

Assessing Mitigation Pathways to Realise Public Health Benefits of Air Pollutant Emission Reductions from Agriculture (AMPHoRA)

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Overview

- ❑ National Institute for Health Research (NIHR) Public Health Research funding call 18/148 - Air pollution: non-road traffic-related outdoor air pollution and health launched in Fall 2018
- ❑ 2-Stage process, funding decision June 2019
- ❑ 2 projects funded on agricultural emissions, AIM-Health (led by Institute of Occupational Health) and AMPHoRA
- ❑ Volume £875k over 3 years, started 1 April 2020

Team

LONDON
SCHOOL of
HYGIENE
& TROPICAL
MEDICINE



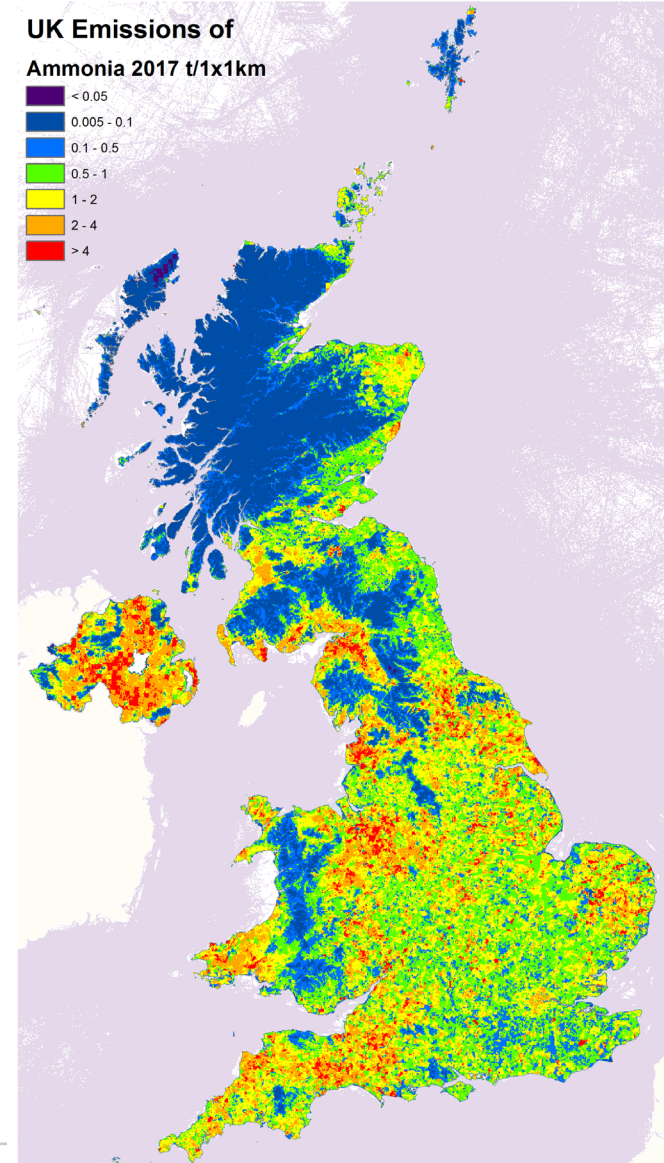
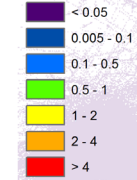
mindthe:gap

EMRC



ROTHAMSTED
RESEARCH

UK Emissions of
Ammonia 2017 t/1x1km



Key questions to address

- ❑ Contribution of **agricultural emissions of NH_3** and other air pollutants to the **exposure of UK population to harmful levels of $\text{PM}_{2.5}$**
- ❑ Effectiveness of **existing and planned policy interventions to mitigate emissions and reduce exposure.**
- ❑ **Public health benefits** in terms of **cost savings and improving well-being** of vulnerable population groups, patients and the general public.

Key questions to address

- ❑ **Impacts of interventions in terms of socio-economic and environmental aspects, accounting for co-benefits and unintended consequences, with a focus on regional and distributional effects.**
- ❑ **Potential co-benefits of emission and dietary changes for greenhouse gas (GHG) emissions, biodiversity and non-communicable disease prevention.**

