

OXLEAP19 CONFERENCE AT A GLANCE

09:15 – 10:00

REGISTRATION

[Entrance Hall]

10:00 – 10:15

WELCOME - Professor Susan Jebb

[Nelson Mandela Lecture Theatre]

10:15 – 11:00

PLENARY SESSION
Professor Corinna Hawkes, City, University of London

[Nelson Mandela Lecture Theatre]
Chair: Professor Susan Jebb

11:00 – 11:25

REFRESHMENTS

[Entrance Hall]

11:25 – 13:00

[SESSION 1 \[Nelson Mandela Lecture Theatre\]](#)

Chair: Dr Marco Springmann

The deforestation footprint of Brazilian beef exports
Erasmus zu Ermgassen et al. (Université Catholique de Louvain)

A systemic and participatory analysis of the commercial broiler industry in South Africa
Kevin Queenan et al. (RVC, University of London)

Demand for animal-source foods: past trends and future drivers
Adam M. Komarek et al. (IFPRI)

The potential of cellular agriculture to reduce environmental impacts of food systems
Hanna L. Tuomisto et al. (University of Helsinki)

The effect of upland pasture management on cattle production
Non G Williams et al. (Bangor University)

Role of livestock in long-term soil health and agricultural productivity
Taro Takahashi et al. (Rothamsted Research)

[SESSION 2 \[Seminar Room A\]](#)

Chair: Dr Brian Cook

EAT-Lancet score and major health outcomes: the EPIC-Oxford study
Keren Papier et al. (University of Oxford)

Household dairy production and child growth: Evidence from Bangladesh
Samira Choudhury and Derek Headey (SOAS, University of London)

Replacing meat with alternative plant-based products (RE-MAP): results of a randomised controlled trial of a behavioural intervention to reduce meat consumption
Filippo Bianchi et al. (University of Oxford)

Using language to increase the attractiveness of plant-based foods
Esther K. Papias et al. (University of Glasgow)

Shifting Consumer Demand for Plant-Rich Foods: An Intervention Playbook for the Food Service Sector
Sophie Attwood et al. (World Resources Institute)

Vegetarian diets and risks of total and site-specific fractures: results from the prospective EPIC-Oxford study
Tammy Y.N. Tong et al. (University of Oxford)

OXLEAP19 CONFERENCE AT A GLANCE

13:00 – 14:00

LUNCH AND POSTER VIEWING

[Entrance Hall]

14:00 – 15:35

[SESSION 3 \[Nelson Mandela Lecture Theatre\]](#)

Chair: Dr Alexandra Sexton

Consumer Acceptance of Cultured Meat: A Systematic Review

Christopher Bryant and Julie Barnett (University of Bath)

In Search of a Structure to Come: A Meaning System of Cultured Meat in Finland?

Toni Ryyänänen and Anni Toivanen (University of Helsinki)

‘Promising the earth’: the coverage of cultured meat in the US and UK elite media, 2013-18

James Painter et al. (University of Oxford)

How *not* to: reduce food disgust

Maya Gumussoy et al. (University of Bristol)

What’s the beef?: the problematisation of meat eating and sustainable diets

Damian Maye et al. (University of Gloucestershire)

Testing the effects of environmental labelling on food selection using an experimental online supermarket platform

Christina Potter et al. (University of Oxford)

[SESSION 4 \[Seminar Room A\]](#)

Chair: Dr Michael Clark

Appraising the socio-ecological role of pasture-fed beef - as part of the UK food system and in the context of a warming planet

Claire Waterton and Dr Lisa Norton (Lancaster University)

Food system “tracers” to analyse healthy and sustainable food systems: tracing milk in India

Kerry Ann Brown et al. (LSHTM, University of London)

Environmental effects of livestock production in Europe – exploring regional differences

Marja Roitto et al. (University of Helsinki)

Sustainability of dairy specialization in Ireland depends on land use consequences and diet change context

Rémi Prudhomme et al. (National University of Ireland)

How Bad Is It? A Systematic Review of the Sustainability of Beef Production in Seven Leading European Countries

Lana Repar et al. (University College Cork)

