2018

Livestock, Environment and People (LEAP) Conference

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LEAP
LIVESTOCK, ENVIRONMENT AND PEOPLE

St Anne's College, Oxford

7th November 2018

Contents

Conference Sponsor

Wellcome Trust's Our Planet Our Health

"Since 2015, we've supported a community of researchers who are taking on the challenges that food systems, increasing urbanisation and climate change pose to our health. We aim to stimulate research excellence and develop global collaborations to drive change"

Welcome

We are delighted to welcome you to Oxford for this Livestock, Environment and People (LEAP) Conference. This event forms part of our LEAP project, funded by the Wellcome Trust as part of the Our Planet Our Health initiative. Our project brings together researchers, primarily based in Oxford, working with partners in IFPRI, TNC and Sainsbury's, to study the health, environmental, social and economic effects of meat and dairy consumption, aiming to provide evidence and tools for decision makers to promote healthy and sustainable diets.

We are grateful to our plenary speakers, Professor Tim Benton, Leeds University, and Professor Dame Theresa Marteau, Director of the Behaviour and Health Research Unit, University of Cambridge, for generously sharing their time and expertise to frame the issues in relation to food production and consumption behaviours respectively. However, the heart of this meeting revolves around the submitted abstracts and we are very pleased to have people from across the UK and beyond presenting their work. We hope that the range of topics will provide a stimulus for interdisciplinary discussions and perhaps the start of new collaborations, leading to a network of researchers focused on the role of meat and dairy in future food systems.

We would welcome your feedback on the value of the day and encourage you to complete the evaluation sheets or to pass on your thoughts directly or by email to any of the LEAP team.

On behalf of the whole LEAP team, thank you for joining us today and we hope that you will have an interesting and rewarding day.

With best wishes,

Professor Sir Charles Godfray

Co-Director of LEAP

Professor Susan Jebb

Co-Director of LEAP

Key Information

Venue

St Anne's College, Woodstock Road, Oxford, OX2 6HS, UK (Click here for further details)

Registration

Ruth Deech Building (building N) from 09:15-10:00 am on the 7th November 2018

Catering

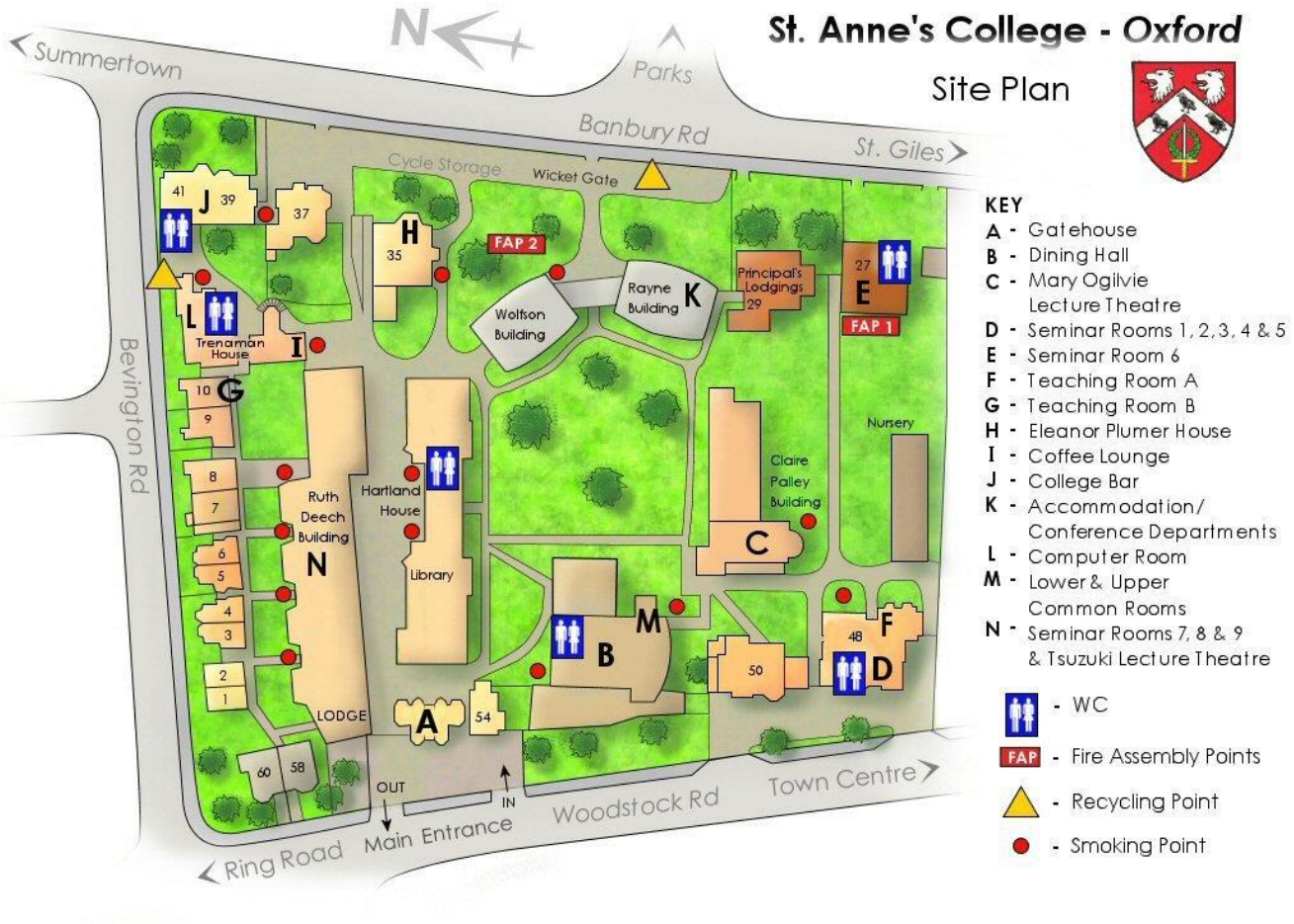
Refreshments, lunch and a drinks reception will be served in the Ruth Deech Building.

Wifi

Please use either Eduroam or 'the cloud' http://service.thecloud.net and set up a username and password (*the cloud is an unsecure browser)

Please tweet using

#OxLeap18 *All sessions are open for tweeting unless otherwise indicated



Map of St Anne's College, Oxford

Plenary speakers

Pass the pasture: meating the issues

Professor Tim Benton, University of Leeds

Livestock products and their role in environmental sustainability (or unsustainability), as well as nutrition and health, are highly contested and politically toxic. On the one hand, some argue livestock can play an important role ecologically and for carbon sequestration and nutrient cycling; others argue that they are principal drivers of environmental degradation. Some say they are key to providing nutrition, others that they create malnutrition. Some say the "Paris-compliant diet" argument is a rich world issue which is inherently unjust to lower-income countries struggling with malnourishment (in the sense of undernourishment).

If we are to tackle climate change, at some stage, human systems need to get to carbon neutrality: to what extent would there be scope for livestock within a zero-net carbon world, and how might we get there? Is there potential for rapid-enough demand-side change, or will a changing climate force us to act later in the century, and, if so, what issues might delay change in demand for livestock create?

Professor Tim Benton

Dean of Strategic Research Initiatives, University of Leeds and Distinguished Visiting Fellow, Chatham House

Professor Tim Benton is Dean of Strategic Research Initiatives at the University of Leeds and Distinguished Visiting Fellow at the Energy, Environment and Resources Department at the Royal Institute of International Affairs at Chatham House, UK. From 2011-2016 he was the "Champion" of the UK's Global Food Security programme which was a multi-agency partnership of the UK's public bodies (government departments, devolved governments and research councils) with an interest in the challenges around food. The key role of GFS was to undertake systemic analysis and horizon scanning, in order to identify research priorities to mitigate the challenges of providing sufficient, sustainable and nutritious diets for all.

He has worked with governments, industry and civil society around the world, including as an Agenda Steward of the World Economic Forum. He is an author on the IPCC's Special Report on land, food and climate. He has published over 150 academic papers, many on the topics of agriculture and its sustainability. His particular interest is currently on food system resilience in the face of climate change.

Changing Minds about Changing Behaviour

Professor Dame Theresa Marteau

Urgent, unprecedented change is needed to our global food system for the Earth to provide a safe environment for humans. This requires huge changes to what we eat, away from meat and dairy products and towards mainly plant-based diets. Achieving this requires not only evidence on the most effective interventions for changing our behaviour but also the political will to implement these.

This presentation will outline contributions from behavioural science grounded in dual process models of human behaviour which highlight the role of non-conscious compared with conscious processes in shaping much of our behaviour. Evidence from changing diet-related and other behaviours at scale will be drawn upon to identify interventions likely to be effective at: i) shifting diets towards plant-based ones, mainly targeting non-conscious processes and, ii) increasing public acceptability for policy change, a major influence on political will to implement effective interventions, targeting conscious processes.

Professor Dame Theresa Marteau

Director of Behaviour and Health Research Unit, University of Cambridge

Professor Dame Theresa Marteau is Director of the Behaviour and Health Research Unit in the Clinical School at the University of Cambridge, and Director of Studies in Psychological and Behavioural Sciences at Christ's College, Cambridge.

Her research interests include:

i. development and evaluation of interventions to change behaviour (principally diet, tobacco and alcohol consumption) to improve population health and reduce health inequalities, with a particular focus on targeting non-conscious processes;
ii. risk perception and communication, particular of biomarker-derived risks, and their weak links with behaviour change;
iii. acceptability to publics and policy makers of government intervention to change behavior.

Conference at a glance

09:15 – 10:00	Registration, coffee/tea [Ruth Deech Building, St Anne's College, Oxford]	
10:00 – 10:15	**Welcome**: Prof Sir Charles Godfray , LEAP Co-director [Mary Oglivie Lecture Theatre]	
10:15 – 11:00	**Plenary session**: Prof Tim Benton, University of Leeds [Mary Oglivie Lecture Theatre] Chair: Prof Sir Charles Godfray	
11:00 – 11:25	Refreshments and networking [Ruth Deech Building]	
11:25 – 13:00	**Session 1A) Chair: Prof Jim Hall** [Ruth Deech Building] **Climate metrics and ruminant livestock** John Lynch & Raymond Pierrehumbert (University of Oxford) **High-resolution mapping of the environmental impacts embedded in international livestock supply chains** Erasmus zu Ermgassen (Université Catholique de Louvain) **Managing large herbivores for biodiversity, food security and broader sustainability** Rachael Durrant and Nicholas Balfour (University of Sussex) **Food over Forages: Improved Arable Cropland Usage for Food Security and Dietary Diversity** Matthew N. Hayek (Harvard University) **Land, water, greenhouse gas and fertilizer intensities of plant- and animal-based food production worldwide** Carole Dalin (University College London) **The water footprint of animal source foods in India** Francesca Harris (London School of Hygiene & Tropical Medicine)	**Session 2A) Chair: Prof Tim Key** [Ruth Deech Building] **Impact of changing meal position and increasing vegetarian availability on vegetarian sales: observational and experimental field studies** Emma Garnett (University of Cambridge) **Effects of substituting plant foods for red and processed meat on ischemic heart disease risk** Paul N Appleby, Tammy YN Tong, Aurora Perez-Cornago, and Timothy J Key (University of Oxford) **Red and processed meat, dairy product consumption and weight change over 14 years in EPIC Oxford** Anika Knüppel, Paul N. Appleby, Timothy J. Key (University of Oxford) **Dietary Patterns in India: Health and environmental impacts of meat and dairy consumption** Rosie Green (LSHTM) **"Has anyone felt sort of ashamed to say they're vegetarian?" Men's experiences of eating less or no meat** Emma Roe and Paul Hurley (University of Southampton) **Differences in drivers of food choice and attitudes toward environmental policies between meat reducers and meat eaters: results from a nationwide cross-sectional survey** Christina Potter, Brian Cook, Filippo Bianchi, Paul Aveyard, & Susan A. Jebb (University of Oxford)

