Quantifying the Environmental Risks from Pig & Poultry Production in the UK

A report by Cumulus and The Wildlife Trusts

Contents

Cumulus Consultants Ltd
1 Gainsborough House, Campden Business Park
Battle Brook Drive
Chipping Campden
Gloucestershire GL55 6JX

Telephone: +44 (0)1386 277970
Email: info@cumulus-consultants.co.uk
Web: www.cumulus-consultants.co.uk

Executive Summary

Research into the environmental impacts of pig and poultry production in the UK to date has primarily focussed on the direct impacts associated with excreta from housing units. However, these systems are also heavily dependent on a significant amount of bought in inputs, largely in the form of feed concentrate, with much wider implications for land use, environmental impacts, and climate change. These impacts are currently not well represented in the scientific literature with no single review of the holistic environmental impacts of the UK pig and poultry sectors having been conducted.

In this report, we explore the wider environmental risks from food produced in intensive pig and poultry units in the UK across a range of environmental factors – including biodiversity, climate, water quality, air quality, land use (both in terms of unit footprint and footprint of additional inputs), and water use. This report provides a robust, evidence-based overview of the environmental risks of pig and poultry production in the UK from available data.

Inventory of the Sector

The scale of pig and poultry production in the UK is significant, almost 1 million tonnes of pigmeat and 2 million tonnes of poultry meat are produced per year, breeding, growing and slaughtering in the region of 11 million pigs and 1.1 billion broilers. In addition, the UK has an egg laying flock of approximately 40 million chickens, producing approximately 12 billion eggs per year. **Section 2** of this Report provides a detailed overview and high-level spatial distribution of the UK pig and poultry sectors.

Pigs

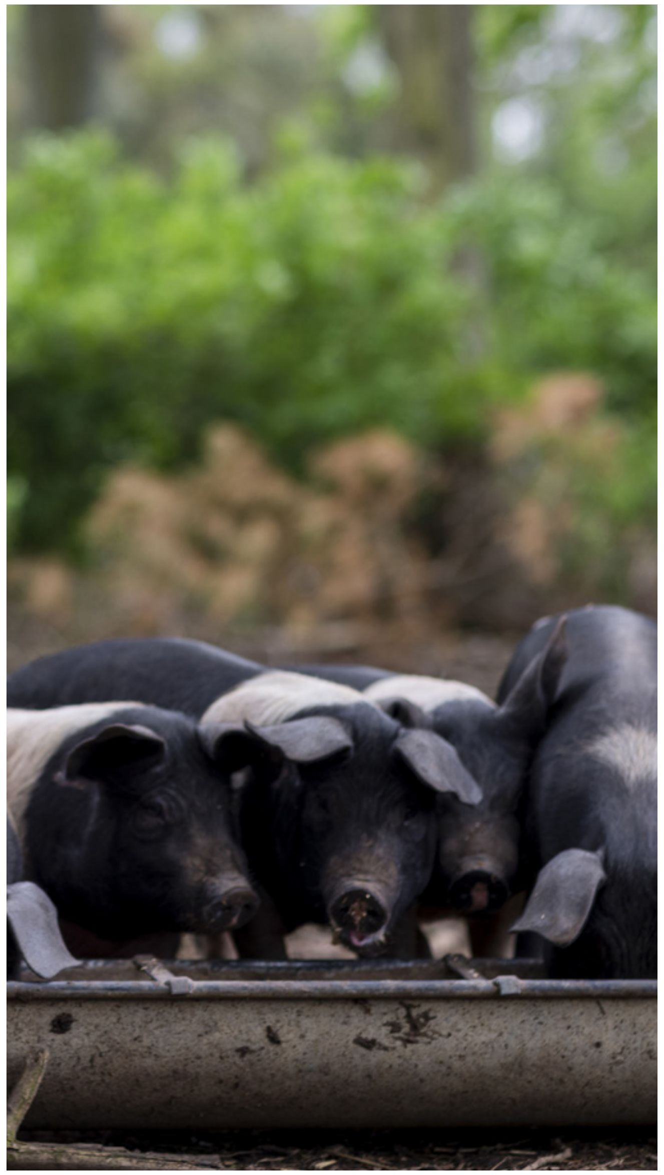
Pig units are located throughout the UK, but are often highly geographically concentrated. For example, of the 1,772 registered specialist pig holdings in England, 30% were in Yorkshire and Humberside, 26% were in the Eastern region, and 14% were in the South West. 15% of England's breeding pig population is located in just one council area – North Yorkshire CC. In Northern Ireland, just two District Councils contain 66% of the pig breeding herd and 69% of the fattening herd.

The majority of breeding herds in England and Wales fall outside of the current environmental permitting regime. In England, only 38% of the breeding herd was on farms which meet the threshold requiring an environmental permit. In Wales, none of the breeding herd is on units of more than 150 sows, and therefore all breeding pigs fall outside the environmental permitting threshold.

Poultry

Poultry units are similarly often highly geographically concentrated. Of the 2,485 specialist poultry holdings in England, 19% were in the Eastern region, 14% were in the East Midlands and 14% in the West Midlands, 19% were in the South West and 12% were in Yorkshire and Humberside. In Wales, 55.8% of the total layer and broiler flock is located in Powys – this region has seen a dramatic increase in poultry numbers from just over 1 million in 2007 to around 5 million in 2020.

Whilst the proportion of poultry in units which require an environmental permit has risen in recent years, a significant proportion of poultry units fall outside of current permitting requirements. For example, in 2023 just 65% of poultry in Powys was in units of 35,000 or more animals (the threshold for permitting being 40,000).



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Inputs and outputs from the UK pig and poultry sector

Typically, the environmental footprint of pig and poultry units is perceived to be small, with production concentrated within housed sheds or densely populated outdoor units. However, whilst the average areas of specialist pig and poultry farms are relatively small, the areas of land associated with pig and poultry production extend well beyond the unit 'footprints'.

Agricultural area used for feed

Pig rations are estimated by AHDB to include approximately 48% wheat, and poultry diets also consist predominantly of wheat. AHDB estimate that poultry feed accounts for 45% of total animal feed production in the UK. We therefore estimate that feed requirements for pig and poultry units include approximately 520,000-580,000 ha of wheat grown in the UK, equivalent to 34-38% of the UK's total wheat crop. This can be considered a conservative estimate for the UK as a whole as it does not account for those producers using on-farm mill and mixing of their own animal feed (i.e. not using purchased compound feeds), and it excludes Northern Ireland .

This land use has associated fertiliser and pesticide inputs which are not typically ascribed to the pig and poultry sector, despite being used to grow commodity crops which are directly linked to the pig and poultry supply chain. We calculate that the associated pesticide use with growing 580,000 ha of wheat equates to 2,621 tonnes of pesticides across 8.32 million treated hectares, of which 24.4% are fungicides (by weight).

UK pig and poultry feed also includes soyabean meal, requiring land use outside the UK of an estimated 730,000ha. However, environmental impacts outside of the UK fall outside the scope of this report.

Excreta Production

The amount of excreta resulting from pig and poultry production in the UK is in the region of 10.4 million cubic metres per year. We calculate that this results in total outputs of approximately 97 million kg/yr nitrogen and 64 million kg/yr phosphate. The generation of excreta outputs is also highly concentrated, linked to the nature of the pig and poultry sector in the UK. In one single council area in England, North Yorkshire CC, the combined volume of excreta from pig and poultry production each year is 1.7 million m3. 69% of all pig excreta in Northern Ireland is produced in just two District Council areas.

In **Section 3.4** of this report, we explore the land area required for spreading excreta under different nutrient loading limits in detail. Our findings show that even where manure from pig and poultry units is applied to land within Nitrogen loading limits, it would likely exceed the phosphorus demands of the crop. When spreading pig and poultry manures to achieve phosphorous crop demands, the land area requirement to maintain a phosphorus balance is significantly higher than the land area requirement under a N loading limit of 170 kg/ha.

Geographic concentrations of the pig and poultry sectors in particular hotspots mean that maintaining N and P balances in soils is challenging, and the land area required to maintain a phosphorus balance is very large. Of particular note are the council areas of Breckland and South Norfolk, and North and North East Lincolnshire. In both Council areas, the land area requirement for spreading excreta from pig and poultry units in order to maintain a phosphorus balance, as a share of the total farmed area, is 61%.

Given that in reality pig and poultry excreta will not be spread evenly across these areas due to logistical challenges of transporting and applying pig/poultry manure and slurry, it is likely that many farms here will be in significant phosphorus surplus – and by extension, a significant source of phosphate losses into the environment.

Environmental risks and impacts of pig and poultry production in the UK

Focus to date on the environmental impacts of pig and poultry production has largely been on the spreading of excreta outputs of these units which, while significant, do not convey the full extent of the environmental footprint of these systems. Wider impacts on soil quality, water quality, biodiversity, and land use are associated with the supply chains and food systems which underpin these units.

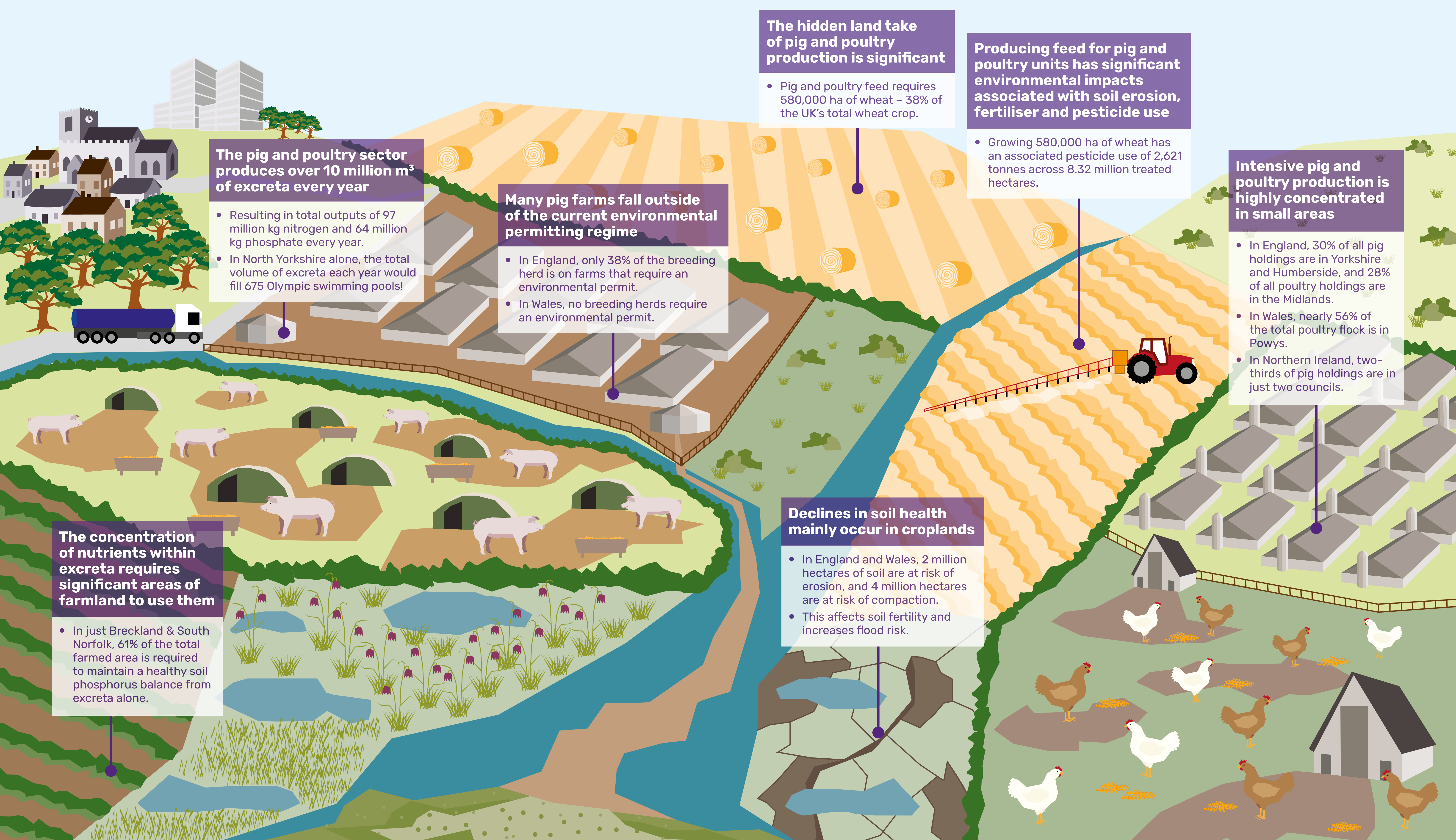
The environmental impacts associated with soil erosion, fertiliser application, and pesticide use on the significant land area associated with producing feed for pig and poultry units are likely significant, but currently fall outside of any reporting or permitting on the environmental impacts of pig and poultry units.

The findings of this report also show that the majority of breeding sows in England fall outside the environmental permitting regulations, alongside significant proportions of other pig populations across the UK. This means that regulators lack a key route to managing the potential environmental impacts of these enterprises. In contrast, a high proportion of poultry is in larger units falling within the environmental permitting regulations. However, even where the permitting regime applies, not all producers appear to be adopting best practice in manure storage and application. The nutrient pollution issues in the River Wye catchment highlight the impacts that locally-concentrated manure applications in excess of crop need and soil capacity can bring.

IMPACTS OF PIG & POULTRY PRODUCTION IN THE UK

The scale of pig and poultry production as a sector across the UK is huge

The UK produces almost 1 million tonnes of pigmeat and 2 million tonnes of poultry meat every year, breeding, growing and slaughtering 11 million pigs and 1.1 billion broilers. In addition, there is an egg-laying flock of around 40 million chickens, producing 12 billion eggs per year.



1 - Introduction

1.1 Background

Our current global food production system is devastating our planet's natural systems, both on land and at sea, driving biodiversity loss, widespread deforestation, and the pollution of our soils, seas and rivers. The food industry globally is also the second-biggest contributor to climate change after the energy sector and a major cause, due to land use change, of emerging infectious disease.

Across the UK, increasingly intensive agricultural practices, driven by an unfair and irresponsible food system demands, have been a primary driver of nature loss. Agriculture in the UK is currently the most significant polluter of our waterways, the main source of ammonia air pollution, accounts for 12% of the UK's greenhouse gas emissions[1], and has been identified as the primary cause of many protected sites for nature being in poor condition.

The production of pigs and poultry via intensive livestock units in the UK is an area of particular concern for The Wildlife Trusts. The impacts of these systems, often highly geographically concentrated and dependent on a significant amount of bought in inputs, are leading to serious environmental degradation. A specific case in point is the River Wye, where Wildlife Trusts have been involved in campaigning and advocacy work to address the issues of water pollution arising from intensive poultry units.

Understanding and analysis of the holistic impacts from farming of monogastric animals at the UK-level is currently limited. There is a significant gap in the literature with no single review of the environmental impacts of the UK pig and poultry sectors having been conducted. Further exploration of the environmental impacts of the pig and poultry sectors at a UK-wide level is needed to reduce the negative impacts from these farming sectors, inform systemic change and support a nature-positive food and farming transition in the UK.

1.2 Aims

The aim of this project is to report on the environmental risks from food produced in intensive pig and poultry units in the UK across a range of environmental factors – including biodiversity, climate, water quality, air quality, land use (both in terms of unit footprint and footprint of additional inputs), and water use.

Stage 1 of the project comprised a scoping report which identified and assessed the key potential environmental impacts and issues of concern; identified what data sets exist and are available/accessible to inform the work; and consulted with a select group of relevant parties to identify key issues/areas of focus. This was completed in April 2024.

Stage 2 of the project comprises a quantified environmental risk report, building on the findings and recommendations of the scoping report.

The aim of this **Stage 2** report is to:

- Provide a robust, evidence-based overview of the environmental risks of pig and poultry production in the UK, with analysis on multiple environmental factors and assessing various methods of production;
- Provide analysis which identifies, quantifies, and assesses these environmental risks relevant to The Wildlife Trusts' policy objectives and the UK's environment targets; and
- Clearly identify areas of concern and possible solutions to address the environmental risks of pig and poultry industry in the UK.

The **Stage 2** report focuses on:

- The risks and potential impacts on water quality, soil quality and biodiversity in the UK;
- The evidence base as opposed to the policy asks; and
- Moving from narrative to numbers, with quantitative robust outputs where possible, including the use of graphics/infographics.

The broader range of environment risks and potential environmental impacts from pig and poultry production, and the risks/impacts outside the UK, are out of scope of the **Stage 2** report, but are acknowledged and noted in the report.

1.3 Approach

The approach undertaken during this project included:

- Inception meeting and work planning
- Collation and analysis of quantitative and spatial data from around the UK
- Review of literature and scientific evidence to determine the extent and manner to which water quality, soil quality, and biodiversity in the UK may be affected.
- Reporting

2 - Inventory of the UK pig and poultry sectors

2.1 Overview

The UK produces almost 1 million[i] tonnes of pigmeat[2] and 2 million[ii] tonnes of poultry[3] meat per year, breeding, growing and slaughtering in the region of 11 million pigs and 1.1 billion broilers. In addition, the UK has an egg laying flock of approximately 40 million chickens, producing approximately 12 billion eggs per year.

The high-level spatial distribution of pigs is shown in **Table 2 1** and for poultry in **Table 2 2**. These data are taken from the June Agricultural Survey 2024[4] and provide a snapshot of the numbers of pigs and poultry at that point in time.

For pigs, both the breeding and fattening herds are situated predominantly in England (77% of the breeding herd and 78% of the fattening herd), with lesser numbers in Northern Ireland (13% of the breeding herd and 15% of the fattening herd), Scotland (9% of the breeding herd and 7% of the fattening herd) and Wales (each 1%).

For poultry, 59% of the breeding and laying flock and 78% of the broiler flock are situated in England, with lesser numbers in Northern Ireland (18% of the breeding and laying flock and 12% of the broiler flock), Scotland (13% and 4% respectively) and Wales (10% and 6% respectively).

The more detailed in-country distribution and trends for pigs and for poultry are described in the sections below.

Table 2 1: Numbers of breeding and fattening pigs in the UK in 2024

Country	Breeding pigs	Fattening pigs
England	325,859	3,354,353
Northern Ireland	56,220	635,871
Scotland	36,238	279,264
Wales	2,201	25,663
Total	420,518	4,295,151

Table 2 2: Head of poultry in the UK in 2024

Country	Breeding & laying fowl	Table birds (broilers)
England	32,160,262	87,923,625
Northern Ireland	9,977,135	13,376,160
Scotland	7,107,263	4,808,022
Wales	5,366,864	6,266,418
Total	54,611,524	112,374,225

i 2019-2023 five year-average production of bone-in carcase weight = 949 thousand tonnes
ii 2019-2023 five year-average production of bone-in carcase weight of broilers = 1,735 thousand tonnes

2.2 Pigs

England

Pig numbers in England have been relatively static over the past 15 years, at between 3.6-4.2 million animals. **Figure 2 1** shows the total breeding and growing herd from 2010 to 2024.