The greenhouse gas impacts of converting livestock farming in England and Wales to organic methods

Laurence Smith et al. (Cranfield University and Royal Agricultural University)

15:35 – 16:00

REFRESHMENTS

[Entrance Hall]

16:00 – 16:45

PLENARY SESSION

Professor Andrew Balmford, University of Cambridge

[Nelson Mandela Lecture Theatre]

Chair: Professor Charles Godfray

16:45 – 18:00

POSTER SESSION AND DRINKS RECEPTION

[Entrance Hall]

PROGRAMME ABSTRACTS

SESSION 1

CHAIR: Dr Marco Springmann

[Nelson Mandela Lecture Theatre]

1. **The deforestation footprint of Brazilian beef exports**
Erasmus zu Ermgassen et al. (Université Catholique de Louvain)
2. **A systemic and participatory analysis of the commercial broiler industry in South Africa**
Kevin Queenan et al. (RVC, University of London)
3. **Demand for animal-source foods: past trends and future drivers**
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4. **The potential of cellular agriculture to reduce environmental impacts of food systems**
Hanna L. Tuomisto et al. (University of Helsinki)
5. **The effect of upland pasture management on cattle production**
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6. **Role of livestock in long-term soil health and agricultural productivity**
Taro Takahashi et al. (Rothamsted Research)

THE DEFORESTATION FOOTPRINT OF BRAZILIAN BEEF EXPORTS

zu Ermgassen, E.K.H.J., Godar, J., Löfgren, P., Sikansi, F., Klarman, S., Phare, J., Vasconcelos, A., Gardner, T., Meyfroidt, P.
Université Catholique de Louvain, Belgium

Almost one-third of global deforestation is driven by the production of commodities such as beef, oil palm, soy, and timber. Despite the importance of forests for the United Nations' Sustainable Development Goals, climate mitigation, and biodiversity conservation, commodity-driven deforestation remains challenging to eliminate, not least because these commodities are traded along complex, international supply chains which spatially separate production from consumption. Few sectors have a bigger impact than the Brazilian cattle sector, responsible for one-fifth of all commodity driven deforestation across the tropics. In this study, part of the Trase initiative (<https://trase.earth/>), we map the sub-national origin of and deforestation embedded in Brazilian meat, offal, and live cattle exports for 2015-2017, a trade worth almost \$6 billion annually. Export markets purchase 19% of Brazil's beef, shouldering 13-14% of deforestation risk, between 66,000-75,000 ha each year, releasing 24.2-30.0 Mton of CO₂/year in the process. We link these impacts to 194 exporting companies, 3,017 importing companies and 150 international markets, finding large spatial variation in the origin of sourcing and deforestation risks of different markets and products.

Three companies, JBS, Minerva, and Marfrig, who have each made a zero deforestation commitment for sourcing from the Amazon, handled 68% of Brazil's cattle exports and shouldered 65.3% of export-associated deforestation risk. 51% of this deforestation risk was linked to sourcing of cattle from the Amazon, and 47.2% from the Cerrado, where their commitment does not apply. 30.6%, 12.1%, 10.2%, and 8.3% of exports (by value) went to China, the European Union, Egypt, and Russia, who were exposed to 26.9%, 4.5%, 16.1% and 14.3% of deforestation risk, respectively. We also identify a disproportionate risk associated with the export of live cattle, which represented only 2.5% of exports by value, but were concentrated in the Amazon state of Pará and were linked to 8.7% of deforestation risk. Our results provide an unprecedented insight into the deforestation embedded in international trade and reinforce calls to improve monitoring and the scope of zero deforestation commitments in the Brazilian cattle sector in order to achieve nationwide reductions in deforestation.

A SYSTEMIC AND PARTICIPATORY ANALYSIS OF THE COMMERCIAL BROILER INDUSTRY IN SOUTH AFRICA

Queenan, K., Cuevas, S., Sobratee, N., Mabhaudhi, T., Chimonyo, M., Slotow, R., Shankar, B., Häslér, B.