Research question & aims

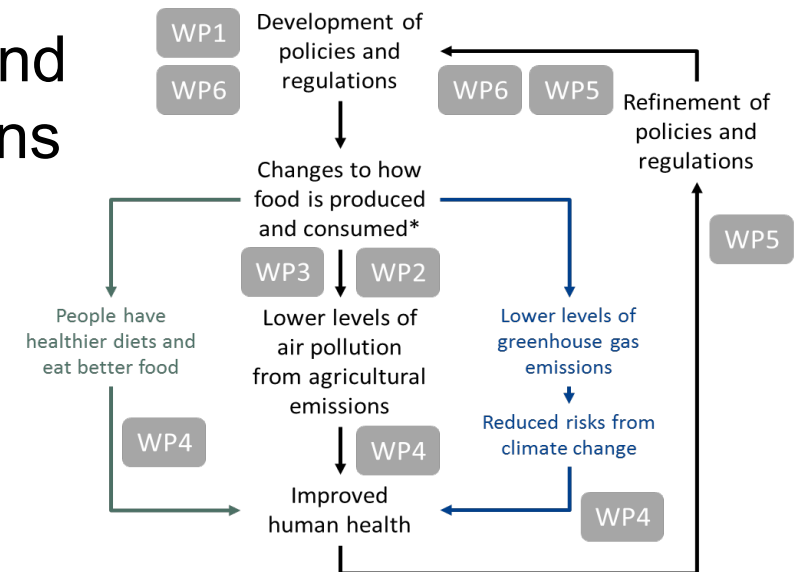
Research Question: *“What contribution can emission reductions from agricultural production make to improving public health in the UK?”*

- Aims: To evaluate the **health impact of food and agriculture strategies** in the UK aimed at **improving outdoor air pollution**, and how to align them with **strategies for reducing chronic disease and improving environmental sustainability**, including **reductions of GHG emissions**, and to understand barriers and opportunities for rapid implementation of policies at scale.

Approach (1)

- To convene a multi-stakeholder group - comprising **government departments/agencies, food and agriculture industry experts, the public, 3rd sector organizations and academics** - to delineate existing and potential future policies with potential to reduce emissions of air pollutants and GHGs through changes to (i) **agricultural technology and land-use management**, and (ii) factors influencing **dietary patterns [WP1]**;
- To quantify the **impact in terms of key nutritional constituents and fulfilment of nutritional needs** of interventions aimed at altering patterns of food consumption and UK production that both help to reduce air pollutant emissions and improve diets for health and sustainability **[WP2]**;

Integration of Work Packages into AMPHoRA's holistic model of links between agricultural air pollution and human health

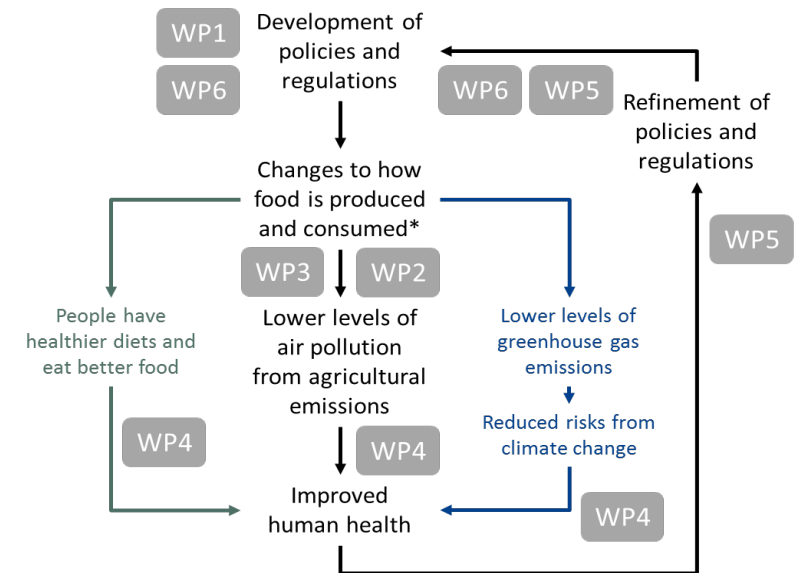


*Such as more fruits, vegetables, and cereals, and fewer animal-based and processed foods

Approach (2)

- To quantify the impact of such policies on **air pollutants (AP), GHG emissions, and on population-weighted ambient concentrations of PM, NO₂, and ozone**, now and in future, under policy scenarios defined in (1) [WP3];
- To **develop and apply models of health impact** capturing the **mortality and morbidity** benefits/harms of changes in air quality of food/agriculture interventions (including both **existing and potential future policies**), and of the associated dietary changes and environmental impacts where relevant [WP4];

Integration of Work Packages into AMPHoRA's holistic model of links between agricultural air pollution and human health



