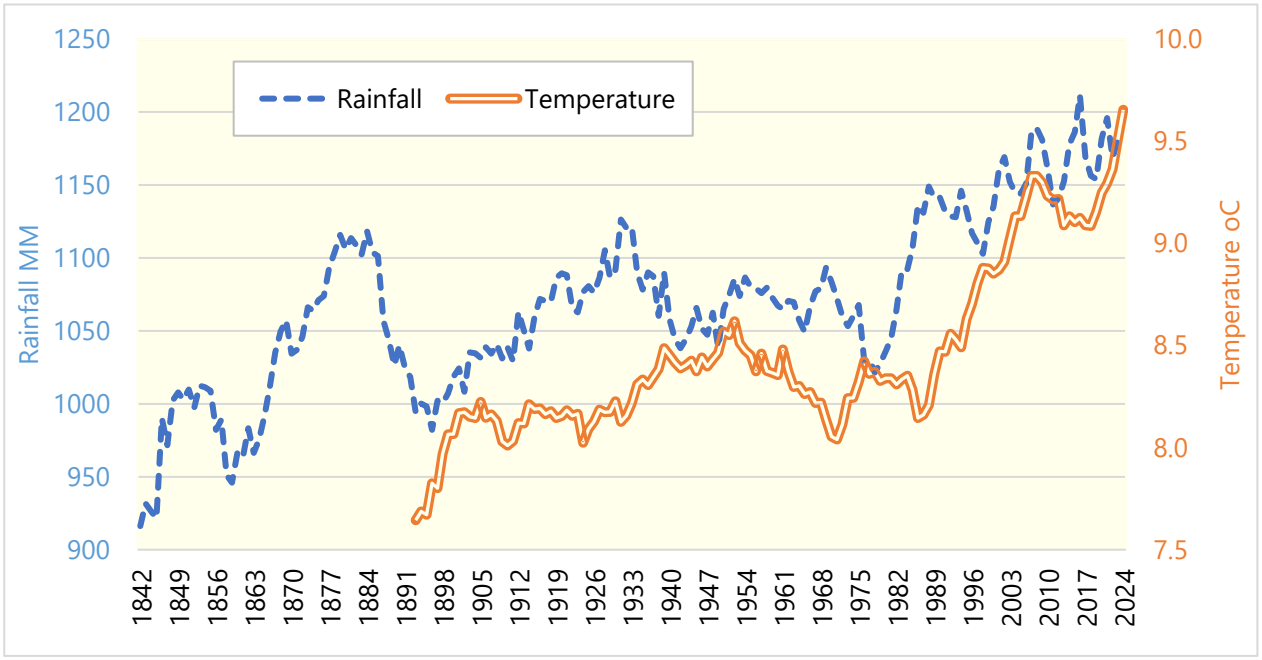
## 3.2 Changing Worlds, Changing Farming Drivers

Farming is going to have to change. Here we illustratively focus on four areas for climate change that are necessities for UK farming to consider and adopt. This includes the need to adapt to it, to adopt climate mitigation actions to limit the risks and avoid the limits of adaptation, changing geo-politics, and the need for business resilience.

### 3.2.1 Climate Change is Real

The climate is changing. It is getting wetter and warmer in the UK [11]. Figure 3 below demonstrates the UK's 10-year rolling average rainfall and 12-month average temperature. Both are calculated per winter cereal growing season (i.e. September to August).

*Figure 3 - UK Annual Rainfall and average annual temperature – 10-year Rolling Average*




*Source: Met Office Data; By growing year (September to August)*

These lines collate large amounts of data, not just the extremes or news headlines, just data from every day for 188 years for the rainfall and 140 years for temperatures. They bring together the 12-month total (for rainfall) and average (for temperature), then each chart plots the rolling 10-year average figure. This removes the anecdotal observations from which people easily reach subjective conclusions about climate change. The lines are clear, objective and easy to read. Inter-seasonal variations are not shown in these charts, they are simply annual figures.

Extreme weather events that have impacted on UK crop production have been ironed out of the charts above. National figures as these, hide regional, or even farm-level variations which are more extreme than

large areas. Again, these variations are not picked out by the charts. There is very strong evidence that this trend is going to continue (and none credible that it is going to stop). It will affect farming. Farmers have to adapt to it and make arrangements for their own business survival. On an aggregated basis, this may have an impact on national food production and therefore the supply of food inputs into the food system.

### 3.2.2 Climate Change: The Need to Adapt

Farmers will be forced to make changes to their businesses to adapt to the more extreme, and more frequently inclement weather in the UK. Defra pointed this out in its Food Security Index stating:

> *As climate change drives more extreme weather … , the adoption of more climate resilient farming practices will become increasingly important.* [12]

Many farmers have already made changes to their businesses, some examples are as follows:

1. Preparing to keep livestock in winter housing for longer. Keeping livestock in sheds is dearer than in fields, even when you already have the sheds. Larger amounts of forage and straw bedding are being made and gathered per animal and held on livestock farms in case of early onset to winter, delayed spring or flooding during the grazing period where stock need to return to their winter sheds.

   Some farming systems are structured so young are born in spring, so in many cases, livestock headcounts rise sharply when sheep or cattle are 'normally' turned out into fields. Again, this builds costs at a far greater rate if rain prevents them going to graze. Mortality rates can also spiral in these situations. The construction of larger sheds is therefore another consideration.

2. Larger slurry lagoons and manure stores. If stock needs housing for longer periods than planned over winter, their manure will need to be collected for a longer period. But field conditions have to be sufficiently dry to apply manure and slurry to a field to prevent runoff into water courses. Unsuitable (wet) weather during the allowable spreading period leaves insufficient spreading time to empty slurry lagoons meaning the facilities need to be larger. Lagoons without covers are filling up quicker by excessive rain. Lagoon covers are being introduced (in part supported by Government grants).

3. Retention of cash in case of sudden need to purchase livestock feed etc. if stock are unable to go into fields. Holding a little more cash in the farm business is a safety net for the lack of most inputs, as long at they are available when they are (suddenly) required.

4. An increase in the area planted of spring cropping in place of winter crops, to spread the risk of poor autumn cropping weather conditions and manage the potentially shorter period when machinery can access fields in good condition. Spring cropping area is on the rise for more than climatic conditions such as spreading overhead costs to a greater proportion of the year, and to manage herbicide resistant grass weeds, but they are contributory.

5. Purchase of larger than otherwise necessary machinery to facilitate drilling, spraying, harvesting and other key operations in shorter time windows between showers. This has been the case for many years, but arguably is becoming increasingly necessary. Some might consider very small, lightweight machinery that can operate sooner after rain and I soft soils, but this technology is in its infancy.
6. More field drainage investment. Despite greater rainfall and crop-damaging weather, drainage is very expensive and is still difficult in some parts to justify. Contractors however, are busy, but the field has to become highly productive for several years to repay that investment.
7. Installation of more summer shade. In periods of unusual heat, stock needs shelter from direct sunlight. This has always been the case, but as summer temperatures rise, this becomes more important. Some dairy farms have also installed water spray coolers in holding pens ahead of milking to cool their cattle. When these are going to be required for only a handful of occasions per year, they are expensive per use.
8. Other growers have found diversified sources of income that have a smaller reliance on the weather on their output.

Farming has always had the challenge of operating in changing weather. Extreme weather conditions tend to be less favourable for farm production, with crop yields falling and livestock fertility and survival rates declining.

### 3.2.3 Climate Change: Mitigation and Net Zero

In the short term, climate-change adaptation measures create a greater impact on food security in the face of a changing, increasingly adverse climate, and certainly a more direct impact to each particular farm than mitigation measures. Over the long term, collectively making changes to a farm business that mitigate the climatic changes helps slow the change, and achieve Net Zero will slow climate change at that point. Adaptive measures are visible and discernible, their impacts can be quickly and locally seen in terms of the continued operation of the farm and those implementing the actions benefit from them. Mitigative measures are not like that. They make a contribution to the reduction of environmentally damaging actions that are occurring throughout the world, through consumption (e.g. driving or eating) and destruction (e.g. forest fires). For example, it is easy to see that draining a field and increasing the forage store per animal makes the farm more resilient to weather patterns, but you cannot tell whether the climate changes when you switch from conventional to regenerative farming practices. Having no personal benefits, mitigation becomes a public good.

New agri-environmental schemes are making inroads into encouraging farmers to embrace mitigative measures to climate change, and importantly not losing money by doing them. Examples include keeping soil covered, planting trees, restoring peat bogs, and building biodiversity. Those that can be implemented

without incurring a reduction of farm output are particularly useful. Many farmers have been voluntarily making changes for several years, especially of course those that protect the farm or add value to their business, or that have been paid for. Markets are emerging to trade captured carbon (sequestrated), which, being land occupiers, provides opportunities for farming.

The renewable energy industry is a response to Government policy to cut emissions of greenhouse gases as a result of human activities. Installing renewable energy requires space, capital and an entrepreneurial mind. Agriculture has all three so is a natural partner for the sector. Renewable energy government financial support has fallen in recent years as technologies become more viable but many are still well suited to farming. Several renewable energy technologies are now viable without support at all depending on locations and situation.

In order to curb the climatic changes we and the rest of the world are experiencing, everybody needs to achieve net zero status, including UK agriculture. This will require more than technical tweaks in the farming industry but a structural shift and fundamental change to the way farming operates [13] [14]. Most commentators also recognise that in order to achieve anything near to Net-Zero in the food supply chain, consumers will have to change their diets too, primarily by reducing their meat and animal product consumption. This cannot be achieved simply by changing production, it is consumption (market demand) that dictates what is produced.

The results from the Climate Change Committee's 7th Carbon Budget indicate that technical changes in UK agriculture will not create a net-zero agricultural sector. Instead, net-zero can only be achieved by demand-side change in ruminant meat consumption to reduce emissions and to free up land for nature and carbon storage[9]. The incentives from agri-environment schemes to provide land for nature and climate mitigation are likely therefore to provide some degree of competition between land for food and land for environmental services. (See Annex 11)

### 3.2.4 Climate Change Mitigation: Carbon Taxes

As of January 2027, Britain will be imposing the Carbon Border Adjustment Mechanism (CBAM) a tax on carbon intensive goods that are imported into the country. This will include building materials such as cement, steel, glass and electricity. Nitrogen fertiliser is included. Comparable goods that are produced in the UK and therefore not imported, are already subject to a carbon tax through the Emissions Trading Scheme (ETS) so CBAM will make both sources comparable. Realistic calculations have suggested that the additional cost of a tonne of nitrogen fertiliser might increase by up to £23 per tonne of urea[10]. It is a

9 *https://www.theccc.org.uk/publication/the-seventh-carbon-budget/*
10 *https://abcbooks.co.uk/cbam-and-fertiliser-prices/*

necessary step to reduce the amount of nitrogen fertiliser in agriculture in the UK as across the globe, it should have a greater impact on the way growers use the (increasingly) expensive input than on the food security issues that could follow.

#### 3.2.5 Changes driven by disruption within the broader geo-political and market context

The current, palpable, change in the global geo-political environment, as exemplified by the new US administration, highlights a number of key issues for global (market) stability. We live in a world of transactional, zero-sum, politics, where multilateral, rules-based approaches are less important. In the world of the deal, my country wins if your country loses. Trade and international relations are less about keeping to international rules and treaties but is more about what countries can get away with. Whilst Trump is pushing the boundaries of what is possible, other countries' leaders are following. Multilateral processes are weakening and multipolarity and fragmentation of global approaches is increasing.

Governments increasingly face a "5-Ds Challenge":

1. **Defence**: The need to invest in defence and wider national security through and adaptation of key systems to build resilience;
2. **Development**: Recognition that climate change is a collective problem, and that it is not possible to focus on domestic action and ignore the needs of lower income and more vulnerable countries because it will eventually impact on us through the exposure of many countries in the global south to negative consequences;
3. **Decarbonisation** for mitigation and the need for sustainability transitions – in the long run, without achieving Net Zero the negative consequences of climate change become more costly and painful to deal with;
4. **Demographics** and aging populations provide a challenge where there is a need for more social security yet with a lower proportion in the workforce; *and*,
5. **Debt**. Sovereign debt is at record levels across much of the world, so raising debt to invest in changing needs is difficult, yet the political space for raising taxes to invest and pay down the debt, whilst meeting the 4Ds above, is very low.

Many governments are increasingly trapped on the horns of a dilemma. Rising tensions and rising climate impacts require more investment but the ability to invest is declining, because the financial needs are rising far faster than the money supply, creating a risk of policy derailment. This is unsustainable. Without increasing investment in decarbonisation, the need for investment in defence and security will grow as climate impacts will increasingly lead to conflict on a global stage and *vice versa*. Investing in security can also lead to unintended consequences which make the situation worse: for example, ally-shoring, on-shoring

and resource nationalism (see Section 5) can increase geopolitical tension by reducing the efficacy of the global market, thus amplifying climate-related market issues, reducing countries' national security and creating more crises. In other words, we seem to be in a vicious circle: the more tense the world becomes, the more difficult it is to cope and address the environmental issue, and the more we will need to focus on crisis management.

Our contention is that climate's impacts and the need to adapt, the drivers for mitigation and the wider geo-political environment will all interact to create markets conditions that are **Turbulent, Uncertain, Novel, and Ambiguous (TUNA)**. Turbulent in the sense of volatile and rapidly moving, Uncertain in the sense of unpredictable, Novel as in new situations arising without historical precedent and Ambiguous: every decision is technically "wicked", coming with downsides as well as upsides.

For UK agriculture, structural change is increasingly going to be likely. Whether because of domestic climate disruption, disrupted supply chains (for inputs like fertiliser), changing demand or regulatory environments forced by changing world circumstances. Building resilience at the farm and food system level is likely to become more important.

## 4 AGRICULTURE IN THE UK: PLAUSIBLE FUTURES AND RESPONSES TO DRIVERS

Looking ahead, mitigation of emissions, alongside the adaptation to climate change required to build farm enterprise and food system resilience are two challenges. Additionally, the market drivers, and the UK demand for what the land sector can provide – whether in preservation of nature or increasing public health through diets – are inevitably going to change, and perhaps change fast, especially in an increasingly volatile and contested world. Farming systems will change as market, institutional, policy and climate drivers evolve. Whilst we can, in theory, plan for this evolution to be smooth, the direction of travel is unlikely to be, as it will be jolted by events, whether climatic shocks, or the emergence of new pests and diseases or wider economic or political ones.

Given the recent US election result, potential for increased geo-political and trade tensions, and for the growth of climate-related disruptions, it is worth considering alternative futures, outside our normal "business as usual" thinking. The UKRI-funded AgriFood Network Plus recently developed Scenarios that imagine futures described by three variables; whether the world becomes:

- more or less volatile, unstable and contested,

- more or less globalised, and
- more radical in its action to tackle environmental issues*11*.

If climate volatility and geo-political tensions rise, and the world becomes more unstable, and if we trade more with close allies than on an open market, food security will inevitably become a more immediate policy concern, it would also be inevitable that the market basis of the UK food system would shift, and with it, *what is grown, how and where, and how much it costs*. Policy is an important shaper of UK agriculture, but the drivers that may shape markets are likely to be more immediate and powerful. W*hat we may consider to be politically, economically or socially difficult (or easy) today may be more (or less) possible in the decades ahead.* From today's political, social or cultural perspective certain actions may (or may not) seem plausible, but the space for change may arise as the world changes.