Royal Veterinary College, University of London

The Sustainable and Healthy Food Systems (SHEFS) programme aims to provide evidence for policy development that delivers nutritious and healthy diets in an environmentally sustainable and socially equitable manner. A literature review and stakeholder system-mapping workshop formed the basis of a conceptual system dynamics (SD) model of the livestock-derived food (LDF) system of South Africa. This highlighted the key structural elements, the linkages to the environment, nutrition and health, and the growing predominance of commercially produced broilers. Subsequently, a whole-system and transdisciplinary analysis of the South African commercial broiler system was initiated. Methods include a scoping literature review, identification and interviewing of key stakeholders and group model building of a broiler SD model.

Per capita broiler meat consumption more than doubled from 1995-2015 and currently exceeds total red meat consumption by 46% (primarily a price-driven phenomenon). Similarly, broiler production increased by 280%, and is dominated by a few vertically integrated companies, distributing through large supermarket and quick-service restaurant chains. With recent deregulation of international trade, imports now account for 25-30% of the total broiler meat marketed, which challenges local producers.

Early results include the following: Feed crops compete for agricultural land, and yields and prices fluctuate with weather variability. Controlled-environment housing relies on non-renewable energy, whilst water use for house cleaning and meat processing is high. Recently, South Africa experienced the world's largest listeriosis outbreak, linked to processed broiler meat, emphasising the system's food safety risks and surveillance gaps.

Our whole-system approach encourages participation of a broad spectrum of stakeholders, to identify and prioritise key problem areas. Group model-building techniques allows SD model development by key stakeholders, which facilitates identification of leverage points and potential policy scenarios to simulate. This process creates a sense of communal ownership of the model, and encourages ongoing interest from participants to identify system-based solutions.

DEMAND FOR ANIMAL-SOURCE FOODS: PAST TRENDS AND FUTURE DRIVERS

Komarek, A.M., Dunston, S., Sulser, T., Cenacchi, N., Willenbockel, D., Wiebe, K.
International Food Policy Research Institute, Washington DC

This study examines past trends and future projections of human demand for animal-source foods (ASF) at the global, regional, and country scale. Projections focused on the effect of changes in human population, income, and the income elasticities of ASF demand. After examining trends in the historical demand for ASF, we simulated scenarios out to the year 2050 using a global multimarket model that focuses on the agricultural sector. Results suggest that projections of ASF demand are sensitive to changes in human population, income, and the income elasticity of demand, especially in China, India, Brazil, and USA, although assumptions about how these elasticities may change over time are subject to considerable uncertainty. Stylized scenarios for changes in the income elasticity of demand for red meat in China and India highlight the sensitivity of red meat demand to changes in consumer behaviour. Projections suggest that the growth in ASF demand is expected to be fastest in Africa, although the majority of future ASF demand is expected to come from Asia, especially China and India. Continued improvement in data and analytical methods will be critical for improved understanding of ASF demand and its implications for human health, environmental sustainability, and employment in agriculture.

THE POTENTIAL OF CELLULAR AGRICULTURE TO REDUCE ENVIRONMENTAL IMPACTS OF FOOD SYSTEMS

Tuomisto, H.L., Ernst, E., Järviö, N., Maljanen, N-L., Mazac, R., Moritz, J., Rätty, N.,
Ryynänen, T.

Future Sustainable Food Systems -research group, University of Helsinki

Food systems, especially livestock production, have a major contribution to environmental change. The possibilities to reduce the environmental impacts of conventional livestock production are limited, and therefore, more radical changes in the food production technologies are required. Cellular agriculture means the use of cell-culturing technologies for producing substitutes for livestock products. The products of cellular agriculture are grouped as cellular and acellular products. Cellular products consists of the actual cells that are cultured, for example, cultured meat that is produced by growing mammalian cells in a bioreactor. Acellular products are substances that are synthesised by the cultured cells, e.g. milk proteins or egg albumin synthesised by microbes (e.g. yeast or micro fungi).