Data is available[5] (for 2021) on the distribution within England of farm holdings and of pig numbers. At that time there were 1,772 specialist pig holdings in England, of which 30% were in Yorkshire and Humberside, 26% were in the Eastern region, and 14% were in the South West.

Breeding pigs tend to be concentrated within specific counties, e.g. in the councils and local authorities that make up Norfolk (21%), North Yorkshire (15%), Suffolk (12%) and the East Riding of Yorkshire (8%). **Table 2 3** shows the ten council/local authority areas in England with the highest number of breeding pigs.

Fattening pigs are also concentrated within specific counties, although there is some separation between the breeding and the fattening stock e.g. with fattening pig populations concentrated in the counties that make up Norfolk (17%) and Suffolk (9%) and in North Yorkshire (19%) and the East Riding of Yorkshire (16%). **Table 2 4** shows the ten council/local authority areas in England with the highest number of fattening pigs. Notably, just five areas (North Yorkshire and the East Riding of Yorkshire, North and West Norfolk, Breckland and South Norfolk, and Suffolk) represent both the five largest breeding herds (55% of the English breeding population) and the five largest fattening herds (61% of the English fattening population).

Northern Ireland

The distribution[6] of the breeding and fattening herds across Northern Ireland's District Councils is shown in **Table 2 5** and **Table 2 6**. Just two of Northern Ireland's District Councils contain 66% of the pig breeding herd and 69% of the fattening herd.

Scotland

The distribution[7] of the breeding and fattening herds across Scotland is shown in **Table 2 7** and **Table 2 8.** Grampian in the north-east of Scotland contains 63% of the Scottish breeding herd and 58% of the Scottish fattening herd.

Wales

The estimated total number (i.e. breeding and fattening populations combined) of pigs in Wales[iii] is in the order of 25,000 animals, with six of the seven Welsh regions containing 5,000 pigs or fewer, as shown in **Table 2 9**.

Pigs - Livestock Demographic Data

Assessments[iv] are made by the APHA (Animal and Plant Health Agency) of pig numbers and pig holdings across Great Britain using a dataset of pig movements reported to the electronic animal movements licencing scheme. These assessments are in the public domain and provide a useful visualisation of pig populations in England, Scotland and Wales. See **Figure 2 3**.

iii Data from the 2023 June Survey kindly provide by Agricultural Statistics, Welsh Government
iv Livestock Demographic Data Group: Pig population report Livestock population density maps for Great Britain, using 2022 to 2023 data

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Proportion of pigs in holdings requiring an environmental permit

Pig farms that are over a specific threshold must under legislation (see **Box 1**) obtain and act in accordance with an environmental permit, and data on the distribution of herds of particular size thresholds is available.

- In England[v], in 2023, only 38% of the breeding herd was on farms with over 750 sows, i.e. the majority of breeding sows fall outside of the current environmental permitting regime. The average size of each of these environment-permitted breeding units in 2023 was 1,090 sows. The proportion of fattening pigs in units of 2,000 or more animals has fluctuated over the past decade between 56% and 62% (in 2023 it was 56%) (see **Figure 2 2**). The average size of each of these environment-permitted fattening pig units in 2023 was 4,100 pigs.
- In Scotland, 58% of the breeding herd is on units of 700+, although the data for how many of these are on permitted (i.e. 750+) units could not be sourced. The proportion of fattening pigs in units of 2,000 or more animals was 63% in Scotland. The average size of each of these environment-permitted fattening pig units in 2023 was 5,000 pigs.
- Data on the breeding herd in Northern Ireland was not provided in size bands that would allow an assessment of the approximate proportion that would be on environment-permitted holdings. However, it can be seen that 85% of fattening pigs are on farms of over 2,000 fatteners. The average size of each of these environment-permitted fattening pig units in 2023 was 9,100 pigs.
- In Wales, none of the breeding herd is on units of more than 150 sows, i.e. pig units are all significantly smaller than the permitting threshold. Whilst data is not available for the fattening herd, the average number of pigs per holding (for those holdings with any pigs at all) is fewer than 30 animals; and for Powys the average number of pigs per holding is just 66 animals.

v Data from the 2023 June Survey kindly provided by Defra Farming Statistics

Figure 2 1: Pig numbers in England 2010-2024

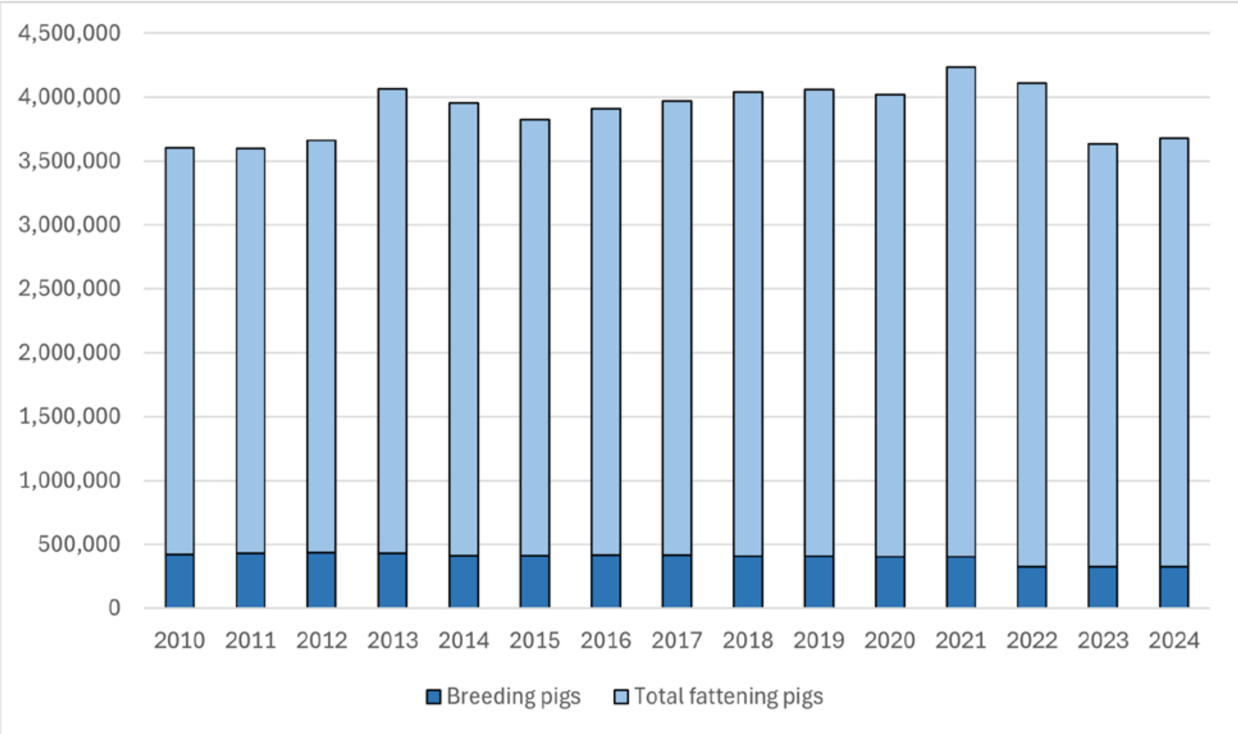

Figure 2 2: Number of fattening pigs by size band of holding in England, 2014-2023[6]

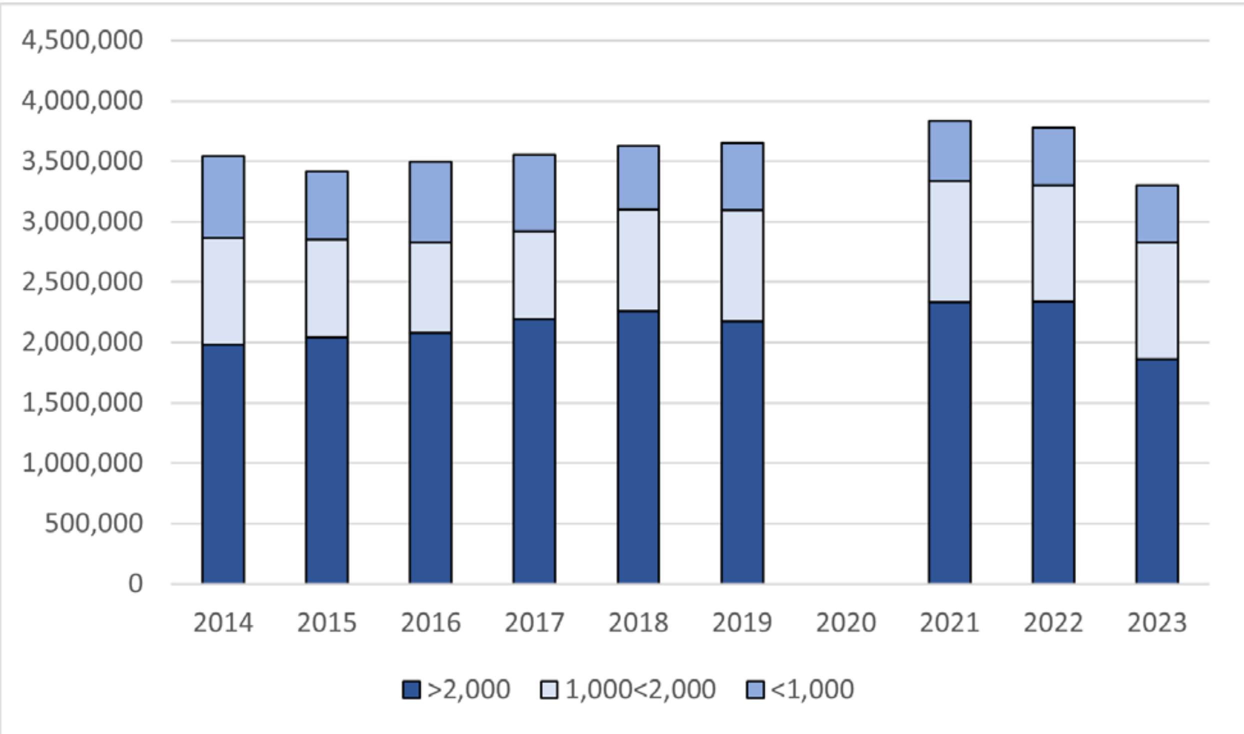

Figure 2 3: Pig population density in GB, estimated from pig movements 2022-2023

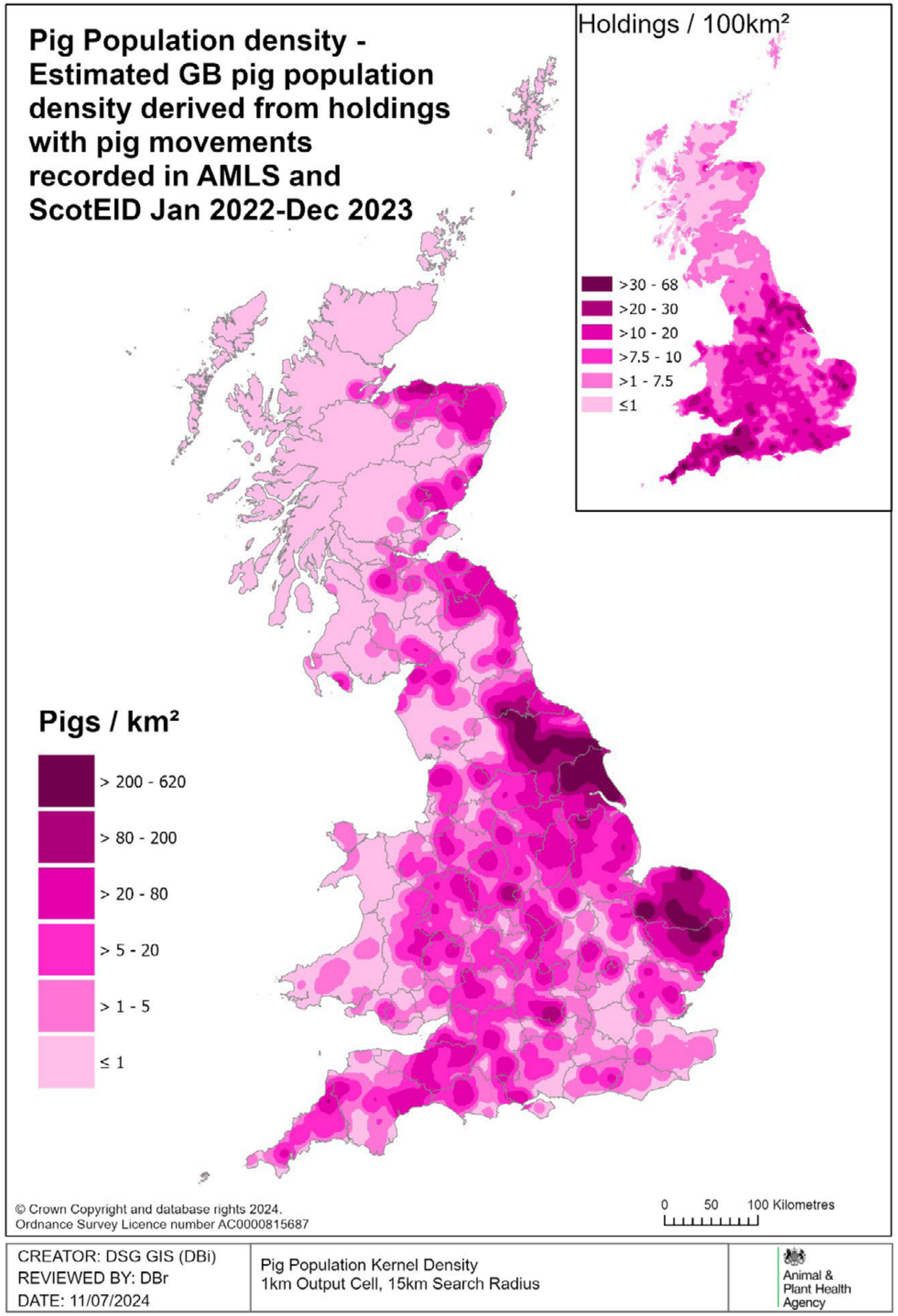

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Table 2 3: 'Top ten' largest breeding pig populations in England by council/unitary authority area (2021 data)

Area	Number of breeding sows	Proportion of England's breeding herd
North Yorkshire CC	60,797	15.1%
Suffolk CC	47,679	11.8%
Breckland and South Norfolk	42,150	10.5%
North and West Norfolk	38,721	9.6%
East Riding of Yorkshire	32,418	8.1%
Lincolnshire CC	17,442	4.3%
North Nottinghamshire	16,016	4.0%
Devon CC	11,836	2.9%
North and North East Lincolnshire	11,768	2.9%
Wiltshire	9,109	2.3%
Total	287,936	71.5%

Table 2 4: 'Top ten' largest fattening pig populations in England by council/local authority area (2021 data)

Area	Number of fattening pigs	Proportion of England's fattening herd
North Yorkshire CC	736,047	19.2%
East Riding of Yorkshire	607,233	15.8%
Breckland and South Norfolk	438,180	11.4%
Suffolk CC	343,018	8.9%
North and West Norfolk	220,685	5.8%
Lincolnshire CC	158,364	4.1%
Devon CC	81,646	2.1%
Oxfordshire CC	70,426	1.8%
Somerset CC	69,248	1.8%
North and North East Lincolnshire	66,239	1.7%
Total	2,791,086	72.6%

Table 2 5: 'Top five' largest breeding pig populations in Northern Ireland by District Council (2023 data)

District Council	Number of breeding sows	Proportion of Northern Ireland's breeding herd
Armagh City, Banbridge and Craigavon	17,184	35.9%
Mid Ulster	14,558	30.4%
Newry, Mourne and Down	4,051	8.5%
Fermanagh and Omagh	3,603	7.5%
Derry City and Strabane	2,401	5.0%
Total	41,797	87.3%

Table 2 6: 'Top five' largest fattening pig populations in Northern Ireland by District Council (2023 data)

District Council	Number of fattening pigs	Proportion of Northern Ireland's fattening herd
Armagh City, Banbridge and Craigavon	227,950	35.9%
Mid Ulster	211,718	33.4%
Newry, Mourne and Down	48,496	7.6%
Fermanagh and Omagh	42,235	6.7%
Derry City and Strabane	29,560	4.7%
Total	559,959	88.3%

Table 2 7: 'Top five' largest breeding pig populations in Scotland by sub-region (2023 data)

Sub-region	Number of breeding sows	Proportion of Scotland's breeding herd
Grampian	19,528	62.7%
Scottish Borders	3,480	11.2%
Highland	1,542	4.7%
Lothian	1,474	4.0%
Tayside	1,242	5.0%
Total	27,266	87.6%

Table 2 8: 'Top five' largest fattening pig populations in Scotland by sub-region (2023 data)

Sub-region	Number of fattening pigs	Proportion of Scotland's fattening herd
Grampian	180,234	57.7%
Scottish Borders	45,968	14.7%
Highland	18,038	5.8%
Lothian	17,642	5.6%
Tayside	15,894	5.1%
Total	277,776	88.9%

Table 2 9: Total pig numbers (breeders and fatteners combined) in Wales by sub-region (2023 data)

Sub-region	Number of breeding and fattening pigs	Proportion of Wales' total pig herd
Powys	12,875	51.9%
Notrh West	4,169	16.8%
South Wales	2,986	12.0%
North East	2,027	8.2%
Carmarthenshire	1,240	5.0%
Ceredigion	795	3.2%
Pembrokeshire	734	3.0%
Total	24,826	100.0%

Box 1 - Environmental Permitting Regulations – Pig and Poultry housing

Pig and poultry housing in the UK are subject to the following regulations, which aim to reduce pollution from industrial activity by controlling emissions. These stem from the Integrated Pollution Prevention and Control (IPPC) Directive.

- Environmental Permitting Regulations 2016 (EPR) in England and Wales, regulated by the Environment Agency and Natural Resources Wales respectively.
- Pollution Prevention and Control (Scotland) Regulations 2012 (PPC) in Scotland, regulated by the Scottish Environment Protection Agency.
- Pollution Prevention and Control (Industrial Emissions) Regulations (Northern Ireland) 2013 (PPC(IE)), regulated by the Northern Ireland Environment Agency.

Operators of all pig and poultry farms above a certain size need to comply with the requirements of the relevant legislation in their country by obtaining, and operating in accordance with, an environmental permit:

- >40,000 places for poultry;
- >2,000 places for production pigs (over 30 kg); or
- >750 places for sows.