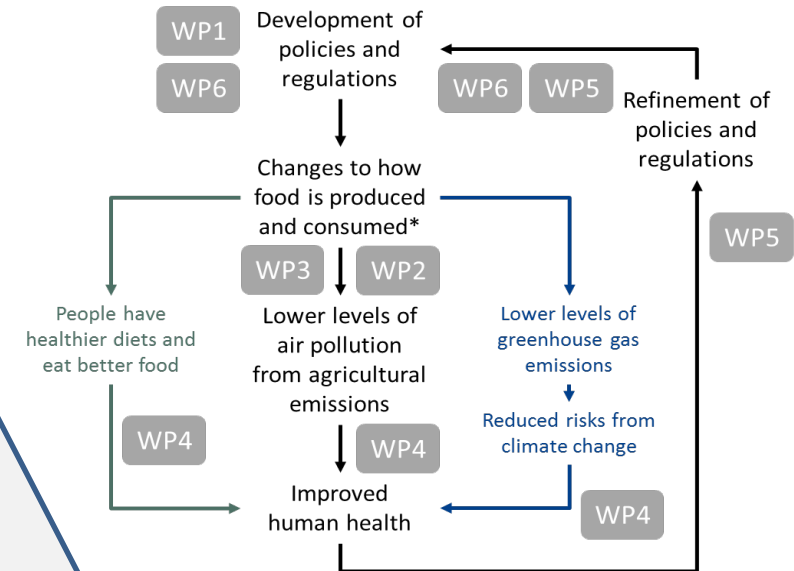
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Including a systematic review on the health impacts of different PM_{2.5} components

Approach (3)

- To **compare policies over time horizons up to 2050** using a multi-criteria assessment framework with assessment criteria developed with the multi-stakeholder group (and to include the fulfilment of AP goals, health, health differentials, GHG emissions targets, economic costs) **[WP5]**;
- To assess the **implications of these analyses for policy development and implementation**, patients and the wider public, taking account of real-world constraints and opportunities, including with the aid of an iterative cycle of stakeholder engagements **[WP6]**.

Integration of Work Packages into AMPHoRA's holistic model of links between agricultural air pollution and human health



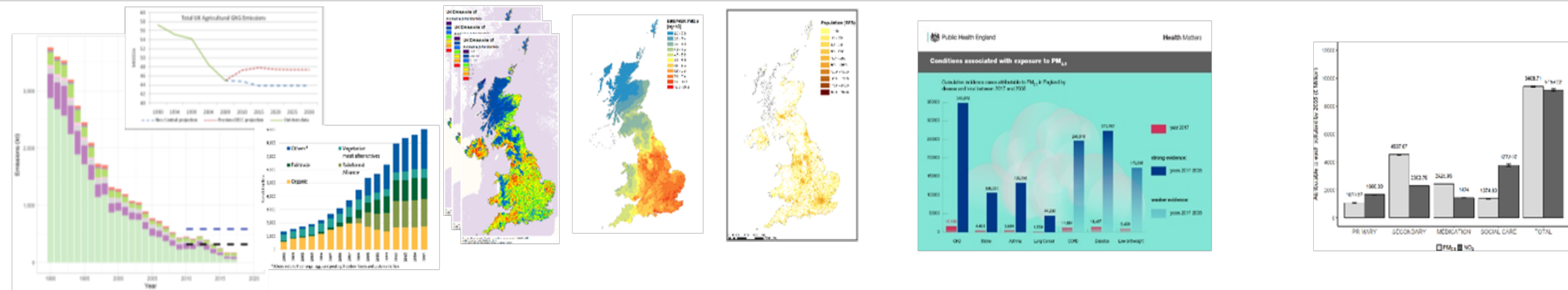
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CEA/CBA and
MCDA