This talk presents the current state of research on the possibilities of products from cellular agriculture to reduce the environmental impacts of livestock production. A few studies have used life cycle assessment for estimating the environmental impacts of cultured meat production in large-scale bioreactors. The results of those studies vary depending on the system design and methodological choices. As the development of cultured meat is still at the laboratory scale and it is not possible to collect data from large-scale production systems directly, the environmental impact estimates rely on many assumptions. It is also unlikely that cultured meat production technology could replace sufficient proportion of meat markets in the short term. However, cellular agricultural technologies that use microbes for producing proteins can be scaled up sooner, and have potential

to reduce environmental impacts, especially when low-emission energy sources are utilized in the production processes. The magnitude of the environmental benefits that could be achieved with these technologies depend on the level of consumers' acceptance and innovation capacity of food industries to produce new interesting products from the novel ingredients.

THE EFFECT OF UPLAND PASTURE MANAGEMENT ON CATTLE PRODUCTION

Williams, N.G., Williams, A.P., Gibbons, J.M., Chadwick, D.R.

SENRGY, Bangor University

A large proportion of the United Kingdom's agricultural land is classified as uplands. The majority of this land is used for livestock production but pasture productivity is often low. This, together with market forces, mean that cattle numbers in the uplands are declining. A continuation of this trend could compromise beef production and lead to other undesirable impacts such as the spread of invasive species. However, improving pasture productivity and grass utilisation could provide numerous benefits such as increasing the length of the grazing season, thereby reducing supplementary feed requirements and decreasing greenhouse gas emissions from agriculture. While many studies have evaluated the effectiveness of pasture improvement methods on increasing pasture productivity, few have focused on the economic and environmental outcomes in relation to the uplands.

Field trials were set up on a typical upland system in North Wales in order to investigate a) the economic and environmental cost-benefits of increasing pasture productivity in the uplands, and b) cattle performance on improved and unimproved uplands and the associated trade-offs. The results showed that while land improvements in the form of lime and fertiliser application led to an increase in upland pasture production, there were no significant interactions between pasture improvement and cattle performance. Results collected post abstract submission will enable us to better understand the effect of altering stocking rates and pasture utilisation on cattle performance. The environmental impact, nitrous oxide emissions in particular, associated with the management options will also be assessed. An improved understanding of this is important for identifying opportunities to increase production efficiencies on-farm as well as reduce greenhouse gas emissions from upland cattle systems. The red meat sector is under considerable pressure to reduce its environmental burden. The findings of this work will be of relevance to this challenge.

ROLE OF LIVESTOCK IN LONG-TERM SOIL HEALTH AND AGRICULTURAL PRODUCTIVITY

Takahashi, T., Rubio, V., Mead, A., Cardenas, L.M., Glendining, M.J., Harris, P., Macdonald, A.J., Lee, M.R.F.

Rothamsted Research

With a growing body of research associating livestock farming with global warming and health costs, a drastic shift towards plant-based diets is often suggested as an effective all-round solution. Implicitly, this argument is predicated on the assumption that reallocation of resources currently assigned to animal production systems will automatically result in efficient cultivation of human-edible crops without long-term agronomic implications. Using data from Rothamsted Research's Broadbalk wheat trial (1843–), this study quantified the marginal effect of manure applications on long-term 'soil health' and nutrient use efficiency (NUE), with a higher-level aim of examining the role of livestock in future arable farming.

We developed a novel computational method tailored for long-term data to evaluate agronomic performances of farming systems. Under the proposed framework, a nutrient freshly introduced into the system was decomposed into three possible fates: (1) instantaneously used for today's production (e.g. nitrogen content in grains); (2) reserved within the system for tomorrow's production (e.g. organic nitrogen retained in soil); and (3) lost without being used for production (e.g. nitrous oxide emitted). Long-term performances of systems were then compared between multiple treatments with and without annual applications of animal-originated organic amendments.

The results showed that short-term NUE ('today') was generally higher under inorganic systems than organic systems of comparable nutrient input rates. A closer investigation revealed, however, that such high performances were almost always accompanied by greater losses of nutrients to the environment, resulting in inferior long-term NUE ('today' + 'tomorrow') and intermittent depletion of soil nutrient stock under inorganic systems. This finding is consistent with a separate study from Rothamsted's North Wyke Farm Platform grazing trial, where higher levels of soil organic carbon were associated with greater nutrient retention in soil and more efficient animal growth. Soil microbial process that underpin these results will also be discussed.