To obtain a permit, it is necessary to complete an application outlining how the installation is operating and demonstrating that the Best Available Techniques (BAT) are used for preventing pollution. BAT Conclusions – the techniques to prevent or, where this is not practicable, reduce emissions from pig and poultry farms – came into force in 2021 and cover the following on-farm processes and activities: nutritional management of poultry and pigs; feed preparation (milling, mixing and storage); rearing (housing) of poultry and pigs; collection and storage of manure; processing of manure; manure land spreading; storage of dead animals.

Once approved, inspections by the relevant regulator take place to ensure compliance. A Pig and Poultry Assurance Scheme is available for pig and poultry farmers in England and Wales achieving a high standard of compliance with their environmental permit.

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2.3 Poultry

England

Poultry numbers in England have been relatively static over the past 15 years, at between 120-140 million head. **Figure 2 4** shows the total number of breeding and laying fowl, table chickens, and other poultry from 2010 to 2024.

Data is available (for 2021) on the distribution within England of farm holdings and of poultry numbers. At that time there were 2,485 specialist poultry holdings in England, of which 19% were in the Eastern region, 14% were in the East Midlands and 14% in the West Midlands, 19% were in the South West and 12% were in Yorkshire and Humberside.

Table 2 10 and **Table 2 11** show the ten council/local authority areas in England with the highest numbers of broiler chickens and laying hens respectively.

Northern Ireland

The distribution of poultry across Northern Ireland's District Councils is shown in **Table 2 12**. Just two of Northern Ireland's District Councils contain 49% of the poultry flock.

Scotland

The distribution of the broiler and laying hen flocks across Scotland is shown in **Table 2 13** and **Table 2 14**.

Wales

Poultry numbers and distribution in Wales from 2002-2020 are shown in **Figure 2-5.** There has been a marked increase in poultry numbers in Powys since 2007, from just over 1 million to around 5 million birds in 2020. The distribution of the combined broiler and laying hen flocks across Wales is shown, for 2023, in **Table 2-15**.

Poultry - Livestock Demographic Data

Assessments[vi] are made by the APHA (Animal and Plant Health Agency) of poultry numbers and poultry holdings across Great Britain using data from the Great Britain Poultry Register (GBPR), which represents the statutory systematic record of the location, species, usual number of birds and seasonal variations, for holdings with more than 50 birds in Great Britain. These assessments are in the public domain and provide a useful visualisation of poultry populations in England, Scotland and Wales. See **Figure 2 6**.

Proportion of poultry in holdings requiring an environmental permit

Poultry units that are over a specific threshold must be permitted, as described in **Box 1**, and data on the distribution of poultry units of particular size thresholds is available.

- In England, the proportion of poultry in units of 40,000 or more animals has risen slightly over the past decade, from 81% in 2014 to 84% in 2023 (**Figure 2 7**). The average size of each of these environment-permitted units in 2023 was 143,000 birds.
- In Scotland, in 2024, 79% of poultry was in units of 40,000 or more animals, with the average size of these environment-permitted units being 126,000 birds.
- The Irish data is presented with different size bands, but nevertheless we can see that, in 2023, 54% of poultry was in units of 50,000 or more animals, with the average size of these units being 99,000 birds.
- Welsh data is available for comparison between 2014-2023, with a focus on Powys (as the dominant region for poultry in Wales). In 2023, 65% of poultry in Powys was in units of 35,000 or more animals. The average size of these poultry units in Powys was 105,000 birds whilst in North, South and West Wales it was 149,000 birds.

vi Livestock Demographic Data Group: Poultry population report Livestock population density maps for GB, using July 2023 data

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Figure 2 4: Poultry numbers in England 2010-2024

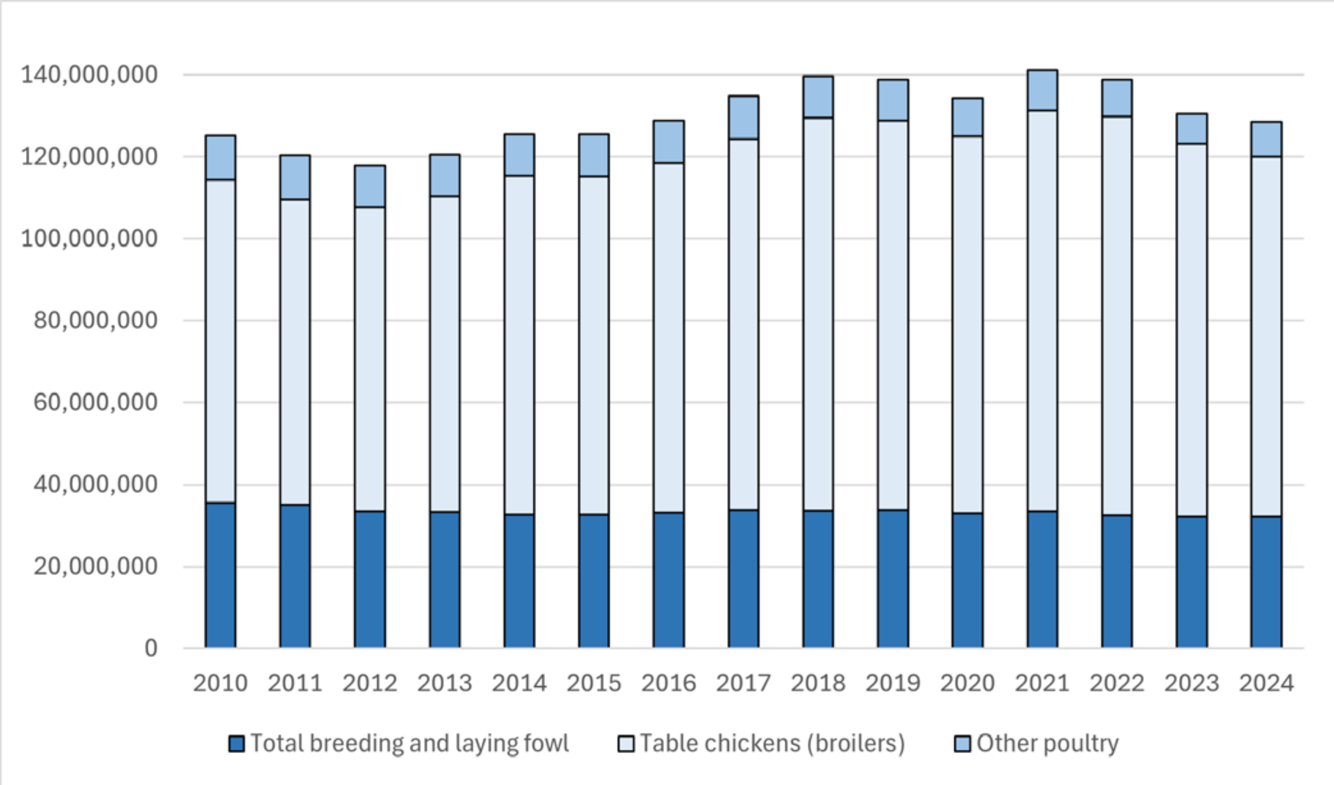

Figure 2 5: Poultry numbers and distribution in Wales, 2002-2020

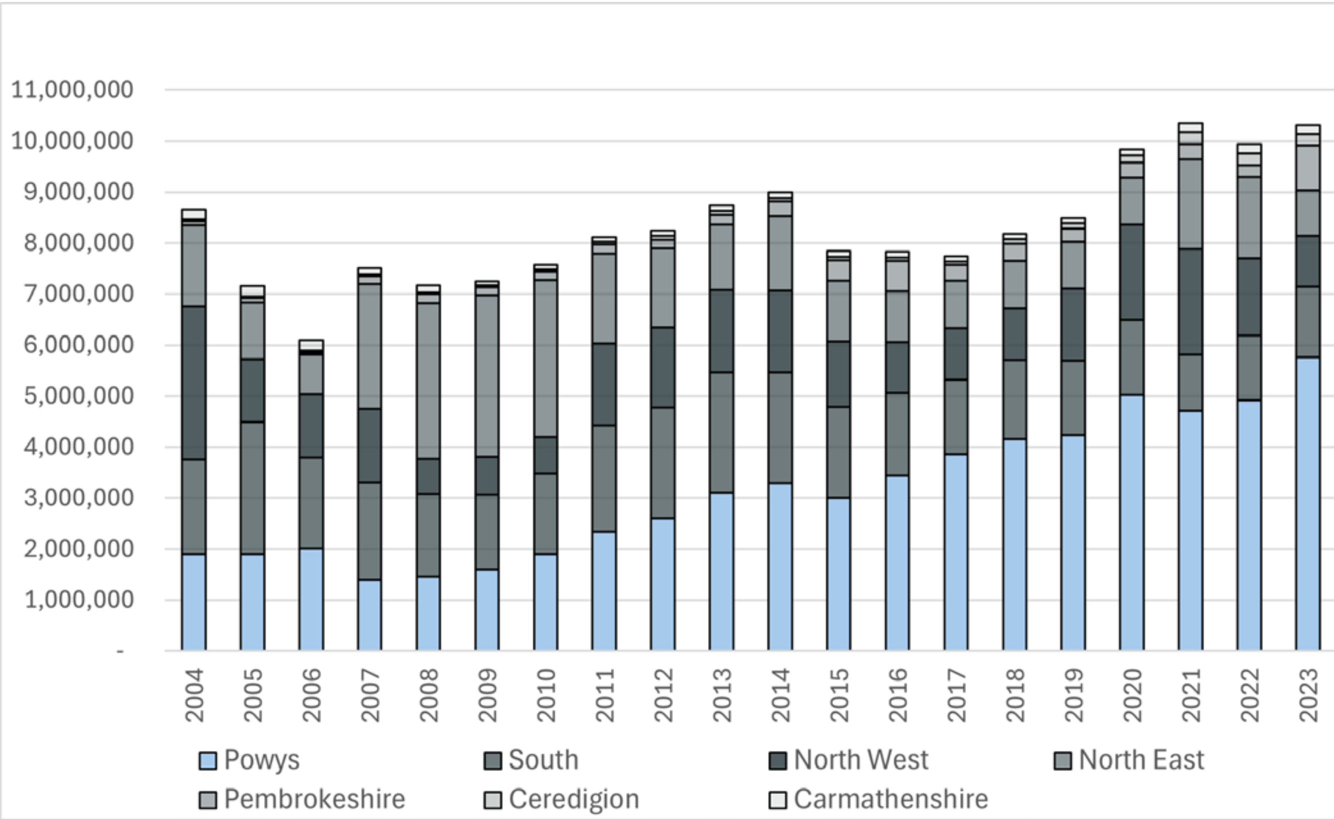

Figure 2 6: GB Chicken Bird Holding Density as Recorded in SAM July 2023

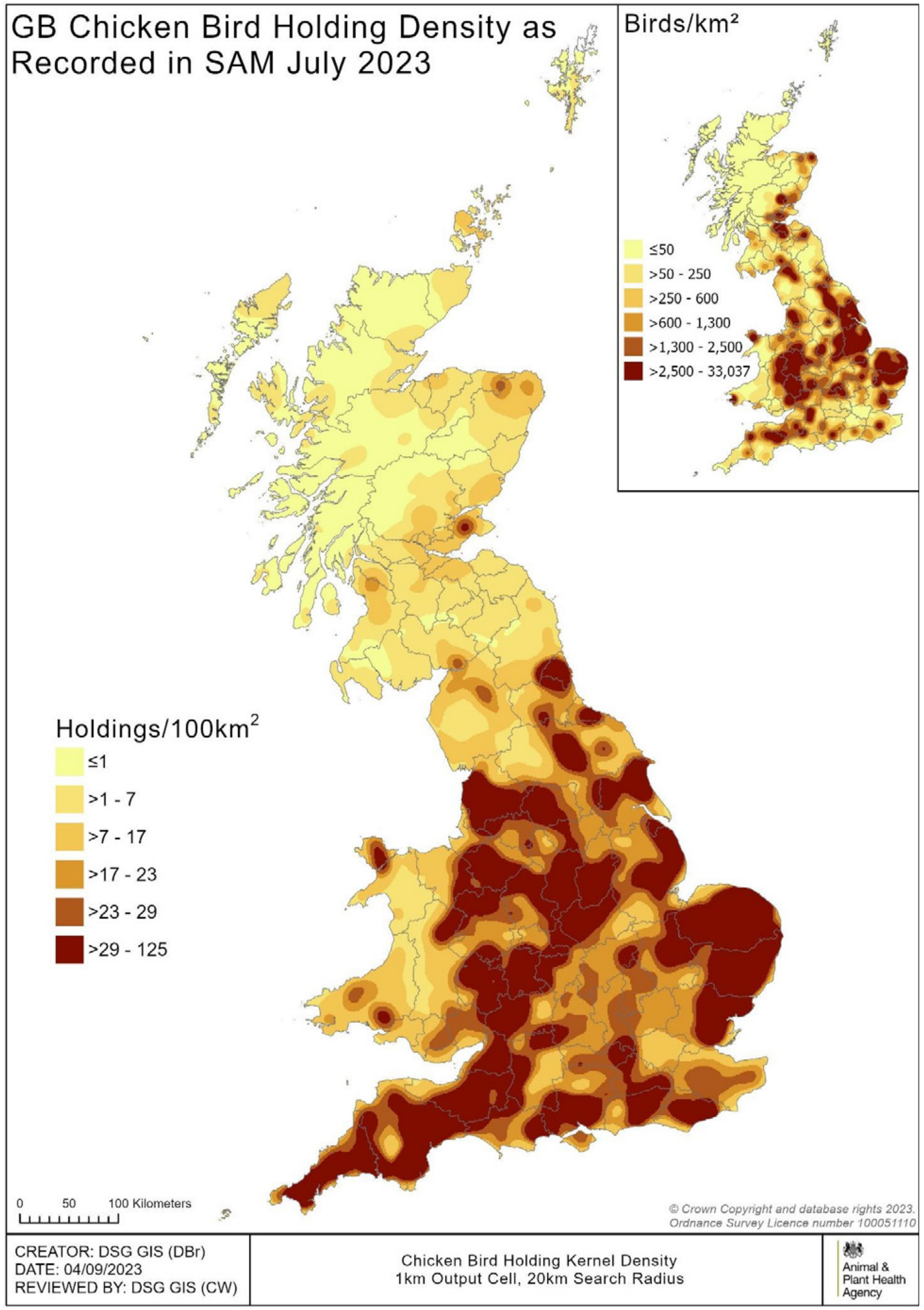

Figure 2 7: Head of poultry by size band of holding in England, 2014-2023

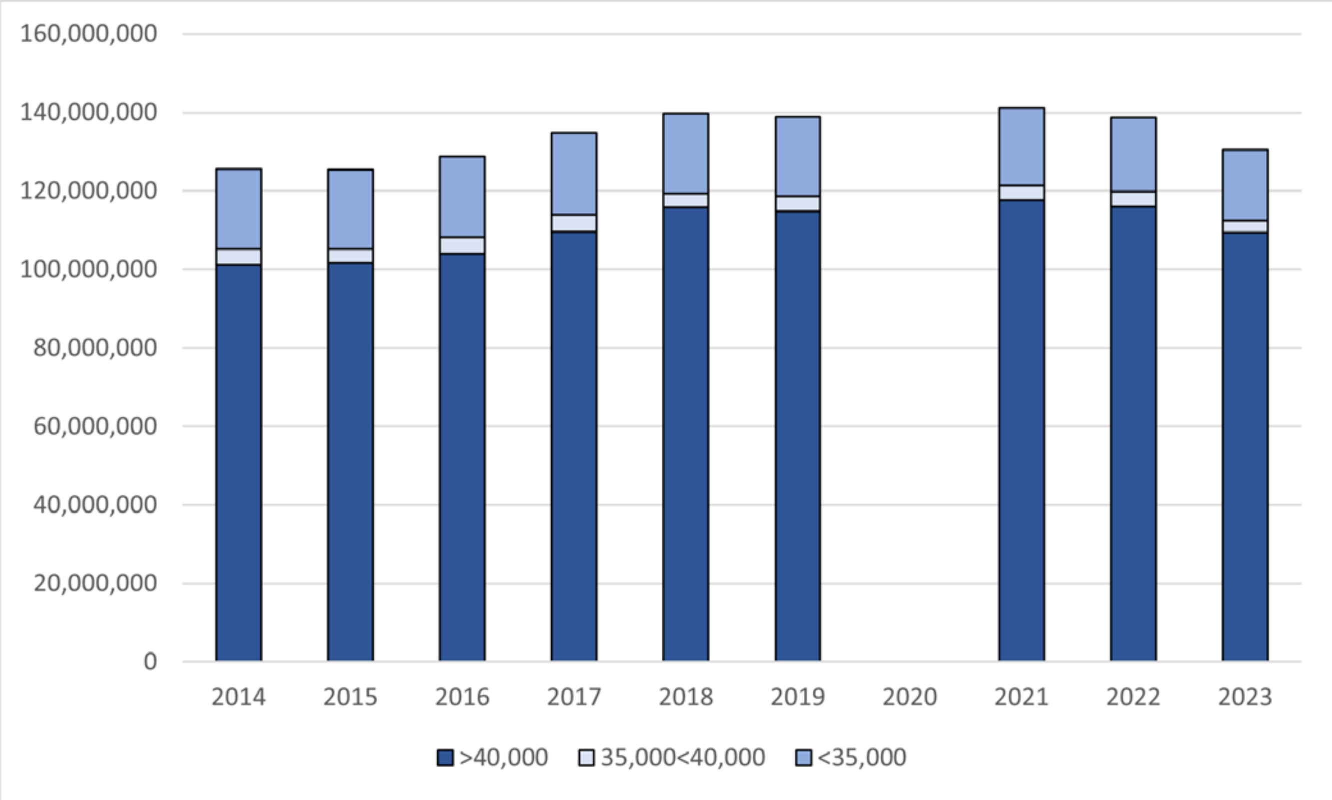

Table 2 10: 'Top ten' largest broiler populations in England by council/unitary authority area (2021 data)

Area	Number of broilers	Proportion of England's broiler flock
Lincolnshire CC	12,191,559	12.5%
Herefordshire, County of	8,384,993	8.6%
Breckland and South Norfolk	8,088,484	8.3%
Suffolk CC	6,588,464	6.7%
Shropshire	6,486,920	6.6%
North and North-East Lincolnshire	5,040,233	5.2%
North Yorkshire CC	4,325,251	4.4%
Devon CC	3,644,126	3.7%
North and West Norfolk	3,381,304	3.5%
North Nottinghamshire	3,351,747	3.4%
Total	61,483,081	62.9%

Table 2 11: 'Top ten' largest laying hen populations in England by council/unitary authority area (2021 data)

Area	Number of laying hens	Proportion of England's laying hens
West Kent	2,310,989	9.3%
Shropshire	1,981,461	8.0%
Lincolnshire CC	1,862,608	7.5%
North Yorkshire CC	1,790,451	7.2%
Leicestershire CC and Rutland	1,277,012	5.1%
Herefordshire, County of	1,208,000	4.9%
East Riding of Yorkshire	887,009	3.6%
Devon CC	866,398	3.5%
Cheshire East	824,594	3.3%
East Cumbria	739,644	3.0%
TOTAL	13,748,166	55.4%

Table 2 12: 'Top five' largest poultry populations in Northern Ireland by District Council (2023 data)

District Council	Head of poultry	Proportion of Northern Ireland's total poultry flock
Mid Ulster	8,552,174	33.4%
Armagh City, Banbridge and Craigavon	3,911,901	15.3%
Mid and East Antrim	3,479,116	13.6%
Causeway Coast and Glens	2,796,869	10.9%
Fermanagh and Omagh	2,784,604	10.9%
Total	21,524,664	84.1%

Table 2 13: 'Top five' largest broiler populations in Scotland by sub-region (2023 data)

Sub-region	Number of broilers (and other table fowl & poultry)	Proportion of Scotland's broiler flock
Tayside	1,407,073	29.7%
East Central	1,008,823	21.3%
Lothian	838,894	17.7%
Dumfries & Galloway	667,415	14.1%
Grampian	19,384	0.4%
Total	3,941,589	83.2%

Table 2 14: 'Top five' largest laying hen populations in Scotland by sub-region (2023 data)

Sub-region	Number of laying hens	Proportion of Scotland's laying flock
Scottish Borders	2,010,372	33.6%
Grampian	1,029,639	17.2%
Tayside	945,563	15.8%
Dumfries & Galloway	429,691	7.2%
Lothian	205,271	3.4%
Total	4,620,536	77.2%

Table 2 15: 'Top five' largest poultry populations in Wales (2023 data)

Region	Head of poultry	Proportion of Wales' total layer & broiler flock
Powys	5,757,238	55.8%
South	1,385,789	13.4%
North West	994,232	9.6%
North East	896,618	8.7%
Pembrokeshire	881,477	8.5%
Total	9,915,354	96.1%

Farm practices – manure and slurry storage

Defra's Farm Practices Survey[8] (2024) gathered responses from pig and poultry producers[vii] in England to a series of questions relating to slurry storage and nutrient management.