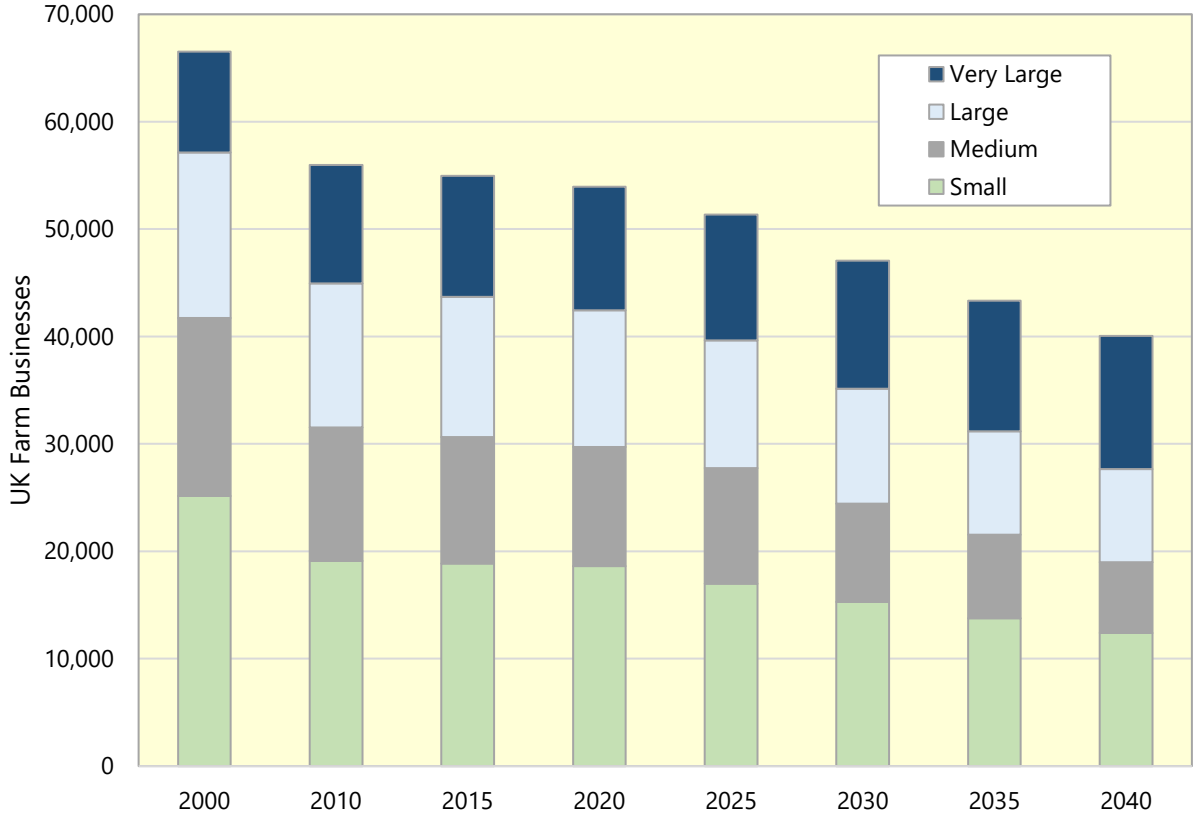
### 4.1 INDUSTRY CONSOLIDATION AND RESTRUCTURING

It seems inevitable that, market movements aside, the economics of farming will become more challenging over the period whilst agricultural policy is shifting to the provision of public goods. This is detailed in Annex 9.2. Not only is it likely that in nominal terms (after inflation has been accounted for), the amount of support is likely to fall in coming years, but also the replacement of a payment for land occupation for one of public good provision is going to incur more costs than those of claiming a Basic Payment. This means whilst income might remain firm, profits are likely to decline if no other business changes are simultaneously made. Other costs of additional regulation and employment are also being built into business operations which will add costs to farming.

This suggests we should expect more business closures, leading to accelerated reduction in the number of farm businesses in the coming decade than usual, assuming markets remain within historic trading margins. Detailed analysis recently published shows a projection of farmer numbers falling in the coming 15 years, by a faster rate than in the last 15 [15]. Headline figures are laid out in the chart in Figure 4.

11 *https://www.agrifood4netzero.net/our-work/scenarios/*

*Figure 4 - Trends in UK Farm Businesses – 2000 to 2040*

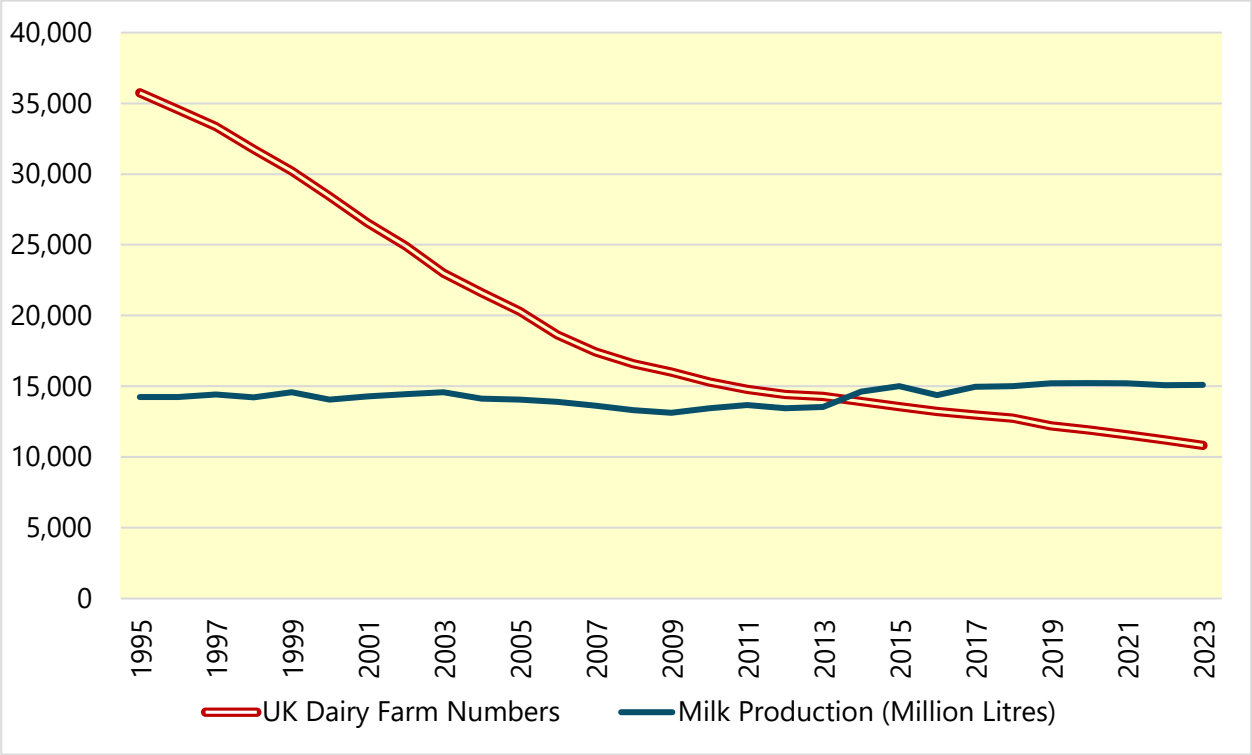



*Source: The Andersons Centre. theandersonscentre.co.uk/farmer-numbers/*

Yet, there is not necessarily a relationship between the number of farmers in the UK and the amount of food being produced, because the bulk of production arises from a relatively small number of very large farms. If a farm goes out of business, it is generally a swift process to reallocate the land, either by sale or rent to another occupant. Most of the time this new occupant will continue to farm in a similar (but hopefully more profitable) manner. The neighbouring farmer now has more hectares to spread overheads over, and might be able to manage the new farm structure so that as much food is produced as before. There is little evidence that a reduction in the number of farmers in the UK will reduce the amount of food produced. For example, Figure 5 shows that whilst dairy farmer numbers have fallen by two thirds in a generation, the volume of milk production in the UK has not changed. This is despite the removal of milk quotas in 2015.

This analysis has not been undertaken for every farming type and there may be a correlation in some, particularly intensive farming systems. Perhaps, for example, if a fruit farmer sold up, the farmland might be turned into less intensive arable or grazing livestock land with lower value of output. Similarly, if an indoor farm such as a poultry unit closed, the buildings might be re-purposed as non-agricultural. At some point, you would expect a relationship between farm numbers and production. For small-area crops particularly in horticulture and niche arable crops, the country might be close to that point, but there is little evidence yet, from the dairy example or overall food self sufficiency, that we are at that tipping point.

*Figure 5 ~ Dairy Farm Numbers and UK Milk Volume Production*




*Source: AHDB, Interpreted by The Andersons Centre*

Since the 1960s, the number of small and very small farms of less than 20 hectares has fallen sharply, while the average size of holdings has risen substantially. This trend has continued with the average commercial holding (over 20ha) growing from 128ha to 148ha since 2005. At the same time, food production has become concentrated in a diminishing number of larger farms. In England, 9% of businesses produced 62% of the total agricultural output, operating on just over a third of the total farmed area. There are just 8,140 of these 'very high output' businesses, selling over £420,000 of produce each year, out of a total of 95,000 farms. This figure does not match the figures in Figure 4 as it includes small and lifestyle farms whereas the chart is those farms employing a minimum of half a full time labour unit.

### 4.2 Farming Approaches: Intensive or Extensive?

The intensity of farming is the amount of input excluding land used to produce a set amount of output. Intensive farming is therefore productive, industrialised, typically, large scale and specialised that uses larger amounts of non-land capital, machinery and chemical inputs per output. Extensive farming systems (e.g. low-input, organic, agro-ecological) typically use fewer inputs per unit of product, but take more land (and usually labour) to produce the same amount of farm goods.

Extensive farming systems typically have different productivity and different environmental footprints (across multiple environmental measurements). Depending on the weighting given to productivity with respect to carbon, water, biodiversity climate impacts, and indirect land use, extensive farming systems are arguably

more sustainable in the round (though this crucially depends on the demand for the agricultural product) [16]. Given that agro-ecological systems are associated with complex rotations, organic nutrient cycling through mixed enterprises there is some evidence that they also promote a form of resilience but this is conditional on business profitability. Thus, as the business and policy environment of farming becomes more volatile through climate change and supply chain volatility, there is perhaps a tipping point where trading expected returns against minimising cash-flow risk results in farmers switching from conventional, intensive and specialised, to more diversified and less input-dependent systems.

In other words, depending on the view point and policy objectives, there is no inherently "right" way to farm either as an individual farmer or from an agricultural policy directive. Land is needed to provide nutritious food and contribute to food security, store carbon, provide space for nature and impact as little as possible. This can arise from intensive agriculture and land sparing or extensive agriculture and land sharing. Each end of the continuum creates a set of co-dependencies (e.g. spatial concentration, requirement for inputs) but inherently there is not a "right or wrong" approach. This is especially true at the farm enterprise level, where there are many routes to building livelihoods depending on farmers specific contexts and values.

### 4.3 REINVESTMENT

Agriculture, being characterised as a highly capitalized but low profit industry has intrinsic problems when it comes to replacing high-cost items, such as machinery or particularly buildings. Land, if well maintained, should remain productive and (if history is a good measure), gradually rise in value. However, machinery and buildings depreciate in value and usefulness, eventually needing replacement, either as their maintenance costs outstrip the replacement costs, or as they become outdated and need upgrading. As an industry where profits tend to represent a relatively small proportion of the capital value of the business, this can be a major decision in the strategy of the farming family and potentially take a while to reach. Such investments might be delayed for reasons of strategic uncertainty (for example if the farmer is reaching a retirement age or new generation not committed to continue the farm). Other delays might be simply based on ability to pay for it. Investing large sums of money in concrete, such as sheds or barns, should add value to the performance of a business but is not re-sellable. For example you cannot resell a second hand slurry lagoon or milking parlour like you can a tractor or plough, but you will need it for your farming system. These decisions are critical to the farm and whilst taking time may help the family reach the right decision, it might also affect food production. This is a feature of farming worldwide and not unique about the UK. Other business sectors may also claim the same.

## 5 HOW SHOULD POLICY CONSIDER FOOD SECURITY?

UK food security, or at least the peacetime process of supply of food to the consumer, has typically been "left to the market". In 2017, HMG's response to the CCC's 2nd Climate Change Risk Assessment was "*The Government recognises that UK food security is built on access to a wide variety of markets, including through a rules-based world trading system operating alongside food production in the UK.*" [17] In 2025, the global situation looks very different, including whether a "rules-based world trading system" continues to meaningful exist.

Our argument above makes a case that, looking ahead, there is a greater need for central planning of food security needs than has been the case in recent decades. In 'normal' and 'calm' times, the current food security policy has been adequate, but 'calm' times are no longer 'normal' times so contingencies are required.

This section discusses how the devolved Governments in the UK are encouraging certain actions from farmers. Britain has lacked a strong and cohesive domestic food policy for sixty years, hence some of the issues outlined in the previous chapter. Henry Dimbleby wrote a National Food Strategy, in 2020 and 2021. Whilst a non-executive director of Defra, this was still an independent publication. Defra published a response to this document, but a National Food Strategy is expected for publication in 2025. A 25-Year Roadmap for Farming is also expected in the same time frame and Government's consultation on its Land Use Framework has been published during the course of this report compilation.

Some countries maintain strict food security policies. China, for example ensures it produces all the grain required to feed its population. China does import comparatively small amounts of wheat and coarse grains (feed grains), but is comfortably the largest wheat producer, largest rice producer (very closely followed by India) and second largest coarse grain grower. But with this narrow focus on grain productions, it does not produce much soybean, a commodity used in vast quantities in the Chinese pig industry, leading to massive imports of over 100 million tonnes per year, that is over a quarter of all soybeans grown in the entire world [18]. Only the short term, critical necessities of calories in grain are being protected by the grain production policy in China.

Britain's food security policy is not that prescriptive (though a new one is currently being compiled). Indeed, the recent UK Food Security Report [19] which extends to 466 pages, appears not to draw such decisive conclusions. Britain's annual Food Security Index [12] lists a series of potential vulnerabilities, without stating a need to change anything. Defra's Food Security Index talks of the need to continue to monitor the impacts of changes to food production, for example from climate change. But monitoring something as it becomes more challenging is not sufficient and action is required to maintain our current or enhanced levels of food security.

The fact that Britain has managed to feed its population successfully (notwithstanding the awful diet that we have typically developed) for the last 60 years without a comprehensive food security plan is no justification to ignore the issue now. The above describes the environmental changes that are occurring meaning several issues will inevitably conspire at some point, which could lead to serious food shortages or more extreme ill health than the country already tolerates. Peering into the future is dangerous, but the trends are describing crises, becoming more frequent and bigger. Food security should become part of the national security strategy, and in such situations, food supply cannot be left totally to the market, which is based on people supplying goods for their own personal gain, rather than solely the national good. It is about balancing risks arising from food supply interruptions, and these risks have downsides too great not to take seriously.

Farm goods produced locally and nationally, offer a different type of food supply resilience to imported food. They remove some threats to continued food supply from solely imports. Examples include:

- Production failures in other countries perhaps because of adverse weather conditions,
- Failures in trade because of imposition of tariffs and protectionist policies
- Civil unrest in other countries, preventing operations of farming, logistics and trade
- Breakdowns in logistics because of fuel crises, or border closures
- Being outcompeted by other countries for limited supplies
- Disruptions at 'choke points' in food import supply chains. For example, key ports (Dover for food), or shipping routes.

Yet being totally self-sufficient also lowers our food security. Being a temperate climate, yields in the UK fluctuate less than in many continental climates, but quality varies more. Many feel more production is generally considered better than less as long as there is a market, meaning surpluses can be exported, (arguably, producing more and processing it into added value products for then exporting is commercially even better). However, focussing solely on home production for home consumption closes trade relations. Crop or production failures in the UK would then jeopardise national food security. The change in climate and rising variation of weather conditions means the variation of crop yield and quality from the UK is becoming greater, just as much as in other countries.

There seems to be little academic or Government research on what the 'right' level of self-sufficiency actually should be (in terms of suggesting a percentage of food consumed for each food type) because it would be a balance of risks to overseas supply chains vs domestic production, and would thus vary with climate and geopolitical circumstances [20]. Having a single target figure for UK self-sufficiency is too simplistic as that figure is likely to move according to availability, prices, demand and policies. A decline in self-sufficiency attracts attention from the farming community, and raises discussion about food security, but most people accept a proportion of imports is good for security. In effect, the market takes these variables and determines the level of home produce and the amount which is imported.

