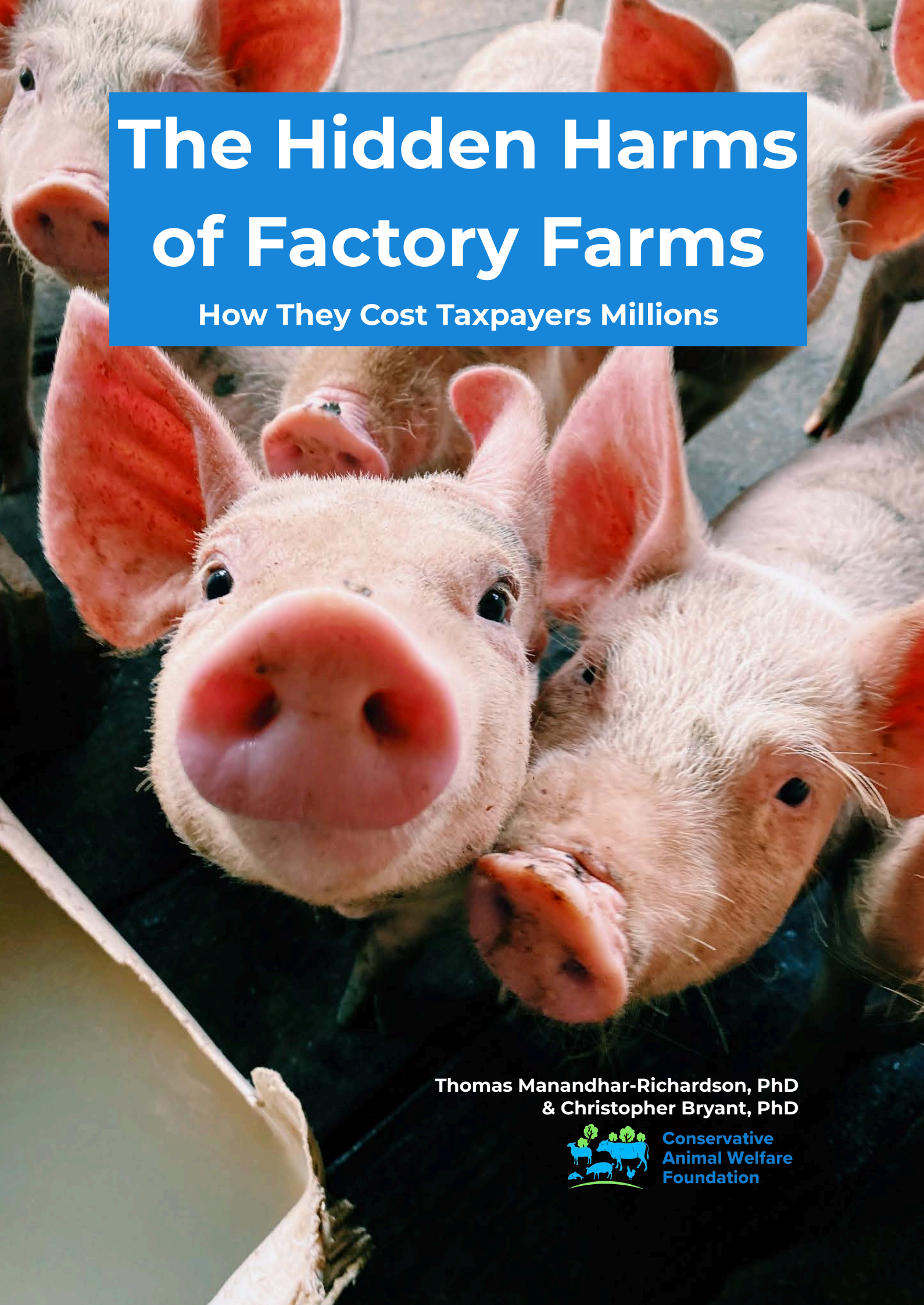

The Hidden Harms of Factory Farms

How They Cost Taxpayers Millions

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Contents

Executive Summary

Livestock farming in the United Kingdom is very different from a few short decades ago. Today, most livestock are consolidated into large factory farms, which have replaced small family farms, especially for pigs and poultry. Although the rise of the factory farm was supposed to make meat cheaper for consumers, it has instead imposed significant costs on society.

This report quantifies the hidden costs of pig and poultry factory farms to the British taxpayer – using publicly-available UK Government data, as well as an original survey of 1,000 UK residents.

We estimate the total amount of the costs to be over £1.2 billion annually. This includes:

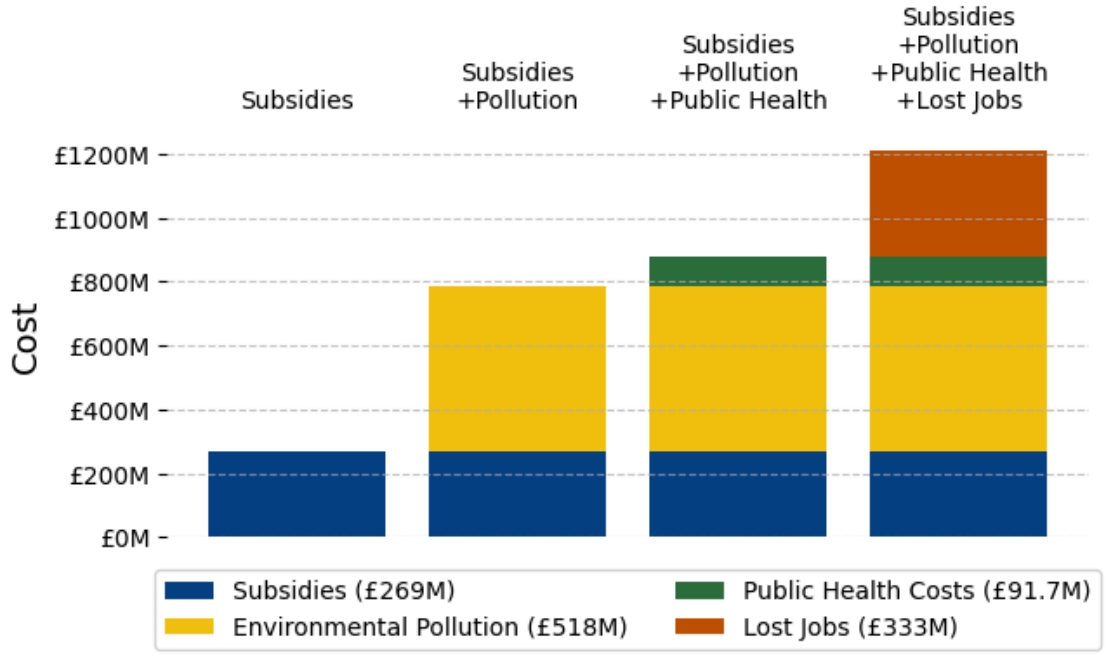
1. **Subsidies:** We estimate 85% of subsidies that go to chicken and pig farmers are consumed by factory farms, amounting to **£269M** a year.
2. **Environmental Pollution:** The cost of air and water pollution from factory farms is estimated to be **£518M**.
3. **Public Health Problems:** The cost of increased respiratory deaths attributable to living near large factory farms is estimated at **£92M**.
4. **Lost Farming Jobs:** We estimate that factory farms have destroyed 14,000 farming jobs with annual salaries not paid valued at **£333M**.

Furthermore, we find little evidence that factory farms make products significantly cheaper, nor that they increase food security. On the contrary, there is no clear pattern of more industrialised animal products getting cheaper than less industrialised products. Moreover, the vast amount of feed that livestock require means that increasing UK meat production means we import more food – not less.

Factory farms have failed to make our food cheaper, failed to improve our food security, soaked up taxpayer money through subsidies, imposed significant costs to the environment and public health, and destroyed thousands of farming jobs.

Policymakers must consider the impact of the £1.2 billion we pay in hidden costs, and restructure incentives to move us towards a more sustainable food production system that benefits all stakeholders, including consumers, farmers, and local communities. In particular, mandatory labels on factory-farmed products should be introduced without delay.

Total Hidden Cost of Factory Farming to The UK: £1.2 Billion



Our Policy Recommendations

1. Do not allow the building or expansion of new megafarm facilities (facilities so big they require DEFRA environmental permits), especially in areas that are vulnerable to river pollution.

2. Restructure subsidies to reward smaller-scale farmers who grow healthier and more environmentally friendly foods, who respect our countryside and champion higher animal welfare based on the 5 freedoms.

3. However the subsidy system is restructured, it should be transparently communicated to the UK public, as there is currently widespread confusion about how the system operates and how many subsidies livestock and factory farms receive.

4. Limit the ability of factory farms to use taxpayer subsidies to export meat more cheaply, ensuring that subsidies enhance UK food security.

5. DEFRA should implement monitoring and restriction of the number of “zero grazing” cattle systems in the UK.

6. DEFRA should monitor animal agriculture jobs specifically, by farm type and animal, to allow us to directly assess the impact of industrial animal agriculture on farming jobs.

1. Background

1.1. UK livestock: from farms to factories

Over the past decade, the UK livestock sector has been intensifying at an alarming rate. The Campaign for Rural England has warned that "small family farms could disappear by 2050", noting that ⅓ of small farms closed their barn doors between 2005 and 2015[1]. These farms have been replaced with fewer, larger facilities that house tens of thousands of animals at a time in cramped conditions.

These extremely large facilities have many names. In the US, they are called *concentrated animal feeding operations* or "CAFOs"[2] and routinely hold over 125,000 chickens or 1000 beef cattle in one facility. In the UK, it is more common to hear the terms "factory farm"[3] or "US-style megafarms"[4]. In this report, we focus on factory farms.

Whilst megafarms are defined by their size (UK megafarms must register with DEFRA, see Appendix C), there is no official definition of a factory farm. Despite this, discussions generally centre on several features:

- Factory farms are typically large, in some cases extremely large.
- Factory farms usually confine animals, often in cages or crates that are barely larger than their bodies.
- Factory farms house large numbers of animals in a small space (known as "high stocking density").

Based on these definitions, most chickens and pigs farmed in the UK are factory farmed; as much as 93.6% of pigs and 79.4% of chickens (See Appendix A for calculations). As a result, our report focuses on the factory farming of chickens and pigs.

Our report does not focus on factory farmed cattle. This is because the percentage of cattle on factory farms is much lower, though data is less available (see Appendix G for a discussion of UK animal agricultural data

[1] Case, (2017).
[2] The Humane League. (2022)
[3] Vidal (2021)
[4] Vaughn (2024)

limitations). A 2019 survey indicated 4% of cattle are kept indoors their entire lives, known as "zero grazing systems"[5]. However, data from the Agriculture and Horticulture Development Board (AHDB) obtained by the BBC suggests that the number of cattle mega farms has been increasing[6]. These megafarms are disproportionately likely to house cattle inside all year, meaning that the true % of factory farmed cattle in the UK is likely significantly higher than 4%. Whilst this suggests a worrying trend towards more factory farmed beef and dairy, we lack detailed enough data, and so focus on factory farmed chickens and pigs.

Given the above, it is unsurprising that factory farms are also generally regarded to be poor for animal welfare. Animal welfare is generally assessed along 5 dimensions (the so-called "5 domains model"): nutrition, health, environment, behavioural interactions and mental states[7]. UK factory farming broadly fails to provide high levels of welfare by the standards of this model.

However they are defined, factory farms are far from what the average UK citizen imagines when they picture a farm. It may not be appropriate to even refer to them as farms at all. The Bureau of Investigative journalism described one intensive chicken unit of 800,000 birds "like something out of a sci-fi film", consisting of "large white polyethene tunnels … .met at the bottom by five mammoth sheds - each as long as a football pitch. Tall metal silos rise up from between the imposing units."[8]

Figure 1: *An poultry factory farm in Shropshire, UK, 2018, reproduced from Caffyn (2021)*[9]

[5] DEFRA (2019)
[6] Prior (2024)
[7] McCulloch (2023)
[8] Wasley & Davies (2017)
[9] Caffyn (2021)

Factory farms justify their existence based on the promise of cheap meat for consumers and increased food security. However the price of food production is not only felt at the supermarket checkout. There are numerous hidden costs that the UK pays for by relying on factory farms, some of which instead reduce UK food security. Our report seeks to expose and quantify these costs, as well as interrogate the benefits of factory farms.

1.2. Subsidies

The current system sends taxpayers' money to factory farms, which can be thought of as a "factory farming meat tax".

The system of agricultural subsidies in the United Kingdom is complex and currently in flux[10]. At the time of writing, the UK is moving from the Basic Payment Scheme (BPS) under the European Union's Common Agricultural Policy (CAP), towards the new Environmental Land Management Scheme (ELMS). While the CAP rewarded farmers based primarily on the amount of land they farm, ELMs aims to reward farmers for implementing more environmentally-friendly practices. Direct payments under the BPS are being gradually reduced, but will still be paid until they are fully phased out in 2027. The exact form the new system will take is currently being debated, meaning the UK has a unique opportunity to transform its agricultural system for the better.

The current system hides these costs in two key ways:

1. Livestock farmers are awarded subsidies based on their land, not their animals.
2. Factory-farmed chicken and pork benefit considerably from crop subsidies.

Contrary to popular belief, livestock farmers do not receive significant government subsidies directly for their animals. Most farmers are not given money per chicken, pig, or cow. This system creates confusion among the public about the amount of subsidies livestock farmers receive.