13:00 – 14:00	Lunch and Poster viewing [Ruth Deech Building]	
14:00 – 15:35	**Session 1B) Chair: Dr Peter Scarborough** [Ruth Deech Building] **What are the environmental and monetary costs of different protein-rich foods?** Imogen Cripps (University of Cambridge) **Towards a sustainable and healthy animal source food system for South Africa** Kevin Queenan[1], Nafiisa Sobratee[2], Rashieda Davids[2], Tafadzwanashe Mabhaudhi[2], Michael Chimonyo[2], Rob Slotow[2], Bhavani Shankar[3], Barbara Häsler[1] ([1]RVC, [2]University of KwaZulu-Natal, [3]SOAS) **Urban food governance and the de-animalisation of the food system** Carol Morris (University of Nottingham) and Minna Kaljonen, (Finnish Environment Institute) **Misconceptions surrounding the role of methane in New Zealand's impact on global climate** Michelle Cain, Myles Allen, John Lynch (University of Oxford) **A three-step strategy for including animal to plant-sourced protein shifts in climate change mitigation policy** Helen Harwatt (Harvard University) **Public regulation, cap and animal welfare: a new challenge towards the promotion of human health, animal welfare and environmental sustainability against climate change** Carla Campanaro (Oxford University; Sapienza University of Rome) and Giovanni Antonelli (George Washington University; Sapienza University of Rome)	**Session 2B) Chair: Dr Jamie Lorimer** [Ruth Deech Building] **Western public resistance to insects as food: Why negative media representations aren't to blame** Jonas House (Wageningen University) **Framing the future of food: The contested promises of alternative proteins** Alexandra Sexton (University of Oxford) **From dull to desirable?: Ethical reflections upon the reframing of veganism as an aspirational cultural practice in the context of climate change** Julie Doyle (University of Brighton) **Assessing and Reducing the Greenhouse Gas Emissions and Land Use of Catered Meals** Anya Doherty (University of Cambridge) **Realistic dietary changes to reduce greenhouse gas emissions in India: a modelling study** Ankita Gupta (University of East Anglia) **Animal agriculture and climate change in the media** Silje Kristiansen (Northeastern University) and James Painter (University of Oxford)
15:35 – 16:00	Refreshments, networking and poster viewing [Ruth Deech Building]	
16:00 – 16.45	**Plenary session**: [Mary Oglivie Lecture Theatre] Prof Dame Theresa Marteau DBE, Director of the Behaviour and Health Research Unit, University of Cambridge. Chair: Prof Susan Jebb, LEAP Co-director	
16:45 – 18:00	Poster Session and Drinks reception [Ruth Deech Building]	

Programme abstracts

Session 1

Session 1 a) Morning

Chair: Prof Jim Hall

John Lynch & Raymond Pierrehumbert (University of Oxford)	Climate metrics and ruminant livestock
Erasmus zu Ermgassen (Université Catholique de Louvain)	High-resolution mapping of the environmental impacts embedded in international livestock supply chains
Rachael Durrant and Nicholas Balfour (University of Sussex)	Managing large herbivores for biodiversity, food security and broader sustainability
Matthew N. Hayek (Harvard University)	Food over Forages: Improved Arable Cropland Usage for Food Security and Dietary Diversity
Carole Dalin (University College London)	Land, water, greenhouse gas and fertilizer intensities of plant- and animal-based food production worldwide
Francesca Harris (London School of Hygiene & Tropical Medicine)	The water footprint of animal source foods in India

Climate metrics and ruminant livestock

John Lynch and Raymond Pierrehumbert, University of Oxford

Ruminant livestock are increasingly recognised as contributors to anthropogenic climate change, as they emit significant quantities of methane from anaerobic fermentation. Methane is an important greenhouse gas, exerting a strong radiative forcing - the process by which greenhouse gas alter the atmospheric energy balance, leading to global warming. However, methane also has a short atmospheric lifespan (around 12 years), in contrast to carbon dioxide. This temporal difference leads to different behaviours from each gas that are not well captured by the most commonly used greenhouse gas metric, the 100-year Global Warming Potential (GWP100) carbon dioxide equivalent.

We explore these issues by demonstrating the impact of metric choice on ruminant livestock emissions footprints. Some examples are highlighted comparing GWP100 footprints with an alternative metric, the 100-year Global Temperature Potential (GTP100). Methane is valued much more highly under GWP100 (28 times carbon dioxide in typical methods), and so systems with lower methane emissions generally look more emissions efficient under this metric. Under GTP100, where the equivalence value of methane is relatively low (4 times greater than carbon dioxide), methane is a less prominent component of the greenhouse gas footprint of ruminant livestock production. This can result in a reversal of apparent emissions efficiency rankings, as a reduction in methane emissions can

sometimes come at a trade-off for increased emissions in other gases, such as increased nitrous oxide emissions due to higher fertiliser application rates.

Either metric can still fail to capture the different temporal dynamics between gases, as under a constant rate of methane emissions an equilibrium concentration is rapidly reached, and so radiative forcing remains the same; in contrast to carbon dioxide, where continued emissions act cumulatively. We demonstrate these principles with a simple energy-balance climate model illustrating of the global warming impact of sustained methane, nitrous oxide and carbon dioxide emissions from ruminant livestock. This more meaningful picture of the climate impacts of each gas has significant implications for how we appraise different ruminant production systems, and how we assess their climate contribution relative to other emitting activities.

High-resolution mapping of the environmental impacts embedded in international livestock supply chains

Erasmus zu Ermgassen, Université Catholique de Louvain

Modern livestock production relies on an international value chain which links the production of crops – notably soybeans in the Americas – to animal feed processors, farmers, retailers, and consumers around the world. When analyzing the environmental impacts in the soy or meat products traded along international livestock supply chains, the sustainability community relies on crude data – typically using national average figures for deforestation risk or greenhouse gas emissions per ton of product. These national-level figures can, however, be misleading. In Brazil (the world's largest exporter of soybeans and beef, and a country twice the size of the European Union), the environmental impacts associated with soy or beef production vary widely between the deforestation frontiers in the Amazon and Cerrado, and consolidated regions in the south of the country. Subnational data on agricultural production and trade have, however, been difficult to access – until recently. Here I will present results from the Trase initiative (http://trase.earth/), a flagship effort to map international supply chains of deforestation-risk tropical commodities at the subnational (i.e. county or municipal) scale. By linking agricultural production, trade logistics, and customs data, we can identify hotspots of deforestation and link them to the companies handling the export of goods, such as soybeans and beef, from that region, right through to the international markets (e.g. the UK) which consume those products. I will showcase the data and present results of our high-resolution footprinting efforts, identifying, for example, the opportunities to reduce greenhouse gas emissions in soy supply chains. The Trase datasets are of use and freely available to policy makers, the interested general public, and researchers working on sustainable livestock.

Managing large herbivores for biodiversity, food security and broader sustainability

Rachael Durrant and Nicholas Balfour, University of Sussex

This study will consider how the objectives of nature conservation and sustainable food security can be reconciled within heavily populated landscapes, taking the management of large herbivores as both a case study and an entry point into this complex policy arena. Drawing on current research from the South-east of England, it will compare and contrast the use of large herbivores in agricultural and

conservation sites from two key angles. First, it will contemplate how the landscape-types produced by different herbivore regimes perform against a range of ecological criteria. Second, it will explore how different understandings of performance change depending on the view that is taken. The study will bring these two strands together by considering how contrasting approaches to management might be related to different outcomes for people and nature. It will then conclude with a proposal for future research directions and engagement.

This research is part of a portfolio of pilot studies under the umbrella of the Sussex Sustainability Research Programme (SSRP). It uses a suite of quantitative and qualitative methods, including both novel and more established approaches, to enable assessment of different sites and management approaches with respect to a range of outcomes including biodiversity and ecological processes, food security and broader sustainability.

Food over Forages: Improved Arable Cropland Usage for Food Security and Dietary Diversity

Matthew N. Hayek, Harvard University

Livestock require 83% of global agricultural land (Poore and Nemecek, 2018). Livestock's land use requirements are vast and have lately been the subject of high-profile scientific and media attention. Commonly in these discussions, the extensive pasture use of livestock or its competition with the human-edible crop supplies is the subject of attention (Cassidy et al., 2013). However, the competition of forage crops, grown on arable cropland but consumed by ruminant livestock, with human food crop production has not previously been explored (Hayek and Garrett, 2018).

We use present-day data of cropland yields and areas (Ramankutty et al., 2008) to assess the global extent and productivity of forage crops. We then optimize the substitution of forage crops for food crops by protein content, using a model of climatically viable yields (Mueller et al., 2012; West et al., 2014). We exclude forage crops in semi-annual rotations from substitution and exclude cereal, fiber, oil, sugar, and bioenergy crops as replacements.

We find that forage crop production represents 11% of the total global cropland area (Fig. 2). Substituting forage crops for high-protein food crops could yield an additional 24 grams of protein per person per day and sufficient calories to feed 1.02 billion additional people per year. Our optimization results in improved food supply diversity, including abundant vegetables, representing 44% of the substitutions (Fig. 2).

Our results are notable in light of official dietary recommendations in the US and China calling for reduced red meat consumption and increased vegetable consumption, as well as the forthcoming EAT-Lancet report concerning healthy and sustainable diets. We conclude that the global provision of improved diets is closer within reach if forage croplands are instead used to grow food crops in the future.

Land, water, greenhouse gas and fertilizer intensities of plant- and animal-based food production worldwide

Carole Dalin, Institute for Sustainable Resources, University College London

Agriculture is responsible for a range of environmental stresses worldwide due to its use of water, land and fertiliser as well as its greenhouse gas emissions. While food demand will continue to increase, the Earth's resources and humanity's carbon budget are limited, and the negative environmental outcomes of food production need to be mitigated. The UN Sustainable Development Agenda recognises the crucial importance of both improving socio-economic welfare (including to end hunger) and protecting natural resources and wildlife. Here, we provide the first consistent, high-resolution (10km) global database of the resources used and greenhouse gases emitted by food production, covering 85% of human calorie intake (92% of animal-based and 83% of plant-based calories). Importantly, our results provide comparable estimates of land, nitrogen, phosphorus, potassium (fertilisers), soil-, surface- and ground-water use and greenhouse gas emissions for a range of crops and animal products, importantly considering animal feed and their geographical origin. These estimates enable to identify areas and food products with particularly high resource or emission intensity, and, crucially, to reveal synergies or trade-offs between different environmental stressors.

The water footprint of animal source foods in India

Francesca Harris, London School of Hygiene & Tropical Medicine

The majority (90%) of freshwater withdrawals in India are for agricultural production. Overexploitation of surface and groundwater is leading to water scarcity in several parts of the country, threatening future food security and livelihoods.

Water footprints (WF) can be used to estimate the volume of rainfall (green) and ground and surface (blue) water consumed in the production of food (e.g. in litres of water per gram of product). Animal source foods (ASF) have been identified as particularly water demanding, so this study aimed to quantify their WF in India and relate this to changing crop production and food consumption.

Livestock population and production data were obtained from the 19th Indian Livestock Census for cattle, buffalo, sheep, goats, pigs and poultry. Feed conversion efficiencies were calculated for each state weighted by production systems (mixed, grazing, and industrial). State-level estimates on the green and blue WF of feed crops were combined with average estimates for drinking and service water use to obtain the water footprint per animal. The WF of food products were calculated based on India-specific conversion factors.

Our estimates show that the WFs of ASF vary spatially. Poultry systems rely heavily on irrigated maize for feed hence chicken meat and eggs have high blue WFs. Trends suggest that milk and chicken consumption is increasing. A shift to industrialised systems could increase yields of livestock products and reduce water use per unit of production. However, the increase in feed crops could lead to greater irrigation demand, accelerating groundwater depletion. Resources could instead be used to produce fruits and vegetables to target nutrition issues in India. Policies to support ASF consumption at quantities consistent with healthy dietary guidelines could limit environmental costs.

Session 1 b) Afternoon

Chair: Dr Peter Scarborough

Imogen Cripps (University of Cambridge)	What are the environmental and monetary costs of different protein-rich foods?
Kevin Queenan[1], Nafiisa Sobratee[2], Rashieda Davids[2], Tafadzwanashe Mabhaudhi[2], Michael Chimonyo[2], Rob Slotow[2], Bhavani Shankar[3], Barbara Häsler[1] ([1]RVC, [2]University of KwaZulu-Natal, [3]SOAS)	Towards a sustainable and healthy animal source food system for South Africa
Carol Morris (University of Nottingham) and Minna Kaljonen, (Finnish Environment Institute)	Urban food governance and the de-animalisation of the food system
Michelle Cain, Myles Allen, John Lynch (University of Oxford)	Misconceptions surrounding the role of methane in New Zealand's impact on global climate
Helen Harwatt (Harvard University)	A three-step strategy for including animal to plant-sourced protein shifts in climate change mitigation policy
Carla Campanaro (Oxford University; Sapienza University of Rome) & Giovanni Antonelli (George Washington University; Sapienza University of Rome)	Public regulation, cap and animal welfare: a new challenge towards the promotion of human health, animal welfare and environmental sustainability against climate change

What are the environmental and monetary costs of different protein-rich foods?

Imogen Cripps, University of Cambridge

Global agriculture and an increasing demand for meat-based protein pose a significant threat to the environment. Our diets, which shape the environment, are themselves highly influenced by food prices. It would therefore be economically efficient for food's environmental cost to correlate with its monetary cost. Yet, while the environmental impact of food is covered widely in the literature, little research focuses on food's monetary cost relative to its environmental impact.

I have collected nutritional data and retail and wholesale prices for a wide range of protein-rich foods, and used systematic reviews of life cycle analyses to investigate their environmental impact. I used the proxies of greenhouse gas emissions (GHGEs) and retail price to represent the cost to the environment and cost to the consumer of our dietary choices, respectively.