A combination of trade and domestic supply is most ideal for a highly populated country with agricultural land, to spread supply risks, encourage a food culture, yet facilitate a diverse and mixed range of food types that cannot be cultivated in UK soils. The risks to the supply of food from agriculture and the reset of the food system, vary across each food type and this includes agriculture (these are explored separately in Annex 12). Food security risks, being an interaction between hazards and, broadly, the state of the world are "radically uncertain" [21]. Whilst hazard prediction is getting more skilful with advances in climate science, predicting extremes sufficiently far in advance for mitigative action remains problematic and becomes more unreliable when timing is considered [22].

The same hazard can have different impacts depending on context, timing, whether it is a single event in time, or simultaneous with others. Political and geo-political responses are also context dependent. There are many hazard/market/response interactions that could create a global supply chain issue, or a food price spike through extreme weather impact production or transport hubs, or major manufacturing facilities, or pest and diseases (including of humans); war and conflict interdicting supply; trade wars and so on. If the number of potential risk cascades is high, even if each one's individual probability is low, the likelihood is that cascading risks will occur, but predicting any specific one will be difficult. This calls for the securitisation of supply routes and resilience building of our food, energy and wider economic systems.

There are numerous routes to securitising economies by building their inherent resilience. These include:

- **Ally shoring and/or diversification of supplies of critical goods**. That is trading preferentially with allies, or partners, rather than with states that can use the trade-dependence as a potential lever of economic power (or war). Diversification is about sourcing critical goods from multiple places and through multiple trade routes, to hedge against any one point of failure.
- **Increasing self-sufficiency/on-shoring**. Increasing or developing local production of goods, or components, again, to avoid trade-dependency. This is often unfeasible for two reasons. First, the loss of comparative advantage increases production prices domestically. Second, supply chain reliance may necessarily remain for components and other inputs (e.g. fertiliser in the case of agriculture).
- **Increasing redundancy/storage**. Many critical value chains are efficiently managed to be more "just in time" than "just in case". Increasing the local storage of key goods has largely been removed because of its costs.
- **Avoiding single points of failure.** The risk to critical supply chains is increased if there are critical production, transport or manufacturing chokepoints [23] (such as key transport infrastructure of canals, ports, railways; or critical processing facilities such as the concentrated cobalt supply chain [24]. Diversifying or modularising, rather than concentrating can reduce risks, but obviously results in very significant infrastructural costs.

- **Development of increased flexibility/agility/substitutability/or reducing demand and doing-without.** Food waste in many countries during COVID-19 lock downs was significant, as supply chains into hospitality outlets were insufficiently flexible to re repurposed towards retail sales [25]. One response to the post-invasion-of-Ukraine energy security crisis was to reduce demand for energy through working with the public to reduce household usage (such as turning down thermostatic controls). Whilst often impossible – with truly critical materials – and often politically difficult, demand side measures are a potential response to resilience building.
- **Early intervention in hotspots of risk**. Development of better forecasting and early warning (FEW) systems for critical supply chains or to reduce hazards, or mitigate their effects can help to buy time to reduce impacts. These include better medium term weather forecasting (e.g. the European Centre for Medium-term Weather Forecasts, ECMWF*12*), or FEWS-NET, the famine early warning network *13*, or pest and disease surveillance, or horizon scanning of critical place-dependent fragility or vulnerability to impacts.

And, of course, to truly reduce the risk architecture in the future, we need urgent action to mitigate both climate change and reduce biodiversity loss. To achieve that, requires political leadership to drive domestic action and increase and rebuild trust in a cooperative multilateral world and its institutions.

All these measures to manage cascading risks and build resilience carry a heavy burden of cost, but the costs of climate-related risks may be significantly greater. A further caveat, is that some of the measures above can have negative global consequences for global responses to future risks. Ally shoring and on-shoring can inherently increase protectionism and resource nationalism and impede global flows of goods for (geo)political advantage, which may amplify the global risks in future.

Thus:

- in the short term, there is a need to analyse the balance of risks and ensure there is a plan for supply chain disruptions.
- In the medium term, need to analyse risks and identify if there is a strategy that balances risk best by increasing diversity of production in the UK and put in place incentives (e.g. horticulture)
- In the long term, need to analyse plausible futures and develop a strategy that balances risks, builds resilience and sustainability and ensures healthy diets. In short, long term food security strategy is about transformation.

12 *https://www.ecmwf.int/*
13 *https://fews.net/*

## 5.1 SECTORAL INDICATORS THAT MAY, IN AGGREGATE, AFFECT UK DOMESTIC FOOD SUPPLY

Given the changes in the world of today and in future – in weather, climate, conflict, technology, economically and socially – developing and maintaining a food security adaptive strategy is key. The balance of risks between broadly supply chain risks and imports and domestic production risks and UK agricultural capability will change, potentially rapidly, and potentially in the short term,

From a UK agricultural perspective, the small economic returns on capital, inheritance tax risks, growing vulnerability to changing weather, switch to payments for environmental services and post-Brexit issues (particularly labour and input availability) means the sector is potentially fragile. Fragile in the sense that farmers feeling vulnerable, if disadvantaged by new combinations of adverse circumstances may "give up". It is therefore possible that relatively large and rapid changes could occur across the sector. This would impact the food security strategy.

Key indicators that should be monitored to keep an indication of food security pointers from the farmers perspective are as follows:

- Availability of labour. Finding people willing to work the unusual but highly rewarding hours on farms, especially the more intensive systems such as dairy farming.
- Amount of soybean imported for the food industry. A partial alternative would help lower the exposure to one crop from three countries, as a comparatively small importer.
- Biosecurity. Keeping track of notifiable diseases and the culling rates
- Supply of nitrogen fertiliser to ensure sufficient for the forthcoming productive year.
- As active ingredients decline, resistance to crop pesticides should be monitored
- Farmer numbers in sectors where numbers are very low will be important, but areas farmed for food goods and their respective crop yields is more important

## 6 HOW SHOULD THE UK FARMING COMMUNITY CONSIDER FOOD SECURITY?

Farmers do not have responsibility to consider food security and should not burden themselves with such a considerable task when they also have businesses to run.

Farmers produce goods (usually commodities) that end up as ingredients that go into our food, along with other goods and services. It is not their legal or moral responsibility to ensure or consider national food security but each plays a role in the overall food system. It is the responsibility of commercial farmers to make a profit, that being the first rule of sustainability. Some farmers with secondary incomes have other non-commercial objectives (most farms have both). Whether these objectives involve producing food, environmental benefits or other diversified market offerings, is the choice of each farmer and Government, the power ultimately responsible for our food security, should manage that accordingly. No producer should feel any responsibility for supporting food security, but will respond to market and policy signals that favour their business.

Food security is all about providing food for the population, not about protecting the farmer *per se*. This report should be read in that way. Indirectly, the farmer is a very useful component in the food supply chain though, so the need to protect the farming community becomes real at that point. For example, in a food security crisis such as an animal disease pandemic, such as Avian Influenza or Foot and Mouth disease, food security experts and policy makers will focus on ensuring sufficient supply to the food chain, not the survival of the farm business. Whether that becomes an issue of relevance in future years is another matter.

## 7 CONCLUSIONS

Our conclusions of this report are as follows:

a) In a time of volatility, ensuring the nation's food supply is a role of Government which need to put the right incentives in place to ensure that the markets continue to work under all scenarios.

b) Increasing farm productivity, or production will, in and of itself, not contribute to UK food security in any meaningful sense

c) Farmers should make appropriate decisions for their own businesses based on their values and objectives whilst recognising that the environmental trend in which they are operating is towards more volatility

d) If the consequences of (c) undermines domestic supply in a way that is detrimental to food security *sensu stricto*, it is the job of Government to intervene and correct it. The market will also send corrective price signals to correct this.

e) Given that "food security" is a misused term, and that a UK farmer does not meaningfully contribute to UK food security (though they might contribute to feeding the UK!) it is awkward (and fundamentally wrong) to use it for lobbying purposes. Nonetheless, it is likely to be increasingly important for UK food security to maintain a productive and healthy UK agricultural sector.

The security of food supply in the UK is unlikely to be compromised by a single factor, it is a combination of two, or possibly multiple factors affecting the nation's ability to ensure "*all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life*" that is more a concern. Fundamentally, the absolute nature of the definition of food security means food security for an entire nation is not achievable. We can only work to get as close to it as possible for now, and more critically, the uncertain future.

Most factors that contribute to achieve that absolute statement are not the concern of the farmer at all (or indeed the food supply chain), but Government and the consumers themselves. The farmer as producer will always follow the lead of supplying what the market demands. If that is insufficient salad and vegetables, and too much other foods, then so be it.

Individual farmers should not feel the burden or obligation of food production and even less, national security issues. Farmers should concentrate on managing their farms as best they can as businesses. Together though, farmers supply the market and meet its needs. The Invisible Hand, is Adam Smith's metaphor for the instruction the market receives when prices move in response to supply and demand changes in a free market. We all work ultimately for personal gain, but in that process, produce goods that people require and are happy to pay for. When the price of that good falls, we know it is no longer in such demand, and *vice versa*.

The future of some foods produced here in the UK does appear to be threatened by several factors. These are based on the tight margins offered from being commodities and the higher than average costs of production (including land) and restrictive regulatory environment.

Climate change is raising costs of farming further. Forward thinking farmers are preparing for a wider range of weather scenarios. Farmers need to make contingencies for these conditions.

Britain should not need to provide enough food for over a quarter of it to be wasted whilst having a debate on food security. The majority of the food waste does not involve the farmer. Most food security or insecurity is generated beyond the farmgate.

However, Government should have a closer relationship with the farming community, not to buy and store, a strategy that would lead to all sorts of financial inefficiencies, but to help to encourage productivity and with it, profitability. Farming has always been exposed to the vagaries of the weather and, even more volatile, of the commodity markets. In the light of that, it is a wonder that so many farm businesses have remained viable over the several generations and, most, will continue to do so.

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# 9 ANNEX

The following sections are annexes of the report, that explore some on-farm implications of the issues discussed above in the main report. It covers the impacts of input availability and trade, as well as the production considerations at farm and sector levels.

## 9.1 INPUT CONSIDERATIONS FOR SELF SUFFICIENCY

If, as a nation, we wish to secure our food supply, at least in part, by producing it ourselves, then the security of provision of the necessary inputs requires consideration to generate the food outputs is also required. The price of a commodity is based on its availability compared with the demand for it. If the supply and demand are not aligned, the price will change accordingly sending messages to both producer (to make more) and consumer (to use less). If the cost of fertiliser goes up for example, it is because demand has outstripped supply and those keenest to procure it will have to pay more. In these conditions, less will be used per hectare and more will come on to the market when it is possible. The opposite is also true. Britain is connected to the World market with almost everything, whether as an importer or exporter (or both), so when the price of something changes substantially, it probably has done in most parts of the world.

### 9.1.1 Seed

Agricultural seeds are mostly saved from the previous year's harvest (either by the farmer or a grain merchant), and, being more valuable (per tonne) than the rest of the crop and often used swiftly (winter crops at least), is usually saved first. There are anecdotal stories of (potato) seed stores being raided and eaten by very hungry locals not able to wait a year for the following crop, a mistake that in the long term is clearly catastrophic, but seldom in the UK.

**Becoming Self Sufficient - Changing Seed in a Food Security Emergency**

Theoretically, the UK already produces sufficient grain to produce all its own energy requirements (calories) in a food security emergency [19]. Considerably increasing the production of pulses in place of livestock farming would raise the total protein provision too. It would involve changing the way we eat and what we grow and take many years to arrange, but Britain has done it before. Even with severe food security issues, it is naïve to believe that the UK can transition to producing pulses and other vegetable proteins to feed the nation over the course of a season. There are barriers that will prevent this from happening.

- Change to agricultural rotations can only take place at drilling time. If a national security issue broke out in say April, few changes could realistically be made before September, and then it would take a year before any of the new crops could be harvested.
- There would not be sufficient seed of the species and varieties required. A harvest from a crop can be saved for seed for many crops (not all varieties). A hectare of some crops makes more seed than

others. This is a function of the weight of the harvest and the kilos of seed required per hectare. Whilst one hectare of oilseed rape seed (non-hybrid variety) can be saved and drilled across over 600 hectares the following season, for peas and beans, being large seeds, a single hectare harvested can only cover 12 to 20 hectares. This means it takes a long time to multiply the required seed in a food-insecure year. From one hectare of wheat grown for seed, another 50 hectares can be drilled meaning the seed multiplies approximately 50 times in the field. This means that production of vegetable proteins in emergency situations would not work and a bank of seed would need to be retained for that purpose if it was suddenly required.

Sometimes spring seed sells out and becomes unavailable, especially when weather in Europe also encourages more spring crop planting throughout neighbouring countries too. Seed merchants keep what they consider to be commercially realistic stock. Whilst this might have a small impact on the crop rotation grown throughout the UK, its impact on the overall food supply and therefore food security would be minimal and go unnoticed as a part of the commercial agricultural system. It would be better for Government to plan for a shortage and ensure there is sufficient in extreme conditions, rather than wait for that situation to occur unprepared.

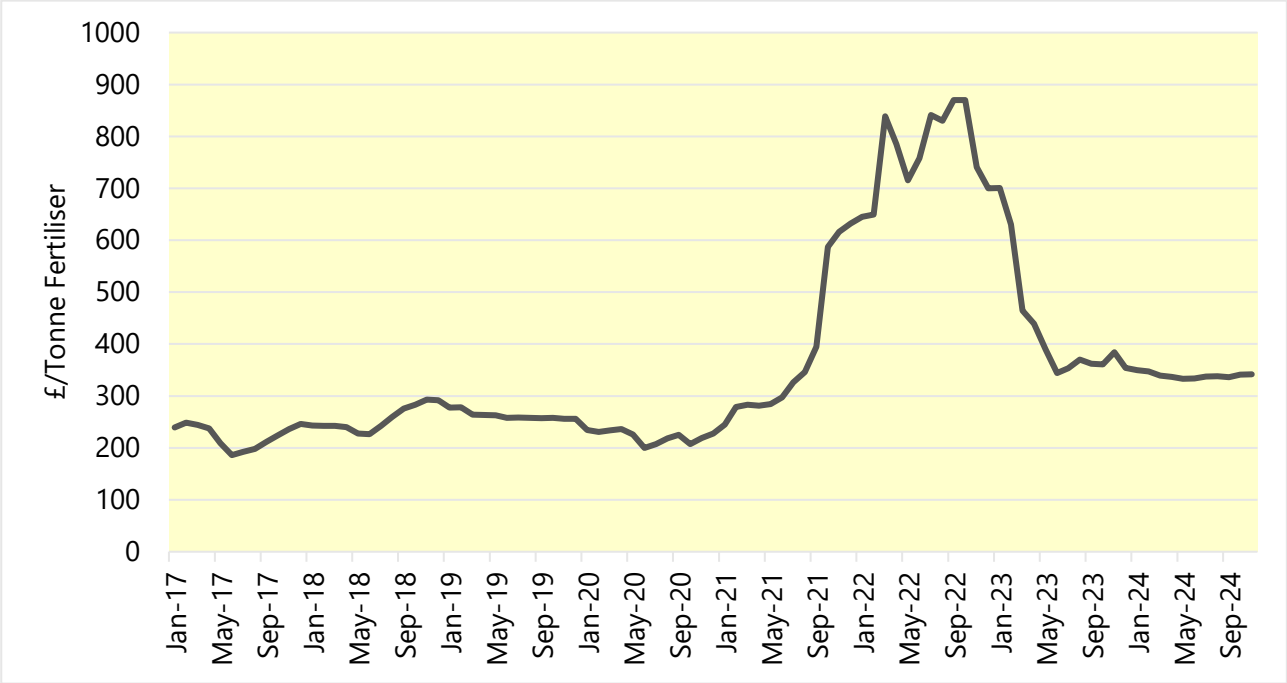
### 9.1.2 FERTILISER

Fertiliser is a necessary input in the process of producing the amount of food that the UK does. Without it, food could still be produced (evidenced by the organic farming sector), but yields per hectare of land would be considerably less and the UK's total production would fall substantially. The three main fertiliser components are Nitrogen, Phosphorus and Potassium. The onset of the war in Ukraine spooked the market across the world for many goods, including some agricultural inputs, fertiliser in particular. It posed serious questions for farmers regarding the economic rationale for them. What is fertiliser worth?