- 63% (of 48 respondents) will store solid manure uncovered, in the open, on a field site;
- 44% (of 64 respondents) will rely entirely on contractors for manure and slurry spreading;
- 91% (of 26 respondents) will export solid manure off farm (with no further storage); and 37% will spread manure direct from the house (with no further storage) ;

Whilst the sample size of respondents is relatively low and the results are difficult to interpret with any accuracy, the figures do indicate that not all producers may be adopting best-practice in manure storage.

Pig and poultry housing

Recent data on the proportions of the UK's pig herd and poultry flock that are permanently housed, and the proportions that have access to outdoor enclosures, is difficult to source and interpret. Historic (2009) estimates[9] for the pig herd are that 40% of the breeding herd is outdoor housed, but that the majority of the fattening herd is housed at least from the point of weaning. Approximately 12,000 ha of land is used for outdoor pigs across the UK[10].

Other than a small proportion (approximately 3.5%[11]) of 'free-range' flocks, broiler chickens are fully housed for the whole of their lives. In contrast, laying hens may be given access to outdoor runs (i.e. free range) but here the use of those ranges is dependent on the environment – with tree cover and other shelter encouraging greater use.

Approximately 68%[12] of UK egg production in 2024 was free-range, with a further 4% being organic. The remaining 28% of production was from enriched (i.e. housing system providing more space and resources than traditional battery cages) or barn systems.

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vii The Farm Practices Survey groups pig and poultry producers together.

3 - Inputs and outputs from the UK pig and poultry sector

This section quantifies key inputs and outputs from the UK pig and poultry sector which are relevant to and influence the environmental risks.

3.1 Agricultural Area and Inputs Used for Feed

Whilst the average areas of specialist pig farms (e.g. 46ha in England)[13] and poultry farms (e.g. 37ha in England) are relatively small, the areas of land required to produce pig and poultry feed extend beyond the pig and poultry unit 'footprints'.

Defra data[14] provides an estimate that 3.57[viii] million hectares (59%) of the UK's cropped area is used to feed livestock, including stock-feeding crops (such as field beans, root crops, brassicas, fodder beet) and other crops used for animal feed (see **Figure 3 1**).

Pigs

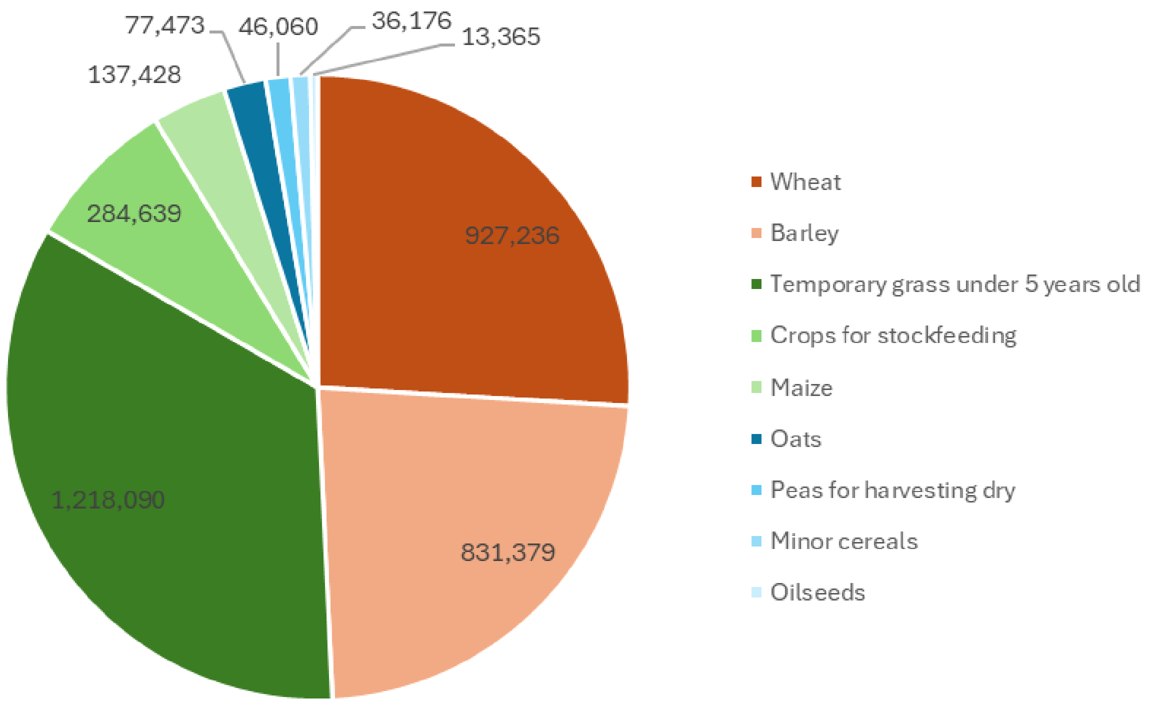
Pig rations are estimated by AHDB to include approximately 48% wheat. Extrapolating from the figures for compound feed production in GB, this would indicate the total volume of wheat used as pig feed in GB to be in the region of 900 thousand tonnes, utilising an area of approximately 120,000 hectares (see **Table 3 1**).

This can be considered a conservative estimate for the UK as a whole as it does not account for those producers using on-farm mill and mixing of their own animal feed (i.e. not using purchased compound feeds), and it excludes Northern Ireland. Considering the food conversion ratio for pig meat production, the total volumes of pigmeat produced, and the estimated use of wheat in pig rations, the total area of wheat grown in the UK for pig meat production may be as high as 180,000 hectares.

Based on this area, and average fertiliser application rates[15] of 140kg nitrogen, 20kg phosphate and 40kg potash per hectare, this equates to an estimated 25,200 tonnes of nitrogen, 3,300 tonnes of phosphate and 6,600 tonnes of potash being utilised to enable feed production for pigs.

Looking at pesticides[16], a figure of 180,000 hectares would amount on average to an estimated 2.54 million treated hectares[ix] and 801 tonnes applied. Wheat receives on average 3 fungicide, 3 herbicide, 2 growth regulator and 1 insecticide spray rounds, with herbicides accounting for 50.7% by weight, fungicides 24.4% and growth regulators 23.6%. Applying these percentages, the 801 tonnes includes an estimated 406 tonnes of herbicide, 196 tonnes of fungicide and 189 tonnes of growth regulators.

Figure 3 1: Cropped area (ha) in the UK used to feed livestock



viii Average figure. 2019-2023

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Poultry

Poultry diets consist predominantly of wheat, and AHDB estimate that poultry feed accounts for 45% of total animal feed production in the UK. If we assume that 45% of feed wheat production is destined for the poultry sector, this equates to 26% of the UK's total wheat crop, utilising an area of just over 400 thousand hectares. Estimating land used for feed wheat production for the poultry industry based on the proportion of wheat in poultry diets in Great Britain gives a similar estimate (see **Table 3 2**). Here again it should be noted that this excludes Northern Ireland production as well as on-farm cereal use that would not be captured in compound feed or Integrated Poultry Unit datasets, such that the estimate can be considered to be conservative.

Based on a figure of 409,000 hectares, and the average fertiliser application rates[17] of 140kg nitrogen, 20kg phosphate and 40kg potash per hectare, this equates to an estimated 57,260 tonnes of nitrogen, 8,180 tonnes of phosphate and 16,360 tonnes of potash.

Looking at pesticides, a figure of 409,000 hectares would amount on average to an estimated 5.78 million treated hectares and 1,820 tonnes applied[x]. Applying the breakdown percentages referred to above, the 1,820 tonnes include an estimated 922 tonnes of herbicide, 445 tonnes of fungicide and 430 tonnes of growth regulators.

Land use outside the UK for UK pig and poultry feed

Both pig and poultry diets include soyabean meal, imported mostly from the US, Canada and South America. Average annual use in UK pig and poultry feed in the UK[18] is shown in **Table 3-3**. If we assume average soyabean yield to be 3.5 tonnes/ha, and average soyabean meal content to be 72.5%, then the average yield of soyabean meal is approximately 2.5 tonnes/ha.

Applying this figure to the average annual use for each sector, we can see that the land use outside the UK for UK pig and poultry feed is in the region -of 730,000 hectares[19]. Nearly 90% of the UK's soy imports are used for animal feed, the majority of which is consumed by the pig and poultry sectors[20].

Maize is also often used in pig and poultry diets, and data on maize and flaked maize use in integrated poultry units (IPU) is available. This varies considerably over time, increasing in volume to 2021, with only limited data thereafter – most likely reflecting the disruptions to global supplies following Russia's invasion of Ukraine.

An average for the last five years of complete annual usage (2017-2021) indicates that the use of maize in poultry diets equates to 4.6% of the use of wheat. If we assume a similar proportion is used across all poultry units then, based on our calculations of total wheat use, we can estimate that the total use of maize in poultry units is approximately 150 thousand tonnes per annum, all of which is assumed to be imported. Yield varies on a country-by-country basis: in the US it may be as high as 10.5 tonnes/ha; in the EU and Ukraine as low as 7 tonnes per hectare. Based on the assumption that imports are predominantly from the EU and Ukraine, this equates to approximately 21,400 ha of land used to grow maize for UK poultry production.

ix These have been calculated by taking the ratio of treated hectares/total area grown for total area of wheat grown in UK, and applying to 180.000 ha. Note, 'treated hectares' refers to the area of land that has been subjected to a specific treatment. Because one hectare of land will may receive multiple different treatments, the area of treated hectares is higher than the total area grown

x These have been calculated by taking a ratio of treated hectares/total area grown for total area of wheat grown in UK, and applying to 409,000 ha.

Table 3 1: Land use for growing wheat for pig feed production (GB)

	Compound[xi] produced (tonnes)	Wheat (tonnes) at 48%	Land use (ha) at 8 tonnes of wheat per ha
Finishing compounds	1,066,000	511,680	63,960
Growing compounds	497,000	238,560	29,820
Breeding compounds	433,000	207,840	25,980
Total			119,760

Table 3 2: Land use for growing wheat for poultry feed production

	Compound[xii] produced (tonnes)	Wheat (tonnes) at 65%	Land use (ha) at 8 tonnes of wheat per ha
Broiler compounds	2,142,540	1,392,651	63,960
Integrated Poultry Units	-	1,147,820	29,820
Layer hen compounds	1,128,600	733,590	25,980
Total		3,274,061	409,258

Table 3 3 Land use outside the UK for UK pig and poultry feed (soya)

UK livestock sector	Total annual soyabean meal use (tonnes)	Average annual meal use in feed	Estimated land use (ha)
Pigs	360,000	9.9%	144,000
Poultry (meat)	1,264,000	21.0%	505,600
Poultry (eggs)	210,000	11.2%	84,000
Total			733,600

xi Compound refers to compound feed, also known as mixed feed. This is a type of animal feed that is formulated by blending various raw materials and additives. It is designed to provide a balanced diet that meets the nutritional needs of livestock, including pigs and poultry

xii Compound refers to compound feed, also known as mixed feed. This is a type of animal feed that is formulated by blending various raw materials and additives. It is designed to provide a balanced diet that meets the nutritional needs of livestock, including pigs and poultry.

3.2 Excreta production

We have calculated indicative figures for excreta output from pig and poultry systems in those areas where pig and poultry populations are highest (details on the methods used are provided in **Appendix 1**). We have also overlaid pig and poultry excreta figures to identify the locations where combined impacts are most significant.

Pigs

We have based our calculations of excreta output on figures published in Defra's NVZ tables and cross-referenced with data in the Agricultural Budgeting and Costings Book[21]. We have accounted for the age profile of animals across the production cycle: for example, the fattening pig population includes weaners, breeders and finishers. We have relied on conservative assumptions, so the figures are a lower band estimate.

Table 3-4 shows the total excreta output from pigs in each country of the UK.

Table 3-5 below shows the ten council areas in England where excreta output from pigs (including both breeding and fattening herds) is highest.

By way of comparison, an Olympic-size swimming pool holds a volume of 2,500 cubic metres. On this basis, pig units in North Yorkshire CC generate 675 Olympic-size swimming pools of excreta per annum. As another way of visualising this, it would be enough excreta to cover the whole of North Yorkshire CC in 0.21mm of excreta each year.

Table 3-6 below shows the excreta output from pigs across Northern Ireland's District Councils. 69% of all pig excreta in Northern Ireland is produced in just two District Council areas.

Table 3-7 below shows the ten areas in Scotland where excreta output from pigs is highest. More pig excreta is produced in the Grampian region than in the rest of Scotland combined.

Table 3-8 below shows the excreta output from pigs across different regions in Wales. More pig excreta is produced in Powys than in the rest of Wales combined.

Poultry

We have based our calculations of excreta output on figures published in Defra's NVZ tables. We have assumed that the layer flock is split 62:38 between outdoor and caged birds (evidence is limited, and this represents our best estimate).

Table 3-9 shows the total excreta output from poultry in each country of the UK

Table 3-10 shows the ten council areas in England where excreta output from poultry (both laying and broiler flocks) is highest.

Table 3-11 shows the areas in Northern Ireland where excreta output from poultry is highest.

Table 3-12 shows the ten areas in Scotland where excreta output from poultry (both laying and broiler flocks) is highest.

Pigs and poultry combined

We have overlaid pig and poultry excreta figures to identify the locations where combined impacts are most significant.

Table 3-13 shows the ten council areas in England where total excreta output from pigs and poultry is highest.

Table 3-14 shows the areas in Northern Ireland where total excreta output from pigs and poultry is highest

Table 3-15 shows the ten areas in Scotland where total excreta output from pigs and poultry is highest.

Table 3-16 below shows the total excreta output from pigs and poultry across the different regions of Wales.

Table 3 4: Total excreta output from pigs in the UK

Country	Excreta output (m³ per annum)
England	7,871,792
Northern Ireland	1,451,344
Scotland	714,021
Wales	53,391
Total	10,090,548

Table 3 5: Excreta output from pigs in England by area

Area	Excreta output (m³ per annum)
North Yorkshire CC	1,687,642
East Riding of Yorkshire	1,330,560
Breckland and South Norfolk	1,025,408
Suffolk	853,811
North and West Norfolk	577,311
Lincolnshire CC	378,281
Devon CC	204,922
North Nottinghamshire	185,281
North and North East Lincolnshire	173,788
Oxfordshire CC	166,295

Table 3 6: Excreta output from pigs in Northern Ireland by area

Area	Excreta output (m³ per annum)
Armagh City, Banbridge and Craigavon	516,931
Mid Ulster	475,241
Newry, Mourne and Down	111,351
Fermanagh and Omagh	97,237
Derry City and Strabane	67,635
Mid and East Antrim	37,550
Antrim and Newtownabbey	37,142
Causeway Coast and Glens	34,601
Lisburn and Castlereagh	32,260
Ards and North Down	26,340

Table 3 7: Excreta output from pigs in Scotland by area

Area	Excreta output (m³ per annum)
North East Grampian	429,399
SE Scottish Borders	104,295
South East Lothian	41,303
South East Tayside	39,701
North West Highland	37,240
SW Clyde Valley	15,902
South East Fife	13,488
South West Argyll & Bute	3,025
North West Na h-Eileanan Siar	2,406
South West Central	2,239

Table 3 8: Excreta output from pigs in Wales by area

Area	Excreta output (m³ per annum)
Powys	27,515
North West	8,910
South	6,381
North East	4,332
Pembrokeshire	1,569

Table 3 9: Total excreta output from poultry in the UK

Country	Excreta output (m³ per annum)
England	244,446
Northern Ireland	56,965
Scotland	31,323
Wales	23,400
Total	356,134

Table 3 10: Excreta output from poultry in England by area

Area	Excreta output (m³ per annum)
Lincolnshire CC	24,806
Herefordshire, County of	16,805
Shropshire	16,665
Breckland and South Norfolk	13,424
North Yorkshire CC	12,754
Suffolk CC	11,315
Devon CC	8,499
North and North East Lincolnshire	8,280
West Kent	8,088
North Nottinghamshire	6,932

3 - Inputs and outputs from the UK pig and poultry sector

Table 3 11: Excreta output from poultry in Northern Ireland by area

Area	Excreta output (m³ per annum)
Mid Ulster	19,157
Armagh City, Banbridge and Craigavon	8,763
Mid and East Antrim	7,793
Causeway Coast and Glens	6,265
Fermanagh and Omagh	6,238
Newry, Mourne and Down	3,292
Antrim and Newtownabbey	2,853
Lisburn and Castlereagh	1,653
Derry City and Strabane	930
Ards and North Down	366

Table 3 12: Excreta output from poultry in Scotland by area

Area	Excreta output (m³ per annum)
SE Scottish Borders	7,036
South East Tayside	5,796
North East Grampian	3,635
South West Dumfries & Galloway	3,351
South East Lothian	2,511
South West Central	1,734
South East Fife	620
North West Highland	479
South West Argyll & Bute	18
North West Orkney	9

Table 3 13: Excreta from pigs and poultry in England by area

Area	Excreta output (m³ per annum)
North Yorkshire CC	1,700,397
East Riding of Yorkshire	1,335,877
Breckland and South Norfolk	1,038,832
Suffolk CC	865,126
North and West Norfolk	582,923
Lincolnshire CC	403,088
Devon CC	213,421
North Nottinghamshire	192,213
North and North East Lincolnshire	182,068
Somerset CC	170,775

Table 3 14: Excreta from pigs and poultry in Northern Ireland by area

Area	Excreta output (m³ per annum)
Armagh City, Banbridge and Craigavon	525,694
Mid Ulster	494,398
Newry, Mourne and Down	114,643
Fermanagh and Omagh	103,474
Derry City and Strabane	68,565
Mid and East Antrim	45,344
Causeway Coast and Glens	40,866
Antrim and Newtownabbey	39,996
Lisburn and Castlereagh	33,913
Ards and North Down	26,705

3 - Inputs and outputs from the UK pig and poultry sector

Table 3 15: Excreta from pigs and poultry in Scotland by area

Area	Excreta output (m³ per annum)
North East Grampian	433,034
SE Scottish Borders	111,331
South East Tayside	45,497
South East Lothian	43,814
North West Highland	37,719
SW Clyde Valley	15,903
South East Fife	14,109
South West Central	3,973
South West Dumfries & Galloway	3,351
South West Argyll & Bute	3,043

Table 3 16: Excreta from pigs and poultry in Wales by area

Area	Excreta output (m³ per annum)
Powys	39,235
North West	10,934
South	9,202
North East	6,157
Pembrokeshire	3,363

3.3 Nitrogen and phosphate outputs

Pigs

We have calculated the output of nitrogen (N) and phosphate (P_2O_5) in pig excreta, based on coefficients published in Defra's NVZ tables. **Table 3-17** below shows the total output in each country.