Data flow



Data and information flow in AMPHoRA



Emission projections
incl. interventions

Emission maps, modelled concentrations
and population-weighted exposure

Health impacts due to exposure
to PM_{2.5} and other air pollutants

Costs and benefits of
interventions

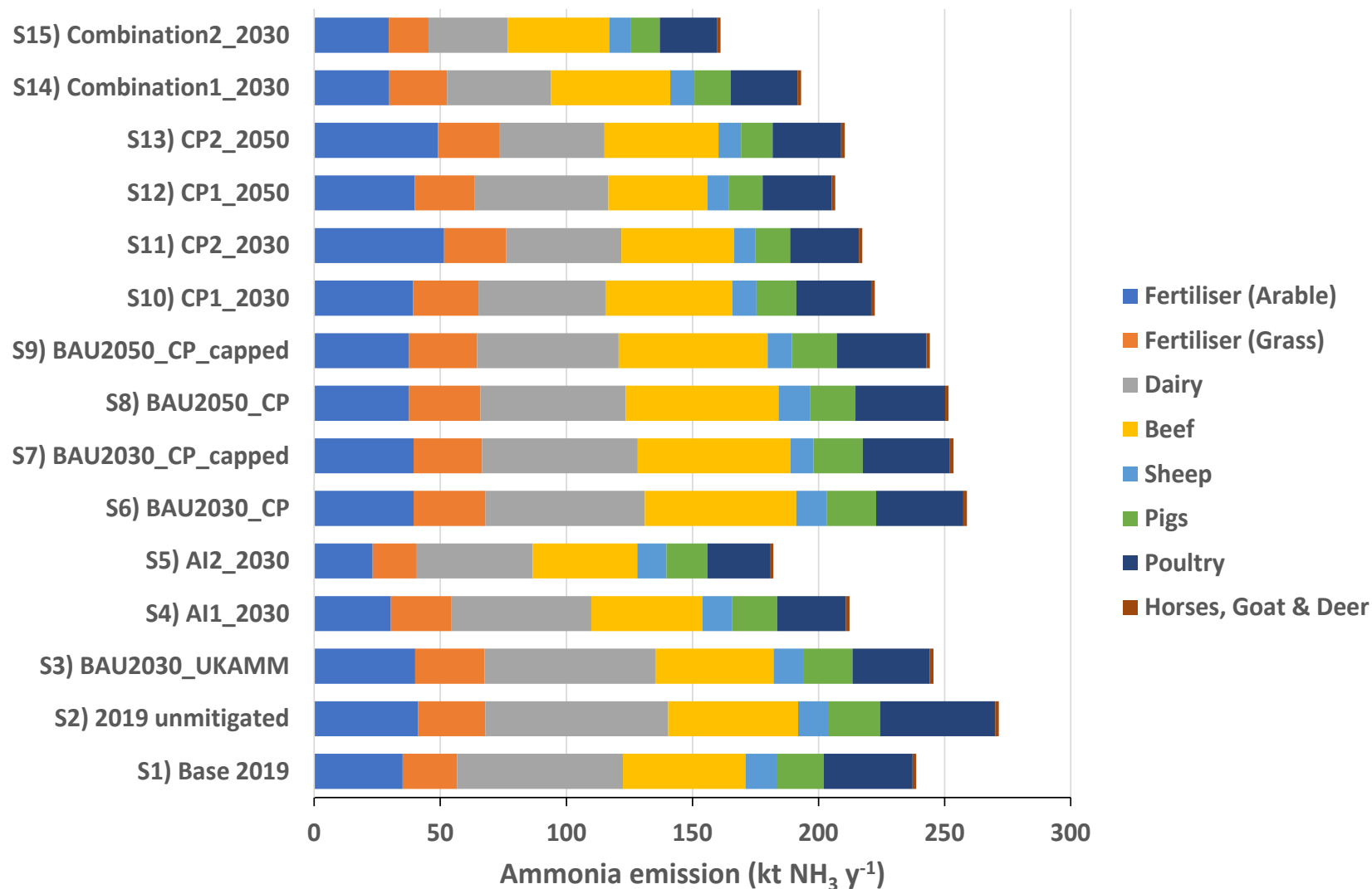
PPIE Activities – Stakeholder events, Focus Groups, review and consultation

Results (1)

Scenario	Short title	Brief description
1	Base 2019	Inventory estimate for 2019 for UK agriculture (2021 submission)
2	2019 unmitigated	Scenario 1 with all mitigation removed
3	BAU2030_UKAMM	BAU for 2030 based on UKAMM livestock number and crop area projections
4	AI1_2030	Scenario 3 with medium ambition mitigation uptake based on the Defra Clean Air Strategy proposal
5	AI2_2030	Scenario 3 with high ambition mitigation uptake based on the pathway to achieving Net Zero for GHG emissions
6	BAU2030_CP	BAU for 2030 based on current consumption/production and market projections with no cap on exports
7	BAU2030_CP_capped	BAU for 2030 based on current consumption/production and market projections with a cap on 100% self-sufficiency
8	BAU2050_CP	BAU for 2050 based on current consumption/production and market projections with no cap on exports
9	BAU2050_CP_capped	BAU for 2050 based on current consumption/production and market projections with a cap on 100% self-sufficiency
10	CP1_2030	Scenario 6 modified to account for taxes and subsidies to reduce livestock consumption/production
11	CP2_2030	Scenario 6 modified to account for replacement of farmed animal products with lab-produced or plant-based alternatives
12	CP1_2050	Scenario 8 modified to account for taxes and subsidies to reduce livestock consumption/production
13	CP2_2050	Scenario 8 modified to account for replacement of farmed animal products with lab-produced or plant-based alternatives
14	Combination1_2030	Combination of scenarios 4 and 10
15	Combination2_2030	Combination of scenarios 5 and 11

Results (2)