SESSION 2

CHAIR: Dr Brian Cook

[Seminar Room A]

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Keren Papier et al. (University of Oxford)
2. **Household dairy production and child growth: Evidence from Bangladesh**
Samira Choudhury and Derek Headey (SOAS, University of London)
3. **Replacing meat with alternative plant-based products (RE-MAP): results of a randomised controlled trial of a behavioural intervention to reduce meat consumption**
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5. **Shifting Consumer Demand for Plant-Rich Foods: An Intervention Playbook for the Food Service Sector**
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Tammy Y.N. Tong et al. (University of Oxford)

EAT-LANCET SCORE AND MAJOR HEALTH OUTCOMES: THE EPIC-OXFORD STUDY

Knuppel, A*, Papier, K*, Key, T.J., Travis, R.C. *Joint first authorship
Nuffield Department of Population Health, University of Oxford

In January 2019, the EAT-Lancet Commission on Food, Planet and Health's report defined a universal reference diet to promote human and environmental health. To evaluate its association with the risk of major health outcomes, we used data from 46 069 participants enrolled throughout the UK in the European Prospective Investigation into Cancer and Nutrition (EPIC)-Oxford.

Method

Using data from food frequency questionnaires collected between 1993-2001, we created an 'EAT-Lancet score' based on the 14 key recommendations. Participants were assigned a point for meeting each of the recommendations, resulting in possible scores from 0-14. We used multivariable-adjusted Cox proportional hazards models to assess associations between fourths of the EAT-Lancet score and risk of hospitalization or death from ischemic heart disease, stroke and diabetes, and total mortality, ascertained through health record linkage.

Results

High adherence to the EAT-Lancet score was associated with lower risks of ischemic heart disease (HR for highest adherence (scores of 12-14) compared to lowest adherence (scores of 4-9) 0.72, 95%-CI 0.63-0.82) and diabetes (HR 0.41, 95%-CI 0.33-0.50) but was not associated with risk of

stroke (HR 1.06, 95%-CI 0.87-1.28) and not clearly associated with total mortality (HR 0.91, 95%-CI 0.83-1.00) in multi-variable adjusted models. No association was explained by one single recommendation, suggesting a cumulative effect.

Conclusion & discussion

In this large prospective cohort of British adults, the EAT-Lancet reference diet shows beneficial associations for ischemic heart disease and diabetes, although no association with stroke and no clear association with mortality. Still, adherence to the EAT-Lancet score might be a marker for healthy lifestyle; therefore residual confounding might operate.

HOUSEHOLD DAIRY PRODUCTION AND CHILD GROWTH: EVIDENCE FROM BANGLADESH

Choudhury, S., Headey, D.
SOAS, University of London

Research from richer countries finds that dairy consumption has strong positive associations with linear growth in children, but surprisingly little evidence exists for developing countries where diets are far less diversified. One exception is a recent economics literature using the notion of incomplete markets to estimate the impacts of cattle ownership on children's milk consumption and growth outcomes in Eastern Africa. In addition to external validity concerns, an obvious internal validity concern is that dairy producers may systematically differ from non-dairy households, particularly in terms of latent wealth or nutritional knowledge. We re-examine these concerns by applying a novel double difference model to data from rural Bangladesh, a country with relatively low levels of milk consumption and high rates of stunting. We exploit the fact that a cow's lactation cycles provide an exogenous source of variation in household milk supply, which allows us to distinguish between a control group of households that do not own cows, a treatment group that own cows that have produced milk, and a placebo group of cow-owning households that have not produced milk in the past 12 months.

We find that household dairy production increases height-for-age Z scores by 0.52 standard deviations in the critical 6–23 month growth window, though in the first year of life we find that household dairy supply is associated with a 21.7 point decline in the rate of breastfeeding. The results therefore suggest that increasing access to dairy products can be extremely beneficial to children's nutrition, but may need to be accompanied by efforts to improve nutritional knowledge and appropriate breastfeeding practices.