Table 3-18 shows the ten council areas in England where nitrogen and phosphate output from pig excreta is highest, ranked by nitrogen output. Note that the relative output of nitrogen and phosphate depends on the ratio of breeding pigs to fattening pigs in each area.

Table 3-19 shows the areas in Northern Ireland where nitrogen and phosphate output from pig excreta is highest, ranked by nitrogen output.

Table 3-20 shows the ten areas in Scotland where nitrogen and phosphate output from pig excreta is highest, ranked by nitrogen output.

Table 3-21 shows the nitrogen and phosphate output from pig excreta across Wales, ranked by nitrogen output.

Poultry

We have calculated the output of nitrogen (N) and phosphate (P_2O_5) in poultry excreta, based on coefficients published in Defra's NVZ tables. **Table 3-22** shows the total output in each country.

Table 3-23 shows the ten council areas in England where nitrogen and phosphate output from poultry excreta is highest, ranked by nitrogen output. Note that the relative output of nitrogen and phosphate depends on the ratio of layers to broilers in each area. This explains why North Yorkshire CC is ranked 6th in respect of nitrogen output, but 5th in respect of phosphate output.

Table 3-24 shows the nitrogen and phosphate output from poultry excreta across Northern Ireland, ranked by nitrogen output.

Table 3-25 shows the ten areas in Scotland where nitrogen and phosphate output from poultry excreta is highest, ranked by nitrogen output.

Table 3-26 shows the nitrogen and phosphate output from poultry excreta in Wales, ranked by nitrogen output.

Pigs and poultry combined

We have overlaid pig and poultry output figures for nitrogen and phosphate to identify the locations where combined impacts are most significant. **Table 3-27** below shows the ten council areas in England where output is highest, ranked by nitrogen output. Note that the relative output of nitrogen and phosphate depends on the relative contribution of breeding pigs, fattening pigs, layers and broilers to overall pig and poultry numbers. This explains why, for example, Breckland and South Norfolk is ranked 2nd in respect of nitrogen output, but 3rd in respect of phosphate output.

Table 3-28 shows the nitrogen and phosphate output in Northern Ireland from pig and poultry excreta combined, ranked by nitrogen output.

Table 3-29 shows the ten areas in Scotland where output is highest, ranked by nitrogen output.

Table 3-30 shows the nitrogen and phosphate output in Wales from pig and poultry excreta combined, ranked by nitrogen output.

Table 3 17: Total output of Nitrogen and phosphate from pig excreta in the UK

Country	N (kg/year)	P_2O_5 (kg/yr)
England	26,748,350	15,285,893
Northern Ireland	4,916,522	2,791,388
Scotland	2,430,739	1,394,515
Wales	182,280	105,202
Total	34,277,891	19,576,998

Table 3 18: Nitrogen and phosphate from pig excreta in England by area

Area	N (kg/yr)	P_2O_5 (kg/yr)
North Yorkshire CC	5,700,982	3,217,403
East Riding of Yorkshire	4,441,171	2,441,464
Breckland and South Norfolk	3,481,891	1,986,848
Suffolk	2,942,650	1,731,549
North and West Norfolk	2,012,072	1,210,567
Lincolnshire CC	1,291,031	744,574
Devon CC	707,617	417,995
North Nottinghamshire	658,138	410,533
North and North East Lincolnshire	606,082	365,104
Oxfordshire CC	565,939	324,464

Table 3 19: Nitrogen and phosphate from pig excreta in Northern Ireland by area

Area	N (kg/yr)	P_2O_5 (kg/yr)
Armagh City, Banbridge and Craigavon	1,741,267	976,679
Mid Ulster	1,596,554	890,303
Newry, Mourne and Down	376,290	212,528
Fermanagh and Omagh	328,818	185,990
Derry City and Strabane	228,354	128,725
Mid and East Antrim	126,918	71,712
Antrim and Newtownabbey	125,452	70,779
Causeway Coast and Glens	116,065	64,508
Lisburn and Castlereagh	108,908	61,379
Ards and North Down	89,427	51,014

Table 3 20: Nitrogen and phosphate from pig excreta in Scotland by area

Area	N (kg/yr)	P_2O_5 (kg/yr)
North East Grampian	1,464,553	843,527
SE Scottish Borders	351,358	197,132
South East Lothian	139,476	78,656
South East Tayside	133,465	74,534
North West Highland	126,491	72,226
SW Clyde Valley	54,591	31,868
South East Fife	45,257	25,169
South West Argyll & Bute	10,084	5,528
North West Na h-Eileanan Siar	8,132	4,595
South West Central	7,565	4,271

Table 3 21: Nitrogen and phosphate from pig excreta in Wales by area

Area	N (kg/yr)	P_2O_5 (kg/yr)
Powys	93,497	53,431
North West	30,275	17,301
South	21,684	12,392
North East	14,720	8,412
Pembrokeshire	5,330	3,046

Table 3 22: Total ouptut of Nitrogen and phosphate from poultry excreta in the UK

Country	N (kg/year)	P_2O_5 (kg/yr)
England	44,471,018	31,396,864
Northern Ireland	9,759,317	7,027,449
Scotland	4,880,711	3,631,689
Wales	3,845,700	2,808,600
Total	62,956,746	44,864,602

Table 3 23: Nitrogen and phosphate from poultry excreta in England by area

Area	N (kg/yr)	P_2O_5 (kg/yr)
Lincolnshire CC	4,918,384	3,380,248
Herefordshire, County of	3,347,612	2,297,457
Shropshire	3,092,974	2,169,774
Breckland and South Norfolk	2,846,454	1,917,700
Suffolk CC	2,370,831	1,602,812
North Yorkshire CC	2,287,824	1,622,616
North and North East Lincolnshire	1,762,071	1,185,897
Devon CC	1,618,952	1,126,434
North Nottinghamshire	1,367,630	941,359
North and West Norfolk	1,190,066	801,780

Table 3 24: Nitrogen and phosphate from poultry excreta in Northern Ireland by area

Area	N (kg/yr)	P_2O_5 (kg/yr)
Mid Ulster	3,298,762	2,371,313
Armagh City, Banbridge and Craigavon	1,508,906	1,084,676
Mid and East Antrim	1,341,972	964,675
Causeway Coast and Glens	1,078,814	775,505
Fermanagh and Omagh	1,074,083	772,104
Newry, Mourne and Down	566,810	407,451
Antrim and Newtownabbey	491,315	353,182
Lisburn and Castlereagh	284,671	204,636
Derry City and Strabane	160,173	115,141
Ards and North Down	62,983	45,275

Table 3 25: Nitrogen and phosphate from poultry excreta in Scotland by area

Area	N (kg/yr)	P_2O_5 (kg/yr)
South East Tayside	970,352	704,178
SE Scottish Borders	966,185	753,487
South West Dumfries & Galloway	542,961	398,503
North East Grampian	501,521	390,391
South East Lothian	448,908	318,749
South West Central	363,202	245,564
South East Fife	85,199	66,443
North West Highland	66,234	51,507
South West Argyll & Bute	2,570	1,971
North West Orkney	1,352	1,001

Table 3 26: Nitrogen and phosphate from poultry excreta in Wales by area

Area	N (kg/yr)	P_2O_5 (kg/yr)
Powys	2,132,095	1,505,275
South	513,203	362,325
North West	368,197	259,950
North East	332,047	234,428
Pembrokeshire	326,440	230,469

Table 3 27: Nitrogen and phosphate from pig and poultry excreta in England by area

Area	N (kg/yr)	P_2O_5 (kg/yr)
North Yorkshire CC	7,988,806	4,840,019
Breckland and South Norfolk	6,328,345	3,904,548
Lincolnshire CC	6,209,415	4,124,823
East Riding of Yorkshire	5,354,219	3,098,415
Suffolk CC	5,313,481	3,334,361
Herefordshire, County of	3,590,647	2,435,808
Shropshire	3,456,594	2,375,431
North and West Norfolk	3,202,139	2,012,348
North and North East Lincolnshire	2,368,153	1,551,001
Devon CC	2,326,570	1,544,429

Table 3 28: Nitrogen and phosphate from pig and poultry excreta in Northern Ireland by area

Area	N (kg/yr)	P_2O_5 (kg/yr)
Mid Ulster	4,895,316	3,261,615
Armagh City, Banbridge and Craigavon	3,250,174	2,061,355
Mid and East Antrim	1,468,889	1,036,387
Fermanagh and Omagh	1,402,901	958,094
Causeway Coast and Glens	1,194,879	840,013
Newry, Mourne and Down	943,100	619,979
Antrim and Newtownabbey	616,768	423,961
Lisburn and Castlereagh	393,579	266,015
Derry City and Strabane	388,527	243,865
Ards and North Down	152,410	96,289

Table 3 29: Nitrogen and phosphate from pig and poultry excreta in Scotland by area

Area	N (kg/yr)	P_2O_5 (kg/yr)
North East Grampian	1,966,074	1,233,918
SE Scottish Borders	1,317,543	950,619
South East Tayside	1,103,817	778,712
South East Lothian	588,384	397,406
South West Dumfries & Galloway	542,961	398,503
South West Central	370,768	249,834
North West Highland	192,725	123,732
South East Fife	130,456	91,612
SW Clyde Valley	54,960	32,115
South West Argyll & Bute	12,654	7,499

3 - Inputs and outputs from the UK pig and poultry sector

Table 3 30: Nitrogen and phosphate from pig and poultry excreta in Wales by area

Area	N (kg/yr)	P_2O_5 (kg/yr)
Powys	2,225,592	1,558,705
South	534,887	374,717
North West	398,472	277,251
North East	346,767	242,840
Pembrokeshire	331,770	233,515

Box 2: Farming Rules for Water –
summary of requirements

The Farming Rules of Water aim to reduce water pollution from agricultural sources by promoting good farming practices. They apply to all farmers in England. Their requirements include:

- Planning applications of fertilisers and manure, including assessing pollution risks and matching application to crop needs. The latter includes having a soil test for all cultivated land every five years.
- Not applying fertiliser to waterlogged, flooded, frozen or snow covered soil or within 2m of inland freshwaters, coastal waters, a spring, well or borehole.
- Not applying manure on water logged, flooded, frozen, or snow covered soil or within 10m of inland or coastal waters, or within 50m of a spring, well or borehole.
- Reducing pollution risks by calibrating equipment and incorporating all manure or fertiliser within 12 hours of spreading.
- Not storing manure within 10m of inland or coastal waters, or within 50m of a spring, well or borehole.
- Preventing soil loss when undertaking farming operations.
- Preventing poaching from livestock within 5m of inland or coastal waters and not placing livestock feeders within 10m of water, or within 50m of a spring, well or borehole.
- Fencing animals out of watercourses.

Source: ABC, 2024; Applying the farming rules for water - GOV.UK

3.4 Land area required for spreading excreta

We have taken the output figures above to calculate the land area required for spreading the excreta under different nutrient loading limits.

Nitrogen

The Farming Rules for Water, which were introduced in 2018 and apply to all farms in England, provide a broad framework to reduce water pollution from agricultural sources by promoting good farming practices (see **Box 2**). This includes matching manure applications to crop needs. The crop-available nitrogen supply from manures depends on a number of variables, including the application timing, application method, and the delay between application and incorporation. Slurry will have higher readily available nitrogen than manure; nutrient content will be influenced by farm-specific feeding and bedding practices. It is therefore impossible to give more than an indicative figure for the land area requirement.

The Nitrate Vulnerable Zone (NVZ) rules, which stem from the EU Nitrates Directive, apply to all farms which are in NVZs across the UK, and specifically aim to reduce water pollution caused by nitrates from agricultural sources. The proportion of agricultural area in NVZs varies across the UK: England 58%; Northern Ireland 100%; Scotland 14%; and Wales 2.3%. Key requirements within NVZs include maximum nitrogen limits for arable land and grassland of 170kg/ha total N. See **Table 3-31.**

If calculations are based on the maximum N loading limit of 170 kg/ha (which is likely an overestimate of the total N loading required to meet crop needs), then the total land area requirement for the ten council areas in England with the highest nitrogen output from pigs and poultry is shown in **Table 3-32**.

Note that these figures assume the maximum N loading limit of 170 kg/ha is met by spreading pig and poultry excreta. In many cases there will be other sources of nitrogen available to crops, which will reduce the N demand – for example, incorporating 'green manures' into the arable rotation will account for significant elements of soil nutritional needs. Furthermore, application of pig and poultry manure to the N loading limit would likely exceed the phosphorus demands of the crop (see below), so the land area requirements here should be considered conservative.

In Northern Ireland, the land area requirement for each Council area is shown in **Table 3-33.**

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In Scotland, the land requirement for the ten areas with the highest nitrogen output from pigs and poultry is shown in **Table 3-34**.

Table 3 35 shows the land area requirement for each of the areas of Wales on the same basis.

Phosphorus

Phosphorus (P) is an essential nutrient for crops, helping with root development, early growth and the ripening of seeds. Phosphorus (P) and phosphate (P_2O_5) are often used interchangeably in soil science, but technically phosphate refers to the crystal form in which P occurs in organic material.

In many areas of the UK the P status of soils has been built up such that cereals tend not to respond significantly to fresh applications of P. At soil P Index 3 or above, crops will generally only require a maintenance application to replace the nutrients which are removed over the rotation, and care must be taken to ensure that total phosphate inputs do not exceed the amounts removed. Whilst phosphate is generally held in the soil, it can also reach a level of saturation, beyond which it will leach through, resulting in contamination of watercourses[xviii].

We have referred to Defra's statistics release on UK and England soil nutrient balances[22]. Estimates for 2023 show that the UK phosphorus balance was a surplus of 2.9 kg/ha of managed agricultural land. Phosphorus offtake (i.e. the total amount of P removed from the soil through the outlets of crop and fodder production) is estimated at an average of 17 kg P per ha.

On the basis that 100 kg of P is equal to 229 kg of P_2O_5, 17 kg of P equates to 38.93 kg of P_2O_5. Using 38.93 kg/ha as a loading limit of P_2O_5 – i.e. the application rate to maintain a phosphorus balance – the total land area requirement for the ten council areas in England with the highest phosphate output from pigs and poultry is shown in **Table 3-36**.

These results show that the land area requirement to maintain a phosphorus balance is significantly higher than the land area requirement under a N loading limit of 170 kg/ha. This is because of the high phosphate/nitrogen ratio in pig and poultry excreta. Given that most manures and waste products are applied for their value in terms of additional nitrogen or organic matter, without regard to the phosphate content, this can often lead to an over-application of phosphate.

Table 3-36 also shows the land area required to maintain a phosphorus balance from spreading pig and poultry excreta as a percentage of the total farmed area in each council area. Of note are the council areas of Breckland and South Norfolk, and North and North East Lincolnshire. Here, the land area requirement for spreading excreta from the pig and poultry sectors to maintain a phosphorus balance, as a share of the total farmed area, is 61%.

The land area requirement exceeds 20% in North Yorkshire CC, Lincolnshire CC, Suffolk CC, the East Riding of Yorkshire, Herefordshire, Shropshire, and North and West Norfolk. Given that in reality pig and poultry excreta will not be spread evenly across these areas, it is likely that many farms here will be in significant phosphorus surplus – and by extension, a significant source of phosphate losses into the environment. Rivers at risk in these areas, which are already failing government phosphate targets in 2019 and 2020[23], include the Rivers Thet and Wissey in Norfolk, the River Swale in Yorkshire, the River Witham in Lincolnshire, and the Rivers Wye, Frome and Arrow in Herefordshire[24].

In Northern Ireland, the land area requirement in each region is shown in **Table 3-37**.

In Scotland, the land area requirement on the same basis (17kg/ha P loading) for the ten areas with the highest phosphate output from pigs and poultry is shown in **Table 3-38**.

In Wales, the land area requirement in each region is shown in **Table 3-39**.