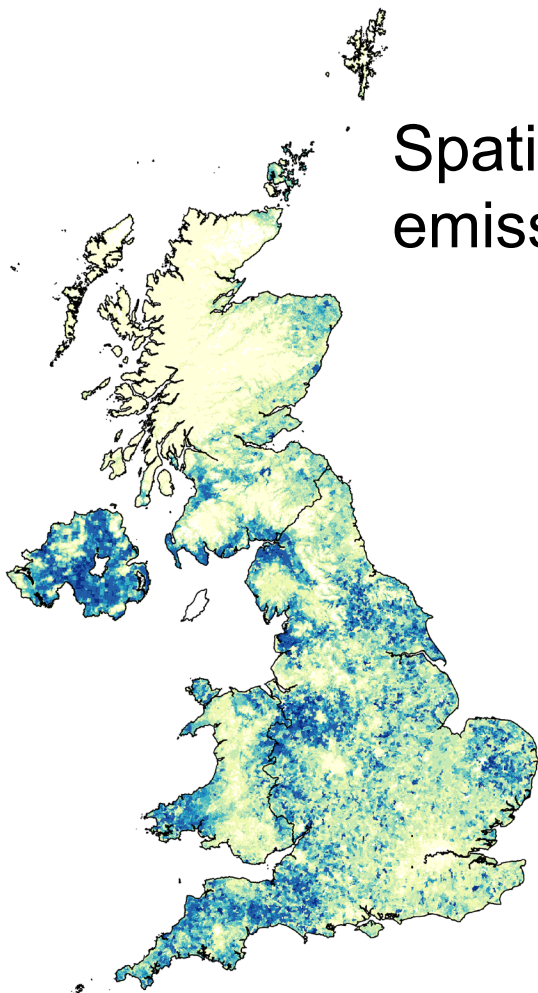
Predicted ammonia emissions (kt NH₃) for UK agriculture for each scenario



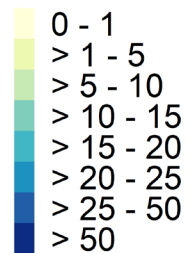
Results (3)

1) 2019 Baseline

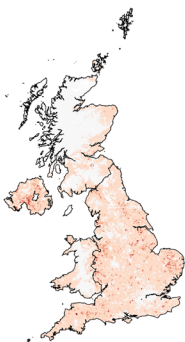
Spatial variability of emission changes



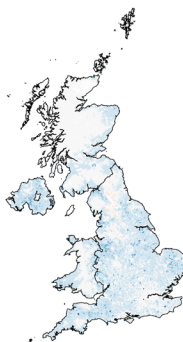
Baseline emissions (2019)
(kg NH₃ ha⁻¹ yr⁻¹)