#### 9.1.2.1 Nitrogen

Nitrogen fertiliser is a commodity, meaning its price can fluctuate wildly according to global factors. It is made from natural gas, so its value is largely linked to gas prices, but also its own supply and demand issues move prices, sometimes sharply. Figure 6 demonstrates this. Between 2017 and mid 2021, Ammonium Nitrate, the most common nitrogen fertiliser chemical format, remained between £200 and £300 per tonne. In 2021 then early 2022, prices jumped, firstly to £600 then to £800 per tonne before falling back to a new level of about £350 per tonne by mid 2023. The first price rise was as the world emerged from lockdown, started consuming fuel more rapidly and pushing crude gas prices up. The second was at the outbreak of the 2022 invasion of Ukraine by Russia.

*Figure 6 - Ammonium Nitrate (Nitrogen Fertiliser) ex-Farm Price*




This volatility, coupled with the decline in the UK fertiliser industry to one (US owned) manufacturer, and therefore lack of self sufficiency was a cause for concern for the House of Commons Environment, Food and Rural Affairs Committee in its Food Security Report in 2023. It aired its views to Government stating;

*The reliance on a single nitrogen fertiliser plant increases the risks to the UK's food security. Given the importance of nitrogen fertiliser to UK food production and food security, the Government should take steps to support the increased production of nitrogen fertiliser in the UK, and in so doing examine the incentives offered by our competitors. The Government should produce an action plan addressing these points*

[26].

In its response, the UK Government stated:

*The UK has been a net importer of nitrogen fertiliser for around half a century. Imports have increased steadily since 1980. Typically, 70 percent of all imported fertiliser goods are from the EU. While CF Fertilisers' decision to permanently close the ammonia plant at its Billingham complex is disappointing, we are confident that the UK's supply of critical chemicals remains resilient. The company intends to continue its fertiliser production using imported ammonia. We are continuing to monitor the security and stability of fertiliser and other supply chains and are working closely with colleagues across government and the devolved administrations, as well as industry figures, to do so. We continue to encourage industry to prioritise diversification and resilience, while we work cross-government to utilise recent and upcoming trade agreements to build further resilience into supply chains*

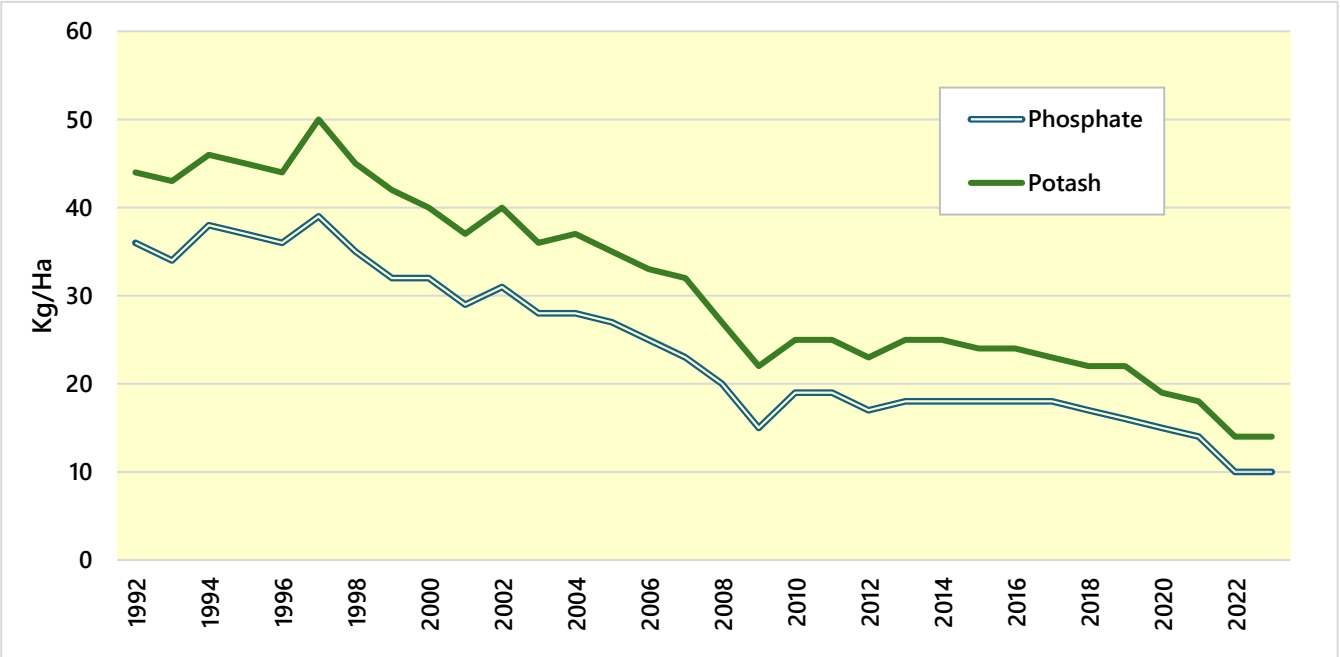
[27].

Government, it therefore appears, is relaxed about the reduction of our domestic nitrogen industry. Many others will be less comfortable. Nitrogen is too expensive for farmers to stockpile for long periods for cash flow and theft purposes and, being potentially explosive, is a liability to keep on farm. It needs to be stored in very good, dry conditions to retain its full functionality, making the storage too dear for most growers. Nitrogen fertiliser's manufacture also generates carbon dioxide as a biproduct which is also necessary in the food supply chain.

#### 9.1.2.2 Phosphate and Potash

The UK relies totally on imports for phosphate fertiliser, having no extractable reserves of its own [3]. The amount used in farming in the UK has been falling consistently over a long period of time [28]. Globally, there is no real risk of shortages.

*Figure 7 - Average Use of Phosphate and Potash kg/ha/year in UK 1992 -2023*




For Potash, the UK has lots of it. A Government publication in 2019 discussed how the amounts in Yorkshire alone exceed what the UK will need for several decades [29]. Like, phosphorus though, the amount that is used in modern UK farming is in decline (Figure 7). In times of severe acute shortage, for example if prices rise sharply or it is unavailable because of supply chain breakages, the farming industry continues without it. The benefit of Phosphorus and Potassium being realised over the long term means their unavailability for one season would not contribute to food security concerns. This makes these minerals less critical in terms of supply chain management.

Fertilisers are an acute source of greenhouse gas emissions, especially nitrous oxide, a particularly nasty GHG, generated in the breakdown (oxidisation) of nitrogen fertiliser in soil in a process called denitrification[14]. Mineral fertilisers are sourced by mining, a process that incurs inevitable environmental damage. There is pressure by lobby groups for agriculture to continue to reduce its use of fertilisers for these reasons, in favour of making better use of other resources such as farm slurry and manure. Sensible allocation of these products (they are not farm wastes), reduces farm costs and makes the farm more environmentally responsible.

### 9.1.3 SPRAYS

Agrochemicals need to be licenced for use. The EU has one licencing procedure for all countries within the Union so the cost is split between each member State. Since Brexit, Britain has to undertake these tasks in its own right, the costs to licence for Great Britain are thus, equivalent to those for the larger area of the EU, making licencing costs per unit of spray sold, much higher in Britain. Licencing agrochemicals that are widely used can be more easily commercially justified, but some, which are for specialist uses or small-area crops, are more difficult for the agrochemical company to justify without increasing margins. This might lead to the removal of some products and therefore a decline in some small-area crops such as horticultural crops.

To provide time for the new system of licencing and approvals to be implemented in the UK, those substances that were due to expire before December 2023, their authorisation period was extended to five years from three. This means that for example, with glyphosate, whose licence was due to expire in December 2022, is now December 2025[15]. Glyphosate use in the EU has been licenced for ten years until December 2033 [30]. As time passes, the regulations on some active ingredients will diverge between the two regions, including maximum residue Levels (MRLs - the amount of the substance that can be detected, allowed in the finished product). This could be a short-term divergence as extension dates vary, or permanent, if different licencing bodies reach different decisions on licences. This has issues on what is legally tradeable between regions.

The Windsor Agreement, a protocol implemented in 2023, aligns Northern Ireland to the Single Market rules for many goods, so means agrochemical use in that region has to meet EU regulations, not GB rules. Trade between Great Britain and Northern Ireland is now consequently hampered by differing rules. For example, herbicide Cinmethylin which is licenced for use in the UK, is not in the EU meaning it has a MRL of zero in the

14 *www.rff.org/publications/explainers/agricultural-greenhouse-gas-emissions-101*
*www.carbonbrief.org/agriculture-major-driver-of-rise-in-nitrous-oxide-emissions-over-past-40-years/*
*https://extension.okstate.edu/fact-sheets/nitrous-oxide-emissions-from-soil.htm*
15 *https://questions-statements.parliament.uk/written-questions/detail/2024-02-09/HL2354/*

EU[16]. Crops with any detectable residue level for cinmethylin cannot be sold to Northern Ireland. This effect reduces the free movement of goods throughout the UK. Mancozeb, a potato blight spray was withdrawn at different times in each region, also causing trade rule issues.

Uncertainty in the licencing of such goods, the distortion of legal trade arrangements between GB and NI and the backlog of work still outstanding for the Chemicals Regulation Division of the Health and Safety Executive (CRD of the HSE), with the varying extensions there are in the industry provides considerable uncertainty for farmers and product retailers. It is unclear how much stock each might be able to hold in case something becomes delisted. Issues like this should be tackled in the next National Action Plan for the Sustainable Use of Pesticides which is awaited[17].

There are approximately 250 active substances licenced for use in the UK, about half the amount from a decade ago. It is more the number of groupings that matter. The loss of certain groups leaves fewer options for pesticide treatment. This leaves greater opportunities for the pests to develop resistance against them. Some Cabbage Stem Flea Beetle populations are showing resistance against pyrethroids being the only viable insecticide group, *septoria* to triazoles and some Blackgrass to Glyphosate[18]. Each of these effects is accelerated by having insufficient alternative tools to manage the pests and nudge away at the productivity of each hectare of arable farming, which, cumulatively poses a threat to the overall food supply in the UK, and providing a food security issue.

### 9.1.4 ANIMAL FEED

Over half of wheat, barley and oats grown in the UK is used for animal feed, most within the UK, some exported. Yet the provision of additional protein for livestock is largely met by imported soya and soya meal with over 3 million tonnes coming into the UK each year [19].

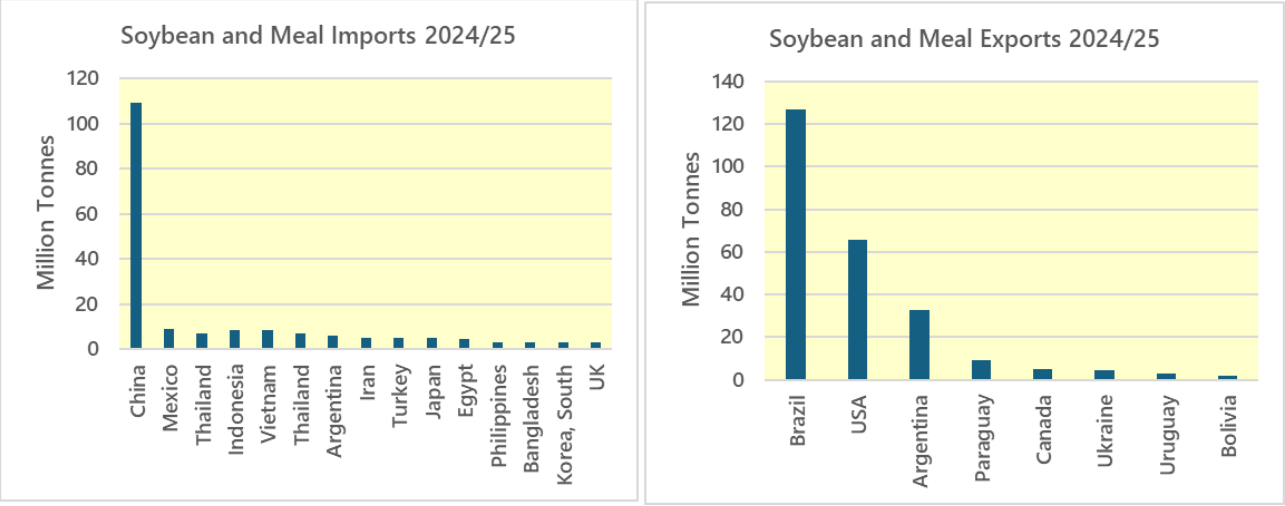
Imports from the EU now incur similar, administrative regulations that imports from other parts of the world have (they are referred to as sanitary and phytosanitary (SPS) non tariff measures (NTM)). The Government, as part of its drive to improve trade relationships with the EU, wishes to implement a veterinary agreement to simplify this again. In a similar manner to the import and use of sprays discussed above, regulations on animal feeds are divided in the UK between Great Britain and Northern Ireland because of the Protocol keeping NI in the Single Market. This slows the movement of feed because of certifications, checks and in some cases prohibitions. Both the UK an EU have rules to protect the safety of their population and farm

16 *https://www.fruitnet.com/fresh-produce-journal/delays-to-post-brexit-agri-chemical-rules-adding-cost-and-uncertainty/260756.article*
17 *https://www.agindustries.org.uk/resource/delays-to-gb-agricultural-chemicals-regulatory-regime-adds-cost-and-uncertainty-for-farms-and-agri-supply-businesses.html*
18 *https://adas.co.uk/news/first-case-of-glyphosate-resistant-italian-ryegrass-found-in-the-uk/*

animals, but they differ slightly. A veterinary agreement would align these differences thereby reducing barriers, making the supply of animal feed a little easier into UK farming[19].

The considerable tonnage of imported soybeans (including soymeal), raises concerns regarding two major issues; environmental sustainability, and food security. Regarding the food security, there are two aspects; firstly global supply is dominated by only three countries, Brazil, USA and Argentina, and secondly, the imports are dominated by only one country; China. Figure 8 demonstrates this. China has massively increased its imports to now account for two thirds of all soybean trade within a generation. Only thirty years ago, China was a net exporter of soya. A small change in soybean demand in China (which is frequent) coupled with a decline in yield in an exporting nation one year could pose substantial concerns over the availability of the animal feed for the UK. There are other environmental and sustainability issues that challenge the supply of soya, but here, we are solely dealing with food security.