My results, looking at over 1400 products from a British supermarket, show a positive correlation between these two costs when using kilograms and serving size as a functional unit, but no relationship when grams of protein is used. However, even where a relationship between these costs is observed, ruminant products, which are the most environmentally-damaging food group, are disproportionately cheap. This decoupling of costs is also seen for wholesale prices, but to a lesser extent than at the retail level, suggesting that supermarkets may contribute to distorting the 'true' cost of food.

Further research into the economics of food sustainability is needed, such as to more fully establish where in the production chain the decoupling between environmental and consumer costs occurs. There is also a need for significant reform in food pricing and a shift of the food economy away from only providing value for money to one that focuses on several values such as animal welfare, environmental and labour costs. Ensuring that the price of food is a fair reflection of all these costs could guide consumers to make more ethical and pro-environmental food choices, and incentivise producers to adopt more sustainable production methods.

Towards a sustainable and healthy animal source food system for South Africa

Kevin Queenan[1], Nafiisa Sobratee[2], Rashieda Davids[2], Tafadzwanashe Mabhaudhi[2], Michael Chimonyo[2], Rob Slotow[2], Bhavani Shankar[3], Barbara Häsler[1]
[1]RVC, [2]University of KwaZulu-Natal, [3]SOAS

In recognition of the environmental impact of food production, specifically animal source foods (ASF), there are calls to shift to considerably lower, even zero ASF diets as the more sustainable, healthier choice. However, this disregards the complexity and interconnectedness of the global food system. Despite advancements in agricultural productivity, the non-uniformity of global food production, distribution and access, results in the triple burden of malnutrition even within the same population groups.

The Royal Veterinary College, through the Wellcome Trust's Sustainable and Healthy Food Systems (SHEFS) programme, aims to provide evidence for policy recommendations for a sustainable and healthy ASF system in South Africa.

Although South Africa is nationally food secure, it faces increasing household food insecurity. The country is undergoing significant transition, including dietary transition. The population is polarising with a growing middle and high-income group, whilst 50% of population remain below the poverty line and 25% of children <3 years-old are stunted.

With a systems thinking and transdisciplinary approach, the ASF system in KwaZulu-Natal Province was mapped together with key stakeholders, to demonstrate its complexity and identify nexus points. We are currently identifying ASF consumption trends through literature reviews, secondary data analysis and primary data collection from different communities. From this data, we will identify a key ASF to trace from consumer back to primary producer and conduct a value chain analysis. A system dynamic model (SDM) is being developed, together with nutritionists and environmental specialists, focusing on commercial and small-scale producers, with qualitative and quantitative variables. These include environmental impact metrics, production inputs and outputs, processing, marketing and retailer distribution, import and export threats and opportunities, consumer behaviour and diet choices and the dietary nutritional outcomes. Through collaboration with policy researchers, the SDM will run simulated scenarios to evaluate potential interventions and likely outcomes.

Urban food governance and the de-animalisation of the food system

Carol Morris, University of Nottingham and Minna Kaljonen, Finnish Environment Institute, Helsinki

This paper will report on the initial findings of an ongoing British Academy funded research project, the aim of which is to explore the potential of urban scale food governance for addressing the challenge of the de-animalisation of the food system. The research brings together and extends two largely discrete debates within social science research into the governance of transitions to a more sustainable agri-food system. The first debate concerns the 'animalisation' of the food system i.e. the over production and consumption of food from animals. This has been identified as a significant impediment to global food system sustainability with the greenhouse gas emissions from livestock production highlighted as a major contributor to climate change (e.g. Steinfeld et al. 2006). An increasingly diverse set of stakeholders argue that a more sustainable food system will need to place greater emphasis on plant sourced foods, hence 'de-animalisation'. However, resistance represents a challenge for research and practice. Research into (de)animalisation is emergent with analysis mostly undertaken at global and national scales neglecting other spaces of action including in particular the urban scale. Urban food governance is the second debate that frames the study. It represents another developing area of investigation which recognises that feeding the city is one of the 'quintessential' challenges of the 21st century. In response, urban governments across the globe have begun to develop a range of food plans, policies and strategies that help "city governments integrate a full spectrum of urban food system issues within a single policy framework" (Mansfield and Mendes 2013: 37). Systematic research attention has yet to be given to how food governance at the urban scale is addressing the challenge of de-animalisation. The study reported here represents an initial attempt to address this gap and is being conducted in the UK and Finland, countries with contrasting approaches to the issue of interest. Findings will be presented from a literature review, document analysis of urban scale food provisioning initiatives and interviews with urban food governance stakeholders in the UK and Finland.

References:

Mansfield, B. & Mendes, W. 2013. Municipal Food Strategies and Integrated Approaches to Urban Agriculture. Int. Planning St, 18:1, 37-60; Steinfeld, H., et al. 2006. *Livestock's Long Shadow*. Rome: FAO.

Misconceptions surrounding the role of methane in New Zealand's impact on global climate

Michelle Cain, Myles Allen and John Lynch, University of Oxford

Misconceptions are prevalent regarding the impact of methane on global warming, with diverse publications describing methane's impact on warming as anything between 4 and 84 times greater than carbon dioxide, depending on the metric and timescale quoted. The root of this inconsistency is the 12 year lifetime of methane, which means that is does not accumulate in the atmosphere as CO2 does. Therefore, calculating a "CO2-equivalent" value for an emission of methane by multiplying by a single number (typically Global Warming Potential, GWP, over a chosen timescale) to represent its true impact on global temperatures is impossible.

Here, we use New Zealand as a case study as a country with a large livestock sector relative to other sectors, and therefore has relatively high methane emissions compared to CO2. Traditional methods for valuing methane emissions (using GWP) understate methane's immediate warming effect, and overstate its long-term impact. Under the Paris Agreement, countries are aiming to limit warming by achieving a balance of emissions. If methane is to play a part in this balance, it is essential to attribute the correct amount of warming to an emission of methane when deciding suitable targets for emissions reductions. It has long been shown in the scientific literature that using GWP does not do this for methane because of its short lifetime.

We propose a simple solution (denoted GWP* as it is a revised usage of GWP), which treats a permanent increase in methane emission rate as equivalent to one-off release of a fixed number of tonnes of carbon dioxide (Allen et al, 2016, 2018). This correctly values the warming impact of methane emissions, so the CO2-equivalent emission does actually generate the same amount of warming as the original methane emission. This is a useful tool for evaluating how methane-intensive sectors such as agriculture can contribute to climate mitigation.

In the case of New Zealand, GWP100 suggests the country's methane emissions are more important than the CO2 emissions. However, the impact of future warming is much greater for the CO2 emissions than methane because of the long lifetime of CO2. Using GWP*, cumulative emissions of methane correctly predict their warming implications, and so are a better way of evaluating policy actions that would bring New Zealand into alignment with temperature goals, and of generalising the concept of "net zero" emissions beyond CO2.

A three-step strategy for including animal to plant-sourced protein shifts in climate change mitigation policy

Helen Harwatt, Harvard University

Strong and rapid greenhouse gas (GHG) emission reductions, far beyond those currently committed to, are required to meet the temperature goals of the Paris Agreement. The GHG reduction required allows no sector to maintain business as usual practices, including energy and agriculture. Application of the precautionary principle requires adherence to GHG emissions budgets, while avoiding reliance on negative emission technologies and exploring a wide range of mitigation options. The agricultural sector offers substantial potential for GHG emission reductions through animal to plant-sourced protein shifts. Unabated, the livestock sector could take between 37% to 49% of the GHG budget allowable under the <2 °C and 1.5 °C targets, respectively, by 2030. Hence, inaction in the livestock sector would mean that substantial GHG reductions, far beyond what are planned or realistic, are required for other sectors. The next 12 years are crucial - animal to plant-sourced protein shifts should be taken up by the Conference of the Parties (COP), and must feature as part of countries' mitigation commitments under their revised Nationally Determined Contributions (NDCs), to be adopted from 2020 onwards. The suggested framework includes an acknowledgment of 'peak livestock', followed by targets for large and rapid reductions in livestock numbers based on a combined 'worst first' and 'best available food' approach. Action could be spearheaded by subnational and non-state actors, including regional and local governments and businesses. In addition to examples of national GHG inventories, examples of the three-step strategy applied to institutional food purchasing will also be presented.

Public regulation, cap and animal welfare: a new challenge towards the promotion of human health, animal welfare and environmental sustainability against climate change

Carla Campanaro, Oxford University; Sapienza University of Rome, and Giovanni Antonelli, George Washington University; Sapienza University of Rome

The main purpose of the paper is to investigate the connections between several aspects of European farm animals and livestock, wildlife conservation, food safety and environmental protection, to analyze and to enlighten the benefits of including and developing animal welfare in the public policy and in the common food and agriculture policy (CAP). The topic of the promotion and enforcement of animal welfare, by using public tools of regulation, can be directly connected to some crucial thematic areas: human health, agriculture sustainability (e.g. meat and water consumption) and climate change's contrast.

A possible tool of interconnections between the abovementioned areas can be seen through the following linkage: public procurement, CAP reform and animal welfare.

The paper wants to analyze how the traditional tools of regulation and of agriculture management through the promotion of animal welfare could improve the contrast to climate change, land and water resources consumption and protect human health.

According the formal interpretation of EU directives, although animal protection is not formally provided, the same provision can be read by a substantial approach, given that the implementation of "green" aspects in public procurement necessarily requires the considerations of animal welfare. In this context, an interesting area to make grow the development towards the integration of green aspects in public procurement could be considered the next reform of the CAP. In the new CAP perspective, green procurement seems to be seen a tool for influencing food consumption and, as consequence, for promoting environmental protection and public health even through animal welfare.

Session 2

Session 2 a) Morning

Chair: Prof Timothy Key

Emma Garnett (University of Cambridge)	Impact of changing meal position and increasing vegetarian availability on vegetarian sales: observational and experimental field studies
Paul N Appleby, Tammy YN Tong, Aurora Perez-Cornago, and Timothy J Key (University of Oxford)	Effects of substituting plant foods for red and processed meat on ischemic heart disease risk
Anika Knüppel, Paul N Appleby, Timothy J Key (University of Oxford)	Red and processed meat, dairy product consumption and weight change over 14 years in EPIC Oxford
Rosie Green (LSHTM)	Dietary Patterns in India: Health and environmental impacts of meat and dairy consumption
Emma Roe and Paul Hurley (University of Southampton)	"Has anyone felt sort of ashamed to say they're vegetarian?" Men's experiences of eating less or no meat
Christina Potter, Brian Cook, Filippo Bianchi, Paul Aveyard, & Susan A. Jebb (University of Oxford)	Differences in drivers of food choice and attitudes toward environmental policies between meat reducers and meat eaters: results from a nationwide cross-sectional survey

Impact of changing meal position and increasing vegetarian availability on vegetarian sales: observational and experimental field studies

Emma Garnett, University of Cambridge

Health and sustainability concerns have led to calls to reduce meat consumption in rich countries but very few studies have long-term data on which strategies are the most effective at shifting eating patterns over the long-term.

I have been working with four Cambridge University college cafeterias to run experiments on whether changing the presentation order of main meals (whether the vegetarian option is encountered first or last when entering the cafeteria) and the availability of vegetarian options (the number of vegetarian options divided by total options) could alter sales of vegetarian meals.

Data on over 200,000 main meals purchased from 2017 and 2018 have produced some expected and unexpected results. Results from experiments on the position of the vegetarian option suggest that order has an effect but that there is also an interaction between order and the distance separating meal options. In one college with a short distance between the "vegetarian first" and "vegetarian last" conditions (85cm), placing the vegetarian option first did not increase vegetarian sales. However, in

another college (180cm distance) vegetarian sales increased by 25% under the vegetarian first condition.

Serving more vegetarian options in cafeterias resulted in everyone – including the most carnivorous – buying more vegetarian and fewer meat meals. Doubling vegetarian availability (e.g. from 1 in 4 options to 2 in 4) increased vegetarian sales from between 50 and 100%. Increasing vegetarian availability is a more reliable and effective strategy to increase vegetarian sales than changing cafeteria layout. If cafeterias served a higher proportion of plant-based meals this could help mitigate climate change, conserve biodiversity, improve animal welfare and improve public health.

Effects of substituting plant foods for red and processed meat on ischemic heart disease risk

Paul N Appleby, Tammy YN Tong, Aurora Perez-Cornago, and Timothy J Key, University of Oxford

BACKGROUND**:** Red and processed meat (RPM) has been associated with increased risk of ischemic heart disease (IHD), whereas plant foods may lower risk.

AIM**:** Our study investigated the isocaloric substitution of plant foods for RPM in relation to IHD risk using data from the European Prospective Investigation into Cancer and Nutrition (EPIC) study.