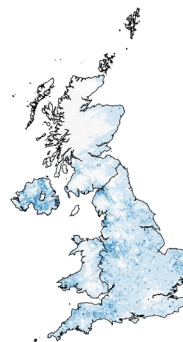
2) 2019 unmitigated



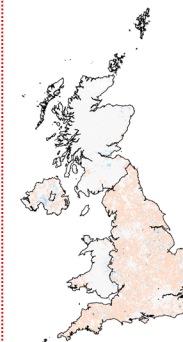
3) BAU2030 UKAMM



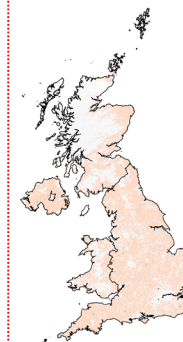
4) AI1 2030



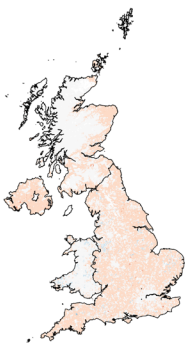
5) AI2 2030



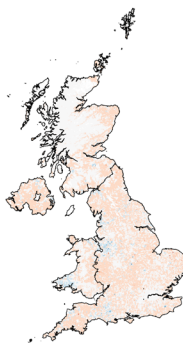
6) BAU2030 CP



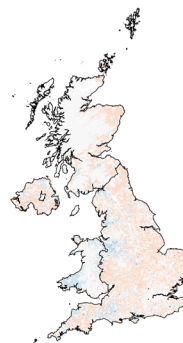
7) BAU2030 CP capped



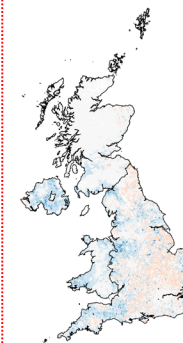
8) BAU2050 CP



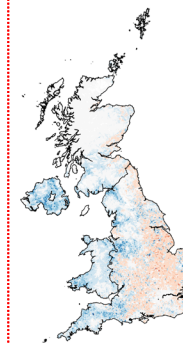
9) BAU2050 CP capped



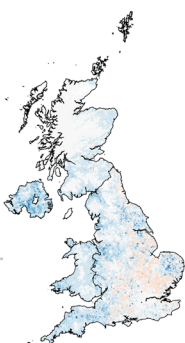
10) CP1 2030



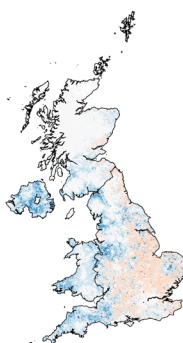
11) CP2 2030



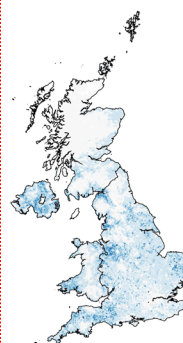
12) CP1 2050



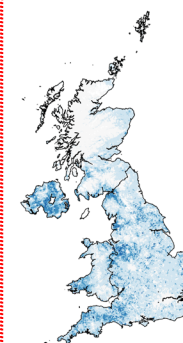
13) CP2 2050



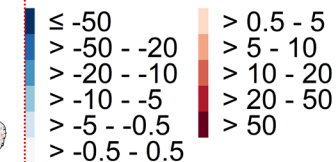
14) Combination1 2030



15) Combination2 2030



Difference to 2019 base
(kg NH₃ ha⁻¹ yr⁻¹)

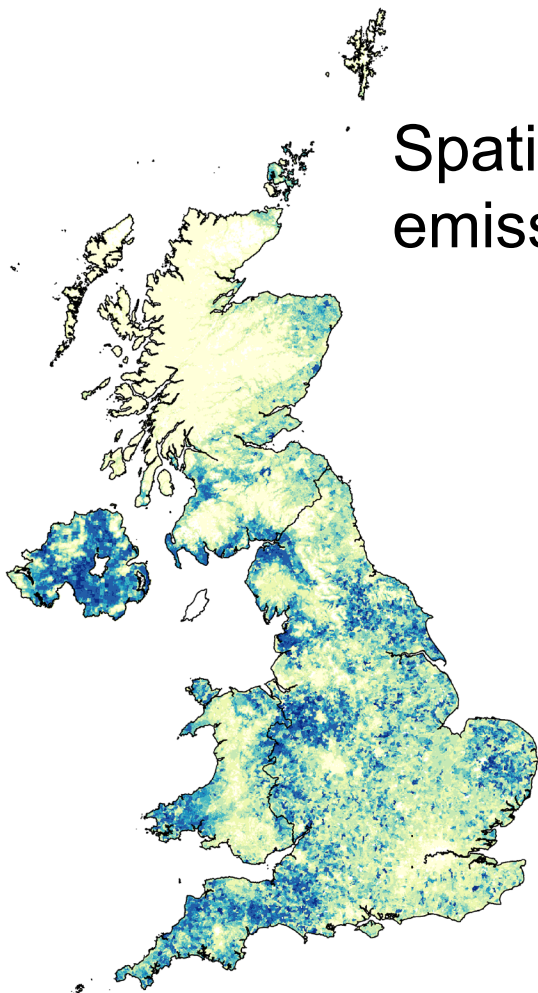
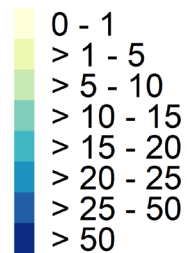


Results (4)

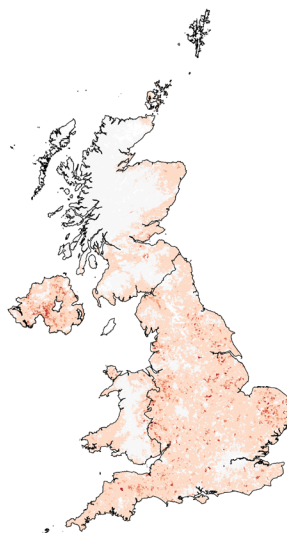
1) 2019 Baseline

Spatial variability of emission changes

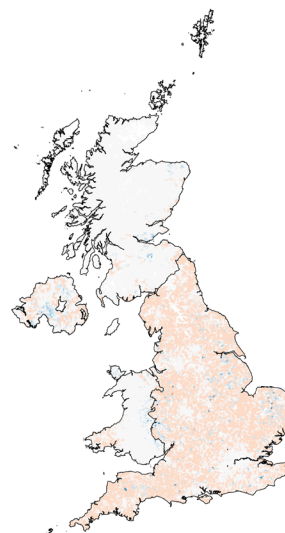
Baseline emissions (2019)
(kg NH₃ ha⁻¹ yr⁻¹)