*Figure 8 - Trade of Soybean and meal combined*



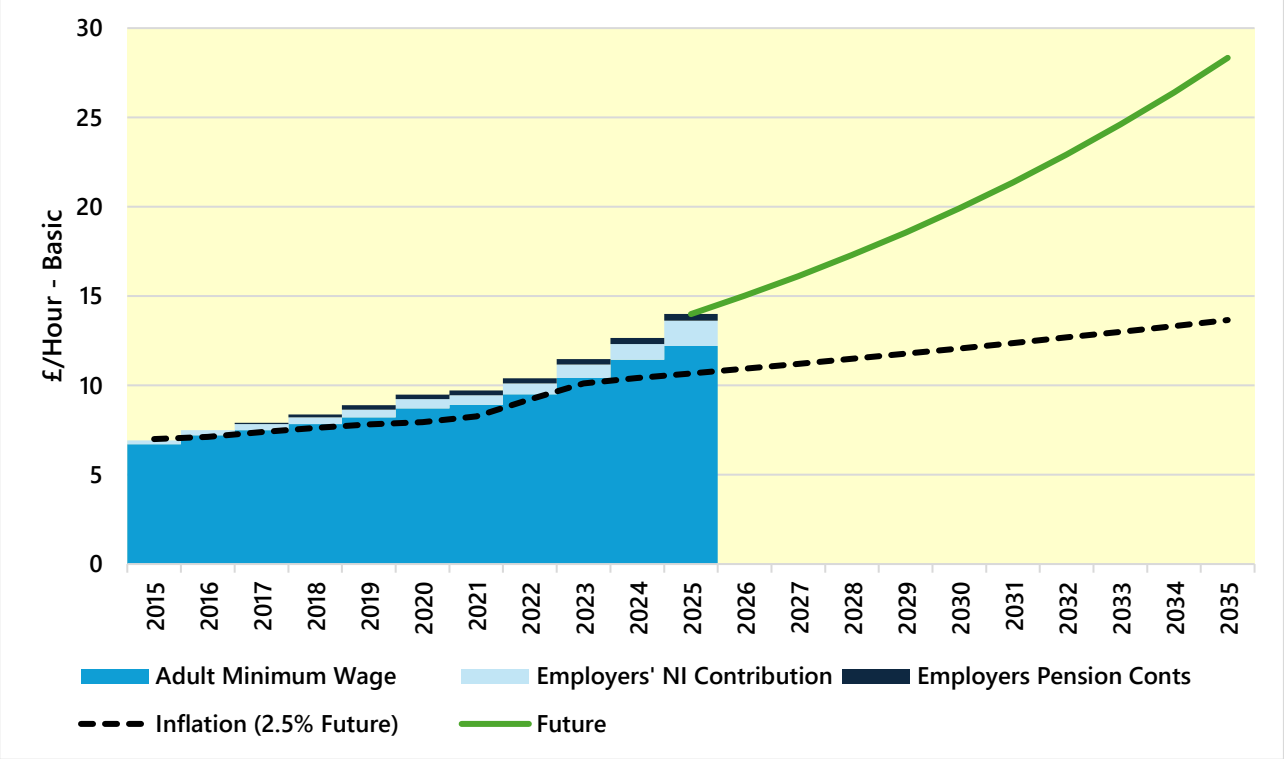

Work is being undertaken on how much scope there is to replace some of the imported soya with locally grown beans[20], but this is a long term project. Whilst soya is not the largest raw ingredient used in animal feed, it is the most imported, and, as the charts demonstrate, is potentially vulnerable. If supply was cut one season, the provision of sufficient protein in animal feed would become an issue. Whilst theoretically, it might take an entire year for the production to resume and availability to return, markets have a capacity to at least partially adapt. But when there are few countries with such large capacity, these options become fewer.

19 *https://ukandeu.ac.uk/explainers/veterinary-agreements/*
20 *Visit https://ncsproject.co.uk/ for details*

### 9.1.5 LABOUR

Labour is at a low in terms of availability and high in terms of cost. Figure 9 shows how the basic cost of employing somebody on minimum wage has increased by more than inflation in the last decade. The chart projects the data forward by 10 years at the same rate that wages have risen by in the last decade and shows inflation at 2.5 percent. Clearly, employing staff is becoming dearer every year in real terms and policy changes suggest this is going to continue or even accelerate further. The chart does not show the rise in less measurable costs of employment such as the changes to sick leave and employees rights that are also taking place.

*Figure 9- Cost of Employing Minimum Wage, no overtime*




*Source: The Andersons Centre, ONS,*

Wage costs are also likely to continue rising above inflation in the coming year for availability reasons. According to official statistics, unemployment hovers above 4 percent in the UK, not historically high. This is about 1.44 million people. But the Office of National Statistics also reveals that a far greater proportion of people, a record of over 2.8 million people are technically employed, but off work on long-term sick leave [31]. This figure has risen by 40 percent in 4 years. It also happens that welfare payments for sick workers are, as of recent changes, now higher than unemployment benefits [32]. From an economic perspective, Government is incentivising people to be ill. Welfare is a necessity, but it generates perverse incentives. Agriculture is included, with staff on long term sick-leave rising 11 percent in 2023 alone, and 44 percent since lockdown [32].

This is causing issues regarding food production on farm, specifically the more labour-intensive processes. Examples include vegetable picking, which is hard work at the best of times, fruit harvesting which, being a seasonal task, makes recruitment more difficult, and dairy farming, which involves very early starts, and potentially long hours. Other examples within the supply chains include at slaughterhouses, with many not wishing to participate in such work are becoming challenged by staff shortages. The NFU reported that potentially £22 million of vegetables were not harvested in 2022 because of a lack of picking staff and the total crop waste could have amounted to £60 million [33]. Clearly this is concerning from the farmers' perspective but also challenges the nation's food security obligations.

The gathering and processing of labour-intensive crops such as potatoes, top fruit, soft fruit and other horticulture is becoming unaffordable without new, expensive technological advances, which are not yet commercialised. Imminent increases to the Minimum Wage, employer's National Insurance and other shifts in employment law will accelerate this trend.

Agricultural produce is, by definition, commodities. This means that it is produced by many businesses in a similar way. Agricultural goods are not branded or have any added value so margins are inevitably tight and the business model has to optimise output. When labour is dearer than in other countries, the economics become difficult to stack up. It is very difficult for farmers to add to the asking price of their goods because costs have gone up.

An Independent Review into Labour Shortages in the Food Supply Chain was published in June 2023 [34]. It highlights how the productivity of the UK farming industry is lower than it should be and makes an association with labour and skills shortages as a cause. It states that the capacity of the UK farming industry is reduced by a constrained and under-skilled workforce. The Review was compiled as a result of observations in the National Food Strategy report [35]. In it, Dimbleby notes insufficient people are entering the food chain workforce.

Arla released a study [36] in which they highlight that the real terms cost of labour in UK dairy farms is 27 percent higher than in late 2019. Finding, recruiting and keeping good staff is increasingly difficult. As a result one in 12 dairy farmers are cutting production, incapable of finding staff to operate the farm.

The UK Food Security Report 2021 claimed (p197) that "*it is unlikely there will ever be a shortage of food due to a lack of labour levels and skills*". However it concedes, that "*in exceptional circumstances, and in times of reduced capacity this could result in reduced supply availability and choice of some agrifood products, in particular fresh produce*" [3]. This brings into question the difference between "reduced production" and "food shortage"; when does one become the other? It brings us back to our discussion on chronic versus acute food shortages once again.

[34] notes that some UK farming companies, particularly in the horticulture sector have off-shored their production facilities in part, to overcome the labour shortages in the UK. Theoretically this does not threaten UK food security, except that once offshored, selling back into the UK is an export which is the same as an export to anywhere else. Food in most EU countries is dearer, meaning the value paid for imports from that farm are generally higher to other countries such as Germany than the UK, plus, being within one Single Market and Customs Union, the barriers are lower, cheaper and quicker.

The cheap food and expensive, unavailable labour combination is gradually reshaping farm businesses and in the process, damaging the UK's food security status. The labour review also suggests that with such a productivity handicap, the level of innovation and innovation is also hampered which holds the industry back long-term.

In 2023, the Food Standards Agency published a report 'Our Food' which highlights the resilience of food supply in the UK is at risk because of skill and labour shortages along the supply chain, such as official veterinarians, butchers and meat inspectors. Insufficient official vets at slaughterhouses for example would curtail the throughput of the meat supply chain, potentially causing issues with meat security [37].

Finally, the Food Standards Agency published another report in 2022 [38] in which they raised concerns about the safety of food in the light of staff shortages in the supply chain. For example, insufficient vets for *ante-mortem* inspections at abattoirs, deterioration because of delayed transport, other microbiological threats as well as food documentation fraud provenance uncertainties.

### 9.1.6 FUEL

It is some people's belief that the price of tractor fuel in the UK is too cheap (John Shropshire, National Farm Management Conference, November 2024). UK farming receives a duty discount for diesel for farm vehicles of 80 percent, lowering it from 52.95ppl to 10.18p per litre. For the end consumer, these also incur VAT. This reduces the cost of diesel (at the time of writing) from approximately £1.40 per litre in the high street, to approximately 67p per litre. This duty discount effectively encourages farmers to use more fuel than other sectors that have to pay the full duty rate.

The farming industry should consider the implications of the loss of the duty discount to farming. If Government wished to encourage the farming industry to reduce its carbon footprint whilst also saving £800 million of duty discounts for the Exchequer, this might happen. High fuel-use farming would be forced to suddenly change it's practices. This would challenge the country's food security. This report is not sufficient to determine the outcome of political choice.

If the total availability of fuel was obstructed, other services would also be critically affected before farming became an national emergency (such as the supply of food to and from supermarkets). So the farming industry would not be at the top of the list if fuel ran dry.

## 9.2 ENVIRONMENTAL PAYMENTS AND LAND USE COMPETITION: ANALYSIS

On Britain's departure from the European Union, UK agriculture's financial support from the Common Agricultural Policy (CAP) inevitably ended. Being a devolved policy, Britain's four national governments can now Govern agriculture in the ways they independently think is best to achieve their own policy goals. Policy divergence across the UK is inevitable, although each country is currently moving in a similar direction albeit at differing speeds.

This chapter primarily addresses the policy changes that are being implemented in England. This is partly because it accounts for the lion's share of agriculture in the UK (69 percent of farm profits over 2019 to 2023 [2]) and also because England is leading the way regarding policy reform and has made most headway in implementing its plans for rural land support. Furthermore, with the release of Defra's Land Use Framework Consultation in late January 2025, new figures of their expected loss of English farmland has also become available which is considered here. Other devolved parts of the UK have also indicated plans to roll out environmental schemes, largely in place of the Basic Payment. Where the per-hectare basic payment is being retained (Scotland), more meaningful environmental conditions are to be applied than the 'Greening' conditions which remain as a legacy of the EU regulations[21].

Policy support specifically for farming or land occupation is winding up, being replaced with payments for "public goods", particularly environmental, which most farmers can benefit from. For clarity, food production is not a public good. It might be good for the public, but the phrase "public good" is a precisely defined economic term. They are "in economics terms, defined as non-rival, and non-excludable". It means everybody can consume the good equally without contest (a view can be enjoyed by two people without payment but an apple needs to be halved and paid for, making it a market (or private) good). There is no additional cost from a second person sharing a public good (think street lights, clean air, hearing skylarks etc).

Undertaking actions that care for the (local) environment inevitably involves using space. This generates a competition for land between agricultural markets and environmental issues. Logical arguments explain that this will reduce the production of food in the UK, some suggesting this may lead to a food security stress-point.

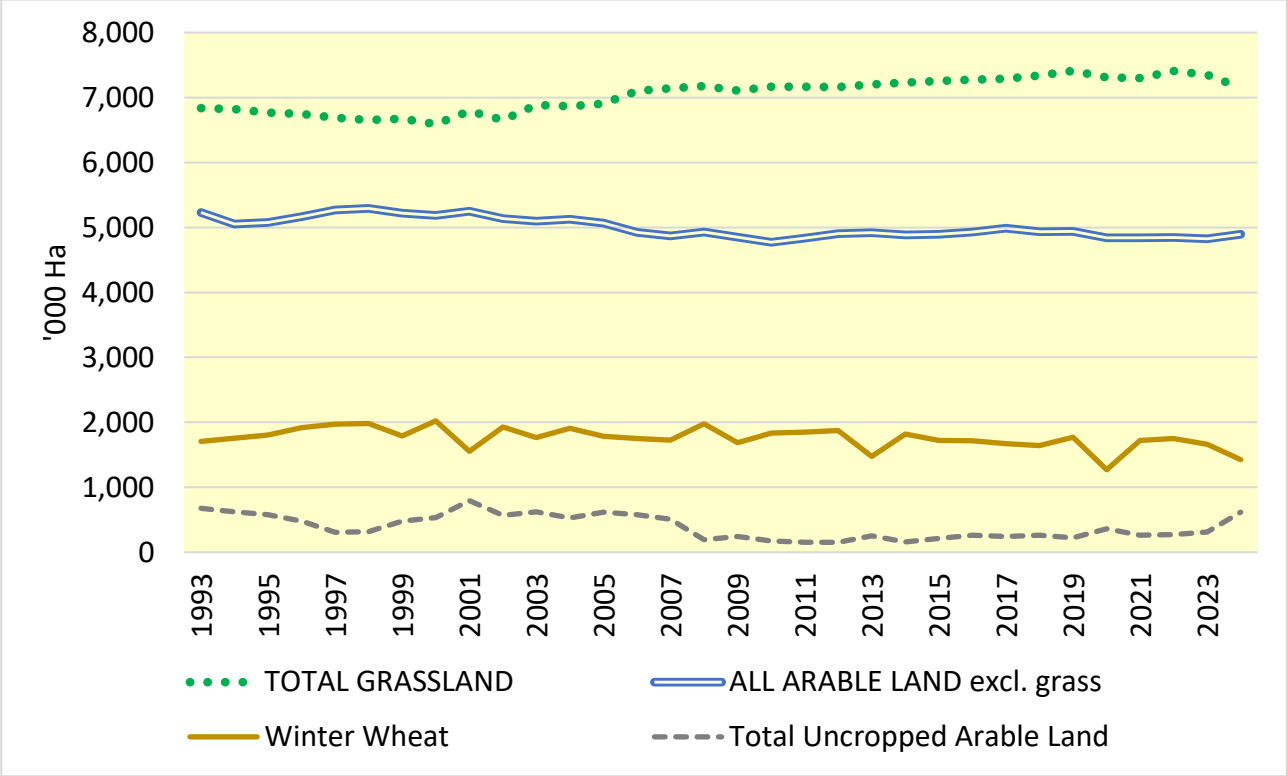
### 9.2.1 Agri-Environmental Schemes

Subsidy across the UK for the production of agricultural goods ended in 2005 (short of a small linked support mechanism for suckled calves and hill ewes in Scotland), when headage and area payments were removed to

21 *Greening was a set of three conditions to receiving the Basic Payment, implemented across the EU in a bid to make the scheme align more closely with the WTO's 'Green Box', i.e. to make it less 'trade distorting'. The actions farmers had to make were environmentally minimal and almost meaningless.*

align UK farm support with World Trade Organisation (WTO) policies. This heralded the introduction of 'decoupled payments'. It allowed farmers to do anything with their land (within certain loose parameters), so could fallow their land and produce nothing, whilst still claiming subsidy for land they occupied. This generated concern at the time that food production would plummet and lead to food security issues. In the event, the decline in areas of cropping and grassland were almost indiscernible as shown in Figure 10. The opportunity to receive subsidy whilst doing nothing with land sounded enticing at the time. Indeed so too does the opportunity for receiving funding for producing an environmental benefit that is not linked to the vagaries of the market or weather. However, early indications suggest that the UK is not going to experience wholesale departure from agricultural production.

*Figure 10 - Cropped areas in UK 1993 - 2024*




*Source: Defra - Agricultural Land Use and Crop Areas in the United Kingdom at 1 June*

Defra does not expect food production to fall substantially as a result of the roll out of the Environmental Land Management (ELM) scheme and has taken steps to make sure that is the case [39]. But some environmental activities it is funding will require land to be spared from traditional farming and used for environmental features. This sounds like a reduction of area for food production and therefore a constraint to our food production. The following examines that claim.

### 9.2.2 Land Area Lost to Environmental Schemes

There are 12.2 million hectares of lowland farmland in the UK, 6 million of which is permanent grassland, approximately half of that is unimproved [40].