METHOD**:** We defined an IHD event as fatal ischemic heart disease (ICD-10 I20-I25) or non-fatal myocardial infarction (I21-I22). Food intakes were estimated using food frequency questionnaires administered at recruitment, calibrated to allow for between-country differences using data from a standardised 24-hour recall questionnaire. Ten food groups that are generally significant sources of protein in the diet were identified, including RPM and three plant food groups: legumes and soya products; nuts and seeds (including nut butter); and cereals and cereal products (excluding cakes and biscuits). The effects of substituting plant foods for RPM were obtained using Cox regression, the model containing all ten food groups and adjusting for age and other dietary and non-dietary factors, tests of differences between the coefficients for RPM and each plant food group in turn simulating the risk associated with substituting 100 kcal/day of plant foods for 100 kcal/day of RPM.

RESULTS**:** Data were available for 375,845 men and women in 8 European countries of whom 5908 suffered an IHD event during an average 12.9 years of follow-up. Substituting 100 kcal/day of nuts and seeds for RPM was associated with a 20% (95% CI: 6%-31%) lower IHD risk. Other plant food substitutions for RPM did not lower risk.

CONCLUSION**:** Substituting nuts and seeds for red and processed meat in the diet probably reduces IHD risk and could be included in disease prevention strategies.

Red and processed meat, dairy product consumption and weight change over 14 years in EPIC Oxford

Anika Knüppel, Paul N Appleby, Timothy J Key, University of Oxford

BACKGROUND**:** Red and processed meat intake has been associated with a higher prevalence of overweight and obesity[1]. Associations between dairy intake and weight change have been mixed, suggesting a beneficial role of yogurt and adverse role of cheese[2].

AIM**:** Our study aimed to investigate the association between red and processed meat, dairy consumption and weight change over 14 years in a cohort of British adults.

METHOD**:** We analysed data from 17,009 men and women between 20-54 years of age who participated in the European Prospective Investigation into Cancer and Nutrition (EPIC) Oxford study. Information about dietary intake was collected using a food frequency questionnaire in 1994-1999. Weight and height were self-reported at baseline and in 2010-2015 after a median follow-up of 14 years. Analyses were adjusted for baseline body mass index, age group, socio-demographic factors, health behaviours and total energy intake.

RESULTS**:** The mean annual weight gain was 301 (SD 238) grams in women and 302 (SD 532) grams in men. Women who consumed >70 grams red and processed meat daily at baseline gained 404 (95%-CI 375, 433) grams and men 354 (95%-CI 308, 400) grams of weight as compared to 281 (95%-CI 269, 293) grams in women and 272 (95%-CI 247, 296) grams in men who did not eat any red or processed meat. There was a U-shaped association between milk intake and weight gain, with higher gains in women in the 2nd, and men in the 2nd and 3rd quartile compared to those with the lowest intakes. There was no association between yogurt and cheese intake and weight change.

CONCLUSION**:** Results suggest a positive association between red and processed meat intake and weight gain in men and women. Further research is needed to disentangle associations between milk and other dairy and weight change.

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Dietary Patterns in India: Health and environmental impacts of meat and dairy consumption

Rosie Green, LSHTM

Undernutrition and non-communicable diseases (NCDs) are important public health issues in India, yet their relation with dietary patterns is poorly understood. The food system is also a major contributor to India's environmental footprint, particularly through greenhouse gas (GHG) emissions from livestock and fresh water used for irrigation. These impacts are likely to increase in future as agriculture attempts to keep pace with India's growing population and increasing preference for

animal products. Within India there is considerable dietary variation, and this study aimed to quantify the health and environmental impacts associated with different dietary patterns.

We identified five distinct diets from a large adult dietary survey in India using finite mixture modelling. These were defined as: Rice & low diversity, Rice & fruit, Wheat & pulses, Wheat, rice & oils, Rice & meat. The Rice & low diversity diet had low consumption of butter and cheese (and was correspondingly low in calories), but milk consumption was relatively high. The highest consumption of milk, butter and cheese was found in the Wheat & pulses pattern, but this pattern also contained the most fruit and veg and was generally healthy. The highest meat consumption was found in the Rice & meat pattern, which was linked to greater odds of hypertension and diabetes and a greater waist:hip ratio. In terms of environmental impacts, the highest GHG emissions and land use were found in the Rice & meat pattern, but the wheat-based patterns had higher use of irrigation water.

Diets in India are likely to become more diverse with rising incomes, moving away from patterns such as the Rice & low diversity diet. Patterns such as the Rice & meat diet may become more common, and the health and environmental consequences of such changes could be substantial given the size of India's population.

"Has anyone felt sort of ashamed to say they're vegetarian?" Men's experiences of eating less or no meat.

Emma Roe and Paul Hurley, University of Southampton

This paper addresses themes of male friendship/isolation and (care for) non-human lives in the organisation of men's consumption spaces. It argues that paying attention to men's consumption spaces – the domestic, eating-out and food retailing – can contribute to understanding how the cultures and socialities of masculinity feature in organised or self-directed moves towards more sustainable non-animal based protein food consumption. How are emergent, marginalised, over-looked eco-masculinities performed in these spaces? Whilst there is a significant literature on food consumption practices there is very little that specifically explores mens' choice of food, cooking and social eating practices outside of professional and celebrity chefs, or domestic foodwork (for exception see Neuman *et* al 2016, Szabo 2013, Meah 2013), and specifically those that reflect an ethos of care for environmental sustainability.

The AHRC funded Man Food research project ran a series of three participatory research workshops with three different groups of men – 'green men', for whom environmentalism and food is a hobby, 'exercise men' whose hobby is bodily self-improvement through exercise and food, and men in receipt of emergency food aid, often isolated through material and social circumstance. The co-produced research aims to understand and ultimately work to reduce animal-based protein consumption practices to address the global need to reduce livestock production. The research fostered horizontal homosociality (Hammarén 2014) and an ecological connection to the nonhuman world – through active, participatory engagement (cooking and social eating) with the materiality of food.

Differences in drivers of food choice and attitudes toward environmental policies between meat reducers and meat eaters: results from a nationwide cross-sectional survey

Christina Potter, Brian Cook, Filippo Bianchi, Paul Aveyard, & Susan A. Jebb, University of Oxford

BACKGROUND: Global average meat consumption is rising, despite evidence of adverse effects on health and the environment. This survey assessed public concerns when making food selections and perceived acceptability of government policies to protect the environment. These factors are examined in relation to frequency of meat consumption.

METHODS: A nationally representative sample of UK adults completed an online survey. Participants were categorised as Meat Reducers (MR; n=308) or Meat Eaters (ME; n=615). MR included participants who identified as vegan, vegetarian, pescatarian (only eat fish) and flexitarian (eat meat less than daily). ME included participants who identified as dairy free, eat white meat only, and meat eaters (eat meat every day). They rated their level of concern (not at all – extremely) for various issues when selecting foods. Principal Components Analysis (PCA) was used to examine the factor structure of these issues. One-way ANOVA assessed differences in level of concern based on dietary group (ME versus MR). Participants also selected three environmental policies from a list to reflect which actions they thought should be prioritised. Using logistic regression, we analysed differences between ME and MR in their top priority for environmental policy actions.

RESULTS: PCA revealed two primary factors that together accounted for 50% of the variance: food 'safety' (including pesticides, additives, GM food) and health concerns. MR were more concerned with food safety ($p<0.001$) and healthiness ($p=0.038$). Logistic regression revealed that MR were less likely to favour subsidies to promote behaviour change (OR: 0.66, 95%CI: 0.46-0.88, p=.007) and less likely to favour no government intervention (OR: 0.36, 95%CI: 0.15-0.87, p=.024). Instead, MR were more likely to favour environmental policies to increase consumer taxes (OR: 2.59, 95%CI: 1.53-4.37, $p<0.001$).

CONCLUSIONS AND IMPLICATIONS: MR express more concern with food 'safety' and healthiness than ME and show higher support for environment policies that discourage behaviours (taxes) rather than incentives (subsidies).

Session 2 b) Afternoon

Chair: Dr Jamie Lorimer

Jonas House (Wageningen University)	Western public resistance to insects as food: Why negative media representations aren't to blame
Alexandra Sexton (University of Oxford)	Framing the future of food: The contested promises of alternative proteins
Julie Doyle (University of Brighton)	From dull to desirable?: Ethical reflections upon the reframing of veganism as an aspirational cultural practice in the context of climate change
Anya Doherty (University of Cambridge)	Assessing and Reducing the Greenhouse Gas Emissions and Land Use of Catered Meals
Ankita Gupta (University of East Anglia)	Realistic dietary changes to reduce greenhouse gas emissions in India: a modelling study
Silje Kristiansen (Northeastern University) and James Painter (University of Oxford)	Animal agriculture and climate change in the media

Western public resistance to insects as food: Why negative media representations aren't to blame

Jonas House, Wageningen University

Since around 2013, insects have been proposed as a sustainable new protein source for Western markets. However, they remain unpopular. This is frequently attributed to a 'Western cultural bias' against insect consumption (entomophagy), in which negative media representations of entomophagy are commonly implicated. Empirical research with producers and consumers of insect-based foods in the Netherlands indicates that the main difficulty with promoting entomophagy is the products themselves. Insects currently reared for Western consumption are essentially unsuitable for use as human food. As such, the role of media representations in precluding dietary change is somewhat overstated. Efforts should focus on the foods themselves, and their place within culinary practices, if insects are to represent a feasible new Western food source.

Framing the future of food: The contested promises of alternative proteins

Alexandra Sexton, University of Oxford

This paper offers a critical examination of the narrative landscape that has emerged with a new movement of alternative proteins (APs) intended as substitutes for conventional meat, milk and egg products. The AP approaches analysed include edible insects, plant-based proteins and cellular agriculture, the latter of which encompasses 'cultured' or 'clean' meat, milk and egg products produced in-vitro via cell-science methods. The paper builds on previous research that has analysed the promissory narratives specific to cultured/clean meat by examining the key promises that have

worked across the broader AP movement. I develop a five-fold typology that outlines the distinct yet interconnected claims that have operated in AP promotional discourses to date. The second part of the paper examines the counter-narratives that have emerged in response to AP claims from different stakeholders linked to conventional livestock production. I offer a second typology of three counter-narratives that have so far characterised these responses. Through mapping this narrative landscape, I show how different types of 'goodness' have been ascribed by AP and conventional livestock stakeholders to their respective approaches. Moreover, the analysis reveals a series of tensions underpinning these contested food futures, many of which have long histories in broader debates over what constitutes better (protein) food production and consumption. The paper's discussion contributes to ongoing research across the social sciences on the ontological politics of (good) food, and the key role of narratives in constructing and contesting visions of 'better' food futures.

From dull to desirable?: Ethical reflections upon the reframing of veganism as an aspirational cultural practice in the context of climate change

Julie Doyle (University of Brighton)

The significant increase in cultural visibility of veganism over the last few years is a welcome change from the decades long denigration of vegans by mainstream media (Cole & Morgan, 2011). Once characterised as faddy, dull and extreme, vegans, and veganism, are fast becoming associated with the aspirational, accessible and sexy (Saner, 2016). Celebrities and social media have played a crucial role in the rebranding of veganism from dull to desirable (Doyle, 2016). High profile vegan celebrities like Ariana Grande and Ellen DeGeneres help communicate veganism to mainstream audiences, whilst social media platforms like Instagram enable 'ordinary people' to present vegan food as aesthetically appealing and accessible. Given the significant contribution of meat and dairy production to greenhouse gas emissions and climate change, the rise in popular cultural representations of veganism is to be welcomed, transforming a once maligned ethical identity into a normalised practice. Yet, in the context of an individualised consumer culture, how are celebrities culturally and politically reframing veganism, and what are the potential impacts upon a more radical questioning of unsustainable and unethical food production? Through an acknowledgement of the history of veganism as an ethical identity and practice, this presentation will explore these questions, to ask what is lost and gained in the current popular cultural turn towards veganism as a healthy and individualised ethical lifestyle that can be marketed and sold? How is a more radical critique of human-animal relations as a necessary process for creating more empathetic, collective and caring societies in the face of climate change enabled or constrained? The presentation will also identify future directions for research on veganism that focus upon the gendered and generational aspects of this popular cultural turn.

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Assessing and Reducing the Greenhouse Gas Emissions and Land Use of Catered Meals

Anya Doherty, University of Cambridge

Institutional cafeterias are a major setting for food consumption in high-income countries, with 1.1 million meals served daily in UK primary schools alone. Yet the environmental footprint of catered meals, as well as strategies to improve their sustainability, remain underexplored. I used over 200 recipes from a Cambridge University college cafeteria to assess the greenhouse gas emissions (GHGEs) and land-use of meals by five meal types. Results showed that ruminant meals have the highest GHGEs, on average 4.85 kg CO2-eq/serving. This was roughly 8 times that of vegetarian meals (0.61) and 17 times that of vegan meals (0.28). Fish and non-ruminant meals showed intermediate GHGEs, on average 1.02 and 1.14 respectively, a non-significant difference. Land-use values showed greater disparity, with ruminant meals having roughly 8 times the land requirements of non-ruminant meals (32m2/serving versus 4m2), 20 times that of vegetarian (1.54) and fish meals (1.31) and more than 50 times that of vegan meals (0.54).