[10] Coe & Uberoi (2023)

When subsidies go towards growing cheap crops, and those crops are sold as animal feed, they are indirectly subsidising livestock. And when most farmland goes towards animal feed, then most subsidies end up inadvertently fuelling the livestock industry. In 2019 Greenpeace estimated that about 71% of European farmland was used for livestock feed[11], with a more recent 2024 analysis in *Nature Food* finding that an alarming 82% of EU agricultural subsidies go towards livestock[12]. This is despite less than half (38%) of subsidies going directly to livestock farmers. In our report we calculate this specifically for the UK for the first time.

The WWF report 'The Future of Feed' gives estimates of the percentage of different crops used for livestock feed in the UK[13]. The report estimated that farmed animals consume 51% of our wheat, 64% of barley, 36% of oats, 60% of maize, and 92% of field peas. Devoting so much farmland to growing animal feed, when it could be used to produce cheaper food for the UK public harms UK food security. This also implies that much of the subsidies paid to growers of these crops are, in fact, subsidies to livestock[14].

To be clear, this report does not argue that all livestock subsidies are undesirable. Farming is difficult work, and farmers are facing unprecedented challenges such as climate change and economic volatility[15]. Even the hardest-working farmers will often struggle. Because of this, some farming subsidies are necessary to ensure a vibrant farming sector that provides jobs and food security to the UK. But as we will show, a substantial proportion of these subsidies go to factory farms, which provide few of the valuable functions that traditional farming should offer.

1.3. Environmental pollution

Animal farms, especially factory farms, are responsible for pollution of their local environments. Animal agriculture pollutes our environment in three key ways: through air pollution, pollution of water systems, and climate change. The substantial climate impacts of animal agriculture are widely discussed elsewhere (see Our World in Data, for example[16]), and are a

[11] Greenpeace (2019)
[12] Kortleve et al. (2024)
[13] WWF (2022)
[14] Springmann (2022)
[15] Stevenson (2024)
[16] Ritchie (2019)

global problem. Here, we focus on air and water pollution, which are felt primarily locally, in the communities where factory farms exist.

According to the World Health Organization, air pollution is the biggest environmental risk to health in the European Union (EU), causing hundreds of thousands of deaths annually[17]. A key source of air pollution is ammonia, which reacts with other compounds in the air to form particulate matter.

Agriculture is the main source of ammonia pollution in the UK, causing 87% of emissions, and animal agriculture is primarily responsible[18]. This happens when animal faeces and urine decompose. One study found that 80% of European agricultural air pollution can be traced to animal agriculture[19].

It is not only local rural populations that are at risk. Airborne pollution from UK livestock can travel long distances, affecting urban areas far from the original source. For instance UK farming is responsible for around 32% of particulate matter pollution in Birmingham, and 25% in London, surpassing local urban sources of pollution[20].

Whilst countrywide ammonia emissions have been falling over time, areas that have granted planning permission to factory chicken farms have seen *increases* of ammonia air pollution of up to 40%[21]. For example, much of Herefordshire's ammonia emissions can be accounted for by factory chicken farms from a single supplier. Indeed, factory farms are particularly polluting sources of ammonia. Concentrating many animals in a small area produces higher concentrations of ammonia in the air, which increases risk. Keeping animals in confinement means that their faeces and urine mix much more than if they range freely. This mixing produces more ammonia than either waste product alone[22].

In addition to health-damaging air pollution, factory farms also generate noxious odours. The corporations that run them downplay this link, correctly pointing out that most farms will smell of animals to some extent,

[17] World Health Organisation (2016)
[18] AHDB. (n.d.)
[19] Leip et al (2015)
[20] UCL (2023)
[21] Wasley & Heath (2024)
[22] Van der Hoeven (2023)

and that smell is not always pleasant. However, there is a large difference between normal farm smells and the intense, headache-inducing odours of a factory farm. One review of 31 studies on industrial odours and health (13 were on large-scale livestock farms) found consistent evidence that nearby residents suffered more headaches and coughs due to the smells than those who lived further away[23]. On the ground reports from Herefordshire and Shropshire have found that factory chicken farms produce terrible smells that local residents say affect their wellbeing, but this is often ignored during planning discussions[24].

Factory farms also pollute rivers, primarily when nitrogen and phosphorus from animal faeces and manure leaks into rivers. When these nutrients enter the water system, they cause eutrophication – excessive growth of algae, which depletes oxygen and kills fish and other aquatic animals. UK rivers are in crisis, with only 15% meeting the criteria for good ecological status[25]. And as with air, a large amount of UK water pollution comes from agriculture[26], and the majority (73%) of agricultural water pollution can be traced to animal agriculture[27].

Farmers need to fertilise their crops, and manure is a key source. Nitrogen and phosphorus are essential nutrients for the soil. But we produce more manure than UK farmland can handle. Every region in the UK now has more nitrogen than it can absorb, and regions with more factory farms have the biggest nitrogen surplus[28]. Manure alone produces 45% more phosphorus than is required by all UK agriculture land[29].

When it comes to river pollution, factory farms are uniquely damaging compared to other forms of livestock farming. When farms are smaller scale and spread out, manure is spread across a wide area. Factory farms generate lots of waste in a small area which surrounding lands cannot handle. In 2021 it was found many operators pay manure brokerage companies to remove the waste as local farms cannot keep up[30]. A 2024

[23] Guadalupe-Fernandez et al. (2021)
[24] Caffyn (2021)
[25] Environment Agency (2022)
[26] Holden et al. (2017)
[27] Leip et al. (2015)
[28] Westcott (2023a)
[29] Withers et al. (2022)
[30] The Food, Farming and Countryside Commission (2021)

report argues that 10 UK river catchment areas are at risk of becoming "dead zones" in the coming years if factory farms continue to proliferate[31].

1.4. Public health problems

By polluting our air and water, factory farms make us sicker. People living near factory farms around the world report increased respiratory diseases, and even higher death rates.

One particularly thorough study of the entire rural and semi-rural Dutch population, some 4 million people, found that living near pig farms, increased mortality risk from respiratory diseases and pneumonia[32]. There were also risks observed for those living close to poultry farms – but only when they were intensive – again suggesting that factory farms are uniquely problematic.

In fact, 75% of studies in the last 10 years show negative health outcomes for those who live near poultry factory farms[33]. In North Carolina, USA, which has some of the highest concentrations of pig and poultry factory farms in the world, living near hog farms increased emergency department visits for urinary tract infections caused by E. coli[34].

Even more concerning, there is evidence that society's most vulnerable bear the brunt of the negative health effects of factory farms. A systematic review of 38 studies found that whilst not all studies found negative effects of living near factory farms, there was strong evidence that those working in them (who are often poor and/or migrant labour with few other options) had worse respiratory health[35]. Within this review, all four studies of asthma in children found higher rates when they attended schools near factory farms. One study found that the lifetime risk of an asthma diagnosis was 2.67 times higher if they lived 1.5 miles from a beef or dairy factory farm[36]. Lastly, large scale studies find that children and the elderly who live in areas with high numbers of livestock are at increased risk of pneumonia, which can be deadly for these vulnerable groups[37].

[31] Soil Association (2024)
[32] Simões et al. (2022)
[33] Perry (2024)
[34] Holcomb et al. (2022)
[35] Douglas et al. (2018)
[36] Schultz et al. (2019)
[37] Baliatsas et al. (2020)

1.5. Fewer and worse farming jobs

Factory farms undercut small-scale, family farmers, making them less economically viable to operate. In the long term, factory farms not only decrease the number of farming jobs, but those they offer in replacement are lower-quality and lower-paid work[38]. A combination of fewer and worse jobs can be devastating to the food security of rural economies, who are less able to afford a nutritious diet even as they live amongst the land where UK food is produced.

A recent analysis of the EU farming sector (as a whole, including crops) found that between 2007 and 2022, farming jobs *decreased* by 38%, with most lost jobs on small-scale farms[39]. Decades of studies in the US have failed to find evidence that industrialising the livestock sector produces jobs[40]. There is reason to suspect this is also true for the UK. As shown in the graph below, the UK has seen 2 out of 3 farming jobs eliminated since the 1960s, with over 1.1 million agricultural jobs in 1961 falling to around 360,000 in 2019. During the same period, meat production nearly doubled from 2.2 million tonnes in 1961 to 4.1 million tonnes in 2019[41]. Producing almost twice as much meat with one third of the workers is the definition of intensification.

[38] Chalmers (2022)
[39] Greenpeace (2024)
[40] Andrews & Kautza (2022)
[41] Ritchie et al. (2023)

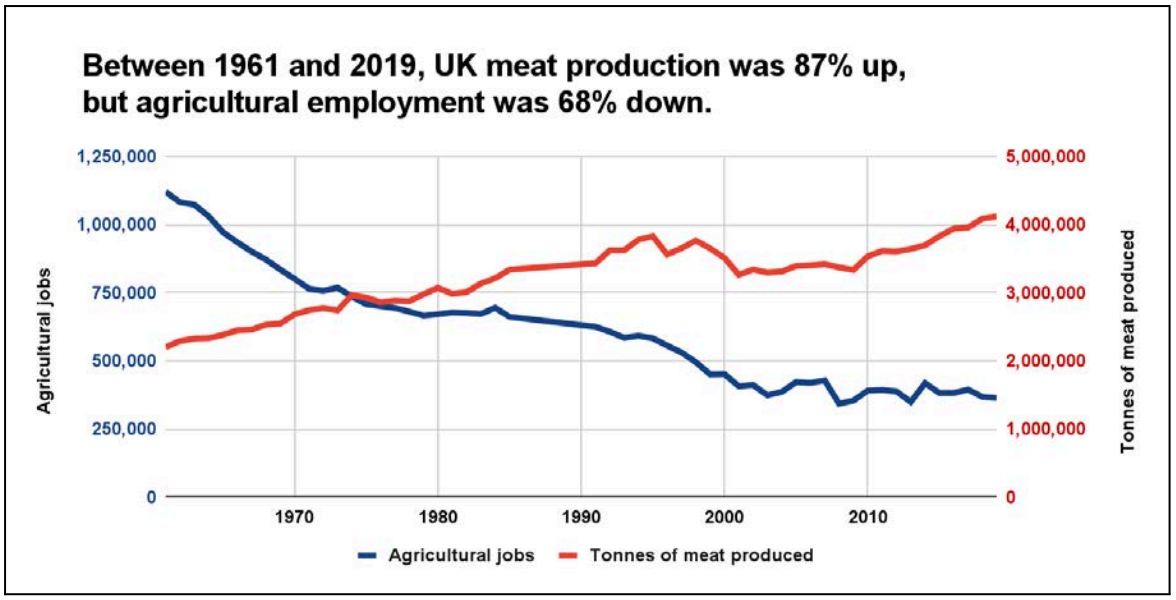


Figure 2: UK meat production and agricultural employment, 1960-2019. By Bryant Research[42].

These large farms are replacing the smaller farms that have fed the UK for generations. The Bureau of Investigative Journalism reported DEFRA figures revealing that 4,000 farms closed down in the UK between 2010 – 2016[43]. Three-quarters of the farms that closed down were in the smallest category (<20 hectares), while the number of large farms (>100 hectares) remained constant.

As well as reducing the number of jobs, centralisation and industrialisation leads to stagnant wages and worse working conditions[44]. Work on intensive farms usually means exposure to higher levels of air pollution, health risks, narrower and more repetitive tasks, and isolation[45].

Proponents of factory farming argue that it improves food security and reduces the cost of food – but neither of these supposed benefits are clear, as we show in Section 4.1 on Food Security and Section 4.2 on Cost Savings.

[42] Flores (2024)
[43] Wasley & Davies (2017)
[44] Bryant & van der Weele (2021)
[45] Dillard (2008)

2. Methods

We quantified the costs of factory farms in four ways:

1. Agricultural subsidies paid to factory farms
2. Environmental pollution from factory farms
3. Health issues from living near factory farms
4. Reductions in the number of farming jobs due to factory farms replacing smaller-scale farms

Additionally, we critically evaluate two claimed benefits of factory farms:

1. The land use of industrially produced meat
2. The change in price of animal products to consumers and the price paid to farmers

To do this, we conducted desk research and statistical analyses of public data (primarily from the UK Government). Additionally, we conducted an original, UK-wide survey of 1,000 people to investigate what the UK public understands about the costs of factory farming.

We detail our methods at a high level here. For more details on the exact modelling and assumptions for each variable, see the Appendices.

Inevitably, we could not quantify all of the diverse damage caused by factory farming. Notably, this report does not quantify hidden costs from antimicrobial resistance due to overuse in farm animals, deaths from food poisoning, contributions to climate change, nor healthcare costs from excessive meat consumption facilitated by cheap meat.

2.1. Quantifying the costs of factory farming

2.1.1. Subsidies

We estimated the subsidies consumed by livestock overall, as well as factory farms for chickens and pigs. We used publicly available data from DEFRA[46] and data from other trusted sources such as the World Wildlife Federation (WWF)[47].

To estimate the subsidies associated with livestock, we combined several subsidies:

- The Basic Payments Scheme (BPS)
- Agri-environmental schemes
- Animal disease compensation
- Coupled payments

BPS and agri-environmental payments go to livestock directly through grassland that they are grazed on, or indirectly when grassland or cropland subsidises animal feed. In fact, 40% of UK cropland and nearly all grassland goes towards feeding livestock[48]. We use the percentage of agricultural land required for livestock (and their feed) as a proxy for the percentage of BPS and agri-environmental subsidies that go to livestock.

Coupled payments are a small class of subsidy awarded based on the production of specific animals in specific areas, such as cows and sheep in some areas of Scotland. We obtained coupled payment numbers[49], as well as disease compensation subsidies from DEFRA[50].