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Table 3 31: NVZ Rules - summary of requirements

Organic Manure[xiii] Closed Periods		Arable Land	Grassland
Soil Type	Sandy or Shallow	1 Aug to 31 Dec	1 Sep to 31 Dec
	All Others	1 Oct to 31 Jan	15 Oct to 31 Jan
Manufactured Fertiliser Closed Application Periods		**Arable Land**	**Grassland**
All Soil Types		1 Sep to 15 Jan	15 Sep to 15 Jan
Nitrogen Limits		**Arable**	**Grassland**
Whole Farm[xiv] – Livestock Manures		170kg/ha total N	170kg/ha total N[xv]
Field Limit[xvi] – Organic Manures		250kg/ha total N in 12 month rolling period	
Crop Needs[xvii] (incl. grass)		N applications must be based on crop needs – some crops have 'NMax' application figures which should not be exceeded	
Storage of Livestock Manure			
Slurry		Pig & Poultry	6 months winter storage

Table 3 32: Land area requirement for Nitrogen from pigs and poultry in England by area

Area	Ha required under 170kg/ha N loading
North Yorkshire CC	46,993
Breckland and South Norfolk	37,226
Lincolnshire CC	36,526
East Riding of Yorkshire	31,495
Suffolk CC	31,256
Herefordshire, County of	21,121
Shropshire	20,333
North and West Norfolk	18,836
North and North East Lincolnshire	13,930
Devon CC	13,686

xiii Slurry/manure with high available N (>30%); includes poultry litter
xiv The 'livestock loading level' – manure deposited through both spreading and grazing
xv There is a derogation allowing 250kgN/ha on grassland than the standard 170kgN/ha but this will have to be applied on a yearly basis
xvi Spreading livestock and non-livestock manures only
xvii From livestock manure and all other sources of N (i.e. manufactured fertiliser)

Table 3 33: Land area requirement for Nitrogen from pigs and poultry in Northern Ireland by area

Area	Ha required under 170kg/ha N loading
Mid Ulster	28,796
Armagh City, Banbridge and Craigavon	19,119
Mid and East Antrim	8,641
Fermanagh and Omagh	8,252
Causeway Coast and Glens	7,029
Newry, Mourne and Down	5,548
Antrim and Newtownabbey	3,628
Lisburn and Castlereagh	2,315
Derry City and Strabane	2,285
Ards and North Down	897

Table 3 34: Land area requirement for Nitrogen from pigs and poultry in Scotland by area

Area	Ha required under 170kg/ha N loading
North East Grampian	11,565
SE Scottish Borders	7,750
South East Tayside	6,493
South East Lothian	3,461
South West Dumfries & Galloway	3,194
South West Central	2,181
North West Highland	1,134
South East Fife	767
SW Clyde Valley	323
South West Argyll & Bute	74

Table 3 35: Land area requirement for Nitrogen from pigs and poultry in Wales by area

Area	Ha required under 170kg/ha N loading
Powys	13,092
South	3,146
North West	2,344
North East	2,040
Pembrokeshire	1,952

Table 3 36: Land area requirement for Phosphorus from pigs and poultry in England by area

Area	Ha required under 17kg/ha P loading	As a share of Total Farmed Area (%)
North Yorkshire CC	124,326	20%
Lincolnshire CC	105,955	22%
Breckland and South Norfolk	100,297	61%
Suffolk CC	85,650	29%
East Riding of Yorkshire	79,589	40%
Herefordshire, County of	62,569	35%
Shropshire	61,018	24%
North and West Norfolk	51,691	27%
North and North East Lincolnshire	39,841	61%
Devon CC	39,672	8%

Table 3 37: Land area requirement for Phosphorus from pigs and poultry in Scotland by area

Area	Ha required under 17kg/ha P loading
North East Grampian	31,696
SE Scottish Borders	24,419
South East Tayside	20,003
South West Dumfries & Galloway	10,236
South East Lothian	10,208
South West Central	6,418
North West Highland	3,178
South East Fife	2,353
SW Clyde Valley	825
South West Argyll & Bute	193

Table 3 38: Land area requirement for Phosphorus from pigs and poultry in Northern Ireland by area

Area	Ha required under 17kg/ha P loading
Mid Ulster	83,782
Armagh City, Banbridge and Craigavon	52,950
Mid and East Antrim	26,622
Fermanagh and Omagh	24,611
Causeway Coast and Glens	21,578
Newry, Mourne and Down	15,925
Antrim and Newtownabbey	10,890
Lisburn and Castlereagh	6,833
Derry City and Strabane	6,264
Ards and North Down	2,473

Table 3 39: Land area requirement for Phosphorus from pigs and poultry in Wales by area

Area	Ha required under 17kg/ha P loading
Powys	40,039
South	9,625
North West	7,122
North East	6,238
Pembrokeshire	5,998

4 - Environmental risks and impacts of pig and poultry production in the UK

This section explores the environmental risks arising from the UK pig and poultry sectors, drawing on the earlier sections and focusing on soil quality, water quality and biodiversity.

4.1 Soil quality

Soil quality can be defined as the capacity of a particular type of soil to perform functions within a natural or managed ecosystem to preserve plants and animals, maintain or enhance climate quality, and support human health and urban environment[25]. The decline in agricultural soil health in recent decades has been well documented[26], as soils become depleted of carbon and nutrients, and lose the biodiversity responsible for regulating and maintaining their function. In England and Wales, declining soil health is associated with an estimated cost of £1.2 billion each year[27], primarily due to declines in soil organic matter and compaction.

Intensive agriculture is one of the leading causes of soil degradation in the UK, and a number of conventional farming practices have been shown to cause soil health declines. The physical structure of soils can be degraded by excessive ploughing, which breaks up the soil aggregates and exposes organic matter to the elements, in turn depleting the soil carbon pool and releasing carbon dioxide to the atmosphere[28].

The action of heavy machinery and trampling caused by unsustainably high stocking levels of livestock can also harm the soil's physical structure, causing compaction that removes the soil pores and channels that are important spaces for plant roots, soil biodiversity, and water retention[29]. Intensive agriculture can also alter the chemical attributes of soils in ways that negatively affect soil health, particularly through the removal of soil carbon and the additions of large amounts of inputs, such as pesticides and additional nutrient loading.

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The severity of the impact of pig and poultry farming on soil quality is dependent on:

- soil type and
- farming and waste management practices and systems.

The pig and poultry sector affects soil quality directly on the farm itself, on the farms which apply the produced manure, and on the land that is part of the pig and poultry supply chain (i.e. land used for growing feed crops).

Pig and poultry production can impact soil quality in a number of different ways and can be measured through a range of key soil indicators:

Soil nutrient levels

The application of manure from pig and poultry farms can increase soil nutrient levels, particularly nitrogen and phosphorus. While this can enhance soil fertility, excessive amounts can lead to nutrient leaching and water pollution. The overapplication of pig and poultry manure is known to be an issue.

Careful site selection and manure management can ensure outdoor pig systems bring many benefits to arable soils, lasting up to three years after pigs have gone. However, poor choice of site and inadequate ground cover can risk soil poaching and surface run-off, which can be detrimental to soil structure and local water quality[30].

Nutrient availability to the following crop after pigs also needs to be taken into consideration i.e. taking account of the Soil Nitrogen Supply following pigs, regular soil sampling for phosphorus, potassium and magnesium, and using information sources and nutrient planning software to guide subsequent fertiliser requirements[31].

In NVZs, a maximum limit of 170kg per hectare of nitrogen from livestock manures may be applied across the holding, with up to 250kg per hectare of nitrogen from organic manures permissible at field level. The field limit does not include livestock manures deposited by grazing animals. The Farming Rules for Water require matching manure applications to crop needs across England.

Soil nutrient balances provide a method for estimating the annual nutrient loadings of nitrogen and phosphorus to agricultural soils. The balances do not estimate the actual losses of nutrients to the environment, but the higher the nutrient surplus, the higher the risk of losses to the environment. Excess nutrients may be dispersed aerially as the greenhouse gases nitrous oxide or ammonia, which can result in nitrogen deposition elsewhere, or they can be transported in water, leading to eutrophication in freshwater and coastal environments.

Soil pH

The spreading of pig and poultry manure can alter soil pH. Nitrification of ammonium-nitrogen releases hydrogen ions into the soil, which make it more acidic. Some soil types are more resilient to this than others, depending on the base cations present. As soil acidifies, the balance of different cations like calcium (Ca^{2+}), magnesium (Mg^{2+}), potassium (K^{+}), sodium (Na^{+}) – which are base cations – and aluminium (Al^{3+}), iron (Fe^{2+}), and manganese (Mn^{2+}) – which are acidic cations – changes[32]. This can affect soil health and crop productivity.

Soil Organic Matter

The spreading of pig and poultry manure can add organic matter and may improve soil structure and water retention. The impact on Soil Organic Matter (SOM)[33], and Soil Organic Carbon (SOC)[34] appears to be dependent on soil type however. A recent study found that despite the high organic fertilizer doses introduced into soils in poultry (170 kg N per hectare as poultry manure) and pig farms (150 kg N per hectare as pig manure), there was no significant influence of these amendments on Soil Organic Carbon content, possibly related to low organic carbon sequestration potential in some Polish agricultural soils[35]. Improper management can lead to soil degradation. Continuous pig farming without proper rotation and cover cropping can degrade soil structure and reduce its organic matter content, impacting long-term soil health[36].

Microbial activity

Manure can boost microbial activity in the soil, which is beneficial for nutrient cycling. However, it can also introduce pathogens if not properly treated. Manure can result in the release of hormones and antimicrobials such as antibiotics.

Heavy metals

Manure may contain heavy metals like copper and zinc (due to feed content), which can accumulate in the soil over time, potentially leading to toxicity issues.

Greenhouse gas emissions

Soil management practices in pig and poultry production can influence the emission of greenhouse gases such as methane and nitrous oxide. For example, bare soils in outdoor pig farming areas can lead to the volatilization of nitrogen, contributing to greenhouse gas emission[37].

Soil erosion and compaction

Dependant on the farming system, and without careful risk mapping, planning and implementation, pig and poultry farming and the farm practices involved in producing feed crops for these systems can lead to soil erosion, soil compaction and capping. When the production of soya for feed is factored-in, soil erosion is also often a repercussion of deforestation outside of the UK.

Pig and poultry production can significantly impact various soil types, particularly those that are level and free-draining, such as chalk and sandy soils. These soils are often chosen for outdoor pig units due to their porous nature, which unfortunately makes them susceptible to issues like soil erosion, compaction, capping and nutrient runoff.

- **Soil erosion:** Pigs' rooting and foraging activities can remove ground cover, leaving soil bare and more susceptible to erosion and nutrient loss. Similarly the movement of pigs can disturb the soil surface, leading to increased erosion, especially on sloped fields. This can result in the loss of topsoil, which is crucial for maintaining soil fertility.

- **Soil compaction and capping:** The weight and movement of pigs, and use of trackways, can compact the soil and lead to capping, reducing its porosity and permeability. This can hinder root growth and reduce the soil's ability to absorb water, leading to increased runoff and potential flooding.

A range of guidance is available for farmers which explore these issues and set out good practices to minimise the impacts.[38 39]

Feed production

Within the UK, 3.57 million hectares (59%) of the UK's croppable area is used to feed livestock[40]. Cereal cropping management practices have altered the soil structure, modifying soil carbon, nitrogen and phosphorus cycles in the soil. Moreover, cereal cropping can cause soil erosion and management practices such as intensive cropping and short crop rotations can lead to soil compaction. Ploughing the soil can also damage beneficial microbial and fungal communities and cause harm to many soil animals and destroy their burrows and refuges, making them more vulnerable to predators[41]. Declines in soil health primarily occur in croplands - 50.5% of all the soil erosion that took place globally in 2012 occurred in croplands, despite them only accounting for 11.2% of the total land area[42].

As much as 180,000 ha of land in the UK is used to grow wheat to feed pigs and 409,000 ha for poultry (see **Section 3.1**). Soil health impacts associated with cropping practices (including tillage, application of inputs, and harvest) across this area should therefore be attributed to the environmental impacts of pig and poultry production.

4.2 Water quality

Water pollution is one of the greatest and most widespread threats to species and habitats in the UK, including those within protected areas. Reporting on the health of our freshwater habitats under the Water Framework Directive shows that in England and Wales, only 14%[43] and 46%[44] of rivers respectively meet the standards for good ecological status, and in Northern Ireland, only 31%[45] of waterbodies are classified as good or high quality. This is largely a consequence of intensive agricultural practices and excess nutrients.

We have seen in **Sections 3.2–3.4** above that the pig and poultry sectors are significant sources of nitrogen and phosphate, and are likely to result in localised nutrient surpluses (particularly phosphate). These can result in soil nutrient surpluses as described in **Section 4.1**. In this section, we assess the potential routes to pollution of water courses, and describe the likely impact of these.

Routes to pollution of watercourses

Nitrates enter water mostly through leaching; phosphates enter water via physical removal, when attached to eroded soil particles, or in soluble form. This can impact biodiversity through eutrophication.

Eutrophication is the process by which nitrates and phosphates are taken up by algae and some aquatic plant species, which are then able to proliferate vigorously, adversely affecting the ecology of rivers, lakes, estuaries or the sea.

It is through the spreading of pig and poultry manure off-site that nutrients will often reach watercourses, but there is also a risk of pollution on-site. For example, outdoor pig systems will often be located on level, free-draining soils such as chalk and sand – which presents a risk of direct run-off and infiltration of contaminated water from fields accommodating pigs into aquifers and watercourses. The Environment Agency has observed a number of key risks with outdoor pig systems, including[46]:

- Nutrient availability to the following crop following a rotation of outdoor pigs is often overlooked;

- Capping (the formation of a hard crust on the soil surface following rainfall on light soils);

- Compaction, from both machinery and livestock; this will hinder infiltration of water and increase the risk of run-off.

Impacts of nutrient loads in water

Nitrogen can contribute to freshwater eutrophication in some situations, particularly in lakes – which are particularly sensitive to nitrogen loading – but it is in saline waters that

4 - Environmental risks and impacts of pig and poultry production in the UK

nitrogen is usually the key nutrient involved in eutrophication. Phosphorus, meanwhile, is the main cause of eutrophication in freshwaters. 55% of assessed river water bodies and 73% of assessed lake water bodies in England fail the current Water Framework Directive (WFD) phosphorus standards for good ecological status which aim to prevent eutrophication. In fact, phosphorus is the most common cause of ecological water quality failures under the WFD in England and so the number one reason for water bodies not achieving good ecological status. Compliance with the P standards is worst in lowland high alkalinity rivers - the dominant river type in England.

In the Environment Agency's assessment of eutrophication impacts on rivers, lakes and reservoirs, agriculture and rural land management is the main sector responsible for not achieving good ecological status for phosphate[47]. Although the largest source of P to rivers is sewage effluent (about 60 to 70% of the total for England), the contribution from agriculture is diffuse, and so occurs across a large number of waterbodies. In addition, the percentage of the total load that agriculture is responsible for is expected to increase from around 25% in 2020 to between 30 and 35% by 2025 as sewage P loadings continue to fall[48]. For lakes, agricultural practices (losses from fertilisers, manures and feed) are generally the largest source of P. The proportions from different sources vary between and within river basins and catchments[49 50].

We consider the biodiversity impacts of excess nutrients in water at **Section 4.3** below. Besides the impact on biodiversity, excess nutrients in water courses can adversely impact on a range of water uses and societal benefits[51]. These include:

Increased water treatment costs - Eutrophication increases the cost of drinking water abstraction and treatment. Problems associated with algae/eutrophication are one of the reasons for Drinking Water Protected Areas (DrWPAs) being designated 'at risk'[52]. Of the 485 surface DrWPAs in England, 266 (55%) are currently assessed as at risk with eutrophication a causal factor in 44 cases (mostly reservoir sites). Algal blooms can block filters in water treatment works, make abstraction from reservoirs problematic, and give rise to taste or odour problems in water.

Reduced value of waterside dwellings - We are not aware of any national studies in the UK of value-loss in waterfront properties affected by eutrophication; however, one regional study in the Mersey Basin has found that leisure and residential property can be devalued by as much as 20% as a result of consistently poor physical water quality[53].

Impact on industrial uses of water - Water bodies and wetlands have a wide variety of industrial uses. These include direct use of clean water as an input to manufacturing, electricity generation, and farming for livestock watering and irrigation; the use of waterways for navigation and transport; and the value of wetlands and water bodies for waste treatment and attenuation. Costs are therefore increased when nutrient enrichment reduces the value of clean water, and when the biomass of aquatic algae and macrophytes increases so that waterways are impeded for navigation. Wetlands also provide a very important function in waste attenuation, providing this ecosystem service for free and so saving on investment in industrial plant[54]. Once water bodies are eutrophic, they may be less able to perform these functions effectively.

Impact on amenity value of water bodies for water sports - Many standing and running fresh and marine water bodies are used extensively for recreational and amenity purposes on the water, such as bathing, boating, windsurfing and canoeing, and for amenity at the waterside, such as angling, dog-walking, rambling and picnics. Eutrophication results in a loss of recreational and amenity value, particularly if water becomes turbid, emits unpleasant odours, and is affected by algal blooms. Such blooms may be simply unpleasant, with green slimy margins to the water, or toxic if blue-green algae are present.

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4.3 Biodiversity

Biodiversity, both within on-farm habitats and in semi-natural habitats affected by on-farm activities, can be negatively impacted by practices associated with pig & poultry systems. Studies show that pig and poultry systems can have a negative impact on biodiversity by three primary means: **(1)** directly, through ammonia emissions and nitrogen deposition; **(2)** directly, through nitrogen and phosphorus run-off into watercourses and groundwater; and **(3)** indirectly, through the land take associated with feed protein, and air, water, and soil pollution cascades through the trophic levels.

Ammonia emissions

Ammonia (NH_3) is produced in pig and poultry excreta through the breakdown of urea and uric acid. Ammonia emissions can have a potentially harmful effect on ecosystems as a result of:

- Exceeding atmospheric ammonia critical levels;
- Exceeding nutrient-nitrogen critical loads, when nitrogen in ammonia is deposited on the ground;
- Exceeding acidity critical loads, due to the process of nitrification.

Critical levels are defined as 'concentrations of pollutants in the atmosphere above which direct adverse effects on receptors, such as human beings, plants, ecosystems or materials, may occur according to present knowledge'[55]. Critical level exceedance is the amount by which concentration exceeds the critical level. Critical loads are defined as 'a quantitative estimate of exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge'. Critical load exceedance is the amount by which N deposition or acidity exceeds the critical load.

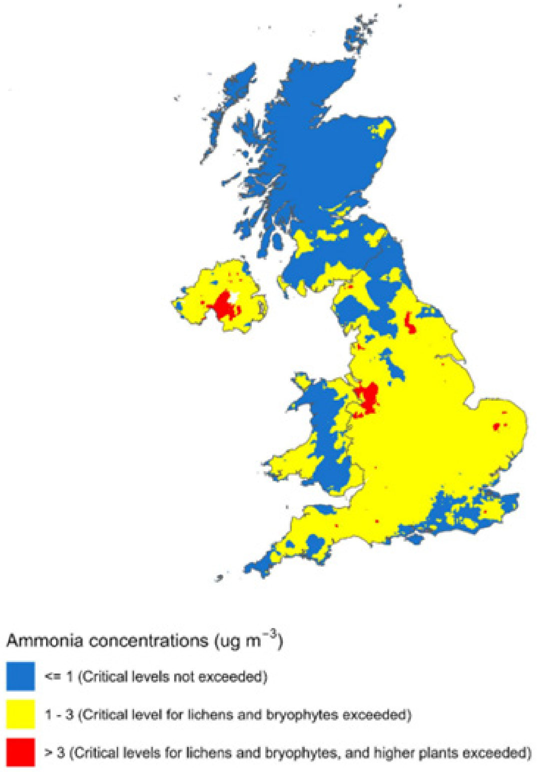
The pig and poultry sectors are significant sources of UK ammonia emissions. While cattle are the largest single source of ammonia emissions (accounting for 44% of all emissions in 2022 and approximately two thirds of livestock emissions) poultry are the next largest emitting livestock group, followed by pigs. According to the Inventory of Ammonia Emissions from UK Agriculture (Rothamsted Research, 2021)[56], poultry account for approximately 12% of all ammonia emissions, and pigs account for 7%. While this is significantly less than cattle, ammonia hotspots from pig and poultry are concentred in high densities where the sheds are located, with high peaks in ammonia concentrations which return to background levels around 2km from the source[57].