Environmental Schemes in Britain currently cover approximately 550 thousand hectares of farmland removed from agriculture, including 266,000 hectares as of July 2024 in SFI options that take land out of agricultural production [41]. This includes ten options that were initially open for farmers to convert their entire farmland but has since been changed to total only 25 percent of any farm [42]. The Higher Level Stewardship scheme also takes some 228,000 hectares of agricultural land in England. Being a more established scheme, it is thought this figure is not likely to change substantially in coming years without policy change. Making a proportional allowance for the devolved parts of the UK of 50,000 hectares makes an overall uncropped environmental space of about 550,000 hectares (266,000 SFI + 228,000 HLS +50,000 devolved = 544,000ha). This area combined is less than has historically been taken out of production from previous schemes such as Environmentally Sensitive Areas and the former Countryside Stewardship Scheme [43]. It is also less than under set-aside 20 years ago and approximately double the uncropped area from the last years' as part of the EU's Common Agricultural Policy (CAP).

Government used to pay farmers to leave land fallow, a scheme called set-aside. There were about 500-600,000 hectares in this scheme most years in the UK. Set-aside ended in 2007. It was a food production management scheme, not an environmental policy, at least initially. It was because other policies were encouraging *overproduction* of food throughout Europe.

There has always been an area of arable land that is uncropped each year. This is for a variety of reasons, some for single years, others longer periods. In June 2024, there were 616,000 hectares of uncropped arable land in the UK including the 544,000 hectares described above. This was the highest area of uncropped land for 19 years. The average area of uncropped land between 2007 and 2023 (before the SFI scheme began in earnest) averaged 290,000 hectares, meaning the uplift in area is about 326,000 hectares (616-290). It suggests the new environmental scheme has persuaded lots of farmers to dedicate considerable hectares to the environmental scheme and stop farming.

The 2023-2024 growing season was the second wettest on record (of 180 years) [11]. Many growers were unable to plant crops, or of those who did, many hectares did not survive and were written off, returning the land to fallow status. Not only did this increase the uncropped area, but, with payments available for other land uses, it incentivised farmers to consider environmental schemes in more detail. Future years of cropping decisions will help us to identify how much of the 2024 year was put into SFI because of the extreme rainfall. For now, we will assume a half. Wetter winters in the future might mean more farmers increase their land dedicated to environmental schemes, being more resilient to extreme weather adversity than crops grown for the market. Even without such schemes, wetter winters would be likely to raise the fallow area anyway.

With approaching half of BPS claimants now engaged with SFI and claimants unable to register more than half their farm to the land-sparing options, the maximum increase in these schemes will be the same again (the other half). However, not all farmers are likely to engage with SFI. Defra's ambition is 70 percent [44]. It is

also expected that larger, more professionally run farms that are more likely to use these land-based options have been in the first half of entrants. It is therefore unlikely that much more land is taken out of production as a result.

Some of the 544,000 hectares is on grassland. The impact on grassland is more difficult to measure as it is unknown how much of it is unused (or under utilised) throughout the course of a year. However, national stocking rates (total grazing livestock units divided by the total grassland area excluding arable forage), are approximately 1.2 GLU[22] per hectare. This is considerably below what most consider to be commercial scale rates of approaching 2.0 GLU per hectare on productive grassland [13]. Low national stocking rates are not new but is a longstanding feature of UK grassland farming.

It is economically rational that farmers do not allocate their most fertile land to environmental options, rather the poor soil quality areas, those fields in marginal areas such as floodplains, far from the farm, or with obstacles like electricity pylons in their way. These areas may have already been either left uncropped, or are historically low yielding areas. The typical yield in these fields will be perhaps half of the average farmed areas, and possibly a third of the higher yielding parts of the farm.

On the basis that the worst and most awkward land is used for these schemes, it is thought the yield lost will be half of the national average or possibly even less. This means we would expect reduction in food production of less than one percent of national production as the environmental schemes are currently operating. The table below summarises the maths.

*Figure 11 - Estimate of food production impact of Agri Environmental Schemes*

| | Area 2024 | all farm land |
|---|---|---|
| All Arable land in UK | 6,167,000 Ha | |
| Permanent Grassland in UK | 5,865,000 Ha | |
| Uncropped arable land inc ELM June 2024 | 616,000 Ha | |
| Average 2007-2023 Uncropped arable land | 290,000 Ha | |
| 2024 Uncropped Uplift | 326,000 Ha | 2.7% |
| Uncropped because of extreme rain | 50% | |
| Fertility of land used in ELM compared with average | 50% | |
| **Productivity of land used in ELM** | **81,500 Ha** | **0.7%** |

This figure takes account of the tenacity and inventiveness of the British farming sector, and that new ways to continue production will be sought. In conclusion, without the benefit of a detailed study, as policy and environmental options currently stand at the moment, it appears that the impact on total food production of

22 *GLU – Grazing Livestock Unit, the equivalent of a medium size, fully grown diary cow.*

the new agri environmental schemes is likely to be slightly lower than one percent of farmed food goods. This is in line with other analysis by AHDB [45].

### 9.2.3 Unexpected Yield Impact

There is some evidence [46] that suggests that including more species into a space (field) by introducing environmental verges, agroforestry, and other such techniques, can actually *raise* yields of the commercial varieties within that space, offsetting the land spared for the environmental initiatives. This is because the loss of monoculture, which dilutes the damage that pests such as funguses, pigeons, and so on have on the concentrated space. It is not necessarily all farming types though with specific evidence majoring on organic farmland. More work on this is ongoing by the Centre for Ecology and Hydrology through the ASSIST programme - Achieving Sustainable Agricultural Systems which is seeing similar patterns, but this work is not yet published.

### 9.2.4 Which Crops Lose Out?

The SFI options that take land out of food production have low input and even nitrogen fixing properties. Indeed, some options, have legumes in their seed mix. Such a mixture of species and growing requirements means that the crops removed from farming in place of SFI options are likely to have been non-cereal crops particularly pulses. The SFI options have similar properties in terms of their take-all[23] break properties and leguminous species included within the varietal mixture. Furthermore, as with most crops, a large gap in a rotation is suitable for pulses to prevent build up of diseases. The cultivation of a legume fallow will not act as a break crop for pulses, and might delay their return to that land for potentially five or sometimes six years. The production of pulses could fall in England as a response to SFI. As of July 2024, over 85,000 hectares of the legume fallow had been registered. This is approximately 35 percent of typical total pulse area. Legumes, tending to have lower gross margins than cereals so are likely to be front of the queue for switching into SFI. This could lead to a fall in pulse areas in the UK in coming years. This would add to the currently deficit in plant protein we have in the UK. The UK is currently undertaking Government funded projects to focus on raising pulse production in the UK to negate this for environmental as well as economic purposes.

### 9.2.5 Land Use Consultation

The analysis above, estimates the food production impact of the new agri-environmental policies as they currently stand in England, plus an estimate for the other Devolved Nations. However, policy does not sit still

23 *Take-all is a soilborne fungus which damages cereals, particularly wheat. Control through genetics or agrichemicals is limited so is managed through rotational practices.*

and, Defra, on behalf of the English Government published a consultation on its thoughts for land use through to 2050, a 25-year horizon from 2025. This paints a different picture of Government's planned changes to land use in the coming generation, including a loss away from farming of 9 percent of farmland, and an additional 10 percent partial loss with farming mingling with environment [47]. Page 17 of the Analytical Annex states:

*Our estimation of the total land use change to deliver our environment and climate targets and commitments amounts to 1.6Mha by 2050, around one-fifth of Utilised Agricultural Area (UAA).*

Roughly half of this area is taking land out of farming, whilst the other half is making changes to how farming operates on that space. It means whilst there will still be food outputs on the land, it will fall over the period. To overcome this land area reduction, production per hectare on the remaining land would have to rise proportionately by the same 20 percent over 25 years. This does not seem a big ask but our population is also rising so total food consumption is likely to continue rising.

## 9.3 AGRICULTURAL SECTORAL ANALYSIS

### 9.3.1 INTRODUCTION TO DOMESTIC FOOD SUPPLY BY SECTOR

Most foodstuffs are inherently seasonal, particularly when dealing with national produce alone, and some more so than others because of limited harvest periods and perishability. Keeping supermarket shelves full is typically a matter of balancing production of goods from different geographic areas, with different seasonality. This doesn't always work. In the last 3 years, there have been (winter) supply chain issues with some food items on some supermarket shelves (notably *eggs in November 2022*[24] *and tomatoes in February 2023*[25]). Neither constituted a food security issue, but both serve to warn us that changes in availabilities can happen swiftly and without much warning. The further we go back through history, the more some foods became available at certain times of year only. It is if those foods do not become available at their expected times of year, then there potentially becomes a problem.

The domestic production of indigenous foods will vary sector by sector and may increase in future. This section examines the food security of each sector of UK agriculture.

Any country that is connected with the international marketplace, whether importers *or* exporters will experience more or less the same price inflation when global factors such as wars, trade barriers, and global

24 *https://www.thegrocer.co.uk/analysis-and-features/eggs-2022-supply-issues-pile-pressure-on-sales/674521.article*
25 *https://www.reuters.com/world/uk/britain-facing-tomatoes-shortage-after-overseas-harvests-disrupted-2023-02-20/*

production issues occur. Commodity markets are global, and being a net importer of a particular good does not expose a nation to inflationary pressure any more than being a net exporter or even trade neutral.

### 9.3.2 BIOSECURITY

Keeping livestock and plants healthy across the entire country is a challenge for every sector of farming, arable and livestock alike which collectively have food security ramifications. At farm level, biosecurity is a concern for commercial, animal welfare and emotional reasons. The farmer has to ensure the continued good health of their crops and livestock. The spread of disease that could affect a large proportion of the national crop, herd or flock of one species, particularly if it involved destroying entire herds of flocks, becomes a food security issue as much as an animal welfare tragedy. The UK has been in this situation before, particularly with the outbreak of Foot and Mouth in 2001, which involved the destruction of over 6 million cows and sheep[26]. Curiously, the incident that closed large swathes of Britain from business and public access, stopped livestock movements in major part of the country and culled entire herds and flocks of productive animals as well as the fattening stock, generated no sense of food security urgency. Of thirteen important reports and investigations that followed the outbreak, none mentioned 'food security'[27]. Yet, the first British report to come up on a search on Germany's recent FMD incident, which has led to trade border closures but has not affected the UK as yet, returned a comment on national food security[28]. Clearly, it is a more topical issue now, than 24 years ago. Presumably, some people feel more vulnerable about their food security than before.

Like agriculture, biosecurity regulation is a devolved policy. Each Government administration can manage animal and plant health independently. Biosecurity vectors do not observe national borders, so thankfully the administrations cooperate on this important policy. The Northern Irish administration also liaises with the Republic of Ireland [48]. "Endemic diseases" are those which are already present in the UK, "exotic diseases" are not generally in the UK and "new and emerging diseases" are new to the UK and Government is assessing their risks. "Notifiable diseases" are classified as serious by Government and all outbreaks must be reported [19]. Examples are Avian Influenza and Bluetongue. The number of notifiable animal diseases has risen over the last decade from almost none in 2013-2015, to over 200 in 2022 then back under 100 in 2023. This does not prove any long-term trends because, when incidences occur, such as Avian Influenza in 2022-23, and Bluetongue in pigs in the same time period, they tend to affect several locations before re-eradication. A

26 *https://www.fairr.org/news-events/insights/uk-foot-and-mouth-outbreak-2001*

27 *This included reports by Defra, Pirbright Institute, Scottish Government, Northern Ireland Assembly, the Institute for Health, the Journal of Rural Studies, Parliaments Public Accounts Committee, National Audit office, BBC Analysis and House of Commons Investigation.*

28 *https://www.gov.uk/government/news/government-introduces-import-ban-of-cattle-pigs-and-sheep-from-germany-to-protect-farmers-after-foot-and-mouth-case*

longer-term dataset would be required to draw trend conclusions. However, the warmer, wetter weather conditions may facilitate new, tropical diseases to remain viable in our climate.

The UK Plant Health Risk Register tracks and records risks to UK crops, calculating risks from an evidence framework. The British Border Inspectorate process is also clearly critical in the protection of the UK from disease from other countries. Being mostly an island, we have some advantage here but the contact with Ireland is sometimes overlooked. The lack of inspections post Brexit, was concerning for British growers, but now, the reinstated inspection authority has control of the health of imports of plants and animal matter to prevent such invasions. It is perhaps not surprising that over this period, the number of notifiable disease outbreaks rose. Only recently, (January 2025), the Government introduced an import ban of cattle, pigs and sheep from Germany, to protect the UK farming industry and food production from Foot and Mouth following an outbreak in Germany[29].

The impact of losses in crops is less emotive, and plant welfare has a lower priority than for animals for welfare rather than food production reasons. However, entire crops can be quickly lost by unmanaged diseases. The Food and Agriculture Organisation (FAO) believes between 20 and 40 percent of all crop potential is lost globally by disease [3]. This loss from full yield potential is thought to be similar in the UK too.  Farmers factor in that yield will be lost from disease, but do what they can to mitigate this.

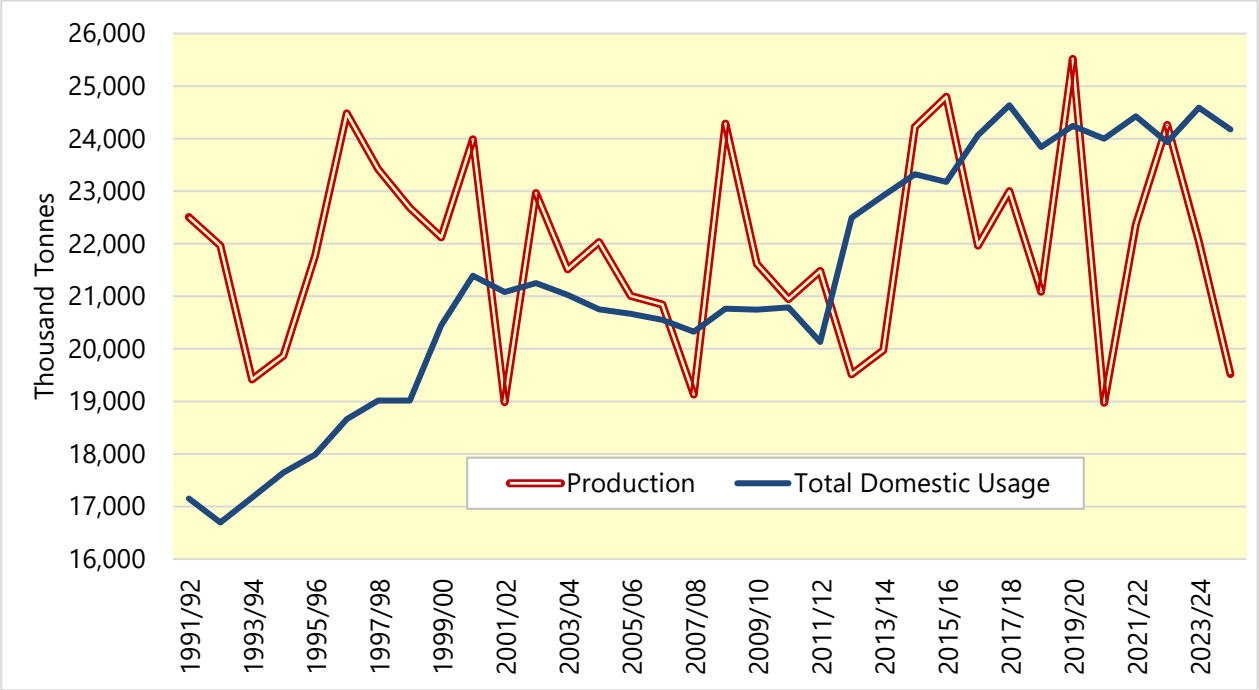
### 9.3.3 ARABLE

#### 9.3.3.1 Combinable Crops

The UK has historically been more or less self sufficient with grains. Production of grain varies between 19 and 25 million tonnes per year and Figure 12 shows that this production range has remained steady but within a 5 million tonne range for at least 35 years.