To estimate the percentage of subsidies that go specifically to factory chicken and pig farms, we estimated the total subsidies going to chickens and pigs more generally, and multiplied that by the percentage of chickens and pigs on factory farms. For example, 93.6% of pigs are on factory farms[51], so 93.6% of pig subsidies likely go to factory farms.

[46] DEFRA (2024a)
[47] WWF (2022).
[48] WWF (2022).
[49] DEFRA (2024b)
[50] Animal & Plant Health Agency (2023)
[51] World Animal Protection (2024)

As chickens and pigs are almost entirely fed crops, we ignore subsidies for grazing land and focus on subsidies that go towards cropland to grow their feed. We partition UK cropland into land that grows food for humans, chickens, pigs, and cows using a 2023 report by the Agriculture and Horticulture Development Board (AHDB)[52].

We also assign a proportion of the animal disease compensation subsidies to chickens and pigs. There are currently no coupled payments assigned to chickens and pigs.

Our full methods are detailed in Appendix B

2.1.2. Environmental Damage

We estimate the cost of environmental damage from factory farms from two key factors: air pollution from ammonia, and river pollution from manure runoff.

To calculate air pollution, we used UK Government data on:

- The total ammonia emitted from all sources[53]
- The "cost per ton" of ammonia emitted (for use in policy cost-benefit calculations)[54]
- The percentage of ammonia emissions from agriculture[55]
- The percentage of agricultural emissions from pigs and chickens[56]

We multiplied these together, then further multiplied by the percentage of chickens and pigs kept on factory farms (see Appendix A), then summed these numbers to get the total cost of ammonia released by factory farms.

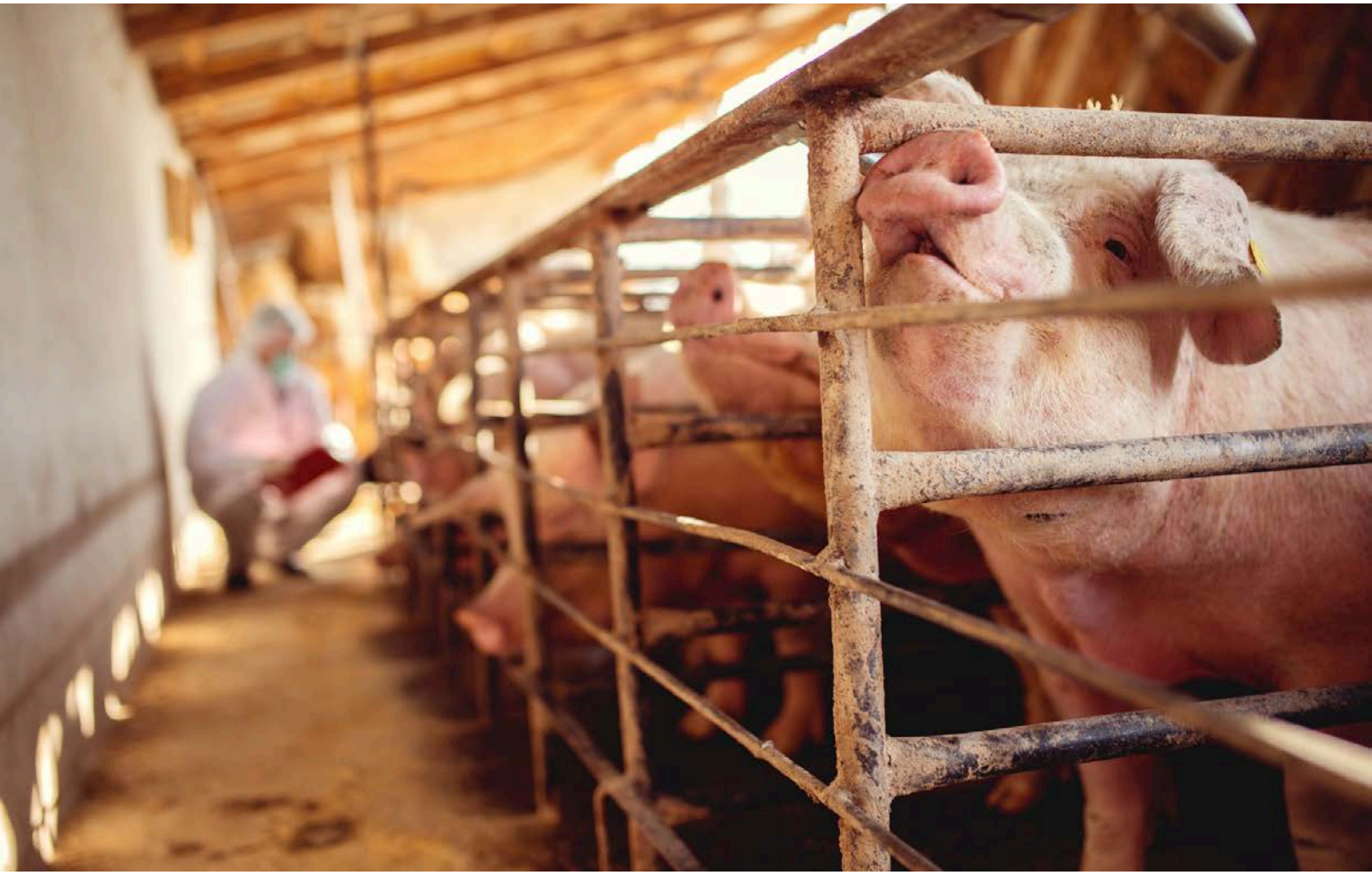
To estimate the costs of factory farm river pollution, we used data on the investment required to protect and improve the quality of the current water system. This was taken from The Environment Agency's report on The Government's River Basin Management Plan[57]. Specifically, the amount of investment required for "rural land management", which primarily refers to fertiliser runoff from agriculture. We use this figure as a proxy for the cost of river damage, as this money would likely not need to

[52] AHDB (2024a)
[53] DEFRA (2024c)
[54] DEFRA (2023a)
[55] DEFRA (2024d)
[56] Misselbrook & Gilhespy (2020)
[57] Environment Agency (2022)

be invested if agriculture had no negative impact on rivers. It is thus an "opportunity cost".

Agricultural pollution comes primarily from synthetic fertilisers and animal manure that leaks into rivers. To partition the damage into these two factors we use the 2023 British survey of fertiliser use[58]. This survey also breaks down the percentage of manure spread on UK fields by source-animal (cow, chicken and pig). As with other figures, we multiply the impact from cows, chickens and pigs as a whole by the percentage of these animals on factory farms and sum them to get the impact of factory farms.

Our full methods are detailed in Appendix D

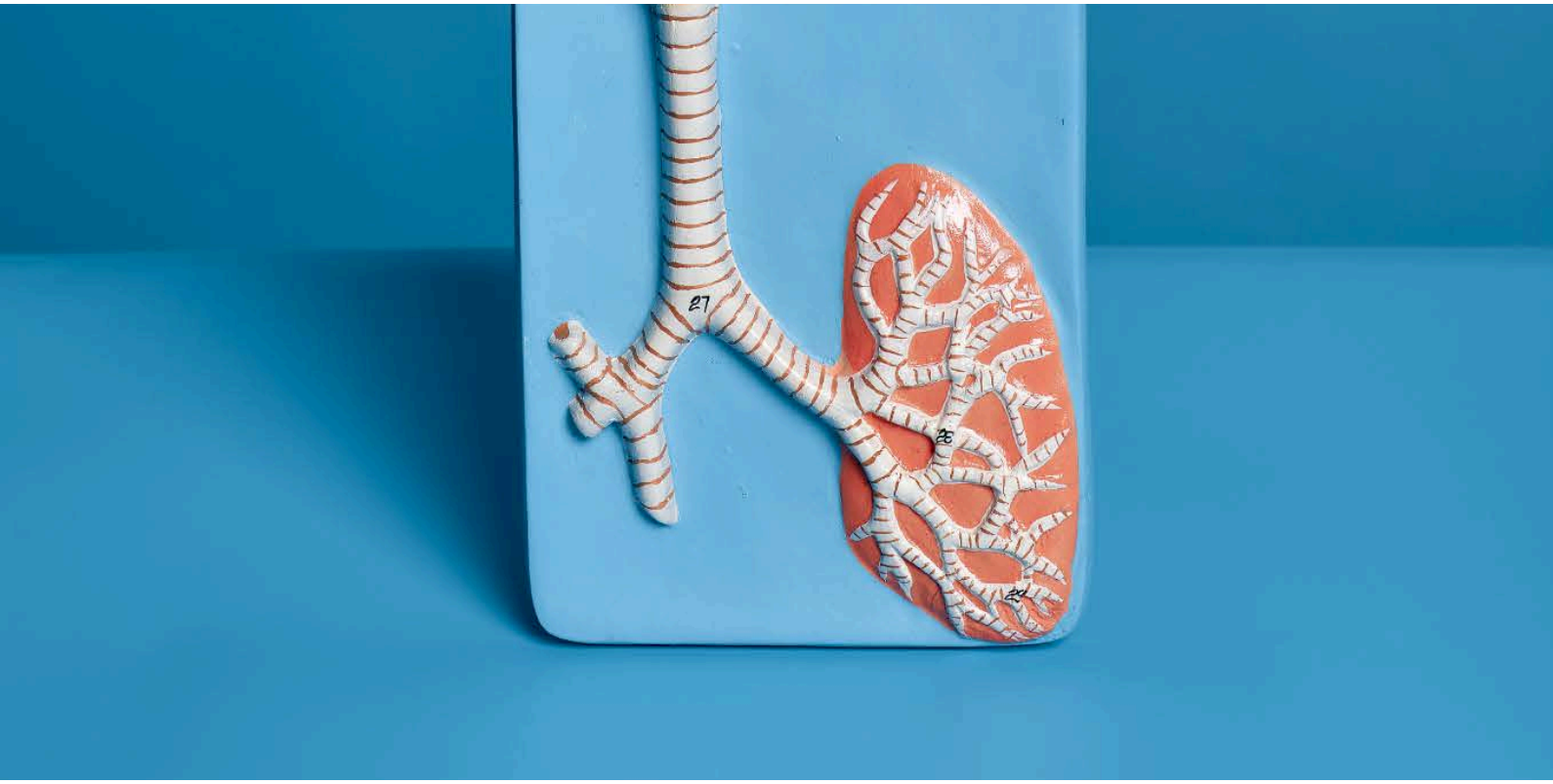


[58] Office for Statistics Regulation (2024)

2.1.3. Health Costs

To estimate healthcare costs associated with factory farms, we calculate the increased deaths from respiratory disease that may be attributable to living within 2km of a megafarm. We use mega farms rather than factory farms here because we are only able to get reliable location data on megafarms, as they are registered with DEFRA (see Appendix C). See 1.1. UK livestock: from farms to factories for the difference between a factory farm and a megafarm as we define them.

We chose respiratory system diseases (RSD) as this is a significant category of diseases, and the category most strongly linked to living near megafarms. We used a recent large, high quality study[59] to obtain hazard ratios for RSD from living within 2km of a poultry or pig megafarm, and combined this with our estimates of the number UK residents living near these facilities. We estimate excess deaths that may be attributable to these facilities, and using the statistical value of a life for the UK[60], we calculate the value of health damage rural communities may suffer. Our full methods are detailed in Appendix E



[59] Simões et al. (2022)
[60] Sweis (2022)

2.1.4. Farming Job Losses

There are two sides to negative changes in jobs over time: jobs that are destroyed, and jobs that are not created that otherwise would be. For example, future autonomous taxis may reduce taxi-driver jobs in the short term, but have longer term effects because fewer taxi driver jobs will be created. When we estimate "job losses" due to industrialisation of the meat sector, we combine both of these.

The industrialisation of the livestock sector is not a single event or even a series of events; it is composed of hundreds of small changes over years. Examples include opening new factory farms, introducing monitoring technology that reduces the need for farmhands to inspect animals as often, and a need for farm labour due to industrial economies of scale. Further complicating things is that there is no publicly available data on farming jobs over time for the UK that we could find.

We tackle these issues using regression modelling to estimate the livestock sector jobs lost/not created for the UK indirectly. We do this two ways:

1. We examined the impact of pork and chicken production on overall agricultural jobs.
2. We analysed data from agricultural jobs across multiple European countries over the past few decades. This allows us to statistically isolate common trends in livestock industrialization's effects on agricultural employment. We can then apply this model to the UK data specifically.

We used two datasets:

- Agricultural employment data from multiple countries.
- Meat production data (pork, and poultry) for the same countries.

We used data from European countries from 1991-2019, with additional data we could find from 1961-1991 for select countries including the UK and US. All data was taken from Our World In Data, who in turn source the data from government agencies and organisations such as the UN and World Bank.

Using a fixed effects linear regression model, we predicted agricultural jobs based on pork and poultry production, accounting for yearly and country-specific trends. This method helps isolate the potential effect of meat production on agricultural employment across different countries and time periods. We can combine this model with UK data to get UK specific effects. Our full methods are detailed in Appendix F.

2.2. Evaluating the benefits of factory farms

2.2.1. Agricultural land use following a transition to alternative proteins

We modelled the agricultural land required to provide the current UK supply of meat, dairy, and meat and dairy alternatives under three different consumption scenarios[61]:

- **Scenario A – Business as usual** (3.2 million tons of meat, 4.7 mt of milk, 0.23 mt of plant-based milk, and 0.08 mt of plant-based meat)
- **Scenario B – Replacing 50%** (1.6 million tons of meat, 2.35 mt of milk, 2.8 mt of plant-based milk, 1.9 mt of plant-based meat)
- **Scenario C – Replacing 100%** (0 million tons of meat, 0 mt of milk, 5.3 mt of plant-based milk, 3.6 mt of plant-based meat).