Notwithstanding the above, it should be acknowledged that the fall in ammonia emissions from the pig and poultry sectors is the main driver in the gradual fall of overall ammonia emissions since 1990. Defra attributes this partly to the Pollution Prevention and Control Act (1999) making all new intensive pig and poultry installations subject to ammonia controls through permitting.

Direct toxicity from atmospheric ammonia - The United Nations Economic Commission for Europe (UNECE) has set critical levels for ammonia at 3µg m-3 for bryophytes (higher plants) and 1µg m-3 for lichens[58]. Above these levels, ammonia can have a direct toxic effect. Studies have shown that ammonia concentrations around pig and poultry buildings can be very high. For example, Pitcairn et al (2002)[59] investigated the impact of ammonia emissions from two poultry units in close proximity to each other, containing 350,000 birds, and estimated to emit around 140,000 kg N year as ammonia. Annual mean concentrations of ammonia close to the buildings were very large (60 µg m−3) and declined to 3 µg m−3 at a distance of 650 m from the buildings. This confirmed the results of an earlier (1998)[60] study by Pitcairn et al, which showed ammonia concentrations close to livestock buildings at 20 to 60 µg m−3. Surveys of species composition of ground flora along transects from the livestock buildings demonstrated changes in species composition 50–300 m downwind of the buildings, with species number doubling at a distance of 650m.

The latest (2024) Air Pollution Trends Report[61], which presents data on exceedances of critical levels and critical loads for the period from 2003 to 2021, showed that 1.7% (4,175 km^2) of the UK land area was exposed to ammonia concentrations above the critical level set to protect higher plants (3 µg m-3), and 55.0% (134,189 km^2) exposed to ammonia at concentrations above the critical level set to protect lichens and mosses (1 µg m-3). This is shown in **Figure 4 1**.

Figure 4 1: 1km x 1km mean ammonia concentrations for 2019-21



Note that hotspots of critical level exceedance are seen in the Breckland area of Norfolk, North Yorkshire, and mid Ulster, where we know there are concentrations of pig and poultry units.

For Nitrogen-sensitive habitats:

- 35.8% of the mapped area of N sensitive habitats in the UK was exposed to ammonia concentrations above the critical level of 1 µg m-3 in 2021;
- the percentage area exceeded ranged from 8.4% for Scotland to 98.8% for Northern Ireland.
- 89.4% of the area of calcareous grassland, and ~ 90-96 % of the area of some woodland habitats (beech and broadleaved woodland) were in areas exposed to ammonia concentrations above the critical level of 1 µg m-3 in 2021. Only 15.5 % of dwarf shrub heath was in areas exceeding this critical level, but this equates to 3,315 km^2.
- 2.0% of the area of N-sensitive habitats in the UK was exposed to ammonia concentrations above 3 µg m-3 in 2021; this ranged from 0.0% in Scotland to 18.9% in Northern Ireland.

For designated sites (SACs, SPAs and SSSIs or ASSIs):

- 36.1% (139) of SPAs, 48.4% (307) of SACs and 60.5% (4,245) of SSSIs (ASSIs in Northern Ireland) in the UK were exposed to ammonia concentrations above 1 µg m-3 on at least part of the site in 2021.
- 75.4-81% of the designated sites in England, 92.1-96.5% of sites in Northern Ireland, 35.3-49.4% of sites in Wales, and 5-9% of sites in Scotland, were exposed to ammonia concentrations above 1 µg m-3 in 2021.
- 1.7% (11) of SACs, 1.4% (4) of SPAs and 1.4% (98) of SSSIs in the UK were exposed to ammonia concentrations above 3 µg m-3 on at least part of the site in 2021. The percentage of designated sites with exceedance of this critical level was unchanged since 2003 (SPAs), or fell by 0.6% (SACs) or 0.1% (A/SSSIs).
- No SSSIs, SACs or SPAs in Scotland and Wales were exposed to ammonia concentrations above the critical level of 3 µg m-3, with the exception of 5 SSSI and 2 SAC sites on the England/Wales border . In comparison, in England and Northern Ireland 2.5% and 5.3% (respectively) of SACs, 3.6% and 6.2% of SPAs, and 1.4% and 9.2% of SSSIs exceeded the 3 µg m-3 ammonia critical level.

Exceeding nutrient-nitrogen critical loads - Deposition of reactive forms of nitrogen increases the availability of nutrient-nitrogen in the environment, favouring those fast-growing species adapted to high nutrient availability and allowing them to out-compete other species. Low nutrient status is important for semi-natural habitats. This effect is well documented, and there are many studies which show a decrease in biodiversity in ecosystems with moderate to high ammonia pollution[62]. Pitcairn et al's (2002) study estimated total N deposition of 80 kg N ha−1 year−1 at a distance of 30m to 14 kg N ha−1 year−1 at 650m downwind of the subject poultry units.

Different habitats have different critical loads for atmospheric nitrogen deposition: some habitats are more sensitive than others, and therefore have lower critical loads. The methods used to calculate and map UK critical loads are described in detail in Hall et al (2015)[63]. For example, neutral grassland has a critical load of 20 kg N/ha/year, while raised and blanket bogs have a critical load of 5 kg N/ha/year. Exceedance of critical loads is an indication that the ecosystem is at risk from potential harmful effects in the long-term.

The 2024 Air Pollution Trends Report shows that average accumulated exceedance for nutrient N for all UK habitats combined was 7.4 kg N/ha/year in 2021 (the latest year for which data is available). 83.9% of N-sensitive habitats (78,687 km^2) in the UK exceeds of nutrient-N critical loads. The nutrient N critical load was exceeded for more than 90% of the areas of seven N-sensitive habitats in all years: calcareous grassland, montane habitats, beech woodland, acidophilous oak woodland, other broadleaved woodland, Scots pine woodland, and mixed woodland. Since 2021, the Trends Report includes a metric against which progress towards the UK Government's Clean Air Strategy target (Defra, 2019) can be measured, i.e. *"to reduce damaging deposition of reactive forms of nitrogen by 17% over England's protected priority sensitive habitats by 2030*". The mean N deposition rate onto priority habitats in England was 22.7 kg N/ha/year in 2016, and 20.0 kg N/ha/year in 2021. Of nature conservation sites in England, Wales and Northern Ireland, 86–100% had exceedance of nutrient N critical loads for one or more features in 2021. This figure is lower for Scotland, at 76.0-85.5% (depending on designation).

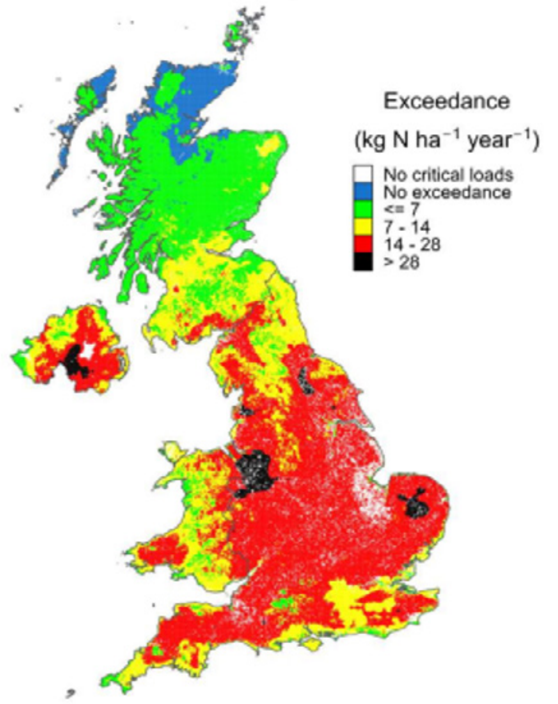
The map of habitats sensitive to nutrient-N (see **Figure 4-2**) shows the wide distribution of these habitats in the UK. Overall then, it is clear that in very many parts of the country, there is a risk of ammonia emissions from pig and poultry units impacting on sensitive habitats.

We can translate this into a map of excess nitrogen, as shown in **Figure 4 3**. This shows the average accumulated exceedance of nutrient-nitrogen critical loads in 2021.

As with ammonia concentrations, it is noteworthy that hotspots of critical load exceedances can be found in the Breckland region of Norfolk, North Yorkshire, west Kent, and mid Ulster.

Figure 4 2: Areas of habitat sensitive to nutrient-nitrogen in the UK (black) and areas without sensitive habitat (white)

Figure 4 3: Excess Nitrogen (Average Accumulated Exceedance of nutrient-nitrogen critical load) in 2021



Exceeding acidity critical loads - Nitrification of ammonium-nitrogen releases hydrogen ions into the soil, which make it more acidic. Some soil types are more resilient to this than others, depending on the base cations (positive ions) present. As soil acidifies, the balance of different cations like calcium (Ca^{2+}), magnesium (Mg^{2+}), potassium (K^+), sodium (Na^+) – which are base cations – and aluminium (Al^{3+}), iron (Fe^{2+}), and manganese (Mn^{2+}) – which are acidic cations – changes[64]. Many plants are sensitive to changes in soil pH and the balance of different elements in the soil.

The 2024 Air Pollution Trends Report shows that in 2021, 44.1% (39,952 km²) of acid-sensitive habitats in the UK exceeds acidity critical loads. In Scotland, this figure is 28.6% (15,569 km²). In England, the figure is 66.7% (15,618 km²).

The percentage of SACs and SPAs in the UK with exceedance of acidity critical loads for one or more features is 66.3% (SACs: 323 sites) and 52.6% (SPAs: 92 sites). The percentage of SSSIs across the UK with exceedance of at least one sensitive feature is 48.7% (2,254 sites). This figure is lowest in Scotland (36.1%), 47.5% in England, 66.1% in Wales, and 66.9% in Northern Ireland (ASSIs).

Nutrient run-off

Nutrients not taken up by crops, or held in the soil, leach into water, from where they may disrupt the equilibrium of nutrient cycles in other habitats.

Nutrient-sensitive terrestrial habitat - Overland or subsurface water flow can transport nitrates and phosphates a long way from the original source of the discharge, well beyond the crop edge or rooting zone, and will have a nutrifying effect on hedgerows, boundary habitats and the plant communities of receiving waters. Woodlands, wetlands lowland heath, and semi-natural grasslands adjacent to intensively cropped areas are most at risk from nutrients entering the system via this route[65]. It can result in a change in species composition, either due to the increased growth of some species, or because of an increase in susceptibility of other species to disease or climatic extremes, for example frost hardiness. The slow transport of phosphorus out of soils means that the effects can be long-lasting.

Importing of feed protein

Besides the direct impacts from ammonia emissions and nutrient run-off, the pig and poultry sector can also impact biodiversity indirectly through the importing of feed protein, as air, water, and soil pollution cascades through the trophic levels. Cereal crops grown for animal feed account for an estimated 40% of UK arable land. In Section 3 above we have estimated the area of UK arable land required to produce feed wheat for the pig and poultry sectors. At nearly 600,000 hectares, we can see that the ecological footprint of the pig and poultry sectors is very significant.

In addition, the pig and poultry sectors rely heavily on imported soya bean meal as a protein source in feed. The UK imports around 360,000 tonnes of soyabean meal annually for pig feed, and 1,474,000 tonnes for poultry feed[66]. The pig and poultry sectors together account for 77% of UK imports of soyabean meal. Most of this imported soya originates from South America, primarily Brazil, Argentina and Paraguay, where large-scale soy production is linked to deforestation concerns. Whilst efforts have been made to use more home-grown legumes as a protein source (see, for example, the Green Pig Research Project), constraints on commercial availability have meant that soyabean meal remains the main protein source in monogastric feeds.

4.4 Wider risks and impacts

This section summarises the wider risks and impacts arising from pig and poultry production in the UK. Detailed analysis on these risks and impacts were outside the scope of this report, but impacts are summarised here as they are relevant to any decisions made on the environmental impacts of pig and poultry systems.

Air quality

The UK pig and poultry sector can have a significant impact on air quality due to the release of various pollutants into the atmosphere.

- ***Ammonia (NH_3):*** see **Section 4.3** above. In general, concentrations of ammonia are higher in deep-pit slurry systems with slats and mechanical ventilation.
- ***Volatile Organic Compounds (VOCs):*** VOCs such as hydrogen sulphide (H_2S) are a by-product from animal waste and feed. These impact air quality and, like ammonia, prevail in deep-pit slurry systems with slats and mechanic ventilation.
- ***Particulate matter:*** Feed, bedding and the movement of livestock generate fine dust or particulate matter.

Factors influencing air pollutants include changes in feed, covering of slurry stores, injection of slurry into the soil, and ventilation management.

Climate regulation

The relatively small size of the pig and poultry sector in the UK, coupled with the intensity of production, mean the reported Greenhouse Gas (GHG) emissions per unit of production are lower than other sectors. The emissions from the production of a kilo of pork are roughly half that of beef or lamb and emissions from poultry farming are lower still[67]. Relative emissions per kg of pork produced have declined by 44% over the last 30-years, which is a greater reduction than recorded for ruminant livestock.

Feed production accounts for between 50 and 70% of the GHG emissions from pig farming, and the remainder is largely from manure management (20-35%) and enteric emissions (11%)[68]. For poultry farming, 60-70% of GHG emissions are from the growing of feed and 30-40% from manure storage and application80. Emissions from feed use are considerably higher if the impact of land use change is factored in.

Changes in growth rate and feed utilisation reduce the relative emissions from the sectors. This is the source of the recent decline in emissions. Per unit emissions tend to be higher when factors reduce the growth rate of pigs. Practices such as outdoor rearing or organic farming tend to have this effect.

Flood regulation

Pig and poultry farms themselves take up a comparatively small area of UK farmland. This means the associated impact on hydrological flows due to land use change associated with the buildings and premises of pig and poultry units will be low compared to more extensive farm types. The 12,000 ha used for outdoor pig farming and areas used for free-range poultry farming will contribute to flood regulation, but not at a scale that warrants focused analysis.

However, impacts on flood regulation will be associated with areas where feed is produced. Within the UK, the production of high-risk cereal crops (e.g. those grown on floodplains adjacent to rivers or on steep slopes) may cause soil erosion in areas with light sandy or slow draining soils. This can result in flooding, the impacts of which may be worsened if large amounts of sediments are transported. In countries which import feed to the UK, large-scale deforestation and soil degradation can increase the rate at which water flows from land and into watercourses. Downstream conurbations, businesses, and habitats can face increased flood risk when large-scale land use change for feed production occurs.

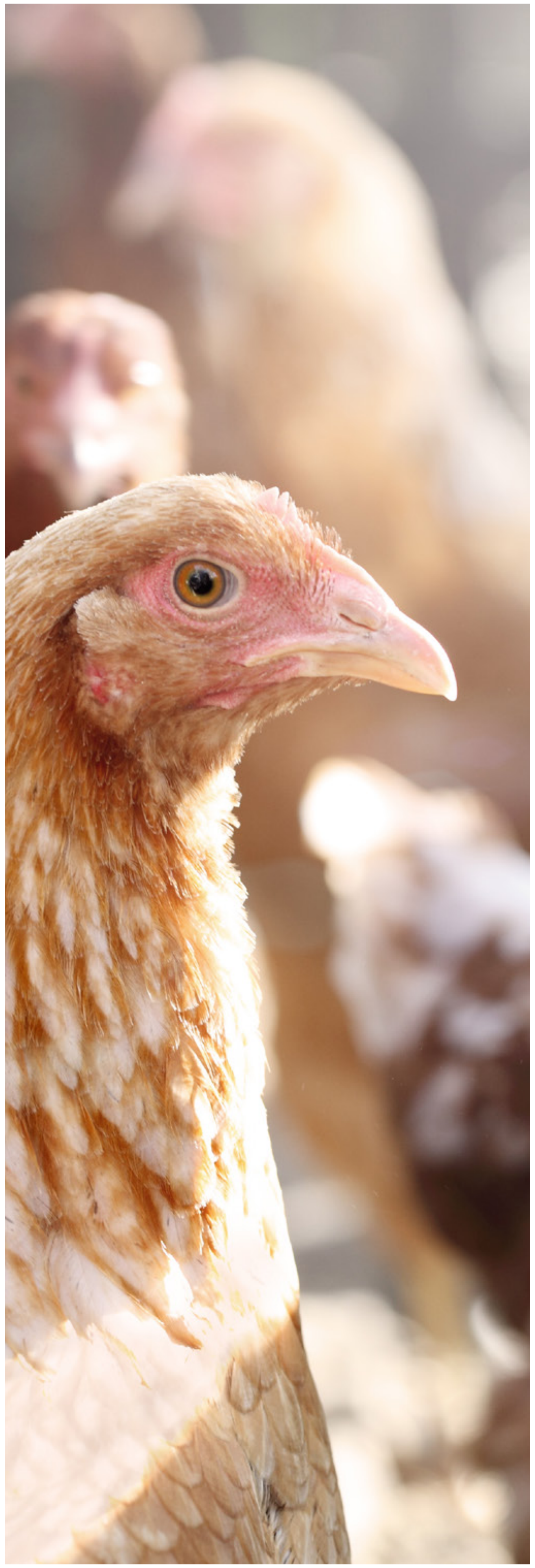
Land Use Change

UK pig and poultry direct land use is small. This is because feed production accounts for the majority of the land use in these sectors. Cereal crops grown for animal feed account for an estimated 40% of UK arable land and an additional 850,000 ha abroad is used for producing soy cake and meal[69]. Much of this imported soy is fed to pigs and poultry. Many of the environmental impacts from land use for feed production are summarised in other impact sections.

Nutrient pollution in the River Wye, whose catchment straddles the English – Welsh border, is a key concern for stakeholders and a major cause of water quality standard failures across the catchment.

- In January 2021, Natural Resources Wales reported that 28 of the 43 water bodies within the River Wye SAC in Wales did not meet their targets for phosphorus.
- The whole of the River Lugg SAC in England, part of the R. Wye catchment, is failing to meet its targets for phosphorus.
- In 2023 Natural England downgraded the status of the River Wye SAC due to water quality failures as well as ecological changes, including declines in Atlantic Salmon, changes in macroinvertebrate populations, and diatom populations which showed the impact of nutrient enrichment[70]. Whilst elevated nutrient levels are not the only pressure impacting the Wye's biodiversity, nutrient pollution is a factor in the ecological degradation seen.

Numerous studies have mapped and modelled the sources of nutrient pollution in the River Wye, in order to inform strategies and plan investment to reduce pollution loads.