29 *https://www.gov.uk/government/news/government-introduces-import-ban-of-cattle-pigs-and-sheep-from-germany-to-protect-farmers-after-foot-and-mouth-case*

*Figure 12 –UK Annual All-Grain Production and Consumption Trend*

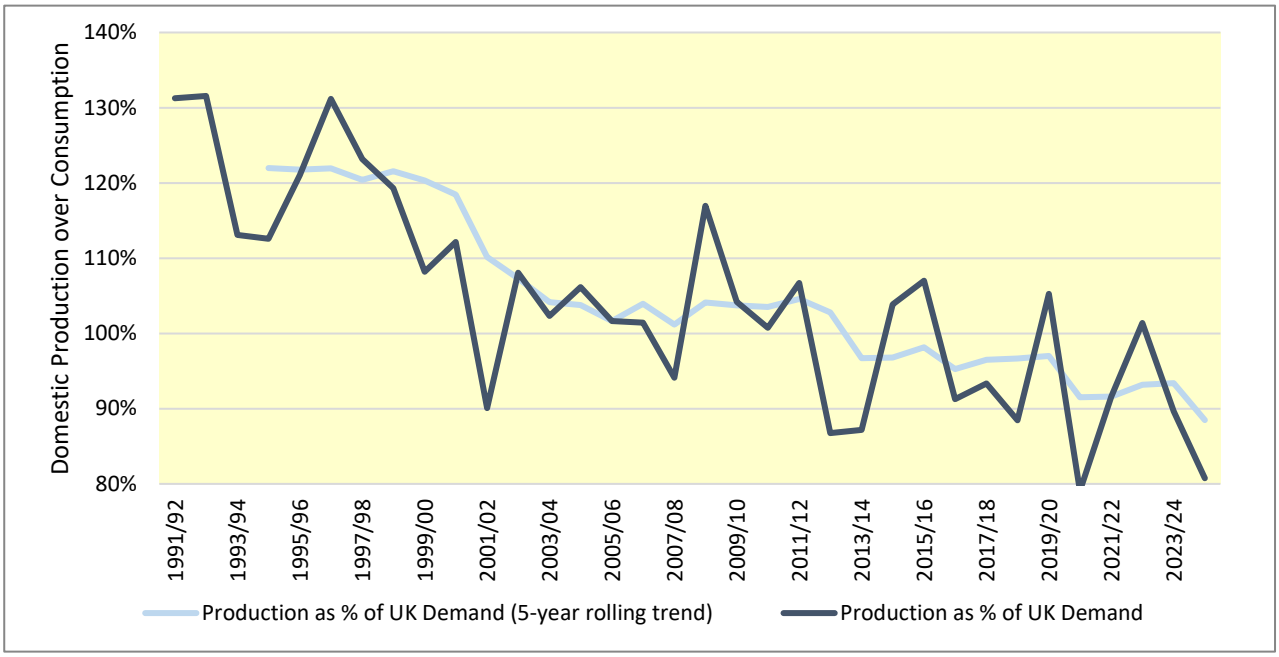



*Source: AHDB & The Andersons Centre. 5-year averages*

Total consumption for all grains however, is on the rise, having increased from around 17 million tonnes in the early 1990's, to between 24 and 25 million tonnes now, where it has held steady for the last eight years. Self sufficiency has consequently moved from over 120 percent in the early 1990's to less than 90 percent in the 2024/25 year. This is shown in Figure 13 with total production as a percentage of total consumption. The difference is met by a rise in imports. In the early 1990's the UK generated roughly 6 million tonnes of grain exports and between 1 and 2 million tonnes of imports. Now, the tonnages have switched round, with approaching 6 million tonnes of imported grain and less than 2 million tonnes of exports in 2023/4 and probably 2024/5. Consumption has risen by 41 percent, and the national population has risen by 21 percent, therefore accounting for half of the increase. We are consuming more per head. The UK is 81 percent self sufficient in milling wheat (higher than for wheat overall). This is the most important crop for food consumption in the UK [19].

Is this decline in self sufficiency a food security problem? It is not possible to tell with certainty until food insecurity happens, but over half of the countries in the world are grain importers. This could either make us feel comfortable and secure to be with many, or that we have competition for the groceries we require. Demand has risen as population has grown and processing has increased, but agricultural production has not followed suit.

*Figure 13 – All Grain Production as a percent of UK Demand*




*Data Source: AHDB*

Over the generation shown in the charts, consumption for human food and animal feed have both increased. The rise has been greatest for non-food uses. We are using a greater proportion of our home-grown cereals on the production of meat and animal produce. Perhaps this is the greater long term risk to food security. It takes several kilograms of grain to produce one kilogram of meat or animal produce. The same is true if measured in calories (energy).

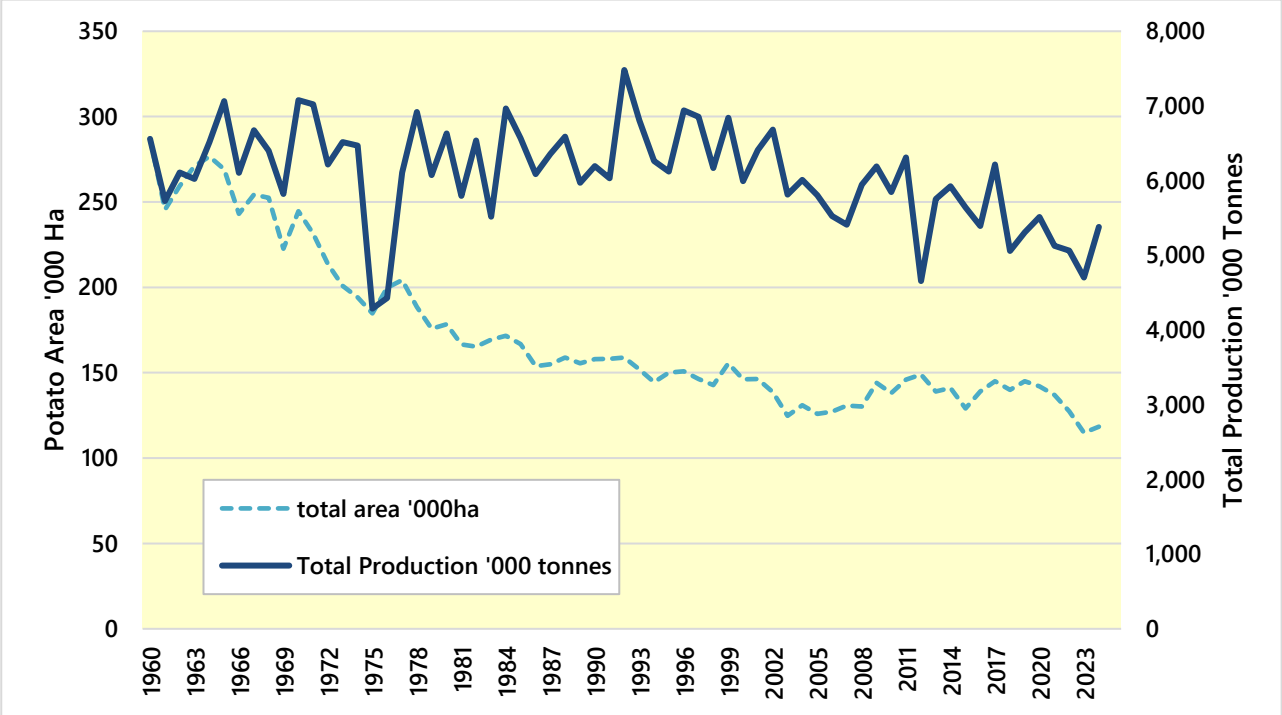
Pulses and oilseeds are two crop groups the UK has been a net importer of for many years. This is for agronomic and political reasons. Soybeans are the world's largest oilseed and vegetable protein crop, providing the broadest range of amino acids. Soybeans are not currently very profitable in the UK as yields are low, so few hectares are grown. Other pulses play an important role in the arable rotation and providing vegetable proteins for both animal and human consumption. There have been several efforts, some of which are ongoing, to raise the production and consumption of UK-produced pulses in the UK. Production tends to be limited by insufficient yields and low returns to farmers. Some claim this is down to attention and knowledge on how to grow them, others cite unpredictability of yields in response to unsuitable weather in the growing season. The UK looks destined to import the majority of proteins and oil for the foreseeable future.

#### 9.3.3.2 Root Crops

Root crops in the arable rotation, specifically potatoes and sugar beet are arguably more likely to demonstrate fluctuations in yield than the cereal crops, largely as there tend to be fewer growers, fewer hectares grown and often specialist machinery (such as irrigation and specialist harvesters) required to do so, coupled with skills specific to one particular crop and potentially greater impact from drought or flood. It

takes a dedicated specialist to remain in these sectors and non-specialists seldom, if ever enter the sectors meaning that these crops experience few new business entrants. Some roots tend to be more susceptible to yield and crop area fluctuation, based on economics, environment and disease pressures. Areas of potatoes have more than halved in a generation as shown in Figure 14, but as yields have doubled, the overall decline in potato production has declined at a lower pace. Nevertheless, net imports have had to rise. Buyers of some crops, roots included, are often keen to protect their relationships with their farmer suppliers and their continued commitment to continue growing the crops. This is difficult in commodity markets where they can be commercially penalised themselves for paying more than a competitor, but not being able to procure the inputs is invariably more expensive than paying a little too much in most cases.

*Figure 14 - Potato Area and Production in the UK*

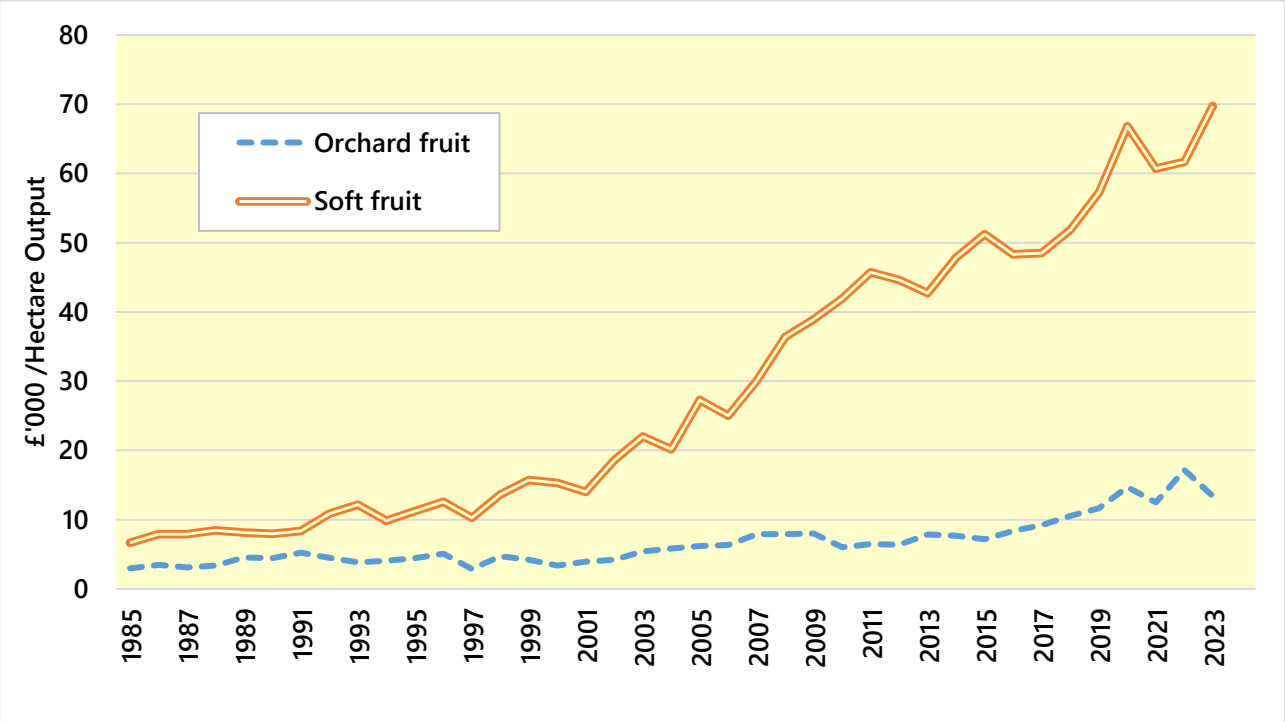



#### 9.3.3.3 Horticulture and Field Vegetables

Horticulture produces the largest range of foods for the British consumer and the healthiest and easiest to prepare foods throughout all of agriculture by a comfortable margin. It is a sector that should be thriving. However, the consumer does not eat enough of it. It comes back to the definition of food security at the start of this paper. The latest Government Food Strategy [49] understandably makes several mentions of wishing to build the horticultural industry. However, there are barriers not being resolved. Being labour intensive for most crops within this category, the issues discussed in the labour section are particularly relevant. Many horticultural jobs are low value, thin margin tasks. We look forward to the new Government's Food Strategy that is anticipated in the first half of 2025.

Horticulture also includes the fruit sector, which is divided into top fruit (tree fruit such as apples and pears) and soft fruit (bush and small plant fruits such as blackberries and strawberries). These sectors have also found the demands of labour, and in some cases, quickly changed demands from buyers such as packaging and fruit size, have challenged the industry. Yet, whilst the top fruit sector has struggled, the soft fruit sector has found ways to add value to its industry. This is in part by extending the productive season, but also implementing innovative changes such as table top and hydroponic systems that facilitate more efficient use of resources. Figure 15 demonstrates this. The Producer Organisation support system that funded initiatives and innovations for groups of collaborating farmers, has contributed to such success.

*Figure 15 - Value of Output per Hectare*




The horticultural sector is the one where food becomes unavailable in the shops most suddenly and frequently. Not only is most of it seasonal, meaning the supply needs to be procured from several parts of the world as well as locally, but its perishability also makes the supply chain particularly difficult to manage. Furthermore, changes to local weather impact consumers' dietary choices, and as horticultural goods cannot be frozen, tend to perish. Horticultural goods account for the highest proportion of food waste, partly for this reason (also partly as some see salads as simply plate decoration).

#### 9.3.3.4 Arable Summary

The key risk factors for future food security from the arable sector of UK farming are as follows:

Short-term:

- Continued security of supply of nitrogen fertiliser must be maintained
- The need to ensure pesticide resistance from fungi and other pathogens is avoided

- Labour availability, particularly for horticulture is a high risk factor.

Long-term:

- Climate change – wetter seasons are becoming incrementally difficult to manage arable farm systems, especially at key times of the year including drilling and harvesting.
- Investment needs – large variation in profitability and levels of future commitment

### 9.3.4 LIVESTOCK

The English Land Use Framework Consultation states that 85 percent of utilisable agricultural area in England is used for livestock, either for grazing or production of conserved feed or grain for feed [50]. The livestock-based component of our diet takes a lot of land and natural resources to produce. Ruminants also turn carbon into methane and carbon dioxide, a more toxic mixture of greenhouse gasses than solely carbon dioxide that other aerobically-respiring organisms produce. Yet, the consumption of meat provides a rich diversity of micronutrients, healthy energy and amazing flavours.

#### 9.3.4.1 Dairy

The dairy industry is one of the few agricultural sectors that produces food every day of the year. The volume of milk production does vary throughout the year but unlike most other farming systems, the farm generates a daily output. This is true for herds that calve all year round, which is approximately two thirds the national herd. The UK produces a surplus of milk and milk products and is a net exporter of dairy products [19]. Almost no raw milk is traded internationally being so perishable and relative low value per kilogramme or litre. A minority of milk is consumed as fresh milk[30], most being processed into less perishable, higher value per kilogramme goods. Any milk shortage or surplus, is traded via these processed goods such as cheese, butter and dry milk powder (DMP).

Figure 5 on page 20 shows the decline of dairy farmer numbers and the remarkably flat production volume over 30 years. This includes the point at which milk quotas were removed with minimal impact. There is little evidence at the moment that the production of milk in the UK is heading into decline, even though it is being operated by fewer businesses. This is a signal of a mature industry, becoming more dedicated and specialist.