The quantity of each food source was calculated to hold constant the total number of calories coming from meat, dairy, and alternatives, and hold constant the proportion of meat/alternatives-to-dairy/alternatives. In other words, Scenarios B and C do not entail a reduction in calories, nor in amount of food.

2.2.2. Cost savings due to factory farms

To assess the claim that factory farms have significantly reduced prices over the past few decades, we graphed 3 variables:

1. Inflation, or the general price level of goods and services in the UK over time. For this we used the Office for National Statistics' Retail Price Index (RPI)[62]
2. The retail prices of animal products, which we also got from the RPI.
3. The price paid to farmers of various agricultural products. We got this from the Agri Price Index[63].

[61] NB total consumption is calculated based on OECD and AHDB estimates of kg per capita consumed multiplied by the total population, whereas total production is reported directly in tonnes by FAO; hence these figures may be different.
[62] Office for National Statistics. (n.d.)
[63] DEFRA (2024e)

2.3. UK Survey

As well as the desk research and modelling described above, we also conducted an original nationwide survey of 1,000 UK residents. Our sample was a broad cross section of the UK, containing all groups of age, region, race, education, income and religion (See Appendix G).

The survey contained questions on whether the participants would be happy living near a regular farm or a factory farm, or whether they were concerned about environmental and public health issues from factory farms. We also asked about how they felt about purchasing products from factory farms. Lastly, we asked how satisfied they were with current allocation of subsidies, and how they felt agricultural subsidies should be allocated.

The full survey instrument is available upon request from Bryant Research[64].

[64] www.bryantresearch.co.uk

3. Quantifying hidden costs of factory farming

Whenever a result is described as “significant”, it is from a statistical model and is statistically significant at $p < 0.05$. We also employ Bonferonni-Holm corrections for multiple comparisons where necessary. Survey findings are presented alongside the topic they relate to.

Many of these estimates relate to the population who live near megafarms. We estimated that 0.64% of households in the UK lived within 2km of a pig megafarm, and a further 2.7% lived within 2km of a poultry megafarm. We found that 1.5% of UK households live within 2km of 2 or more poultry megafarms and 0.3% live within 2km of 2 or more pig megafarms.

This means that among households near megafarms, almost half are actually near two or more. This is because they tend to be built near each other. This is a worrying finding as the health and pollution dangers of megafarms are likely to be far worse when they are clustered in the same area.

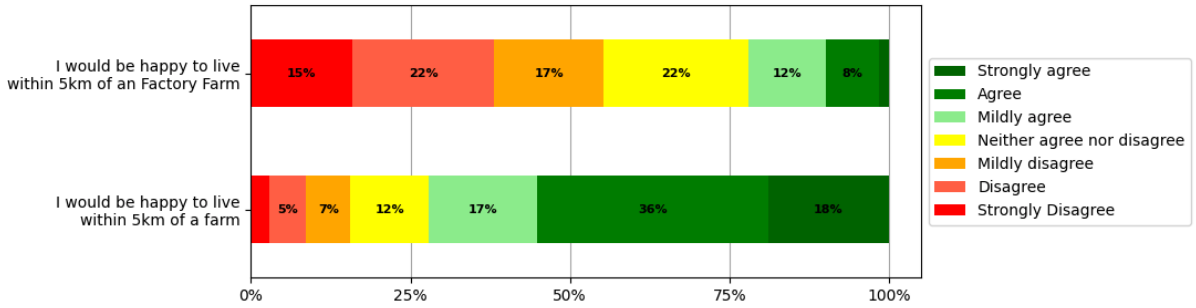


Figure 3: UK public opinion on whether they would live near a factory farm.

Survey respondents reported that they’d be happy to live near a farm (72.1% agreed), unless that farm was a factory farm, where 55.2% said they would not be happy. 15.8% expressed a strong preference against living near a factory farm.

3.1. Subsidies

We estimate that livestock directly and indirectly received £2.1B in agricultural subsidies in 2023, around 73% of all UK agricultural subsidies. This is largely consistent with recent results from the EU, though slightly smaller[65].

Livestock farmers receive subsidies directly for:

1. Owning farmland where they house and graze animals
2. Environmental initiatives
3. Other smaller subsidies such as animal disease compensation and coupled payments.

However, they also indirectly consume an equally large value in subsidies through animal feed.

Worryingly, we find that 84.5% of subsidies that go to chicken and pig farmers are consumed by factory farms. This amounted to £269M in 2023. The intention of agricultural subsidies is to ensure that UK farmers earn a living for their work, not factory farm owning corporations who awarded £12M in bonuses to their directors alone in 2023[66].

The intention of agricultural subsidies is to ensure that UK farmers earn a living for their work, not factory farm owning corporations who awarded £12M in bonuses to their directors alone in 2023.

[65] Kortleve et al. (2024)
[66] Westcott (2023b)

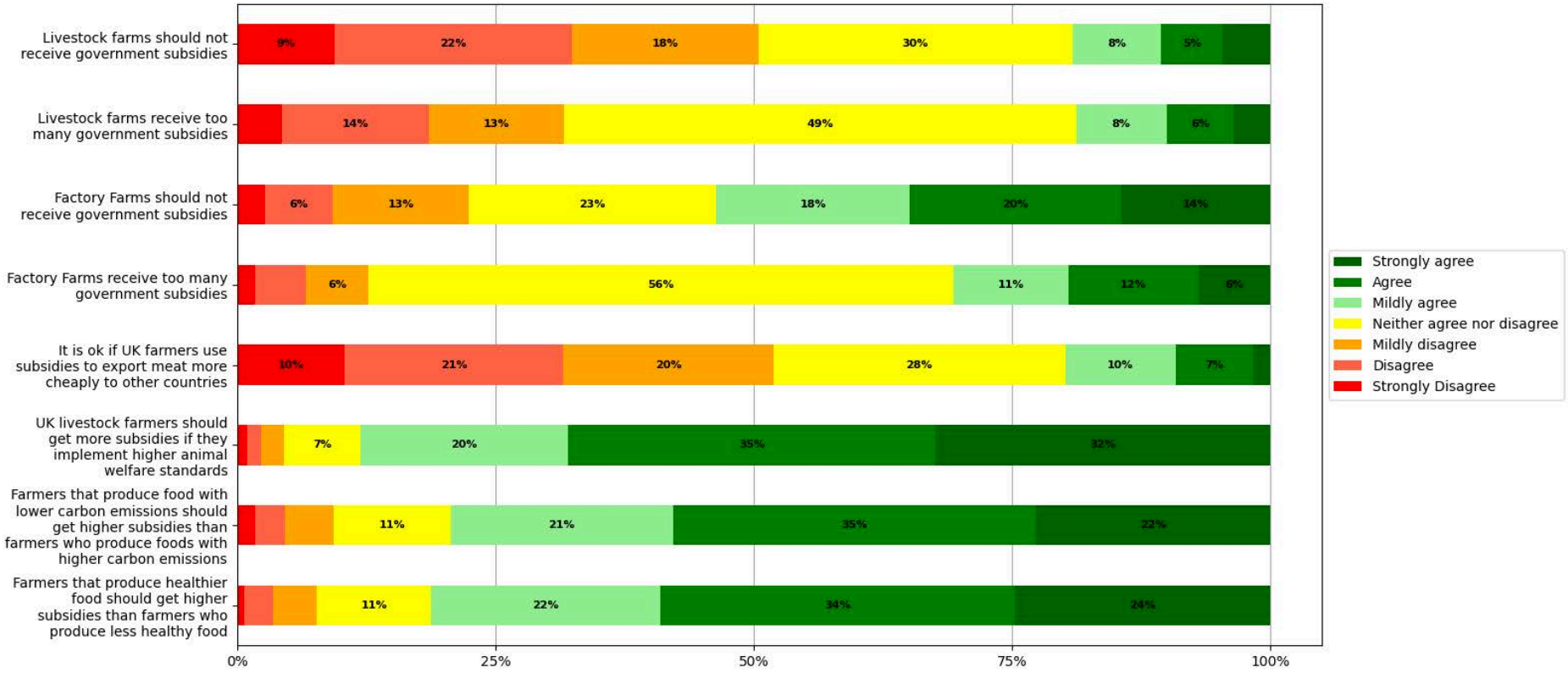


Figure 4: UK public opinion on how agricultural subsidies should be allocated

As shown in Figure 4, survey respondents were generally in favour of livestock farmers receiving subsidies (50.5% in favour), though a similar number (49.6%) were unsure whether they received too many subsidies.

On the other hand, a slim majority of respondents agreed that factory farms should **not** receive any agricultural subsidies (53.6%), with just 22.4% disagreeing. Whilst 56.6% were unsure whether factory farms received too many subsidies, over twice as many people thought they did (30.7%) than thought they didn't (12.7%).

The fact that large numbers of the public are unsure of whether livestock farmers and factory farms receive too many subsidies illustrates the confusing and perhaps hidden nature of the subsidy system.

There was clear agreement among respondents that farmers should receive greater subsidies if they implemented higher animal welfare standards (88% agreed), produced food with lower carbon emissions (79% agreed) and healthier food (81% agreed).

We agree with the UK public that some farming subsidies are necessary. However, it is not in the interest of the UK or its farmers if large amounts of subsidies go towards factory farms, who as we will see, pollute rivers, sicken local communities, automate away jobs at every opportunity, whilst failing to uphold high animal welfare standards that British citizens expect.

3.2. Environmental Damage

In total we estimated the cost of air pollution from ammonia discharged from chicken and pig factory farms to be £458M. Additionally, we estimated the cost of river pollution from manure produced in factory farms to be a further £60M. In total, factory farms may be responsible for pollution costing the UK as much as £518M a year. The results are broken down by species in Table 2.

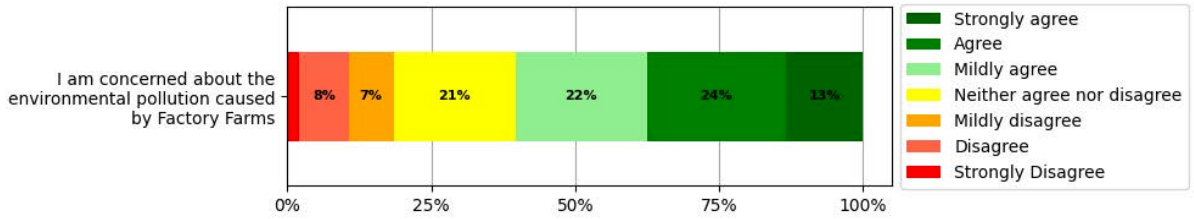


Figure 5: UK public opinion on concern about environmental pollution from factory farms

Our survey shows the British public recognises the dangers of factory farm pollution: 59% were concerned by the environmental pollution caused by factory farms, and 13% were strongly concerned.

Animal	Animals on factory farms (%)	Subsidies consumed	Cost of excess respiratory deaths	Annual cost of ammonia pollution from factory farms	Annual cost of river pollution from factory farms
Chickens	79.4%	£192M	£50M	£242M	£23M
Pigs	93.6%	£78M	£41M	£143M	£37M
Total	NA	£269M	£92M	£457M*	£60M

Table 2: A summary of results. Note that £ amounts are rounded to the nearest £M, so totals may not appear to sum correctly. *Note that the total for ammonia pollution includes an additional £88M in damage due to pollution from growing animal feed.

3.3. Health Costs

We estimate a 1.03% increase in deaths from Respiratory System Disease (RSD) for the 2M people who live within 2km of a megafarm. Using the "Value of a Statistical Life"[67] for the UK, the potential loss of life is worth £91.7M annually.

The increased risk was higher for those living near pig megafarms (where risk of death from RSD was 1.7-3.4% higher) than poultry megafarms (0.4%-0.9% increased risk). However since more people live closer to poultry megafarms than pig megafarms, the cost is higher (£50.4M a year).

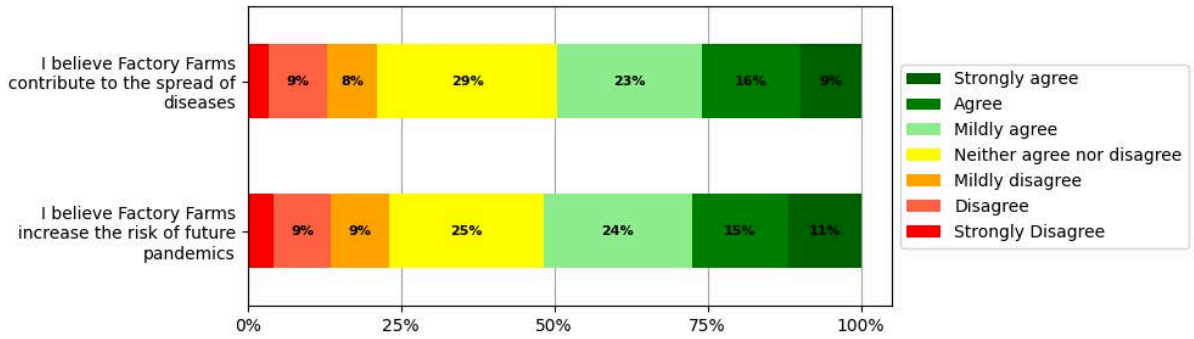


Figure 6: UK public opinion on whether factory farms contribute to disease and pandemics

We found that around half of respondents believed that factory farms contribute to the spread of disease and pandemics. Of the half that didn't, 25-30% did not know, and a minority of 20-25% disagreed.