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5 - A Case Study: The impact of Poultry farming in the River Wye Catchment

Most recently, updated Source Apportionment modelled analysis[71] by EA (England) and NRW (Wales) indicated that the Upper Wye carries approximately 67 kg/day of phosphorus with rural land use contributing 72% of the average daily load, and the Lower Wye carries approximately 195 kg/day with rural land use contributing 74%. Within this picture, there is local variation – in some sub-catchments without sewage treatment works, approaching 100% of the phosphate load comes from agriculture.

The RePhoKUs Project led by Lancaster and Leeds Universities explored phosphate loadings in the Wye catchment, finding a strong link between catchment phosphorus input pressures, manure phosphorus loadings to the land surface and build-up of soil phosphorus across the English part of the Wye. Although causal links are hard to evidence given the paucity of data on where and when manures are applied, various other studies have also demonstrated the broad links between manure applications, soil P fertility status and river P concentrations and loads[72].

The RePhoKUs Project concluded that farming in the catchment generates an annual phosphorus surplus of up to 3,000 tonnes, which is accumulating in the catchment soils. This amount of unused phosphorus is nearly 60% greater than the national average and is driven by the large amounts of livestock manure produced in the catchment.

As part of the project a Substance Flow Analysis (SFA) was undertaken to quantify the stocks and flows of elemental P within the Wye catchment. The analysis maps all significant materials associated with different sectors of the food system which are entering, leaving or circulating within the catchment. 2016 data suggested that cattle, poultry and sheep were each roughly contributing around a third to the manure loadings in the catchment[73], but using updated data the SFA showed that poultry manure was now the source of 2,579 tonnes P per year compared to a total of 3,454 tonnes from cattle, sheep and pigs combined; meaning poultry was now the source of around 43% of total manure loadings.

In the Wye, soil P levels continue to be greatest in those catchments with the greatest manure P **production.** River P export also tended to be greater in sub-catchments with higher P surpluses, reinforcing the links between manure applications to land, and river pollution – and therefore the role of poultry manure in the poor condition of the River Wye[74].

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6 - Conclusions and analysis

6.1 Conclusions

This report aims to provide a robust, evidence-based overview of the environmental risks of pig and poultry production in the UK, and quantify the environmental risks from pig and poultry production at a UK-wide level. The analysis highlights the significant, and often hidden, scale of the pig and poultry sector in the UK and the wider implications of this production system on land use, water quality, and biodiversity.

The report reaches the following conclusions:

- ***The scale of pig and poultry production as a sector across the UK is huge, with significant volumes of nutrient outputs generated***

  The UK produces almost 1 million tonnes of pigmeat and 2 million tonnes of poultry meat per year, breeding, growing and slaughtering in the region of 11 million pigs and 1.1 billion broilers. In addition, the UK has an egg laying flock of approximately 40 million chickens, producing approximately 12 billion eggs per year.

- ***Intensive pig and poultry production is highly concentrated, with the majority of England's pig population housed in just 5 council areas***

  The UK has significant populations of pigs and poultry, predominantly in England, followed by Northern Ireland, Scotland and Wales. Within each country, there are regional concentrations of pigs and poultry, notably in Yorkshire, East Anglia, Armagh, Mid Ulster, Grampian and, in respect of poultry, the Welsh borders and South West England.

- ***The hidden land take of pig and poultry production within the UK is significant***

  The areas of land required to produce pig and poultry feed extend well beyond the pig and poultry unit 'footprints'. It is estimated that UK pig and poultry feed require approximately 520,000-580,000ha of wheat , equivalent to 34-38% of the UK's total wheat crop, with associated fertiliser and pesticide inputs. UK pig and poultry feed also includes soyabean meal, requiring land use outside the UK of an estimated 730,000ha.

- ***The pig & poultry sector outputs over 10 million m3 of excreta every year, highly concentrated within the areas farmed***

  The amount of excreta resulting from pig and poultry production in the UK is in the region of 10.4 million cubic metres per year. This results in total outputs of approximately 97 million kg/yr nitrogen and 64 million kg/yr phosphate. In one single council area, North Yorkshire CC, the combined volume of excreta from pig & poultry production each year is 1.7 million m^3.

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- ***The concentration of nutrients within excreta produced means that significant areas of farmland are required to effectively use them***

  Geographic concentrations of the pig and poultry sectors in particular hotspots mean that maintaining N and P balances in soils is very difficult. In particular, the land area required to maintain a phosphorus balance is very large, and given the geographic concentration of pig and poultry units, as well as the logistical challenges of transporting pig/poultry manure and slurry, there are likely to be many farms in these areas which are in significant phosphorus surplus - and by extension, a significant source of phosphate losses into the environment.

- ***The environmental impacts associated with soil erosion, fertiliser application, and pesticide use on the significant land take associated with producing feed for pig and poultry units are likely significant***

  But currently fall outside of any reporting or permitting on the environmental impacts of pig and poultry units. Focus to date has been largely on the spreading of excreta outputs of these units which, while significant, do not convey the full extent of the environmental footprint of these systems.

- ***Many pig farms fall outside of the current environmental permitting regime***

  The majority of breeding sows in England fall outside the environmental permitting regulations, alongside significant proportions of other pig populations across the UK. This means that regulators lack a key route to managing the potential environmental impacts of these enterprises. In contrast, a high proportion of poultry is in larger units falling within the environmental permitting regulations. However even where the permitting regime applies, not all producers appear to be adopting best practice in manure storage and application. The nutrient pollution issues in the River Wye catchment highlight the impacts that locally-concentrated manure applications in excess of crop need and soil capacity can bring.

- ***The pig and poultry sector account for 19% of UK ammonia emissions***

  While this is significantly less than cattle, ammonia hotspots from pig and poultry are concentrated in high densities where the sheds are located, with high peaks in ammonia concentrations. However, the fall in ammonia emissions from pig and poultry since the Pollution Prevention and Control Act (1999) suggests the positive impact of legislative permitting in this area.

- ***Data monitoring and reporting on the environmental impacts of pig and poultry production systems could be improved***

  Data on pig and poultry production, permitting, practices and impacts across the UK is fragmented (by country and by topic) and incomplete, making it difficult to establish an overview and monitor trends. This is particularly the case when assessing impacts associated with the inputs and feed production for these systems.

6.2 Considerations for progress towards Environmental Objectives

Soil Quality

Soil quality risks associated with pig and poultry production include, in addition to maintaining soil nutrient balances, potential impacts of manure on soil pH, soil structure and soil health, soil erosion and compaction, and related GHG emissions.

The Government's Environmental Improvement Plan[75] (EIP) sets out a target to bring at least 40% of England's agricultural soil into sustainable management by 2028, and increase this to 60% by 2030. The management of excreta and outputs from pig and poultry production should form a key consideration of this target, given the significant volumes produced and the concentration of nutrients, particularly Phosphorous, and the impact of these nutrients on soil health. This report identifies that in the most extreme cases of Breckland and South Norfolk and North and North East Lincolnshire, the land area requirement for spreading excreta from the pig and poultry sectors in order to maintain a phosphorus balance, as a share of the total farmed area, is 61%.

Given the highly concentrated nature of pig and poultry production, and the lack of a strategic approach to ensuring outputs are managed and transported appropriately, it is likely that a continuation of the status quo presents a barrier to achieving the EIP target for the proportions of soils in sustainable management.

Furthermore, the significant land take associated with pig and poultry feed production used for growing cereal crops raises concern for achieving this target. Tillage, nutrient application, pesticide use (including fungicides), and compaction associated with these activities are directly attributable to the pig and poultry sector. Demand for high-volume, low-cost inputs into pig and poultry systems places further demand on cereal cropping to achieve high outputs at a low cost, which often results in negative environmental outcomes. Given the findings of this report, progress towards the Government's EIP target for sustainable soil management should consider cereal cropping for pig and poultry systems as a specific area of interest.

Water Quality

Water quality risks from pig and poultry production include eutrophication in fresh waters and saline waters from excess nitrogen and phosphates. Phosphorus is the main cause of eutrophication in freshwaters, leading to water quality failures under the Water Framework Directive. Common across the UK is the overarching aim of bringing waters to good chemical and ecological status where cost-beneficial to do so (originally introduced by the EU Water Framework Directive and brought across into UK Regulation upon Brexit), and the commitment under the Global Biodiversity Framework (Target 7) to "reduce pollution risk to levels not harmful to biodiversity by reducing nutrients lost by half, reducing risk from pesticides by half and work towards eliminating plastic pollution". Further specific targets or actions aimed at enabling the achievement of these goals are then set out by individual Governments across the UK.

In England, agriculture and land management is responsible for a greater proportion of WFD failures than any other sector, and sector-specific and broader overarching targets exist with the aim of reducing this impact.

A target set under England's Environment Act 2021 requires the reduction of nitrogen, phosphorus and sediment pollution from agriculture into the water environment by at least 40% by 2038. Although expressed as a national target, Government's intention was that contributions would be focussed on pollution reduction in the catchments of waterbodies where this would also achieve other benefits, including achieving WFD targets and reducing nutrient pollution to protected sites such as SACs. An interim target within the Environmental Improvement Plan speaks to this ambition, requiring an initial 10% reduction by 2028, but a 15% reduction in catchments containing protected sites in unfavourable condition due to nutrient pollution. In practice, achievement of these targets will ultimately require reductions well beyond 40% in some areas, balanced by lower reductions in other areas to achieve the 40% reduction on average. Given the concentration of pig and poultry production (and therefore the application of nutrient-rich manure) in certain areas, specific focus will need to be given to managing the impacts of these manure applications in areas with WFD failures, Protected Area pollution, or other environmental ambitions reliant upon reducing nutrient impacts upon the water environment.

Also contained within the EIP is a commitment to restoring 75% of our water bodies to good ecological status. This is a legal obligation stemming from the WFD Regulations which require achievement of this goal by 2027; a target which is set to be dramatically missed. In reviewing its future approach to achieving the goals of the Regulations, Government should consider whether specific action is needed in catchments impacted by manure applications from pig and poultry operations.

Similar considerations may be necessary in Wales, Scotland and Northern Ireland in any areas where pig and poultry production, or associated feed production, is known to be preventing the achievement of water quality targets. In addition to consideration of nutrient pollution, pesticide pollution remains a concern in relation to water quality and more widely. Whilst certain pesticides are considered under the WFD regime, wider action is necessary to reduce the harm caused by unsustainable pesticide use and UK Governments have this year jointly published a UK National Action Plan (NAP) for the sustainable use of pesticides. Given the large areas of land to which pesticide is applied in the production of feed for pig and poultry enterprises, the ambitions of the NAP, particularly where relevant to wheat and maize, should consider the benefits of targeting growers that supply the pig and poultry sector, such as through supply chain networks.

Biodiversity

Biodiversity risks from pig and poultry production include: directly, through ammonia emissions and nitrogen deposition affecting nitrogen-sensitive habitats; directly, through nitrogen and phosphorus run-off into soil, watercourses and groundwater affecting nutrient sensitive terrestrial and aquatic habitats; and indirectly, through the land take associated with feed grain and protein. While the pig and poultry sectors are less significant as an overall source of ammonia emissions than cattle, ammonia hotspots are more likely from pig and poultry where the sheds are concentrated in high densities.

The Environment Act 2021 includes targets to halt the decline in species populations by 2030, and then increase populations by at least 10% to exceed current levels by 2042. The Environmental Audit Committee noted in their Water Quality in Rivers Report that "Improving the quality of the water in rivers in England should be considered a principal objective through which the Government and public bodies can deliver on the legally binding duty,...to halt the decline in domestic species". The Government's Environmental Improvement Plan (EIP) sets out goals on the journey to achieving these targets, however the Office for Environment Protection have highlighted that progress against these targets is largely off track[76]. Key drivers for why progress on the EIP has stalled include actions on sustainable farming practices, addressing water pollution, and effective regulation. Analysis from this report highlights how environmental permitting around pig and poultry systems in the UK does not currently account for wider impacts associated with the feed and inputs associated with these systems, which should form a material consideration for policy and regulation for this sector.

The pig and poultry sectors also account for the majority of UK imports of soyabean meal (77%), and are therefore important drivers of soy production - which adds to deforestation pressures abroad.

Land Use

The Wildlife Trusts have a strategic goal to achieve "*nature in recovery with abundant, diverse wildlife and natural processes creating wilder land and seascapes where people and nature thrive*", with an impact measure of 30% of land, freshwater, and seas being managed for wildlife by 2030. The UK Government have also committed to achieve "30by30" within Target 3 of the Global Biodiversity Framework[77], which states that governments will aim to *"Ensure and enable that by 2030 at least 30 per cent of terrestrial and inland water areas, and of marine and coastal areas, especially areas of particular importance for biodiversity and ecosystem functions and services, are effectively conserved and managed through ecologically representative, well-connected and equitably governed systems of protected areas and other effective area-based conservation measures".*

Pig and poultry production systems are often considered to have a small ecological and geographic footprint, and so have typically formed the periphery of land use change discussions to date. However, this report highlights that the land use associated with feed production for these systems in the UK is significant at almost 600,000 hectares for wheat alone. This clearly places pig & poultry systems as a key consideration of future land use decisions in the UK and progress towards the 30by30 target, and should form an important element of the upcoming Land Use Framework in England which aims to assess how land in England can best be used to achieve nature and climate targets.

This is particularly the case when assessing where feed for pig & poultry units is grown, as a proportion of arable cropland on lowland peat is used to grow cereal crops for use in animal feed[78]. The emissions resulting from cropland on peat are more than 7.5 million tonnes CO_2e per year[79], and are a key driver in the decline of peatland soils.

Wider Risks

Wider risks arising from pig and poultry production in the UK relate to air quality, climate regulation, flood regulation, land use change, animal health and welfare, disease and pest risk, antibiotic use and risks to human health. Although detailed analysis of these risks fell outside the scope of this report, they will be relevant to local decision-making about the impacts of pig and poultry enterprises on a case by case basis, such as through the planning system.

Glossary

Term	Definition/description
AHDB	Agriculture & Horticulture Development Board
APHA	Animal and Plant Health Agency
BAT	Best Available Techniques for preventing pollution
Broiler	Chicken bred and raised specifically for meat production
Compound (feed)	Animal feed that is formulated by blending various raw materials and additives to provide a balanced diet that meets the nutritional needs of livestock, including pigs and poultry
EPR	Environmental Permitting Regulations
GHG	Greenhouse Gas emissions
IPPC	Integrated Pollution Prevention and Control Directive
NVZ	Nitrate Vulnerable Zone
SAC	Special Area of Conservation
SPA	Special Protection Area (birds)
SSSI /ASSI	Site or Area of Special Scientific Interest
Soil Organic Carbon	The measurable component of Soil Organic Matter. It refers to carbon component of organic compounds. Soil Organic Matter is difficult to measure directly, so laboratories tend to measure and report Soil Organic Carbon.
Soil Organic Matter	The organic fraction of the soil that includes plant and animal residues at various stages of decomposition, cells and tissues of soil organisms, and substances synthesized by soil organisms. It plays a vital role in maintaining soil health and fertility.
WFD	Water Framework Directive

Appendix 1: Methodology for calculating outputs

Livestock age profiles

The spatial distribution of pigs and poultry is based on data from the June Agricultural Survey 2024.

The June Survey provides a snapshot of the number of pigs and poultry at that point in time. It does not provide a detailed breakdown of the age profile of these animals.

The age profile of animals is important, because, for example, a sow will produce more excreta than a maiden gilt, and a 66kg finisher will produce more excreta than a 7kg weaner. Defra publish estimates of the excreta produced for different age classes.

We have accounted for this by allocating a percentage of the total number of animals to each age profile in the production cycle based on the length of time they spend in the system. See **Tables 1.1 and 1.2.**

By way of example, in order to maintain a constant breeding herd of x, at any one point in time there will be (x*25%) maiden gilts and (x*75%) sows.

In poultry, the age profile is not so relevant because excreta and nutrients data is published for the production cycle as a whole. However, we do need to differentiate between caged hens and free-range hens, and the June Agricultural Survey only publishes figures for poultry layers as a whole.

It is difficult to find up-to-date and reliable data on the percentage of free-range layers versus caged layers. We have used an assumption, based on estimates from the RSPCA, that 62% of poultry layers are free-range and 38% are caged. So based on a total laying flock of x, at any one point in time there will be (x*62% free-range layers) and (x*38% caged layers).

Calculating excreta production

We have calculated the output of excreta produced by pigs and poultry by taking the annualised output figures published in the ABC Agricultural Budgeting and Costings Book 99th Edition (2024) and multiplying them by the number of animals in each age profile / stock class, which is derived by the process outlined above. By way of example, we show our workings for a hypothetical breeding sow herd in **Table 1.3**.

Calculating Nitrogen and Phosphate outputs

We have calculated the output of nitrogen and phosphates produced by pigs and poultry by taking the annualised output figures published in Defra's NVZ tables and multiplying them by the number of animals in each age profile / stock class. By way of example, we show our workings for the N output of a hypothetical breeding sow herd in **Table 1.4**.

Calculating the land area required for spreading excreta

We have taken the output figures calculated as above and estimated the land area required for spreading excreta under different nutrient loading limits.

Calculating the land area requirement for N at a loading limit of 170kg/ha is a straightforward calculation dividing the total N output by 170.

Calculating the land area requirement for P requires an additional step because the output figures are for phosphate (P_2O_5), but soil nutrient balances are based on phosphorus (P). To replace an average phosphorus offtake of 17kg per ha, we have calculated the phosphate limit by multiplying by 2.29. This gives a phosphate limit of 38.93 kg/ha. The land area requirement is then a straightforward division of the total phosphate output by 38.93.

Table 1.1 Breeding sows

Age profile	Time in system	Percentage
Maiden gilt 66kg and over	5 months	25%
Sow 66kg and over	22 months	75%

Table 1.2 Fattening pigs

Age profile	Time in system	Percentage
1 weaner place, 7-13kg	0.5 months	10%
1 weaner place, 13-31kg	1.6 months	31%
1 grower place, 31-66kg	2 months	39%
1 finisher place, 66kg	1 month	20%

Table 1.3 Excreta production for a given number of breeding pigs

Livestock class	Number	Volume of excreta per animal	Total volume of excreta
Maiden gilts	25	2.04 m3 / annum	51 m3 / annum
Sows	75	3.96 m3 / annum	297 m3 / annum
Total breeding herd	100	-	348 m3 / annum

Table 1.4 N output for a given number of breeding pigs

Livestock class	Number	Output of N (kg/year)	Total output (kg/year)
Maiden gilts	25	11.1	277.5
Sows	75	16	1,200
Total breeding herd	100	-	1,477.5

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The Wildlife Trusts

enquiry@wildlifetrusts.org
wildlifetrusts.org

@WildlifeTrusts
@wildlifetrusts
@thewildlifetrusts