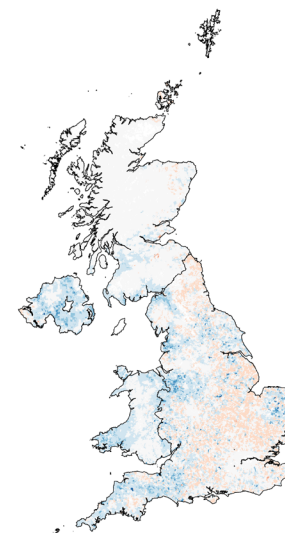
2) 2019 unmitigated



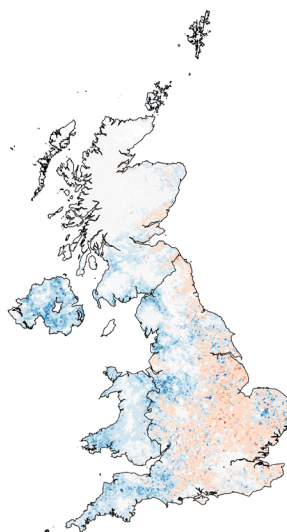
5) AI2 2030



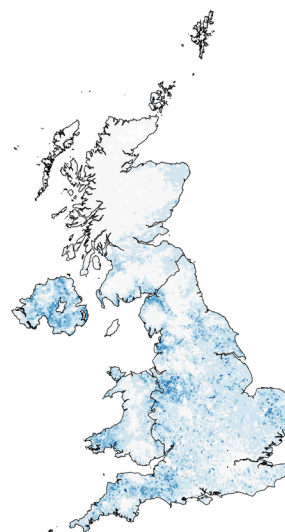
10) CP1 2030



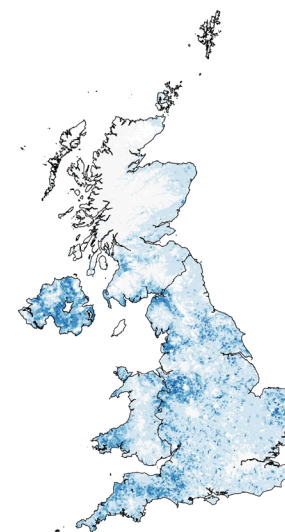
11) CP2 2030



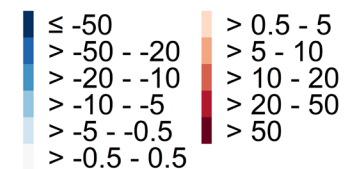
14) Combination1
2030



15) Combination2
2030



Difference to 2019 base
(kg NH₃ ha⁻¹ yr⁻¹)



Engagement activities



Guidance Code of Good Agricultural Practice (COGAP) for Reducing Ammonia Emissions

Published 27 July 2018

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- Executive summary**
- How to get support to reduce your ammonia emissions
1. Introduction
 2. Scope and cover your organic manures
 3. Apply organic manures effectively and efficiently
 4. Use manufactured nitrogen fertilisers effectively and efficiently
 5. Dairy and beef sector-specific measures
 6. Pig sector-specific measures
 7. Poultry sector-specific measures
 8. References

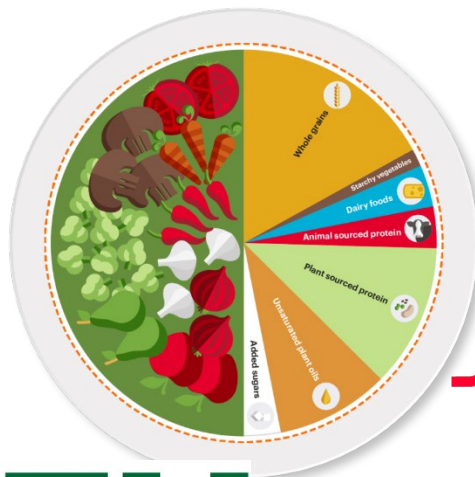
Executive summary

This Code of Good Agricultural Practice (COGAP) for reducing ammonia emissions is a guidance document produced by Defra in collaboration with the farming industry. It explains the practical steps farmers, growers, land managers, advisors and contractors in England can take to minimise ammonia emissions from the storage and application of organic manures, the application of manufactured fertiliser, and through modifications to livestock diet and housing.