3.4. Farming Job Losses

We found that industrialisation of the UK livestock sector has both stalled job creation and eliminated jobs at different times in previous decades. As seen in Figure 7, meat production remained steady and the sector cut jobs between 1990-2000, whereas between 2000-2019, the sector increased meat production, but did not create any new jobs in doing so. Without the influence of factory farms, this market growth would have created thousands of farming jobs.

[67] Sweis. (2022).

Our econometric model (see Appendix F) suggests that if the UK livestock sector had halted industrialisation at the year 2000, by 2019 the sector would have created 14,000 new jobs across the entire agricultural sector, an increase of 3.7%.

Given an average farm worker salary of £23,800[68], this results in £333M in "wages not paid".

We should emphasise that some technological progress is both inevitable and beneficial for an economy. But our analysis serves to highlight the cost that industrialising the livestock sector has on farming jobs. A move back towards smaller scale farming is likely to create farming jobs.

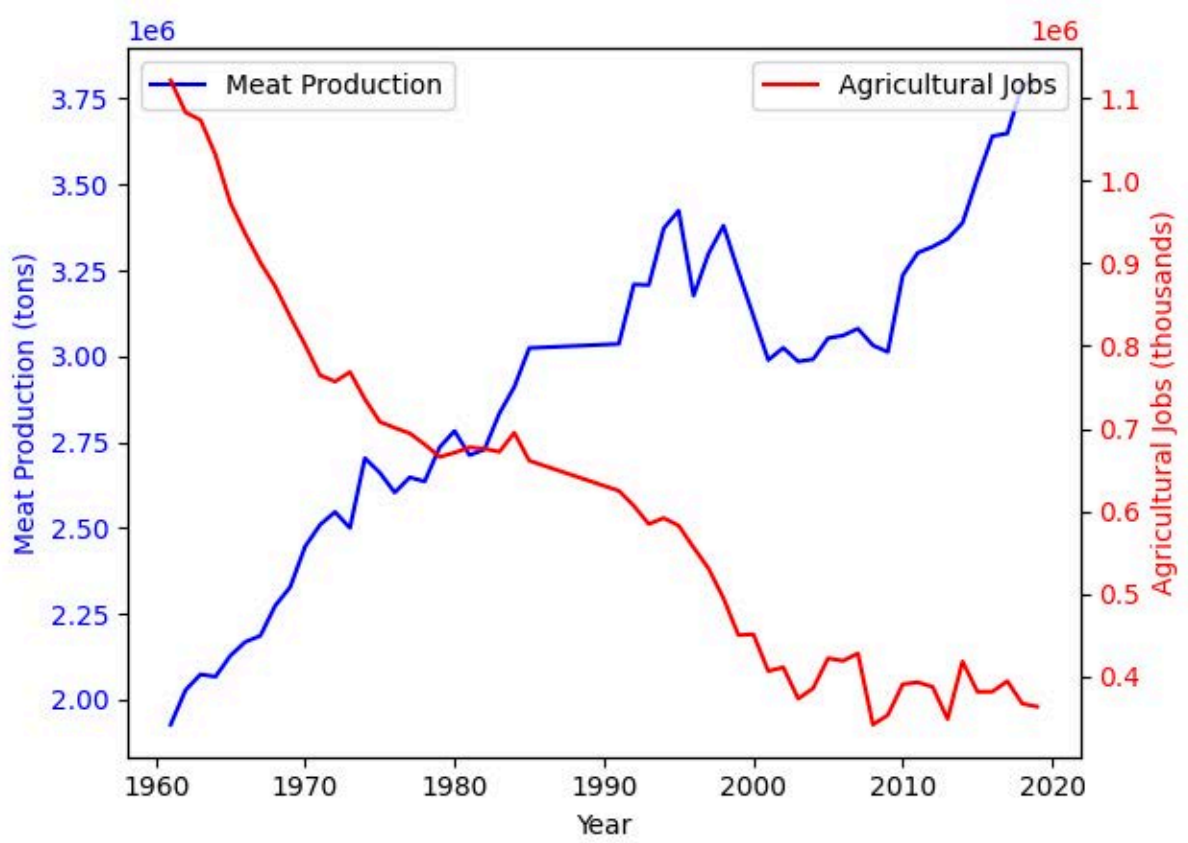


Figure 7: The change in meat production and UK agricultural jobs, 1960 to 2020 (the latest data which was available).

[68] Talent.com (2024)

Building on this, in our survey we found overwhelming agreement among the UK public that factory farm negatively impact small-scale farmers:

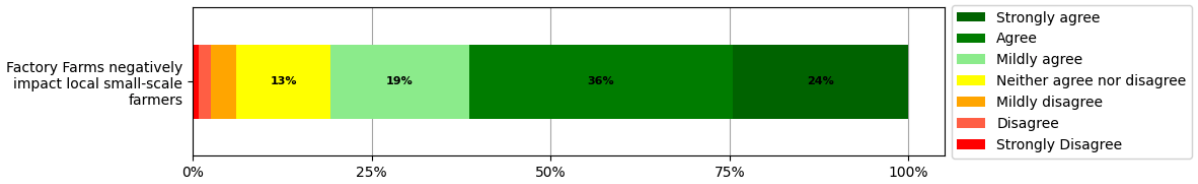


Figure 8: UK public opinion on whether factory farms impact small-scale farmers

3.5. General attitudes towards factory farms

Lastly, we found that 52.1% of consumers actively tried to avoid products from factory farms, and 71.5% of consumers reported being willing to pay more for products *not* from factory farms.

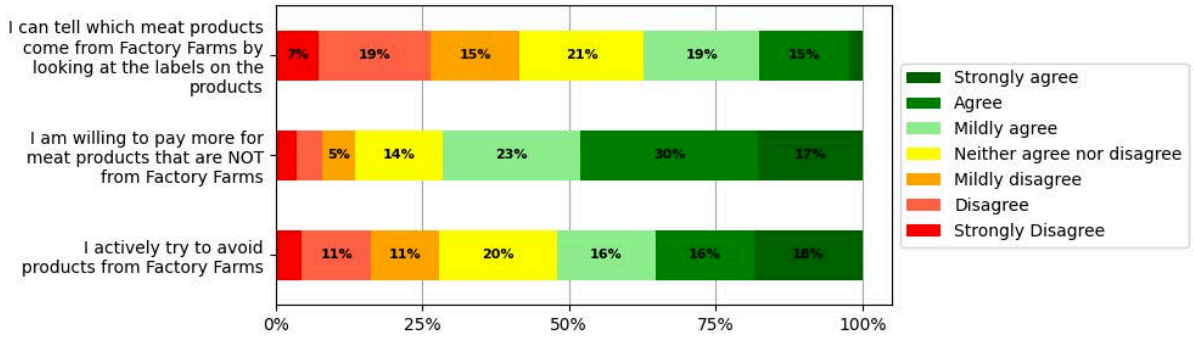


Figure 9: UK public opinion on labelling of factory farm-produced animal products

Despite this, more often than not, consumers struggled to identify when products came from factory farms: 41.6% of participants reported not being able to identify when a product came from a factory farm based on their labels, whilst 37.3% said they could. This suggests that consumers would find mandatory labelling of factory farm products useful when choosing products that align with their values and preferences.

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4. Scrutinising the benefits of factory farms

Our analysis has highlighted multiple hidden costs that factory farms inflict on society, but what about the benefits? Proponents of factory farms claim two major benefits:

1. Fulfilling consumer demand for meat at the lowest possible price
2. Increasing food security by allowing more food to be produced in the UK.

However, as we will argue in this section, these benefits are either exaggerated or misleading. Moreover, while factory farms are more efficient than some forms of protein production, there are far better options in terms of efficient use of land and other agricultural resources.

4.1. Food Security

4.1.1. Do factory farms produce more food from less land?

At first, it might seem obvious that factory farms decrease the amount of land required to produce food – confining animals in large facilities with high stocking densities uses less land than providing them with fields to roam on.

However, the vast majority of the land involved in rearing livestock is not their home, but their feed. In fact, 40% of UK cropland is devoted to growing animal feed. Even this is not enough to meet the feed requirements of UK poultry and pork, forcing us to import over 3 million tons of soy animal feed per year[69]. This reduces UK food security by reducing independence. This is shown below:

[69] Sustain (2023)

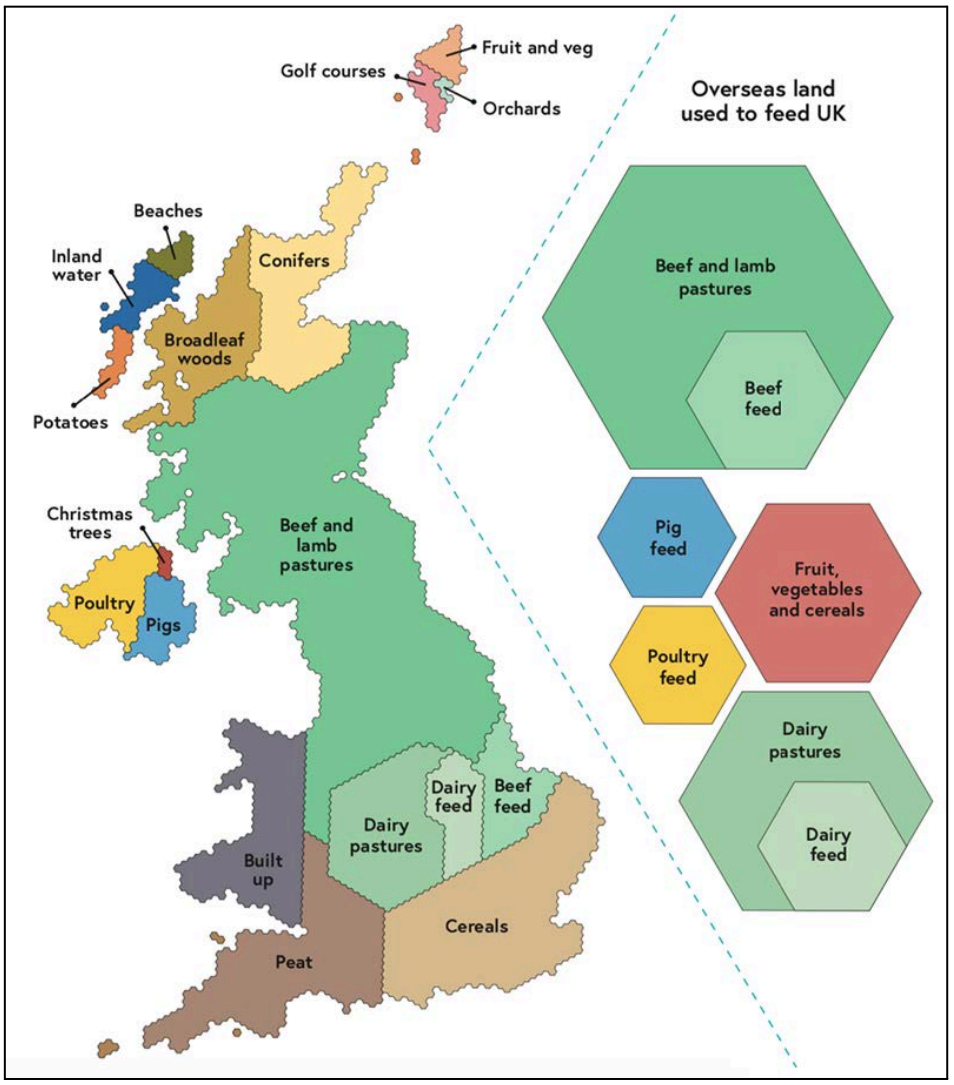


Figure 10: A map showing the land consumed by UK livestock. Reproduced from [The National Food Strategy](#)[70]

Therefore, a system that appears to be land-efficient is, in fact, largely outsourcing the land required to produce meat and dairy to other parts of the world, increasing our reliance on imports.

4.1.2. UK food security is undermined by exports

As well as importing large amounts of animal feed, we export large amounts of animal products. In 2023, the UK exported 298,312 tonnes of pig meat, 134,000 tonnes of cow meat, and 80,000 tonnes of sheep meat[71].

[70] National Food Strategy (2022)
[71] AHDB (2024b)

This is evidence that meat production capacity is not a limiting factor for our food security, and a narrow focus on increasing domestic meat production capacity may even compromise food security. Additionally, exporting meat produced using taxpayer subsidies arguably violates a key purpose of the subsidies, which is to ensure that the UK public has affordable food.

Unsurprisingly, our survey found that the UK public takes a dim view of subsidies being used to allow meat producers to earn better profits selling their produce abroad: just 20% agreed it was acceptable.

4.1.3 True food security through alternative proteins

Moreover, there are protein production methods which are far more land-efficient than factory farms. Plant-based alternative proteins offer vast savings in land use.

As shown, when holding constant the calories coming from meat/alternatives and dairy/alternatives, replacing 50% of UK meat and dairy with alternatives would entail a 47% reduction in the quantity of agricultural land required (Scenario B vs Scenario A), and a full replacement would result in a 94% reduction in land. This figure is largely in line with estimates produced in the literature[72].