Meal-based strategies were analysed for reducing these impacts. Across 8-week lunch and dinner menu plans at the cafeteria, replacing ruminant meals with non-ruminant or vegetarian meals could have reduced food-related GHGEs by 17-39% and 30-50% respectively. Land use could have been reduced by 51-71% and 68-79% respectively. Additionally, replacing high-impacting meals with the low-impacting meals across all meal types could have reduced GHGEs by 15-31%, which could mostly be attributed to a reduction in the mass of animal-based products in each meal. Analysis of wholesale food prices and cafeteria meal sales showed these catering interventions to be financially viable.

These findings highlight the substantial difference that feasible meal-based strategies could make to food-related climate and land footprints in catering institutions, which have great potential to bring about shifts to more sustainable diets.

Realistic dietary changes to reduce greenhouse gas emissions in India: a modelling study

Ankita Gupta, University of East Anglia

India's current per capita consumption of livestock products is one of the lowest in the world, however it is growing rapidly with rising incomes and urbanization. This poses a challenge for reducing food-related greenhouse gas emissions. Growing body of evidence focused on developed countries suggests shifting to plant-based diets, however India also faces the burden of undernutrition. Hence, dietary recommendations to meet climate change goals must simultaneously maintain the balance of nutrients. Realistic changes in food habits would also account for diversity of diets across India. This study uses the National Sample Survey (2011–12) of household consumption expenditure to find optimal diets for different states in India, while differentiating between rural and urban diets, which would reduce greenhouse gas emissions while minimising deviation from the current dietary styles.

The diets are optimised to meet targets for reduction in greenhouse gas emissions per person which would maintain the total emissions at the current level in 2030 and 2050. We find that households could achieve the emission reduction targets as well as overcome nutrient deficiencies within their food budgets by diversifying their diets, particularly towards coarse cereals, pulses, and fruits and vegetables, and away from rice. The dietary changes are also accompanied by reductions in water use. However, these dietary shifts may be discouraged by current agricultural and food pricing policies, particularly among the poor. Our models also show that reducing emissions beyond 20% through dietary changes alone will be unlikely without radically changing current consumption patterns, hence emphasising the need for additional strategies such as reducing food waste along the production chain and increasing agriculture efficiency.

Animal agriculture and climate change in the media

Silje Kristiansen, Northeastern University, and James Painter, University of Oxford

Agriculture is a major greenhouse gas emitter. It urgently needs to become more sustainable, and sustainability starts with consumers and the food they consume. Food related GHG emissions can be reduced by humans eating more plant based food and less animal products (Smith et al., 2014, p. 838; Harwatt et al. 2017; Wynes & Nicholas, 2017). There is a huge potential in dietary changes, since a meat-eating diet contributes about twice as much GHG emissions as a vegan diet (Scarborough et al., 2014). A change in eating habits requires people to be informed that a change is needed and why it is needed. As communication scholars we know that whereas awareness of an issue via the mass media does not induce immediate behavioral change, it is a prerequisite for the public to change their behavior (Neff et al., 2009).

GHG emissions from the transportation and energy sector are much discussed, but emissions from agriculture seem to receive much less media attention (Neff et al., 2009; Wynes & Nicholas, 2017). One study speaks about “a livestock policy vacuum” in which little attention is directed to this issue by policy-makers and opinion leaders (Bailey et al. 2014, p. 7). Key reports such as the FAO´s ‘Livestock´s long shadow’ (2006) and UNEP´s ‘Growing greenhouse gas emissions due to meat production’ (2012) appear to have been largely ignored by the media and by policy makers.

In the first study of its kind, we aim to establish how much media attention has been given to the issue of animal agriculture’s impact on the climate since 2006, and whether there has been an upward trend in recent years. Our media content analysis also investigates how the issue is treated in terms of topics, actors, tone and solutions for reducing animal agriculture’s impact on the climate. We analyze online and print articles from two media organizations (one left-leaning, one right-leaning) each in the UK and the USA: The Guardian, the Telegraph, the New York Times and the Wall Street Journal.

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Poster abstracts

Future Diets in India: A systematic review of food consumption projection studies

Carmelia Alae-Carew, London School of Hygiene & Tropical Medicine

Undernutrition rates in India remain stubbornly high while the country simultaneously faces a growing burden of overweight and obesity. Rapid changes to the food system and a growing population are likely to affect the nutrition and health status of the Indian population in the future. Characterisation of likely future diets in India is needed to inform agriculture and health policies and ensure food and nutrition security.

We performed a systematic search of six databases to identify studies from published and grey literature projecting the consumption of one or more food groups or food items in India to at least one future time point beyond 2018.

We identified a total of 11 relevant studies. There was marked heterogeneity in food items, timescales, models and variables used, as well as variability in the reporting quality of the included studies. Seven studies analysed consumption data from the National Sample Survey Organisation. Three studies used econometric partial equilibrium models to create their projections. Sufficient data were available to explore future trends in nine major food groups. Overall, the projections suggest that in India, dietary diversity is likely to increase, with meat and dairy consumption predicted to increase especially in urban settings.

Overall available projections of Indian diets suggest lower grain consumption and greater dietary diversity, with the magnitude of the predicted increase in meat and dairy consumption expected to increase in accordance with income growth. Beyond the benefit of predicting potential food supply-demand gaps in the future, consumption projections provide a means to examine the impacts of changing consumption patterns on natural resource use and human health. Gaps remain in the methodological reporting quality of the current evidence base.

Understanding Antimicrobial Use in UK Pig Systems

Harriet Bartlett, University of Cambridge

Overuse of antimicrobials in livestock is linked to the emergence of antimicrobial resistance with consequences for animal health, as well as impact among humans and the environment. Pig antimicrobial use (AMU) is of particular concern due to the large quantities used and the administration methods (prophylaxis and group medication are common) and resistance is commonly found in pig waste and the surrounding environment. AMU is quantified via several metrics, but the limitations that could result from their use in pigs have not yet been evaluated. Reductions in AMU may be achieved via system transitions and management changes, and it is important that changes are considered holistically, also considering the implications on animal welfare and profit.

I evaluated AMU metrics used in the UK pig industry, I compared different system AMU and I investigated production parameter correlates of use. I found estimates of different metrics to be limited by data availability and accessibility, and that knowledge of their limitations is crucial if we are to use metrics to assess antimicrobial resistance emergence risk. Using real farm data, I found metric choice to be key; different metrics change the ranking of farms in terms of scale of AMU. Critically important AMU must be reported separately from total AMU, as correlates of total use were not necessarily an indicator of critically important AMU. In wean-to-finish systems, organic had lower AMU than conventional, but this gap was smaller in critically important use, and smaller still in the most crucial critically important antimicrobials. I identified important production parameter correlates of AMU such as feed conversion ratio (FCR): higher FCRs were associated with lower AMU, weight of piglets: heavier piglet weaning weight was associated with greater AMU, and, perhaps consequential to disease rates, high mortality was associated with greater AMU.

Analysis of the main research trends on the environmental effect of various diets

Rocío Berrade Asín

OBJECTIVE: This poster exposes the following hypothesis:

- The effect of various diets on the environment is an issue of growing interest;
- Researchers studying it adopt an ethical stance of have a political approach in favour of finding more sustainable diets.

The purpose of this study is to validate the hypothesis, establish the state-of-the-art, gather articles as an unavoidable basis for further research and asses the degree of interest it arouses among researchers.

METHODOLOGY: At the beginning of this research, a selection of articles was made by searching some key words among the most relevant journals according to its impact factor. Sixteen publications written between the year 2000 and 2017 became object of the study. The most important journals for this study have been Cell for being the higher on the impact factor ranking offering articles with key words and Science for having provided most of the texts studied (a 62.5% of them). For the development of this project, the qualitative analysis software ATLAS.ti was used. There has been a review of the literature, a collection of data and a transcription and analysis of interesting quotations for the accomplishment of this projects objective.

RESULTS: The analysis of the number of publications over time has proven the first hypothesis. The totality of authors showed avocation to find more sustainable diets in a global scale. All the manifestations around the three more relevant items (trade-off, plant-based diet and trilemma) agreed with the second hypothesis.

CONCLUSIONS: Both hypotheses are confirmed. Additionally, an increasing interest is shown over the topic diversify crops and how globalization is helping it become a realistic option for a more sustainable diet. Furthermore, there is little appearance of economists, politics or food-related researchers among the authors, leaving room almost exclusively for ecologists and environmentalists.

Replacing Meat With Alternative Plant-Based Products (RE-MAP): Development of a behavioural intervention to reduce meat consumption

Filippo Bianchi, Paul Aveyard, Nerys Astbury, Brian Cook, Emma Cartwright, Susan A Jebb, University of Oxford

BACKGROUND: Reducing meat consumption could help prevent chronic diseases andprotect the environment. Meat-substitutes could support shifts towards plant-based diets, but lack of familiarity with these products may prevent their uptake among meat-eaters. We developed an intervention to reduce meat consumption through extended exposure to meat-substitutes.

METHODS: First, we defined the target behaviour as a reduction in meat consumption among a general population of adult meat-eaters. Second we considered existing literature to identify putative psychosocial drivers of this target behaviour. Third we used the Behaviour Change Wheel to construct a multi-component behavioural intervention targeting these psychosocial drivers of meat consumption. Last we held a public discussion group to optimise the materials and test the acceptability of our intervention.

RESULTS: The behavioural analysis highlighted five putative psychosocial drivers underpinning the target behaviour: (D1) eating identities, (D2) attachment to meat, (D3) attitudes, (D4) subjective social norms, and (D5) behavioural control of meat consumption. To influence each of these drivers we combined four intervention functions: (F1) environmental restructuring enacted through four-weeks provision of meat-substitutes, (F2) education enacted through information booklets outlining the health and environmental benefits of eating less meat, (F3) social modelling enacted through success stories vignettes of people who reduced their meat consumption, and (F4) training enacted through the provision of written recipes. Ten members of the general public attended the discussion group and considered the intervention likely to be acceptable. They provided comments to make the information booklets more accessible to non-specialists and actively engaged in the development of success stories vignettes. Conclusion and implication: A behaviourally-informed intervention to motivate and support meat-eaters to eat less meat was developed, including the provision of meat-substitutes, information on the benefits of eating less meat, success stories, and recipes. The effectiveness of this intervention will be tested in a randomised control trial: ISRCTN13180635.

Restructuring physical micro-environments to reduce the demand for meat: a systematic review and qualitative comparative analysis

Filippo Bianchi[1], Claudia Dorsel[2], Emma Garnett[3], Paul Aveyard[1], Susan A Jebb[1],
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BACKGROUND: Reducing meat consumption could help to protect the natural environment and promote population health. Interventions restructuring physical micro-environments might help to change habitual behaviour. We synthesised the scientific evidence pertaining to whether, and which, interventions restructuring physical micro-environments effectively reduce the demand for meat.

METHODS: We did a systematic review of quantitative studies evaluating the effectiveness of interventions restructuring physical micro-environments to reduce the demand for meat. We identified relevant records by searching six electronic databases (CAB Abstracts, Embase, PsycINFO, Science Citation Index, MEDLINE, and Dissertations & Theses) on Aug 31, 2017, contacting experts, screening publicly accessible online resources, and searching references. We included studies that evaluated the effectiveness of interventions restructuring physical micro-environments to reduce the demand for meat, defined as the actual or intended consumption, purchase, or selection of meat in real or virtual environments. We extracted data pertaining to the study samples, the interventions, and meat demand at the follow-up closest to intervention completion and at the longest follow-up, with the former representing our primary outcome. We synthesised data narratively and did a qualitative comparative analysis to identify configurations of intervention characteristics associated with, and those not found to be associated with, significant reductions in meat demand. Our Systematic Review is registered with PROSPERO, number CRD42017081532.

RESULTS: Of 10 733 titles and abstracts screened for eligibility, we assessed 60 full papers and included 14 papers reporting on 18 studies with 22 intervention conditions. Three interventions reducing the portion size of meat servings reduced meat consumption in randomised trials. Three interventions providing meat alternatives with supporting educational material were associated with reduced meat demand in pre-post design studies. Three of four interventions altering the sensory properties (eg, visual presentation) of meat or meat alternatives at point of purchase reduced meat demand in randomised trials. Four interventions repositioning meat products to be less prominent at point of purchase were associated with lower meat demand, but only two such interventions reached statistical significance in a randomised trial and a multiple treatment reversal design. Only one of five interventions manipulating the description of meat or meat alternatives at point of purchase was associated with lower meat demand in a multiple treatment reversal design. Evidence from randomised trials evaluating a pricing intervention or interventions restructuring several aspects of micro-environments was too scarce or inconsistent to be conclusive. The results from our qualitative comparative analysis supported the findings of this narrative synthesis.