The average dairy herd size in the UK is 170 cows in 2024 according to AHDB data[31]. There are many farms operating with well over double that herd size, and in some cases considerably more than that. This suggests that the country has potentially far to go yet, with increasing herd size and the associated reduction of farm numbers before overall production would fall. This leaves opportunities for the industry to continue to

30 *https://www.gov.uk/government/statistics/milk-utilisation-by-dairies-in-england-and-wales/a30506ef-cc9a-4c68-953f-6c9d63d1b9d4*
31 *https://ahdb.org.uk/dairy/uk-and-eu-cow-numbers*

restructure. With the continued decline of farmer numbers though, whilst the total production remains robust, other potential challenges arise regarding the supply chain. A lot of farming takes place on each dairy farm, but when they become very spread out because of declining numbers, the economics of supplying or collecting something from a farm become more challenging.

Dairy calves play two important roles in the food supply chain. One to replenish the dairy industry with breeding and therefore milking cows, and secondly the supply of (both financially and environmentally) inexpensive calves for the beef industry.

Yet the dairy sector is faced with a series of challenges. Dairy farming involves long, unsociable hours and is hard work. Finding people willing to undertake such work is difficult. In 2024, Arla published results from a survey identifying these pressures on dairy farming. The survey found that farmers are finding it increasingly difficult to recruit, and simply finding somebody with the right skills and attitude was very difficult [36]. One farmer in 12 has cut production as they cannot find staff. Pay is not the issue either with rates over a quarter higher since pre-lockdown and Brexit levels. The survey finds recruitment could become a main reason for dairy farmers leaving the industry. Labour is becoming the primary limiting factor for milk production in the UK. For years, land has been considered the primary resource on UK farms. Perhaps this is changing. The availability of labour is a key challenge in the dairy farming sector.

For dairy farms to maintain their rising output per farm requires ongoing reinvestment. Issues surrounding this are covered in Chapter 4 on Farm Structures. Replacing a milking parlour for example is an investment that cannot be resold. It makes farming easier and facilitates larger herds. For some farms, the return on new buildings and machinery can be tight, meaning it can take some years to pay back. These decisions become a decision on long term commitment to farming by the family involved.

The key risk factors we see for future food security from the dairy sector are as follows:

Short-term:

- Labour

Long-term:

- Reinvestment needs – large variation in profitability and levels of future commitment
- Climate change - less summer grass growth and more housing and associated costs

#### 9.3.4.2 Beef & Sheep

The UK is self sufficient in sheepmeat production and partially so for beef, albeit with net imports from Ireland [19] Section 2.1.1. With regards to food security, there are two aspects to this farming sector. First, the production of grazed red meat is an inefficient way to produce food, taking a large amount of land over a relatively long time to produce the meat. It is consequently more expensive to produce in terms of costs and also environmental footprint than most other commodities [51]. Beef and lamb are produced on lowland farms for rational reasons, some concerning the farm system, others to do with farmer preferences. Making money from beef and sheep is difficult. It takes a long time from start to finish to produce a beef or sheep carcass, often needing to keep two animals alive for it (animal plus mother).

The second aspect, the main benefit of grazed red meat with regard to food security, is the ability to produce healthy nutritious food from mechanically inaccessible grassland. These otherwise agriculturally difficult parts of British farmland, where tractors and other machinery cannot safely access, is of little alternative value for food production. It might have other uses (e.g. environmental), but here we are considering food supply.

This is the sector of farming with lowest profits. This is in part, because of the relatively low barriers to entry, more extensive and arguably gentler lifestyle, making it more desirable firstly for those coming out of intensive farming such as dairying, and also those wanting to enter farming after a successful career in other sectors. Non-farmers taking up sheep farming is relatively common, whereas there are few examples of lifestyle entrants going into dairy or intensive poultry farming for examples. Currently, this does not threaten food security, and there are more farms with some beef or sheep than any other farming enterprise. So that many farms lose money in producing stock for market is not a threat as yet to food security.

The UK is a net importer of beef by value, as a consequence of our preference to higher value cuts of meat than cheaper ones. The UK imported just less than 300,000 tonnes of chilled, frozen and processed beef in 2022. It exported 154,000 tonnes of chilled and frozen beef and beef offal [19]. This means that, without trade, the cuts we do not tend to purchase would be either very cheap or wasted, making the higher value cuts dearer. Making use of as much of a carcass as possible makes more efficient use of the animal and reduces wastage. This is known as 'carcass balancing'. For this reason, our exports are just as important for British food security as the imports we actually consume. Without such two-way trade, the cost of beef would be higher or there would be more wastage in the system, thereby potentially lowering the value of beef at the farmgate but raising it at the retailer.

For sheep, whilst the exports outstrip imports most years, Britain is also the sixth largest lamb importer in the world. This is because lamb is a seasonal food and most Britains are not partial to mutton, adult sheep meat. The lamb that we eat in the autumn and winter has been recently slaughtered in a local abattoir supplied by a local farmer. It is likely to have low food miles. Yet the average food mile distance for lamb eaten at other times of the year is very high, having been imported into the UK almost certainly from New Zealand. It's a

seasonal thing which has continued through a long term arrangement with what was once a British Colony. Some legacies last longer than others.

Some years, our net trade is very small, but that hides considerable imports and equal exports. The relationship between Britain's imports and exports are relevant for our food security, giving us more affordable lamb to consume throughout the year rather than a surplus for half of it. In this instance, the trade offers us value, choice and year-round lamb.

The key risk factors we see for future food security from the beef and sheep sector are as follows:

Long-term:

- Farm viability because of low profitability.
- Climate change – the beef sector in particular is under pressure to reduce its GHG emissions as it makes a disproportionate contribution for the output it generates.

#### 9.3.4.3 Poultry Meat and Eggs

In Britain, we have a preference for white poultry meat rather than brown. Thus, large amounts of brown poultry meat are exported to those who prefer it, and in return, white (breast) meat is imported to meet our likings. If such trade arrangements were not available, and surplus brown poultry meat was available, we would probably eat and enjoy it, but perhaps pay a little less than consumers in other countries. Possibly less so with parts like poultry feet and heads. Whilst there is a marginal advantage of selling white meat at a premium here, and brown meat at its own premium there, and those advantages outstrip the cost of haulage and tariffs, then the trade will continue. The poultry processing industry is dominated by four large companies; 2 Sisters, Avara Foods, Moy Park and Cranswick which account for 90 percent of production. Small independents account for the rest.

In 2022, a report identified a shortage of workers in the meat processing sector was causing issues with the supply of finished meat over the previous three years as slaughter rates were lowered to the level the staff could cope with [38]. That was during the Covid lockdown period. The work is largely relatively low-value work and arguably not the most desirable environments for many people. Securing the right attitudes as well as skills is difficult.

The production of poultry meat, is the most efficient in mainstream farming. Only cold blooded farmed animals (such as fish and insects) generate a better food conversion ratio. This is critical in the provision of food security, and affordable animal products. However, as this report is being compiled, avian influenza is being detected in the UK from Yorkshire, to Cornwall to Merseyside. It is a contagious, notifiable disease, which has led to protection zones, and surveillance zones and flock culling. Farms have closed their doors to

unnecessary visitors and remain vigilant. A serious spread, affecting many farms in several parts of the country, could affect food supply in a manner the consumer starts to notice*32*.

Eggs play an important role in the provision of amino acids, as well as minerals and vitamins. They each hold the correct balance of nutrients to maintain life and are produced all year round. Being a commodity, their price can be volatile. With poultry, as the lives of the animals is short, the farmer has greater control in terms of maintaining production. When prices fall considerably, production can be adjusted down swiftly too, and vice versa. This means that production can decline when margins are tight, meaning empty shelves on occasions.

Poultry consumes almost half of the soybean imports into this country*33*. They also have fewer alternative feed options than some other livestock sectors. This means that a breakdown of the supply of soybean might lead to a supply disruption of poultry meat in the first instance and then eggs in the second. Coupled with the previous point on restocking rates, this sector would be most likely be first to stall production in this scenario.

The primary risks observed in the poultry sector regarding food security are as follows:

- Avian influenza is a concern which could lead to the loss of a large proportion of the national flock.
- Soybean consumption is very high, without alternatives. If it becomes unavailable one season, poultry production might have to stop.

#### 9.3.4.4 Pigs

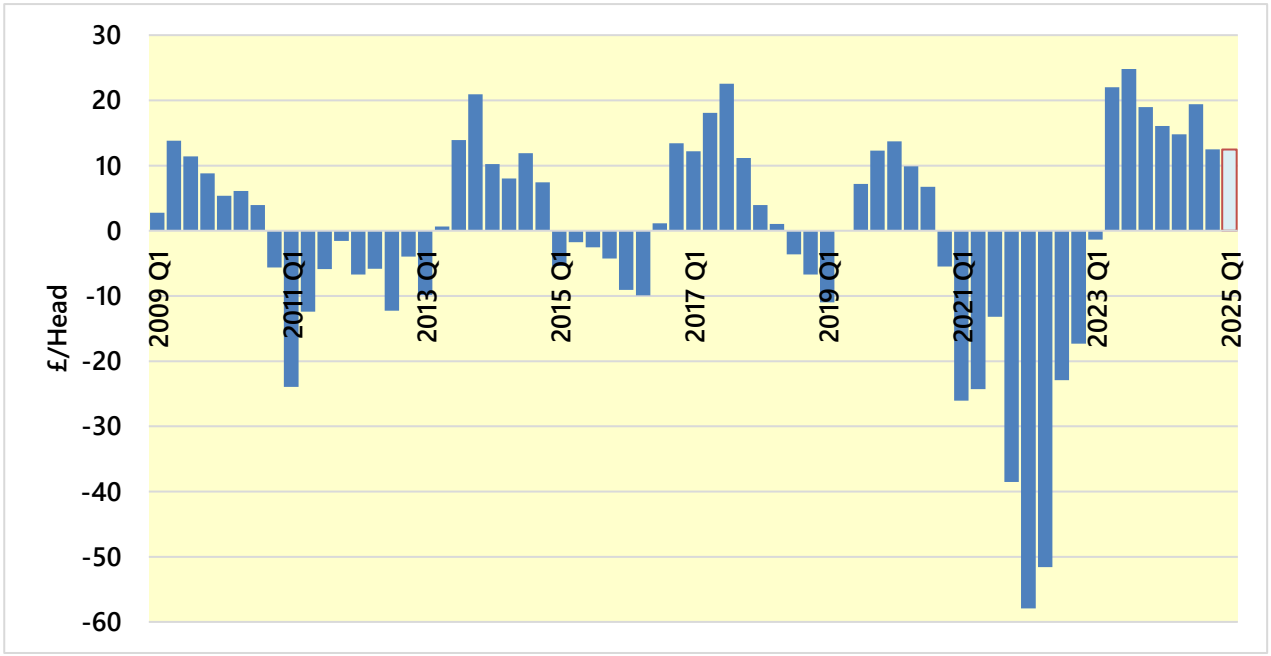
The pig sector has come out of a period of sharp loss-making, which lasted from the fourth quarter of 2020 until early 2023. Since then, returns per sow have been good and the industry has been recouping its losses made in the previous 3 years. According to the net margin calculations published by AHDB each quarter, the typical farmer in the sector has not made a cumulative net profit since 2009 when their dataset began, they just about break even overall after accounting for their own time[34]. Pig numbers were impacted, falling from half a million breeding sows in 2021 to 430 thousand only a year later. Now they are ten thousand lower still. The sector is highly commoditised, and therefore highly sensitive to global price movements.

Commodity prices are volatile. They respond more quickly to market fundamentals than products or service prices. No better commodity to demonstrate that than pigmeat. The 'Pig Cycle', demonstrated in Figure 16, is formally 100 years old this year. It was named in 1925 by Mordecai Ezekiel, a USDA and UN FAO agricultural economist who later worked on Franklin's 'New Deal'. The downturn in the cycle in 2021 and

32 *https://www.gov.uk/government/news/bird-flu-avian-influenza-latest-situation-in-england*
33 *https://www.eci.ox.ac.uk/sites/default/files/2022-07/FSR-soy-demand-chains_NOV21.pdf*
34 *https://ahdb.org.uk/pork-costings-and-herd-performance*

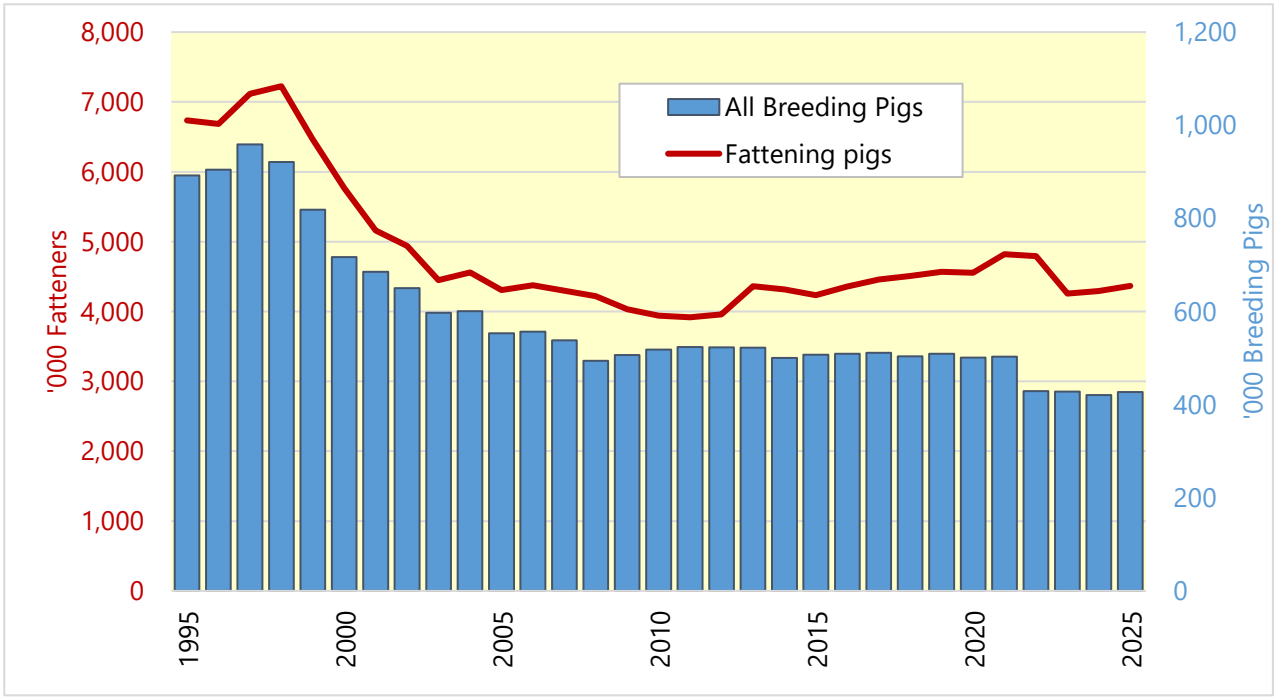
2022 was unusually deep – caused by stagnant prices, high costs and disruptions in the supply chain with slaughterhouse closures.

*Figure 16 - Estimated Net margin per pig - AHDB*




As a result of the large profitability drop, the number of pigs in the UK fell by ten percent as shown by Figure 17.

*Figure 17 - Pig Numbers in the UK*




The British pig breeding herd count might never recover. Breeding pig numbers have fallen for many years, particularly during the price dips. Pork is Britains favourite red meat (by quantity consumed), yet our pig herd is in long-term decline. We may become increasingly dependent on imported meat.

Similar to other livestock sectors already discussed, the carcass balance is important with pigs. There are parts the British consumer does not value, whilst others do, and vice versa. This is a critical part of keeping the cost of pig meat down, the returns to the supply chain including the farmer up and minimising food waste.

The main issues regarding the loss of food security in the pig sector are as follows:

- The loss of soyabean, while less of an issue than poultry, would cause serious problems to the pig industry.
- African Swine Fever is a risk that could close a large proportion of the industry down if it got out of hand in the UK.
- The commodity cycle is more volatile in the pig sector, hence the 'pig cycle' leading to many farmers finding it unsustainable.