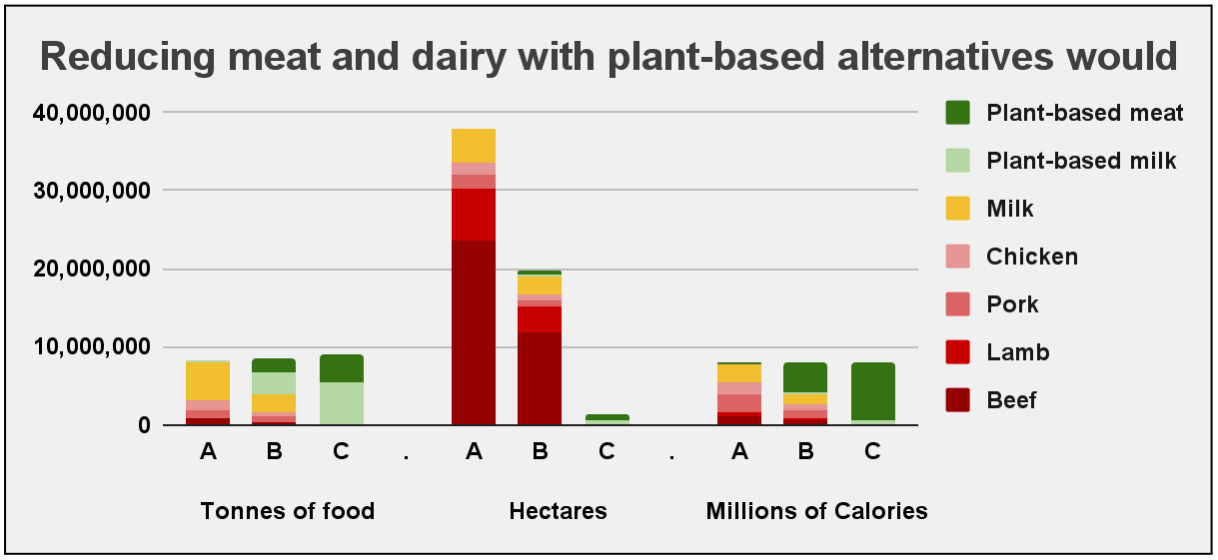


Figure 15: UK agricultural land use under various alternative protein scenarios.

[72] Bryant (2022)

These substantial land savings could be used to improve UK food security and benefit farmers. Surveys indicate that many farmers would be happy to transition from animal agriculture to farming plants and rewilding if they could earn a good income from it[73]. Currently the UK imports 40% of its sugar beet, 30% of potatoes and 20% of oilseeds[74]. The UK is likely to be able to meet much or all of these demands using the land freed up from even partial transition to alternative proteins. Moreover, UK farmers may even be able to produce a surplus in many crops. These crops could be used to produce more alternative protein products, which are high value exports that the rest of the world is increasingly demanding[75]. Rather than farming animal products that require billions in subsidies to be profitable and cost society millions more in hidden costs, UK farmers could profit from global demand for alternative proteins.

Furthermore, as the UK moves away from land-based subsidies towards more targeted grants, land saving initiatives such as growing alternative proteins could lead to savings in subsidies. Currently, UK farmers have little incentive to produce more food on less land, as it reduces the subsidies they have access to, which are stable income (compared to the volatile, weather dependent income from farming). Savings in subsidies from alternative proteins could save the UK government money, or be redirected to give other farmers increased subsidies to transition to alternative proteins at no additional cost to the public, ensuring they are paid a fair wage for their work.

Some criticise alternative proteins as unnatural – but they are no less natural than factory farms, which raise animals in cramped conditions, often with daily doses of antibiotics and with little daylight.

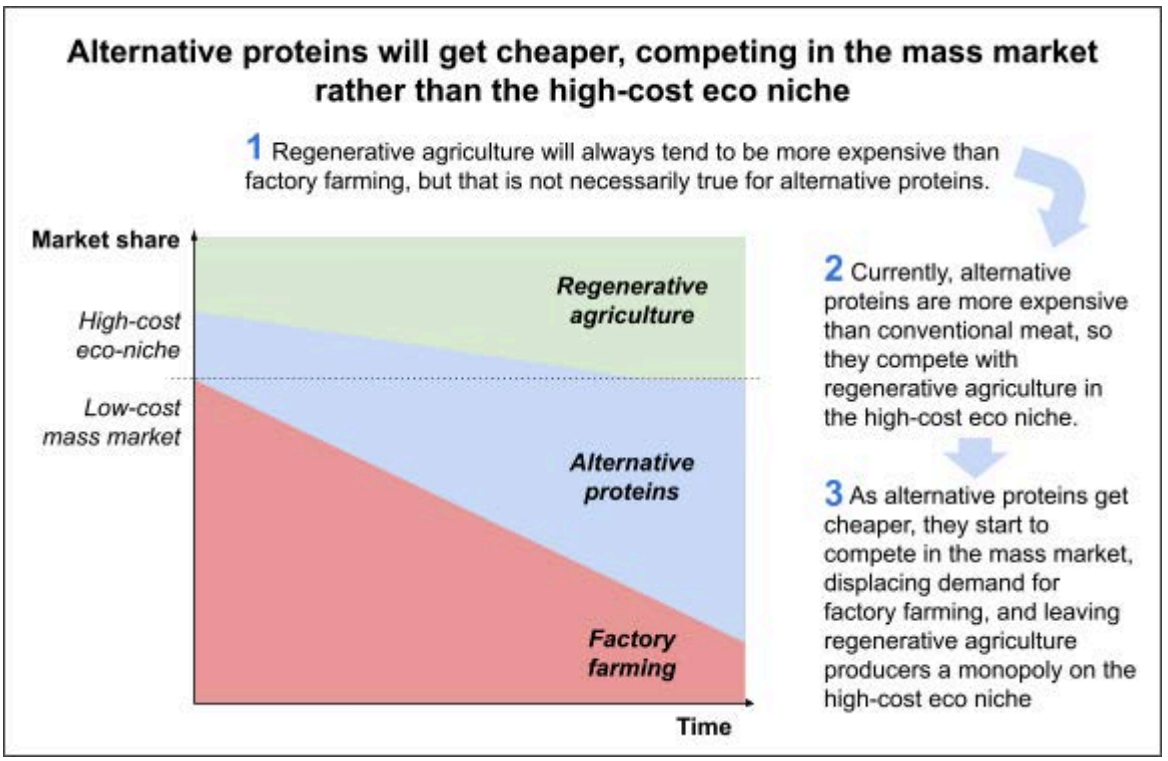
Some criticise alternative proteins as unnatural – but they are no less natural than factory farms, which raise animals in cramped conditions, often with daily doses of antibiotics and with little daylight. Moreover, there is a strong potential for alternative proteins, including plant-based and

[73] Stockfree Farming (2022)
[74] DEFRA (2023b)
[75] Morach et al. (2022)

cell-cultivated alternatives to meat, fish, dairy, and eggs, to co-exist with regeneratively farmed animal products, thus catering to premium and mass-market segments. Indeed, a report by the Green Alliance highlighted the potential for a 'marriage of convenience' between alternative proteins and regenerative agriculture, which aims to have better outcomes for the environment and for animal welfare[76].

Currently, alternative proteins and high-welfare animal products from regenerative agriculture are both more expensive than conventional animal products. Unfortunately, both products are also likely to appeal to a similar niche of eco-conscious consumers, meaning that they may be in competition at this higher price point.

However, when the price of alternative proteins falls below the price of conventional animal products, it is likely that alternative proteins will compete with conventional animal products for the mass market, leaving more of the high-end eco-conscious market to regenerative agriculture.



[76] Green Alliance (2023)

4.2. Cost savings

The second major purported benefit of factory farms is that they make meat more affordable. In this section we evaluate this claim by taking a detailed look at the historical prices paid by consumers for animal products – as well as the prices paid to farmers.

It is true that factory farms can, in theory, reduce production costs, mainly through economies of scale (i.e. a lower cost per unit achieved with many units)[77]. However, this is often assumed rather than proven. In the US, The Pew Commission reviewed more than 40 years of studies into industrial animal agriculture and rural communities and noted that "*claims of increased efficiency are often unproven*"[78].

Factory farms may also be able to leverage their scale to get favourable conditions from suppliers and workers, for example by paying less for feed and lower wages[79]. In doing so, they may benefit UK consumers with lower prices by imposing hidden costs on other sectors of the economy.

4.2.1. Much lower retail prices do not reflect similarly low production costs

Those who claim that factory farms reduce food costs point to the large price premiums on high-welfare animal products[80]. However, large differences in *retail price* don't always reflect equally large differences in *production cost*.

In fact, differences in retail costs are likely to be larger than differences in production cost. This is because high-welfare products – being more expensive – are likely to sell far fewer units than low welfare products. From the retailer's perspective, selling fewer units within the same limited shelf space requires them to charge a higher margin on each unit sold.

4.2.2. Retail price & farm price

Though factory farms are able to produce meat more cheaply, this doesn't mean that all of these cost savings will be passed onto consumers. In fact,

[77] Molnár (2022)
[78] Andrews, D. & Kautza, T. (2022).
[79] Winters (n.d.)
[80] Clark et al. (2017)

a considerable amount of these savings do not even end up in the pockets of farmers that raise the animals in factory farms, instead fueling corporate profits.

One analysis of the US pork market found that, while there was indeed a modest decrease in the price paid by consumers, the price paid to hog farmers had decreased significantly, with the difference being captured by processors and retailers. In fact, between 1982 and 2020, the margin for processors and retailers increased by 46% – while the price paid to farmers decreased by 73%.

Figure 16: Changes in the retail price of pork in the USA relative to changes in farmgate prices (price paid to farmers). Adapted from Food and Water Watch (2022)[81].

We conducted a similar analysis for the UK, the first of its kind. Each graph below shows three lines representing various prices over time: a blue line representing the price paid to farmers, a red line representing the price paid by consumers, and a yellow line representing overall inflation.

Each graph is indexed to 1988 = 100, meaning that subsequent values are relative to this point. The difference between the red line (retail price) and the blue line (agricultural price) represents the relative margin for retailers, processors, and other intermediaries. The difference between the red line and the yellow line represents the retail price of each good relative to inflation (i.e. whether it is getting cheaper or more expensive in real terms).

[81] Food and Water Watch (2022)

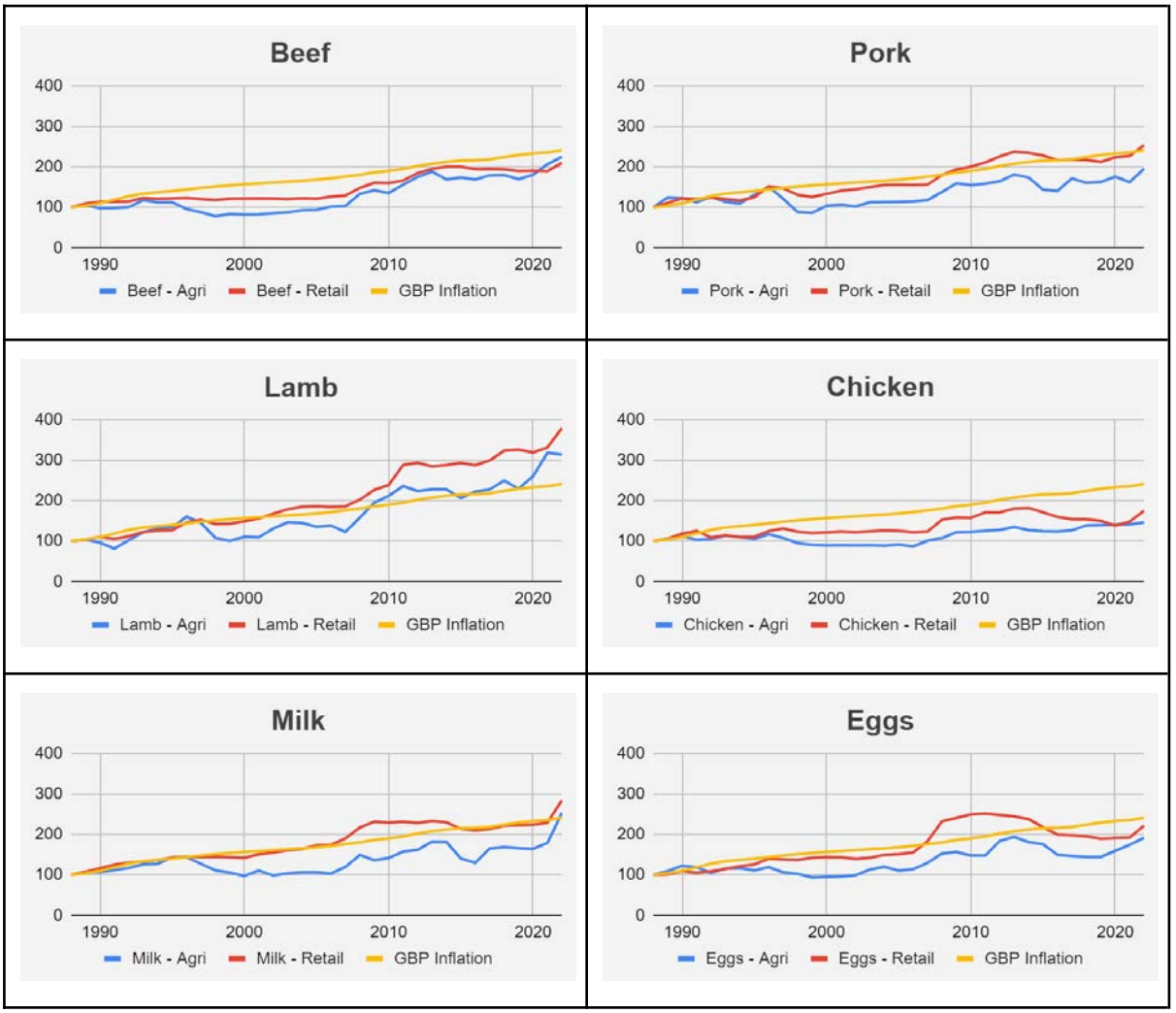


Figure 17: Trends in the retail and agricultural prices, as well as inflation, 1988-2021. Indexed to 100 (1988). Data from ONS (n.d.) and DEFRA (2024e).