INTERPRETATION: Some interventions restructuring physical micro-environments could help to promote lower demand for meat. Interventions reducing portion sizes of meat servings, providing meat alternatives, or changing the sensory properties of meat and meat alternatives at point of purchase offered the most promise in the context of experimental studies.

Navigating Patterns of Sustainability in Creation and Consumption from Online Recipe Data

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Food production represents a large portion of environmental burdens in the Anthropocene. While most efforts to close the food gap focus on increasing production, the issue can – and should, given the magnitude of the challenge – be simultaneously addressed from the consumption side.

Digital technologies are increasingly supporting our daily lives, shaping patterns of habitual practice. In relation to food consumption, they are causing a convergence of private and public spheres: social media platforms – such as food blogs and recipe websites – allow the public a glimpse of what is cooked and eaten at home. Food culture is furthermore preserved in material form within recipes and cookbooks. In contrast to traditional cookbooks, online recipe sites are more participatory in design and furthermore provide longitudinal data on the popularity of recipes, user interactions, and sustainability trends.

Analysing big data from social media activities with regards to sustainability topics generally, and the impact of the food system more specifically, is still in its infancy. This research aims to advance the field by evaluating trends – focusing on proxies for sustainable diets – of a large dataset of over 240,000 recipes from the most frequently visited German recipe website, accounting for over 17 years of user activity. A complex network approach is used to develop a 'recipe atlas' – a highly informative visual representation of the recipes' content and preparation – to reveal the latent structure of recipe author and user behaviours. Life Cycle Assessment and nutritional data is furthermore connected to recipe ingredients to estimate environmental and health impacts, while interviews with recipe users and authors provide insights into subjective theories of creation and consumption.

This interdisciplinary research advances the knowledge on the evolution of food practices and takes on the challenge of applying methods of computational social science to sustainability issues.

Accounting for genetic changes in environmental impact modelling of pig systems

Mathias Bo Ottosen, Stephen Mackenzie, Michael Wallace, Ilias Kyriazakis, Newcastle University

We have developed a framework to account for the environmental impacts that may arise from genetic changes in pigs. The model can predict the effect of changes to individual growing pig and sow traits, and interactions between them, for environmental impact in commercial pigs. An LCA model was developed for a typical commercial Danish pig system, accounting for genetic correlations between traits. The model included Global Warming Potential, Terrestrial Acidification Potential, Aquatic Eutrophication Potential and Agricultural Land Use as impact categories. Variance and correlations between traits were taken from literature on western commercial pigs. The traits were tested systematically by a one at a time sensitivity analysis (OaTSA), correlated clusters sensitivity analysis (CCSA) and by the Sobol, correlated and uncorrelated sensitivity (CS and UCS respectively). The latter three sensitivity analyses took into account that some traits are genetically correlated. The model was highly sensitive to average daily gain between 30-100kg and energy used for maintenance in the OaTSA, but also for clusters containing typical sow performance traits, such as weight gains and losses during gestation and lactation, and lactation feed intake in the CCSA. The Sobol index confirmed the importance of the late growth rate and the maintenance, but UCS resulted in the maintenance

having a more dominant effect, and the CS had substantial negative values for growing pig mortality. The negative CS for mortality traits implies that interactions between correlated traits counteract much of their effect on the system and underline the importance of accounting for these correlations when modelling the implications of genetic change for environmental impacts. In future work we will consider how changes in these traits will affect the environmental impact of pig systems. For the first time an LCA capable of showing the implications of pig breeding strategies for environmental impact has been developed.

Endorsing dietary guidelines in China: a quantitative assessment of potential changes in food consumption and associated greenhouse gas emissions

Sabina Ciorasteanu, SOAS, University of London

The rapid nutrition transition that China is now undergoing, the so-called "Westernisation" of diets, has tremendous negative consequences for both human health and the environment. Against this backdrop, the Chinese government released new Dietary Guidelines for the Chinese population (CDGs) in May 2016, and has been actively promoting them since. Most probably, adjusting the average Chinese diet so that it fulfils the dietary requirements will involve a significant change in consumption habits. Its impact on the environment is less clear.

This poster represents an investigation into the potential quantitative impact on food consumption and on the associated levels of greenhouse gas emissions (GHGEs) that could result from dietary change in China. A mathematical model is used to simulate, quantify and compare the effects on the consumption of various food groups (e.g. pork, beef, cereal, vegetables, dairy, etc.) and levels of GHGEs, resulting from two different scenarios: consumers complying with the CDGs or adopting the World Health Organization (WHO) dietary norms. Finally, recommendations are made about the most suitable and realistic diets that have health and environmental co-benefits. Four waves of survey data from the China Health and Nutrition Survey are used, and estimates of the GHGEs for each good group analysed are compiled from the appropriate literature.

The model shows significant deviations for certain food groups between current diets and nutritional recommendations, and concludes that adopting either the CDGs or WHO guidelines could simultaneously improve population health and environmental sustainability.

The public, intensive animal production and policy; the need for greater and more transparent communication

Beth Clark[1], LA Panzone[1], GB Stewart[1], Ilias Kyriazakis[1], J Niemi[2], T Latvala[2], P Jones[3], R Trante[3] and LJ Frewer[1] *[1]Newcastle University, [2]Natural Resources Institute Finland (Luke), [3]University of Reading*

Sustainable intensification is an increasingly common feature of modern farming, with animals in these systems more prone to certain production diseases (PD). To ensure the acceptability of animal production in the future, and to maintain public trust in stakeholders across the food chain, public attitudes towards these, including interventions to both prevent and treat PD, need to be understood, and addressed in policy. Two systematic reviews of 80 and 54 studies explored public attitudes and willingness-to-pay for farm animal welfare (FAW), with a largescale survey (n=2,330) of 5 European countries used to explore attitudes to PD.

Findings show that the public have concerns about intensive production systems, in relation to concerns about FAW standards, linked to the requirement for humane treatment and naturalness within animal husbandry. The acceptability of interventions to prevent PD in production systems were linked to these concerns, with consumers indicating greater preferences for more proactive interventions utilising housing and hygiene strategies. The use of medicine based interventions raised concerns in relation to food safety, human health and antimicrobial resistance, with all studies highlighting concerns over antibiotic usage. Results also highlight the influence of the identified concerns, perceived risks and benefits on attitudes and subsequent behavioural intention to purchase food from intensive systems.

Industry and policymakers should consider these concerns in future policy actions, potentially applying a combination of market and policy-based solutions to align consumer preferences for FAW with standards applied within intensive animal production. Policies and regulation are required to ensure the interventions to deliver safe food, as well as to promote actions focused on the reduction of anti-microbial resistance. The research highlights the need for effective communication and knowledge exchange with all stakeholders involved in the supply chain, as well as transparency in decision-making linked to policies focused on FAW in intensive animal production.

Localism and small-scale dairy farming in the Metropolitan Region of Rio de Janeiro (Brazil)

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Rural-urban complexity is observed across the Metropolitan Region of Rio de Janeiro where a group of dairy farmers has been able to resist by elaborating flexible strategies adapted in the face of rural change. This study aims to investigate small-scale dairy farming in the industrialized Southeast Brazil. Against a linear view concerning external interferences in rural localities, we have argued that farmers in metropolitan context possess resilience, which contributes to complex outcomes. This is often made possible by the difference between farming systems in Greater Rio de Janeiro in contrast to those distant from and less affected by large urban centres. Dairy farming within cities and on their periphery is the direct opposite of large-scale agroindustry. Farming in metropolitan regions is characterised by fragmented patterns of land ownership, the predominance of small-scale farmers, products with aggregated value, and more direct forms of marketing produce to local consumers. Farmers sell milk to small and medium-scale local dairies, many of which were set up by groups of farmers and this aggregates greater value.

The study is based on primary research undertaken in Greater Rio de Janeiro. The interviews were often undertaken in cooperation with local and regional governments whereby over the years methods shifted from those typical of top-down development research to bottom-up strategies. An analysis of the nature of the place, founded on bottom-up information flows and qualitative investigations. Different types of knowledge, organizations, local innovation, and cross-scale linkages are part of this process in which farmers are proactive. The research highlights patterns of dairy farming resilience whereby farmers have adapted to rural change that has arisen in the Metropolitan Region of Rio de Janeiro.

The water footprint of human diets; a systematic review

Francesca Harris, London School of Hygiene & Tropical Medicine

The production of human diets is the main driver of global freshwater use. With population growth, changing diets and climate change, water scarcity is likely to intensify. Dietary change could be part of the solution to reduce human water use.

Water footprints are the main indicator used for water consumption, therefore this systematic review aims to i) assess the evidence on the green (rainfall) and blue (ground and surface) water footprints of diets, ii) evaluate the influence of dietary factors on water footprints, including the amount of meat, dairy, fruits, vegetables, cereals and calories in the diet, iii) identify research gaps to inform future analyses.

A total of 36 studies were included in the review. Diets were explored in various scales and contexts: global (n=4), multicounty (n=6), national (n=20), subnational (n=3), urban (n=6) or specific population groups (n=2). Dietary information was primarily estimated from the Food and Agricultural Organisation Food Balance Sheets. The median (IQR) green water footprint was; 2441 (2005-3501) L/capita/day, blue; 243 (163-350) L/capita/day. Individual dietary water footprint estimates were extracted from studies (n=1984) and dietary predictors assessed using a mixed-effect regression model. Meat, poultry and dairy products (g/capita/day) had the strongest effect on increasing total and green dietary water footprint ($P<0.001$). Cereals and fruit consumption were strong predictors of dietary blue water footprint ($P<0.001$). There was no evidence that vegetable consumption was correlated with any of the dietary water footprints. Total calories of the diet had the greatest effect on green water footprint. Despite gaps in current research, this review suggests that consumption of animal source foods increases dietary water footprints. However, location of food production is an important factor in determining water use, and in the context of global food trade more evidence is needed on the impact of diets on blue water resources and scarcity

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Local level food expenditure patterns as part of systems approach to investigate the resilience of the UK pig industry

William James and Conor Goold, University of Leeds

In common with the rest of the world, the UK is experiencing major shifts in dietary patterns, as evidenced by changing patterns of food and drink expenditure. These changes may be the result of socio-demographic factors, trade policies, agricultural practices and food industry marketing. In turn, these changes put pressure on food industries that compromise their resilience. The PigSustain project is applying a systems approach to investigate the resilience of the UK pig industry to diverse factors, including farming intensification and consumption patterns.

Using spatial microsimulation, we are estimating household expenditure of various meat products for each local authority district of the United Kingdom for the years 2008 – 2016 using the Living Costs and Food Survey. GIS analysis is applied to combine simulated expenditure datasets with socio-demographic, economic and commercial datasets. Expenditure patterns will be incorporated into a broader systems model representing the UK pork industry to examine how changes in expenditure will influence the demand of pork in the supply chain. The systems model combines aspects of system

dynamics, discrete-event and agent-based modelling to simulate the production of pigs for slaughter and the retail process. Results from the spatial microsimulation will be used to inform a spatially-explicit systems model which represents how expenditure patterns vary with demographic information.

Gleaning Lean Culture: On Lean Logic

Natalie Joelle, Birkbeck, University of London

Since the term 'lean' was coined to describe and disseminate the efficiency innovations of the Toyota Production System to an Anglophone audience, 'lean thinking' has spread across the world: healthcare, government, and environmental management increasingly take what is called 'the lean leap'.

This polemical poster connects the rhetoric of 'lean' to its troubling technological source in the slaughterhouse using what I term a 'gleanological' method: a genealogy of global lean technologies and their roots in the packing of lean meat. It has never been more important to name, and in so doing, call out the investments of 'lean' than in our current climate crisis, in which the production of lean meat and its by-products is the largest single cause of greenhouse emissions and a leading contributor to climate change.

Gleaning the phrase 'lean culture' from management handbooks for our critical lexicon innovatively connects contemporary systems of control within and across species with a term that is as specific and identifiable in how it permeates everyday language as it is global and transdisciplinary in reach. Gleaning 'lean culture' is an urgent response to the violence and ecocide encoded in the lean management of everyday life. The meanings of the word 'lean' are then some of the most important to consider today to inform action.

Biodiversity at risk under future cropland expansion and intensification

Laura Kehoe, The Nature Conservancy, Global Lands (TNC)

Agriculture is the leading driver of biodiversity loss. Global demand is rising for resource intensive foods such as meat and dairy and this will put even more pressure on natural systems. However, the future impact of agriculture on biodiversity remains unclear, especially because previous research has neglected agricultural intensification and because high path-dependency in agricultural development is often assumed - although the past suggests rapid and drastic change occurs frequently. Here, we investigate the full option space of possible future impacts of agriculture on biodiversity at a 1-km² resolution.