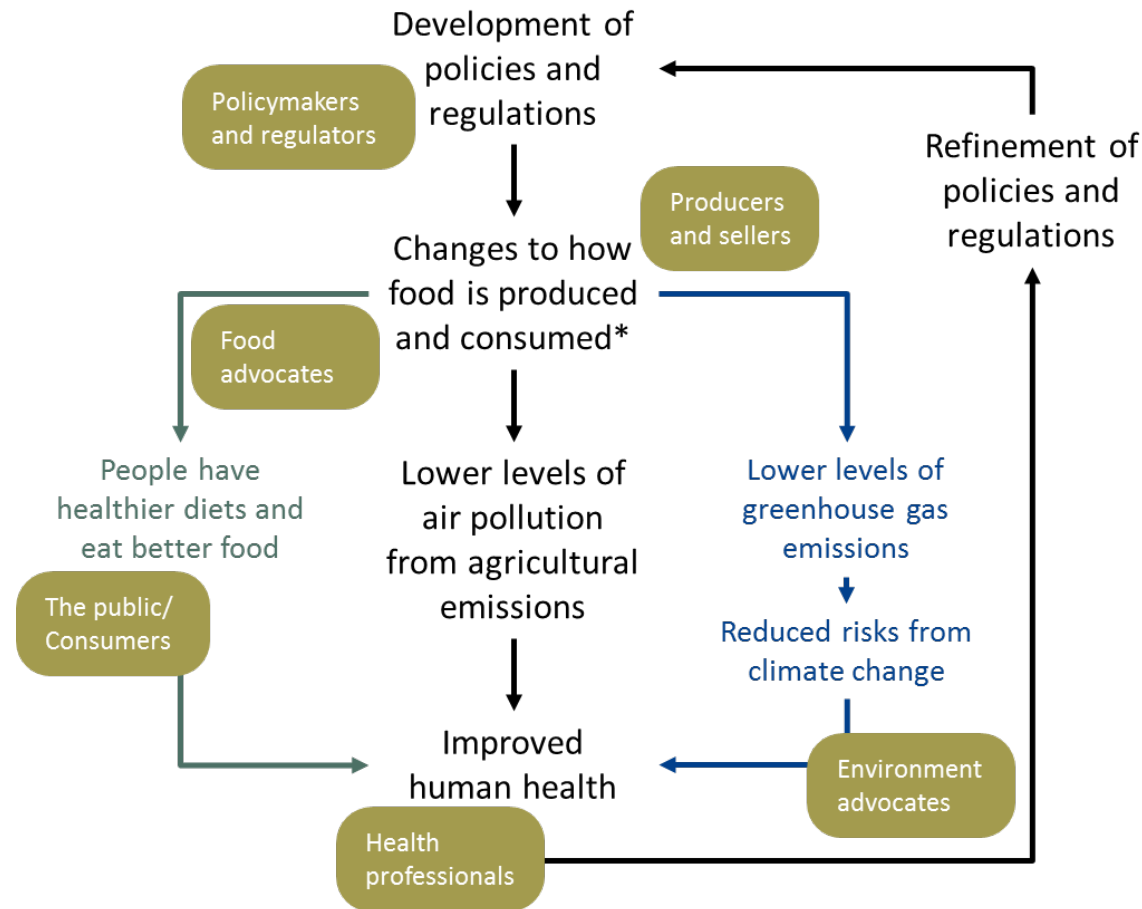
Ammonia (NH₃) is a key air pollutant that can have significant effects on both human health and the environment. The government has agreed to reduce ammonia emissions by 8% in 2020 and 16% in 2030, compared to 2005 levels. Around 85% of ammonia emissions in the UK come from agriculture. These targets can be achieved through widespread adoption of the measures in this Code.

Nitrogen, in the form of ammonia, is lost from organic manures (such as slurry, solid manure and litter, digestate, sludge and compost) when they come into contact with air, particularly on warm or windy days. Nitrogen is also lost from manufactured fertilisers during spreading. The more that this occurs, the more nitrogen is lost as ammonia, meaning the material is a less effective fertiliser and loses value. Therefore, measures to reduce ammonia emissions and improve overall nutrient management practices could reduce the amount of manufactured fertiliser that farmers need.

A summary of key points is provided in each chapter of support are provided in each chapter



Stakeholder Engagement in AMPHoRA's holistic model of links between agricultural air pollution and human health



*Such as more fruits, vegetables, and cereals, and fewer animal-based and processed foods

Next steps

- ❑ Complete scenario runs with the EMEP4UK atmospheric chemistry transport model
- ❑ Undertake full health impact assessment for the scenarios.
- ❑ Assess costs and benefits of scenarios for air pollution and health in the UK, including co-benefits e.g. on greenhouse gas emissions.
- ❑ Engage with stakeholders and the public on AMPHoRA results

<https://amphora-project.org.uk/>

Due to CoVID impacts on staffing, AMPHoRA has requested a no-cost extension by 9 months and aims to complete by end of June 2023