Firstly, one sign that factory farms are delivering on their promise of reduced prices would be the price of a good increasing slower than inflation. Whilst this appears to be the case for chicken and beef, it is not the case for pork or milk and there is inconsistent evidence for eggs.

If factory farms were driving prices down with greater efficiency, we would see prices lower than inflation for the heavily industrialised chicken, somewhat for the moderately industrialised pork and eggs, and little to none for beef and dairy products (which have only recently begun industrialising). We do not clearly see this pattern. This suggests that either factory farms are not delivering cheaper animal products as promised, or there are forces that counter the productivity gains.

Second, we can look at the trends in the blue line relative to inflation. For all except lamb, the blue line consistently falls below inflation, which indicates that the real price farmers get has been declining over time.

In almost all cases, the red line (representing retail price) has outpaced the blue line (representing agricultural price) starting in around the mid 90s. This represents retailers, processors, and other intermediaries increasing their share of the profit margins compared to farmers.

Third, agricultural prices for pork, chicken, and eggs – the most intensified of the sectors in the UK – have failed to keep up with inflation since the 80s. This represents pig and poultry farmers getting less income in real terms. In the case of pork, the inflation-adjusted retail price was actually higher despite farmers' incomes being lower.

Since 1988, for almost all animal products, inflation-adjusted prices paid to UK livestock farmers have decreased significantly, while the margins for retailers and other intermediaries have increased.

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4.2.3. Does the UK public believe that lower prices justify factory farms?

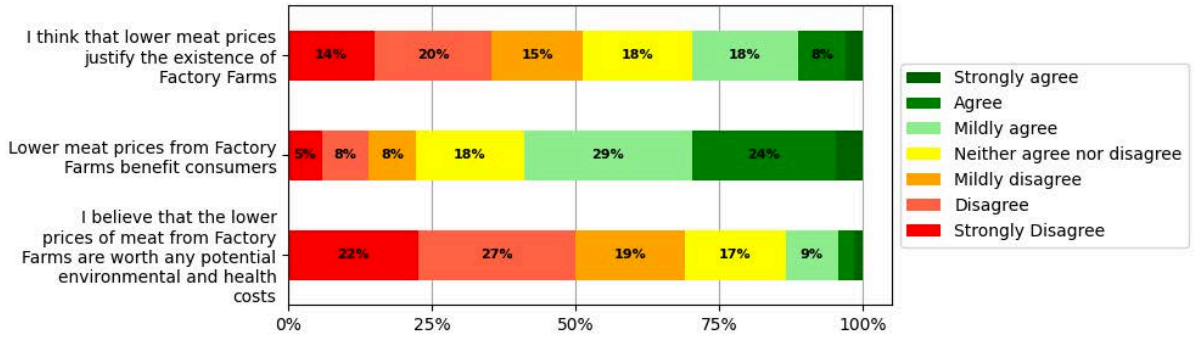

Figure 18: UK public opinion on factory farms and prices

Factory farms justify their existence by arguing that consumers desire low-priced meat above all else. We found that the UK public does agree that lower meat prices benefit consumers.

However, the UK public does not think that lower prices justify the existence and harms of factory farms. Only 58.9% of respondents believed that lower meat prices from factory farms benefit consumers, despite this being their key selling point.

On the contrary, only 30% agreed that lower prices justified the existence of factory farms. The majority of UK respondents, (69%) felt that low prices did not justify the potential health and environmental costs of factory farms, which we have revealed are substantial.

5. Recommendations

Our report leads us to the following recommendations:

1. **Do not allow the building or expansion of new megafarm facilities (facilities so big they require DEFRA environmental permits), especially in areas that are vulnerable to river pollution.**

2. **Restructure subsidies to reward smaller-scale farmers who grow healthier and more environmentally friendly foods, who respect our countryside and champion higher animal welfare based on the 5 freedoms.**

3. **However the subsidy system is restructured, it should be transparently communicated to the UK public, as there is currently widespread confusion about how the system operates and how many subsidies livestock and factory farms receive.**

4. **Limit the ability of factory farms to use taxpayer subsidies to export meat more cheaply, ensuring that subsidies enhance UK food security.**

5. **DEFRA should implement monitoring and restriction of the number of "zero grazing" cattle systems in the UK.**

6. **DEFRA should monitor animal agriculture jobs specifically, by farm type and animal, to allow us to directly assess the impact of industrial animal agriculture on farming jobs.**

In 2024, freed from the EU's wasteful CAP policy, the UK is presented with a unique opportunity to build a new agricultural sector that benefits both farmers and the UK public. We have shown that factory farming costs the UK millions, through diverting subsidies, damaging our health, our air and rivers, whilst failing on their promise of upholding food security. Our survey results confirm that the UK public agrees: factory farming has no place in the future of UK agriculture.

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Appendices

Appendix A: The percentage of chickens and pigs on factory farms

For the purposes of our report, we define a factory farm as a facility that confines animals in small cages for much or all of their lives. This includes facilities that use farrowing crates for sows, and enriched/colony cages for chickens.

A 2024 report by World Animal Protection summarises DEFRA data that shows:

- 60% of sows are kept in farrowing crates for significant portions of the year (205,691 pigs)
- 96% of fattening pigs are kept indoors most or all of the time (4,575,334 pigs)
- 95% of broiler chickens are kept in enriched cages (110,618,000 chickens)
- 35% of layers are kept either in enriched cages or in barns with little to no time outside (14,375,550 chickens). The remaining are free range.

We combine sows and fattening pigs together for an overall estimate that 93.6% all pigs are kept in factory farming conditions (there are far more fattening pigs than breeding sows).

We also combine broilers and layers together for an overall estimate that 79.4% of all chickens are kept under factory farming conditions (There are far more broilers than layers).

Appendix B: Estimating the subsidies that go to factory chicken and pig farms

UK subsidies explained

Data on subsidies split by farm type (i.e. livestock vs crops, factory farm vs traditional) was not readily available. Moreover, as mentioned above, factory farms may receive substantial indirect subsidies. As a result, we estimated the subsidies using publicly available data from DEFRA and other trusted sources such as the World Wildlife Federation (WWF). The latest subsidy data is for 2023 so we use this where possible.

The two largest sources of farming subsidies in the UK are the Basic Payments Scheme (BPS, 69.3% of subsidies in 2023, totalling £2050M) and Agri-environmental schemes (22.5%). The remaining 8.2% of subsidies include animal disease compensation, coupled payments (payments tied to production quotas) and minor other payments.

What percentage of UK agricultural subsidies goes to livestock?

BPS payments are almost entirely land-based, with no specific allocations for livestock. To our knowledge, the only criterion for BPS eligibility is the amount of land, regardless of farm type. As such, we estimate the percentage of British farmland used to grow livestock feed as a proxy for the percentage of total BPS subsidies that go to livestock.

Agri-environmental subsidies are composed of many different schemes and the eligibility for livestock farms, and factory farms will vary. We were unable to find the data to estimate this exactly. Moreover, these schemes change regularly, causing confusion among farmers, which means that not all eligible farms apply and receive them. As such we assume that, as with BPS payments, the land used for livestock, factory farms and their feed is a proxy for the amount of Agri-environmental subsidies they received.

Livestock presumably receive all £45M of animal disease compensation subsidy. Inspection of DEFRA data did not find any coupled payments to chickens and pigs in 2023 (though 40M went to beef and £7M to sheep). This leaves 3.6% of subsidies remaining, but as it is unclear how much of these that livestock are eligible for, we conservatively assume none of them.

We first calculate the percentage of subsidies that go directly or indirectly to all livestock. Livestock likely consume nearly all subsidies from agricultural grassland, which amounts to 60% of land based subsidies. The remaining 40% of land based subsidies go to cropland, of which livestock consume 40%. This means they consume 40% of 40%, which is 16% of cropland subsidies. Thus in total livestock are responsible for 76% of land based subsidies. Add disease compensation and decoupled payments, we find that livestock directly and indirectly received £2.1B in agricultural subsidies in 2023, around 73% of all UK agricultural subsidies. Almost all of this was indirect, with these subsidies funding the production of cheap feed.

Estimating the subsidies that go towards industrial chicken and pork

Next, we estimate subsidies going to chicken and pig farms, and those specifically that go to factory farms. Chicken and pig farms are eligible for some proportion of BPS payments and environmental schemes, alongside some animal disease compensation. We assume they consume no grassland subsidies.

Regarding animal disease compensation, we were unable to determine the proportion for chickens and pigs specifically. This also may change year to year based on disease outbreaks that are specific to each animal. As such we assume that 72.3% of it goes towards chickens and pig farmers as pork and poultry represent 72.3% of meat UK consumption.

Next, we estimate what proportion of Basic Payment Scheme (BPS) payments go to chicken and pigs, produced across all farms as well as factory farms specifically.

As stated above, 40% of UK cropland is used for animal feed. We partition this into poultry feed, cattle feed and pig feed using a 2023 report by the Agriculture and Horticulture Development Board (AHDB) on the tonnage of animal feed produced in the UK. We find that 15.66% and 50.24% of UK produced animal feed went to pig and poultry farming respectively. As such we assume that 15.66% and 50.24% of UK cropland subsidies go towards these industries.

Once we determined the percentage of UK BPS subsidies that go to each of pigs, and chickens, we multiplied them by the percentage of these animals that are kept in factory farms (found here). This showed that

factory farms received 84.5% of subsidies that went to chicken and pig farms went to factory farms (£2.69M).

Further Assumptions unstated above

- We assume that factory farms get the same level of subsidy per animal as smaller scale farms.
- We assume that livestock farmers get no subsidies for the land that their farm is built on.
- We assume that animals on factory farms eat the same amount of feed as animals not on factory farms. In reality, they likely eat more, which causes us to underestimate subsidies captured by factory farms.
- We assume that all crops fed to livestock require the same amount of land per ton of feed produced. In reality, pigs, chickens and cows are fed different crops, so a ton of feed for each animal will take slightly different amounts of land. This assumption means that we overestimate the proportion of subsidies going towards animals whose diet requires less land to produce, but equally underestimate the proportion of subsidies going towards animals whose diet requires more land to produce.

Appendix C: Estimating the percentage of UK households that live near an industrial megafarm

Note: This analysis and the analyses based on it (notably the section on health costs) refer to “megafarms” not factory farms. This is because these analyses require the locations of specific farms. As there is no consensus definition of what constitutes a factory farm, there is no data source of their locations. Location data for megafarms (defined below) however does exist and are collected by DEFRA, so we use it here.

The UK Department for Environment, Food & Rural Affairs (DEFRA) requires that any facility housing extremely large numbers of pigs or poultry must obtain environmental permits (Environmental Permitting Regulation, or EPR permits). We obtained the location of all pig and chicken megafarms in England and Wales using the Transparent Farms UK API which uses public data from DEFRA and The Food Standards Authority (FSA). It contains all DEFRA EPR registered chicken and pig farms, as well as all dairy farms of all sizes. Notably it does not include any intensive farms for Scotland or Northern Ireland. As such, our dataset is restricted to chicken and pig megafarms in England and Wales. After removing duplicates and farms with no latitude and longitudes, we had a final sample of 2236 farms; 1858 poultry megafarms, 368 pig megafarms and 10 mixed chicken and pig facilities.

We obtained the location of a representative sample of UK household addresses using "Price Paid" data on all the houses sold in the UK in 2023 from HM Land Registry (724,385 houses). Some house sales are not in the data and a list of exclusion criteria can be found here. We removed the 0.1% of houses with no provided postcode. HM Land Registry only provides postcodes, but to calculate distances to mega farms these needed to be converted to latitude and longitude measures. Preliminary testing using open-source geocoding API showed unacceptable levels of accuracy. As such, we used the Google Maps geocoding API to obtain the latitude and longitude of. Due to computational and budget constraints we limited our analysis to a random sample of 134,163 houses.

We then computed the Haversine distance in km between each house and each megafarm in our data, as well as the closest megafarm to each house and how far away it was. We used this data for our analyses.

Assumptions

We assume that a random sample of houses from the 2023 UK land registry is a valid proxy of a random sample of UK households. More specifically, we assume that households near megafarms are sold at equal rates in a given year to households not near megafarms. This further assumes that the percentage of households within 2km of a megafarm is a good proxy of the number of people over the age of 30 living within 2km of megafarms.

Appendix D: Estimating the cost of environmental pollution from industrial animal agriculture

We estimate the effects of environmental pollution of factory farms through 2 mechanisms:

- Air pollution from ammonia emissions
- Water pollution from manure runoff

Air pollution

To calculate the cost of air pollution from factory farms, we focus on ammonia, as this was the most reliable data and is likely to account for the large proportion of the total caused by animal agriculture. In 2022 the UK Government documented 259,000 tons of ammonia emitted from all sources. The UK Government recommends pricing each ton of ammonia emitted at £9,667 when doing policy cost-benefit calculations. This means that ammonia from all sources costs the UK £2.5B. 87% of this is thought to come from agriculture overall. Using the 2020 Inventory of Ammonia Emissions from UK Agriculture report by DEFRA we find that this can be broken down into:

- 13% poultry
- 7% pigs

The rest is accounted for by other animals (most notably sheep), fertiliser, and non manure digestate (sewage). We multiply each of these percentages by the percentage of these animals held on factory farms (see Appendix A) to obtain the percentage of total UK ammonia pollution costs that can be attributable to factory farm animals, which we estimate to be 16.99%. This means ammonia air pollution attributable to factory farmed chicken and pork is costs the UK £370M a year.