Based on an extensive database of local biodiversity responses to agriculture, we find up to 30% of species richness and 31% of abundance potentially lost, mainly due to agricultural expansion across the Amazon and Sub-Saharan Africa. Intensification risk-areas include India, Eastern Europe, and the Afromontane (7% species richness and 13% abundance loss). Many high-risk regions are not adequately covered by conservation prioritization schemes and exhibit low national conservation spending along with high agricultural growth. Considering rising agricultural demand, our results highlight areas where effective land-use planning may proactively mitigate biodiversity loss.

The effectiveness of altering the default order of foods and offering swaps on the saturated fat content of food purchases in an experimental online supermarket: a randomised controlled trial

Dimitrios A. Koutoukidis, Susan A. Jebb, Jose M. Ordonez-Mena, Michaela Noreik, Melina Tsiountsioura, Sarah Payne-Riches, Paul Aveyard, Carmen Piernas, University of Oxford

BACKGROUND: Meat, diary, and their products are the main sources of dietary saturated fat (SFA). Reducing saturated fat intake can lower LDL cholesterol and reduce cardiovascular disease risk. Interventions to reduce the SFA content of food purchases may help reduce later consumption. This trial examined the effect of altering the default order of foods and an individualised and explicit offer to swap to an alternative food on the SFA content of food purchases in an online shopping experiment (ISRCTN13729526).

METHODS: UK adults who were the primary grocery shoppers for their household were recruited online and invited to buy 10 items in a bespoke experimental online supermarket. Participants were randomly allocated to one of four arms (i) to see foods within a category ranked in ascending order of SFA content (ii) receive the offer to swap to a food with less SFA, (iii) a combination of both interventions, or (iv) no intervention. The primary outcome was the difference in %energy from SFA in the shopping basket between any of the four arms. The outcome assessors and statistician were blinded to intervention allocation.

RESULTS: Between March and July 2018, 1240 participants were evenly randomised and 1087 with data were analysed. Participants were 65% female and aged 38y (±12). Compared with no intervention (n=275) where the %energy from SFA was 24.8% (±5.0%), altering the order (n=259) reduced SFA by -5.3% (-6.6 to -4.1)) and offering swaps (n=279) by -2.0% (-3.2 to -0.8). The combined intervention (n=274) was significantly more effective than swaps alone (-4.3% (-5.5 to -3.1)) but not different than altering the order alone (-0.9% (-2.2 to 0.3)), p=0.127 for interaction.

CONCLUSIONS AND IMPLICATIONS: Altering the default order to show foods in ascending order of SFA and offering an explicit swap with lower SFA reduced %energy from SFA. Altering the default order may be a more promising intervention than swaps for improving food purchasing behaviours and, potentially, reducing meat and dairy consumption.

The influence of weather on the health and welfare conditions of pigs in the UK: a time-series analysis

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Given the seasonal nature of some health and welfare conditions in livestock, we explored the extent to which weather factors explain these patterns and whether there are parallels with human health.

We obtained the health and welfare data from Food Safety Agency and Animal and Plant Health Agency and UK weather data from MET Office. Time- series of the weekly prevalence of respiratory diseases for the period 2010-2015 were assessed graphically and in relation to averaged weekly ambient temperature, adjusting for seasonal patterns, trends and day-of-week effects. The metric considered was weekly maximum temperature lagged by up to five weeks. The best fitting model at

the national was chosen based on the model deviance outcomes. Analyses were conducted at both the national and county levels. We further performed a meta-analysis on the county level by combining the effects of maximum temperature on the prevalence of respiratory.

The model averaging lags between week 0 and week 5 showed the best fitting with the lowest deviance 0.846658 at the national dataset. In averaged lag 0-5 models, there were a 0.991 times decrease in the prevalence of respiratory conditions for every one-decrease in temperature below 15 °C. In the county level datasets, the pulled effects of all counties had a relative risk of 0.986 (95% CI 0.986, 0.986) per one-degree decrease in temperature below 15°C, which was more precise in county-level than in national level.

Although prevalence was not based on the onset of a disease, but rather on the diagnosis of diseases, there was some clear evidence of an association between changes in maximum temperature and prevalence of health and welfare conditions at the county level, but not at the national level. Many studies assessing the association between ambient temperature and mortality in humans and cattle have found a J- or U-shaped curve appropriate to describe the relationship; however, in our study, it was a rather A-shaped curve in the national dataset and inconstant patterns in the county-level datasets. This may be because we used the morbidity rather than mortality data.

Global water scarcity intensified by meat production in the past and future

Guoyong Leng and Jim Hall, University of Oxford

Global meat production has increased 4-5 fold since 1960s, and is expected to rise in the future to meet the increasing demand driven by growth of population, income and urbanization. Large amounts of water are required for meat production including drinking water and irrigation for feed crops. The imbalance between water availability and demand for meant production would potentially lead to water competitions with other water use sectors, and thus intensifying water scarcity locally and regionally. Investigating the contribution of meant production to water scarcity is therefore critical for enhancing our understandings of the environment impact of livestock production. To date, water scarcity for meat production by livestock type (e.g. poultry, cattle, pig, and sheep & goat) has been unclear in the past and future. In this study, we will reconstruct historical spatial-temporal patterns of water availability and demand in global meat production areas, based on which water scarcity is estimated. The role of meat production in intensifying water scarcity is further explored by livestock type for both high-income and low-income countries. Analysis will be conducted for projecting future water scarcity under various scenarios of meant production, land use and climate change. We will simulate the changes in water availability and demand for meat production regions using global eco-hydrological models driven by CMIP5 climate projections. Changes in water scarcity under 1.5 ^{o} and 2 ^{o} warming worlds will also be compared to investigate the potential benefits of keeping global warming within 1.5^{o} for reducing the severity of water scarcity for meat production.

Distancing death: welfare and slaughter in the British halal meat industry

Hibba Mazhary, University of Oxford

In the context of rapidly increasing global meat consumption, and the environmentally destructive nature of the meat industry, it is important to investigate meat consumers' motivations and priorities for such consumption. The halal industry accounts for a growing proportion of global meat intake, and hence is an insightful angle from which to explore animal consumption. This project focuses on the ways in which a concern for halal intersects with a concern for animal welfare and environmental concerns regarding meat production, and how these have implications for the scale, practices and understandings of meat consumption. The treatment of animal death and animal welfare in the British halal meat industry is a topic that aims to make contributions to debates across many disciplines and sub-fields, in particular animal geography, geographies of food, animal ethics and anthropology. The first research question addresses animal welfare concerns; I intend to investigate to what extent animal welfare motivates British halal meat consumers and producers. This PhD research project then explores which distancing techniques from animal death are employed in the British halal meat industry. This is linked to the subsequent research question of whether proximity and awareness of animal death has an impact on individual meat consumption. The research project investigates this claim that intimacy with animal death can reduce both individual and mass consumption. Moreover, the project explores the policy implications of considering animal welfare in the British halal meat industry, including whether a national halal standard can be established, which is a complex issue given the existence of multiple competing bodies and food standards. I will adopt a mixed-methods approach to address my research questions, including interviews, focus groups and textual analysis, as well as analysing quantitative data from food diaries and online surveys.

Meat, maladies and the macrocosm: Why curtailing meat consumption is essential for global population health and the environment

Kathryn A. Miller, Kirsten F. Thompson, Paul Johnston, David Santillo, Reyes Tirado, University of Exeter

Excessive food consumption has repercussions for the climate, global ecosystems and human health, the last evidenced by increased incidence of obesity and non-communicable diseases including, cancer, diabetes and cardiovascular disease. Dietary studies show that every income bracket is affected by inadequate intake of appropriate nutrients and in many countries both malnourishment and obesity are prevalent. Escalation in meat consumption in recent decades – a symptom of cultural shifts, population growth and globalisation – is part of the problem.

We investigated the health benefits of reduced meat consumption through a synthesis of current literature. Reducing – but not necessarily eliminating – the consumption of red and processed meat has health benefits. Studies suggest a diet comprising no more than 300g of cooked red meat per week can help reduce the risk of developing colorectal cancer. A balanced diet high in non-starchy vegetables and fruits can reduce the risk of developing chronic diseases including cancers of the digestive tract, lung and liver. Substituting one serving of red meat per day with nuts was associated with a 30% reduction in the risk of developing coronary heart disease.

Reducing industrial-scale meat production could bring huge environmental benefits. Livestock farming produces 14.5% of all anthropogenic greenhouse gas emissions. Decreasing the meat content of a

typical western diet by 30% could lower those agricultural emissions by 14%, and begin to address habitat loss, aquatic and airborne pollution, the misuse of antibiotics and disease transmission.

Large-scale epidemiological studies demonstrate the benefits of diets high in fruits, vegetables, pulses, nuts and tubers and low in processed foods and meat. One of the greatest challenges will be to change entrenched consumer behaviour. A powerful tool to overcome the inertia will be clear communication of scientific evidence for the health and environmental advantages of plant-based diets to encourage positive choices.

The environmental implications of projected future diets in India

James Milner, London School of Hygiene & Tropical Medicine

Rapid economic development and urbanisation in India are transforming the food system and traditional dietary patterns are changing to diets higher in fat, sugar, salt and animal products. These trends may affect the environmental and health impacts of Indian diets. The aim of this study was to identify potential future diets in India, and quantify their associated environmental impact.

We projected Indian diets based on recent trends in household level food expenditure using Indian National Sample Survey (NSS) data from 1990 to 2011. Annual mean consumption (kg/household/year) of all food items was grouped into 10 representative food groups. Consumption of each group was projected to the year 2030 using an autoregressive integrated moving average (ARIMA) time series forecasting method. We assigned food production-related greenhouse gas (GHG) emission data for India to each food group.

Our nationally representative, data-driven projections found that by 2030 there will be increases in consumption of oils and dairy/eggs, with consumption of some cereals (sorghum, millet, and maize) and pulses projected to decrease greatly. Other food groups including rice, wheat, fruits, vegetables and meat, showed only minimal changes from current diets. Overall, these changes are likely to increase the consumption of saturated fat in Indian diets in the future. The changes in dietary composition resulted in only modest changes in production-related dietary GHG emissions by 2030, though with considerable urban/rural and regional differences.

Understanding trends and patterns of food consumption allows us to better understand future threats to planetary health and their potential solutions. Our study suggests that if diets continue on current trajectories in India, there may be implications for environmental sustainability and potentially changes in diet-related non-communicable disease risk.

Why Milk Matters

Maureen Minchin, Milk Matters Pty Ltd, Australia

A milk hypothesis explains more than the hygiene hypothesis about the causes and costs of inflammatory disease epidemics such as diabetes and allergy. These diseases are being vertically communicated between generations, in bodies programmed for obesity by infant feeding.

All mammalian milk is a species-specific, dynamic, bioactive, living tissue that actively modulates development. Infant feeding is the single most important postnatal influence on gene expression and the body microbiome. And the process of lactation has significant positive effects on the health of

mothers. Milk production and milk both also have huge effects on population health, the economy, society and the environment.

This presentation will outline some new knowledge about what the presence or absence of breastfeeding (and the presence of bottle-fed industrially-processed substitutes) in early life means for population, economic, and environmental health. It will also summarise the reality, costs, and harms of infant formula. It will suggest that these justify significant research and structural and societal action to:

- end the universal assumption of formula safety and equivalence to breastmilk, and the marketing that creates this delusion;
- reduce the unnecessary use of infant formula with its multiple needless environmental costs (ingredients, processing, packaging, transport, feeding, water use, etc)
- enable – not simply urge - breastfeeding to the WHO template;
- provide women's milk for those who cannot breastfeed, and
- commercialise human milk's emerging medicinal value (inter alia, restoring antibiotic sensitivity, providing pluripotent stem cells, and destroying tumours.)

Societal investment in breastfeeding and women's milk, and an end to structural subsidies of environmentally-damaging ersatz substitutes is long overdue. Milk determines development. Milk matters - mightily.

Pasture fed livestock – what can it contribute to sustainable livestock futures?

Lisa Norton, Lancaster Environment Centre

The 'Sustainable economic and ecological grazing systems - learning from innovative practitioners' project started at the beginning of 2018 and is carrying out research to understand the multiple sustainability axes of animal (particularly beef) production on farms employing Pasture for Life (PFL) approaches. This poster will outline the approaches which are being taken by the project to make these assessments and how the project will link with wider research on pasture fed livestock. In the first year of the study 60 PFL farms are being contextualised within the wider pasture landscape of the UK in terms of pasture composition and soil parameters. Where possible, results from this contextualisation will be presented. Extensive farmer interviews designed to collect and interpret data on the provision of Public Goods by PFLA (PFL association) farmers are also being carried out across the 60 farms. This poster will discuss the use of the Organic Research Centre's Public Goods Tool and present some of the findings from summer 2018. The poster will go on to discuss issues and questions raised by the field visits and farm interviews in 2018 and present the projects proposed methods for furthering our scientific understanding of the potential benefits of pasture fed approaches from multiple sustainability objectives.