We might also estimate the ammonia pollution due to fertiliser used on cropland that is then fed to animals on factory farms. This added another £88M. The 2020 ammonia inventory found that fertiliser use is 15% of total ammonia pollution, and the percentage of this going to animal feed would be 40% across all animals. We multiply this by the % of commercial feed consumed by factory farmed chickens and pigs (55% of all feed). The result

is that an estimated 4.04% of ammonia pollution comes from fertiliser used to grow crops for factory farmed chickens and pigs.
In total, across the animals and their feed, factory farmed chicken and pork releases ammonia into the air whose damage can be estimated as £458M a year.

Assumptions of air pollution calculations

- We estimate the costs of emissions assuming all emissions affect the UK. In reality air pollution can "travel" and as such some of these costs will be borne by other countries, and the UK will be affected by air pollution from other countries.
- Crucially, we assume that ammonia pollution from animals on factory farms is equal to that of higher welfare, less intensive practices.

River pollution

In 2022 The Environment Agency outlined the investment required to meet England's river basin management plans (RBMPs). This detailed that over the following 37 years it would require nearly £87B to prevent deterioration of England's rivers. £59B of that would be required for "rural land management", amounting to £1.6B a year. We use this figure as a proxy for the cost of environmental damage due to agriculture overall, as arguably this money would not need to be invested if agriculture had no negative impact on rivers.

Chicken litter contains significantly more nitrogen and phosphorus than cow manure and slurry and it is more available to crops in the months after it is laid. Additionally pig manure is much higher in P. A rough estimate is 3-5 times more available nitrogen or phosphorus for poultry litter and twice as much for pig manure. As such we increase the share of pollution by 3 times for poultry and 2 times for pig manure.

We assume that nearly all damage to rivers from agriculture comes from manure and fertiliser runoff. In the 2023 British Survey of Fertiliser Practice they found that 64% of farms used organic manure, including slurries, farmyard manure (FYM), and poultry manures. We use this 64% as a proxy for the amount of fertiliser that is manure, and thus infer that animal

agriculture is liable for around 64% of river damage. They break manure use down by farmed animals; we extract the numbers for pigs and poultry. We then multiply these percentages by the percent of animals confined on factory farms of each type. We were unable to determine the percentage of UK cropland that uses non-organic fertilisers to determine the river pollution from feed.

We find that 2.29% of river damage due to fertiliser runoff comes from factory chicken farms and 3.6% from factory pig farms. This amounts to £23M and £37M respectively, for a total of £60M in river pollution costs annually.

Assumptions of river pollution calculations

One way in which our estimate is likely to be too small is that it only considers English waterways. However it is not clear how the costs could be scaled appropriately to Welsh, Scottish and Northern Irish waterways.

On the other hand, we attribute all rural land management costs to agriculture when this may also include forestry (though a breakdown is not provided). We believe our estimates are informative as long as our simplifying assumptions do not grossly bias our estimates consistently in the same direction. However, we realise that assumptions that cause over and under estimation cannot be expected to combine to a net effect of 0 bias.

We use the percentage of fertiliser used that is manure as a proxy for the percentage of damage from agricultural runoff due to animal agriculture.

Appendix E: Estimating the public health costs due to proximity to industrial animal agriculture

We calculated the health cost to rural communities from proximity to megafarms (see appendix C). Our broad approach was to multiply the increased death risk by the number of people living near megafarms to get the number of additional deaths potentially attributable to megafarms. We then multiply this by the value of a statistical life to get the cost to the UK.

We could not find large-scale studies on the health effects of living near industrial animal agriculture for the UK specifically (see Appendix G). Instead, we used Simoes et al., 2022, which is the largest and most representative sample we could find. This study investigated the entire suburban and rural population of the Netherlands over the age of 30, representing ~4M people. They found that proximity to high intensity farms was associated with increased risk of death from respiratory disease. We use their hazard ratios for death from Respiratory System Disease (RSD). This is because the most severe health risks from proximity to industrial animal agriculture are generally respiratory diseases. RSD captures the majority of respiratory diseases, covering ICD-10 codes J00-J99, and notably including Chronic Obstructive Pulmonary Disease (COPD), but not lung cancer.

Simeos et al., give hazard ratios for several distances (0.5km, 1km, 1.5km, 2km) from high intensity farms, but as the hazard ratios do not vary significantly we average them to produce a single hazard ratio for each animal. Because they have varying levels of precision, we compute a weighted average of the effects rather than a simple mean. This means that more precise estimates have a larger influence on the average. We used the 95% confidence intervals around the hazard ratios to estimate the standard error using the standard formula. We natural log transform the upper and lower hazard ratios to make them symmetrical about 1, then subtract the lower from the upper and divide by (2 x 1.96) as this is the z-score for a 95% CI. Then we weighted each measurement by the inverse of the variance which is the standard error squared. As Simeos gave 5 year hazard ratios, we rescale them to 1 year hazard ratios. This gives us, for pigs and chickens, the increased odds of dying from RSD in any given year from living within 2km of a megafarm.

Next we found the death rate of RSD for the general UK population in 2023. According to the ONS an average of 74,080 people died each year of RSD in England and Wales between 2015 and 2019. There was no notable upward or downward trend in death counts. As such, we assume that the average of these years is a good proxy for 2023 deaths. Because the population of England and Wales in 2023 was 60,854,700 people this produces a yearly death rate of 121.7 per 100k people.

We estimated the percentage of the UK population living within 2km of a megafarm in Appendix B. Multiplying these percentages by the population of England and Wales gives us the numbers of people at risk from higher rates of respiratory system disorders due to proximity to megafarms.

We then calculate the expected number of RSD deaths per year, assuming megafarms had no mortality risk using the base death rate of RSD. We calculate additional deaths due to megafarms using the base rate and the hazard ratios of living near a megafarm. As health hazards are generally considered to be multiplicative, we square the hazard ratio for those living near 2 megafarms. Lastly we multiply the additional number of deaths by £3.64M as this is the value of a statistical life for the UK in 2019 (estimated at $4.7M USD in Table 1 of Sweis (2022), which is considered an authority on these measures).

Assumptions

- That the negative effects of Dutch megafarms on surrounding community health is a good proxy of the negative effects for the UK. If Dutch farms are more dangerous than UK ones, this will cause us to overestimate the costs to the UK, but if Dutch megafarms are safer we will underestimate. Likewise if the UK NHS is better at preventing respiratory deaths than the Dutch system we will overestimate, whereas if the NHS is worse, we will underestimate.
- That the majority of societal health costs caused by living near megafarms are captured by RSD. If there are other costly health risks (at least 1 review argues there is), our estimate will be too low.
- Simoes et al., 2022 find that in all cases low intensity farms have a smaller health effect on Respiratory System Diseases than high intensity farms, in most cases the hazard ratio is =<1. As such we assume that were high intensity farms to be replaced with low intensity farms, nearly all healthcare costs would disappear. This

assumption may be more or less reasonable depending on the hypothetical deindustrialisation of the meat sector; in the case where meat production was maintained by changing high intensity farms for a much larger number of lower intensity ones, this assumption may not be accurate, as it is unclear whether proximity to many low intensity farms is as bad for human health as proximity to few high intensity ones. This assumption may cause us to overestimate.

Appendix F: Farming job estimates

Estimating the UK jobs lost / not created due to the industrialisation of pork and poultry sectors is difficult for 2 reasons:

1. There is no public data on the number of people employed in livestock farming that we know of (see Appendix G).
2. It is difficult to isolate the effect of industrialisation just by looking at changes in agricultural jobs in the UK alone. The number of agricultural jobs in the UK overtime is affected by a large number of factors that may be unrelated to industrialisation.

We overcome these issues 2 ways:

1. We estimate the effect of chicken and pork production on **all** agricultural jobs, not just jobs in the livestock sector. The data is directly available.
2. We use data from a variety of developed countries to isolate the effect of "livestock industrialisation". By examining a number of developed countries who have industrialised their livestock sectors and extracting the common trend, we get an estimate of the average effect of livestock sector industrialisation and agricultural jobs.

We combined 2 datasets:

1. A dataset of agricultural employment for various countries around the world compiled by Our World In Data from various sources.
2. A dataset of total countrywide meat production, using FAO data compiled by Our World in Data. We summed the tonnage of meat produced for pork and poultry only

For both datasets, we selected all countries in Europe, for the years between 1991-2019. This was the full range of the data available, however data from 1961-1991 was also available for Finland, France, The Netherlands, Spain, Sweden, the UK and the US, which we also included.

The model we used to estimate the effect of livestock sector industrialisation on agricultural jobs was a fixed effects linear regression.

This model predicted total agricultural jobs from total meat production, with fixed effects of year and country.

The fixed effects design means that the model is not vulnerable to abnormal years (such as 2008) or abnormal countries (meat production in the US is the highest in the data by a wide margin), though we also conduct robustness analyses below. The model thus isolates the potential effect of total chicken and pork production on agricultural jobs.

Assumptions

We assume that countries in the data have seen at least some industrialisation of their livestock sectors over time. If this is true, the common patterns between countries across years reflects the effect of industrialisation on a given country.

By using meat production as a proxy of meat sector industrialisation, we are assuming that meat production *only* affects agricultural jobs by reducing the number of livestock farming jobs. Increasing meat production may also come from a number of unrelated factors: improvement in livestock genetics, economic growth, and decreasing meat imports to name a few. However, none of these would be expected to *reduce* the number of jobs in the agricultural sector, so are unlikely to confound our analysis.

On the other hand, meat production may also increase if the number of farms increases, which should increase the number of agricultural jobs. Additionally, animals raised on factory farms are more likely to be fed crops than animals on small scale farms, so we should expect that the industrialisation of the UK livestock sector will have increased the number of agricultural jobs in crops. Both of these factors *increase* the number of agricultural jobs, so they cannot account for our finding that increased meat production *decreases* agricultural jobs. In fact, this will mean that we somewhat underestimate the number of livestock jobs that have been destroyed/not created due to livestock industrialisation.

To calculate job losses due to industrialisation for the UK specifically, we apply the coefficient from our multi-country regression model to UK data. This means that we are assuming that the UK has average levels of industrialisation compared to other countries in the dataset. In fact, it is

likely the UK has seen *more* livestock industrialisation than the average European country. As a result this means our estimates of job losses will be further underestimated.

Fixed effect model cannot definitively prove that something causes something else. However they can provide reasonable estimates provided some assumptions are met. For us to conclude that increasing meat production *causes* a decrease in agricultural employment, we must make two assumptions.

- That increased meat production in a country does not decrease agricultural jobs through any other mechanism other than automation. If it does, our estimates of job losses will be overestimated.
- That there is no unmeasured third variable that increases production and decreases agricultural jobs as a whole. While we are unable to identify any such variables, we cannot be sure they do not exist.

Model robustness checks

We refit the model many more times, each time excluding a different country or year to test whether results were strongly impacted by the inclusion of certain countries or years. In all cases the results were largely similar, and in all cases meat production had a statistically significant negative effect on agricultural employment.

We also repeated the entire analysis redefining meat production to include beef too. Consistent with our hypothesis, the effect of meat production in these models showed a weaker, but still significant, negative effect on agricultural jobs. This is unsurprising because beef has seen considerably less industrialisation compared to chicken and pork.

Appendix G: Data Limitations

Whilst our report details significant costs to the UK, it also highlights how the costs are often hidden or underestimated due to lack of transparent data.

For example, whilst the number of people employed in UK agriculture is available, DEFRA does not specifically report the number of jobs in animal agriculture. Given that defenders of factory farms claim they are job creators (a claim not supported by our analysis), it is vital to track jobs in animal agriculture to verify the truth of the matter.

Moreover, most studies of health damage due living near factory farms have been conducted in America or Europe, with no studies from the UK.

Lastly, there is no government data on the number of intensive cattle operations. This lack of transparency has been noted by others, including the BBC. There is strong indication that thousands of cattle are kept in these 'zero grazing' systems, where they are confined inside for their lives, eating grain rather than pasture. Allowing this system to proliferate would be a costly mistake, as this report shows.

Appendix H: Survey demographic tables

Gender		**Income**	
Female	49.7%	Less than £20,000	12.1%
Male	49.4%	£20,000 to £39,999	31.3%
Other	0.9%	£40,000 to £59,999	22.5%
Age		£60,000 to £79,999	14.6%
18-29	24.1%	£80,000 to £99,999	9.1%
30-44	38.2%	£100,000 to £124,999	3.7%
45-59	25.7%	£125,000 to £149,999	1.6%
60+	12.0%	£150,000 to £199,999	0.8%
Region		£200,000+	0.4%
East Midlands	10.4%	Prefer not to say	0.8%
East of England	9.3%	**Education**	
London	3.1%	Some school	0.8%
North East	5.3%	GCSEs or equivalent	13.7%
North West	10.9%	A Levels or equivalent	25.8%
Northern Ireland	1.1%	Bachelor's degree or equivalent	40.2%
Scotland	4.0%	Master's degree or equivalent	16.6%
South East	17.3%	PhD degree or equivalent	2.9%
South West	11.4%	**Urbanicity**	
Wales	4.1%	Suburban	48.9%
West Midlands	11.1%	Urban	28.3%
Yorkshire & Humber	11.8%	Rural	22.8%