Meat consumption and risk of diabetes in British adults: results from the EPIC-Oxford study

Keren Papier, Paul N Appleby, and Timothy J Key, University of Oxford

INTRODUCTION: The global prevalence of diabetes is high and rapidly increasing. In addition to body size, consumption of specific foods may contribute to the development of diabetes. We assessed the relationship between meat intake and diabetes risk in British adults.

METHODS AND PARTICIPANTS: The analysed cohort included those from the European Prospective Investigation into Cancer (EPIC)-Oxford study who were diabetes free during baseline recruitment (1993-1999), with available dietary intake data and categorized as regular meat eaters (>50 grams per day: n=15,181); low meat eaters (<50 grams of meat per day: n=7,615); fish eaters (ate no meat but consumed fish: n=7,092); and vegetarians and vegans (ate no meat or fish: n=15,426), and linked hospital admissions or death data for diabetes (n=45,314). We used Cox proportional hazards models to assess associations between diet and risk of diabetes.

RESULTS: Over a mean of 17.6 years of follow-up, 1224 cases (or deaths) of diabetes were recorded. Risk of diabetes was strongly associated with body mass index (BMI) (P for trend <0.001), and mean BMI was highest in regular meat eaters. Compared with regular meat eaters, low meat eaters, fish eaters, and vegetarians and vegans were 37%, 53%, and 37% less likely to develop or die from diabetes (hazard ratio (HR) = 0.63, 95% confidence interval (CI) 0.54–0.75; HR=0.47, 95% CI 0.38-0.59; and HR = 0.63, 95% CI 0.54-0.74 respectively). These associations were substantially attenuated after adjusting for BMI (low meat eaters: HR = 0.78, 95% CI 0.66 -0.92; fish eaters: HR =0.64, 95% CI 0.51 -0.80; and vegetarians and vegans: HR = 0.89, 95% CI 0.76 -1.05).

CONCLUSIONS: Our findings suggest that consuming a low or non-meat diet may assist with the prevention of diabetes, probably largely because of a relatively low BMI.

Meat intake and prostate cancer risk: a prospective analyses in UK Biobank

Aurora Perez-Cornago, Ruth C Travis, and Timothy J Key, University of Oxford

INTRODUCTION: Prostate cancer is the most common cancer in males in the UK, with around 47,100 cases diagnosed in 2015. There is relatively high variation in incidence rates worldwide, suggesting that differences in exposure to environmental factors, such as diet, may play a role in prostate cancer development. Therefore, the aim of this study was to study the association between meat intake and prostate cancer risk in UK Biobank.

METHODS AND PARTICIPANTS: We studied 215,000 men from the UK Biobank study who were aged 40-69 years and free from cancer at baseline. Participants provided their frequency of consumption of processed meat, red meat and poultry via a touch screen questionnaire at the assessment centre. Multivariable Cox regression models were used to estimate hazard ratios (HRs) and 95% confidence intervals (CIs).

RESULTS: During a median of 5.6 years of follow-up, 4,562 participants were diagnosed with prostate cancer. Compared with men who reported consumption of red meat less than once a week, those who consumed red meat 3 or more times per week had a significantly higher prostate cancer risk (HR=1.23; 95% CI=1.07-1.43, p-value=0.004). No associations were observed between total meat, processed meat or poultry intake and prostate cancer risk.

CONCLUSIONS: In these preliminary analyses from UK Biobank there was some evidence that higher consumption of red meat was associated with an increased risk of prostate cancer. Future research will examine associations by tumour characteristics.

The effectiveness of environmental sustainability labels on consumer demand for and willingness-to-pay for foods: protocols for two systematic reviews

Christina Potter, University of Oxford

BACKGROUND: Environmental sustainability labels provide an indication of the sustainability of a product in order to guide consumers to make environmentally conscious decisions. Studies have found that the presence of an environmental sustainability label on a product influences consumer purchasing behaviour. To date, the role of these labels on consumers' demand for foods has not been systematically explored. Two systematic reviews will be conducted to explore the effects of environmental sustainability labels on consumers' (i) selection, purchase or consumption of foods, and (ii) willingness-to-pay for foods.

METHODS/DESIGN: Relevant literature will be identified from searches of seven electronic databases. Following pre-defined criteria, two independent researchers will screen titles and abstracts to determine which papers to include. All human populations will be included. Any type of experimental intervention study written in English will be included. Papers reporting non-experimental analytical studies or qualitative studies will be excluded. Two researchers will extract study data using a standardised data-extraction form. The quality of each study will be assessed using the Quality Assessment Tool for Quantitative Studies.

DISCUSSION: The primary aim of these reviews is to synthesise the evidence of the effects of environmental sustainability labels on the selection, purchase, and/or consumption of foods and on individuals' willingness-to-pay for foods. In the first review, a narrative summary will be provided of the papers and we will explore the similarities of labels to draw some conclusions on their effectiveness. In the second review, a meta-analysis of the effects of environmental sustainability labels on willingness-to-pay for foods will be provided. These reviews are registered on Prospero (IDs: CRD42018094330 and CRD42018087635).

Beef It Up: Prospects for Beef Production in Ireland as a Key Driver of Sustainable Food Systems

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The importance of developing sustainable food systems has grown over the last number of years in terms of delivering food security and safety, nutrition and a neutral impact on the environment. The objective of this poster is to explore the role that the beef production system plays in shaping more sustainable food systems in Ireland. Comprehensive data were derived from national statistical reports and an analysis was conducted of various indicators of beef production performance and sustainability. The results show that the Irish beef sector accounts for over a third of all agricultural output and over 20 percent of Irish food and drink exports. In addition to the economic impact, beef farmers are often located in marginal or economically disadvantaged areas of Ireland and contribute to the social fabric and cultural capital of rural communities. They create public goods such as protection of the environment, preservation of the landscape and unique features, such as stonewalls

and hedgerows, all of which positively contribute to rural tourism and the image of Ireland. In addition, consumers are now increasingly concerned about the sustainability of food production and Ireland produces some of the world's most sustainable beef. Over 80% of Irish beef is grass-fed which leads to healthier meat, lower in fat with a high content of omega-3 fatty acids. The carbon footprint of beef production is well below the European average and animal welfare is very high by global standards. However, changes to the Common Agricultural Policy budget and climate change policy may lead to lower beef prices and impact the economic viability of beef production. This poster concludes that the beef production sector forms an integral component in building a sustainable Irish food system linked to specific geographical rural areas, lower carbon footprint, health benefits for consumers and protection of the environment.

The greenhouse gas emission impacts of generational and temporal change on the UK diet

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In the literature, only current (and future sustainable) diets and their associated GHGE are typically discussed. Little attention is given to existing dietary patterns and trends, and how these impact on future diets. This poster examines how embodied greenhouse gas emission (GHGE) associated with UK dietary preferences have changed over time, with attention given to how age changes diet and how different generations have had different GHGE due to their dietary composition.

Using dietary data from the National Food Survey (1975-2000), the Living Cost and Food Survey (2000-2018), and the National Diet and Nutrition Survey (2008-15), and GHGE from Audsley (2002). We have calculated GHGE related to household consumption of selected foods by age of main diary keeper or individual reporting split in to 10 year 'generations' 1910-2000 with diets reported at 5 year intervals.

It was found that differences in generational eating habits (such as meat and dairy consumption) do produce diets with different GHGE footprints. The 'baby boomer' generation (born 1940s-60s) having the largest generational footprints.

Cumbrian Salt Marsh Lamb experienced in the landscape of the littoral: local consumer perceptions of quality

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Food brands offer a myriad of attributes to promote to consumers, some scientific such as omega 3 fatty acid content, some psychological "it roams free". Unlike branded meat which celebrates the breed of animal, such as Aberdeen Angus beef, or Herdwick lamb, it is the terrain and its flora, which define the quality of salt-marsh lamb and production depends upon a variety of breeds. Many categories of attribute can contribute to the development of a food brand. However, certain embedded food products feature such a strong association with the landscape they are a feature of the 'lifescape' of local inhabitants (Convery et al., 2004). In order to develop a credible brand, to be sold by locals to visitors the brand development process needs to be informed by local perceptions of Cumbrian salt marsh lamb (CSML) in the landscape.

Twenty soft-laddering interviews with residents of the locale of salt-marsh lamb production facilitated the process of means end chain analysis to elicit a hierarchy of cognitive associations.

Results showed that like other regional products CSML facilitates networks of trust and community participation. The vision of CSML in the landscape added to place appreciation, the qualities of the saline environment and accompanying specific fauna were thought by some to influence the flavour. The environment of production also provoked reflections on time, stress-free conditions and food rituals, to tides and to qualities of 'Englishness'. Analysis of responses found valuable non-food centred considerations for brand development of CSML.

Theoretical implications of the findings indicate the potential value of a new "pre-product" experience attribute. Whilst practical findings require local events, participation and education to ensure a local entrenchment of brands.

Vegetarians and vegans have a lower risk of ischaemic heart disease but a higher risk of total stroke: results from the prospective EPIC-Oxford study

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BACKGROUND: Vegetarianism has become more common, but its relevance for cardiovascular diseases subtypes is uncertain. We examined the associations of vegetarianism with ischaemic heart disease (IHD) and stroke in a cohort study in the United Kingdom.

METHODS: In the prospective EPIC-Oxford study, participants were recruited in 1993-2001 and classified into four diet groups: regular meat eaters: ≥50g of meat per day [n=16332], low meat eaters: <50g of meat per day [n=8096], fish eaters [n=7506], and vegetarians (including vegans) [n=16254]. Multivariable-adjusted Cox regression was used to estimate the risk of IHD and stroke (including ischaemic and haemorrhagic types) identified through record linkage until mid-2016.

RESULTS: Over 18.1 years of follow-up, 2820 cases of IHD, 1072 cases of total stroke (519 of ischaemic stroke and 300 of haemorrhagic stroke), and 3565 cases with the composite of IHD or stroke were recorded. Compared with regular meat eaters, the low meat eaters, fish eaters, and vegetarians had 12%, 14%, and 24% lower risks of IHD, respectively (p heterogeneity<0.0001). In contrast, low meat eaters, fish eaters and vegetarians had 22%, 28% and 29% higher risks of stroke (p heterogeneity=0.01). Overall, compared with regular meat eaters, the vegetarians had a 14% lower risk of composite IHD or stroke (hazard ratio 0.86, 95% CI 0.78-0.95), equivalent to 8.6 fewer cases (95% CI 4.1-12.4 fewer) per 1000 population over 10 years.

CONCLUSIONS: Low meat eaters or non-meat eaters had lower risks of IHD but higher risks of stroke. Overall, vegetarians had lower risk of a composite of IHD or stroke events.

Haematological parameters in people of different diet groups in UK Biobank

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BACKGROUND: There may be differences in haematological parameters between meat-eaters and vegetarians. We aimed to study this in the large United Kingdom (UK) Biobank study.

METHODS: A complete blood count was carried out in all UK Biobank participants at recruitment. We examined haemoglobin, white blood cell counts, and platelet counts, in regular meat-eaters (>3 times/week of red and processed meat consumption, n=222,958), low meat-eaters (n=223,670), poultry-eaters (n=5,094), fish-eaters (n=10,562), vegetarians (n=6,859), and vegans (n=442) of white ethnicity, and meat eaters (n=4,139) and vegetarians (n=1,456) of British Indian ethnicity.

RESULTS: In both white and British Indian populations, compared with regular meat-eaters (or meat-eaters in Indians), all other diet groups had lower mean haemoglobin concentrations (difference not significant in white vegan women), and were generally more likely to have anaemia (haemoglobin < 130 g/L for men and <120 g/L for women), e.g. 8.7% of regular meat eaters vs 12.7% of vegetarians in white premenopausal women. In the white population, all other diet groups had lower mean counts of total white cells, eosinophils, lymphocytes, monocytes and neutrophils compared with regular meat eaters (p-heterogeneity<0.001 for all), but basophil counts were similar across diet groups; in British Indians, there was no significant difference in any of the white cell counts by diet group. Compared with white regular meat eaters, low meat eaters, poultry eaters, fish eaters, and vegans had lower platelet counts, while vegetarians had higher counts; compared with British Indian meat-eaters, vegetarians had higher platelet count.

CONCLUSIONS: In UK Biobank, people with low or no red meat intake generally had lower haemoglobin concentrations and were slightly more likely to be anaemic. The lower white cell counts observed in low and non-meat eaters, and differences in mean platelet counts between diet groups, warrant further investigation and may be related to disease risk.