REPLACING MEAT WITH ALTERNATIVE PLANT-BASED PRODUCTS (RE-MAP): RESULTS OF A RANDOMISED CONTROLLED TRIAL OF A BEHAVIOURAL INTERVENTION TO REDUCE MEAT

Bianchi, F., Aveyard, P., Stewart, C., Astbury, N.M., Cook, B., Jebb, S.A.

Nuffield Department of Primary Care Health Sciences, University of Oxford

Reducing meat consumption could prevent non-communicable diseases and protect the environment. While preparing vegetarian meals requires new recipes, meat substitutes may offer an easier approach to start reducing meat intake. However, food neophobia can deter their use.

Aim and Methods

To investigate whether receiving an intervention centered on providing free meat substitutes promotes switching from meat to meat substitutes immediately and four weeks after the intervention. 115 healthy adult volunteers who ate meat regularly were recruited through advertisement and individually randomised to the intervention (N=58) or no intervention control condition (N=57). The four-week intervention comprised (i) free plant-based meat substitutes, (ii) information on the benefits of eating less meat, (iii) success stories of people who reduced their meat consumption, and (iv) recipes. The frequency of weekly meat and meat substitutes consumption was measured with a questionnaire at the baseline and at four and eight weeks and analysed using linear regression models adjusting for baseline.

Results

112 participants completed the trial and were included in the analysis. Compared with the no-intervention control, receiving the intervention led to 3.8 fewer weekly meals containing meat at four weeks ($b=-3.8$; 95%CI=-6.4 to -1.2, $p=0.004$), but there was no evidence of this at eight weeks ($b=-1.4$; 95%CI=-4 to 1.2, $p=0.28$). The intervention led to an additional 6.9 weekly meals containing meat substitutes at four weeks ($b=6.9$; 95%CI=5.5 to 8.3, $p<0.001$) and to an additional 3.4 weekly meals containing meat substitutes at eight weeks ($b=3.4$; 95%CI=1.9 to 5, $p<0.001$).

Conclusion

Interventions that expose consumers to trying meat substitutes promote their use and may reduce meat consumption, but it is uncertain whether the effect on meat consumption is durable.

USING LANGUAGE TO INCREASE THE ATTRACTIVENESS OF PLANT-BASED FOODS

Daneva, T., Semyte, G., Papias, E.K.

Institute of Neuroscience and Psychology, University of Glasgow

Consumer food choices are heavily influenced by expectations of taste and enjoyment. Plant-based foods, however, are typically anticipated to be less enjoyable than meat-based foods, especially among frequent meat eaters. To address this problem and facilitate sustainable consumer choices, we examined the potential of using language to increase the attractiveness of plant-based foods.

In Study 1, we examined the language used in the labels and descriptions of 240 meat-based, vegetarian and vegan ready meals commercially available in the UK. We found that meat-based foods were more often described with words related to sensory experiences of consuming the food, whereas the vegetarian and vegan foods were more often described in terms of ingredients. Based

on the grounded cognition theory of desire (Papies & Barsalou, 2015), we argue that sensory features in food descriptions can induce simulations of eating the food, which can increase a food's attractiveness. Therefore, in Study 2, we manipulated the labels of 40 meat-based and 40 plant-based foods to either contain features that can induce eating simulations, or not. Specifically, we modified the labels to include sensory, hedonic, and eating context features; or only food ingredients and visual features ("Burger patty with rice based on soya protein, cabbage, and beetroot pieces" vs. "Pub-favourite burger with soft soy, crispy cabbage, aromatic rice, and deliciously sweet beetroot"). 174 participants indicated for each food how attractive they found it, and whether the description made them think about what the food would taste and feel like (i.e., whether it induced consumption simulations). In line with our pre-registered hypotheses, enhanced labels increased consumption simulations and attractiveness, and effects on attractiveness were mediated by consumption simulations. Enhanced labels for plant-based foods were especially effective in influencing frequent meat eaters.

This research suggests that descriptions of plant-based foods can be improved, and that theory-based approaches to food descriptions can help facilitate the transition to a more plant-based diet.

SHIFTING CONSUMER DEMAND FOR PLANT-RICH FOODS: AN INTERVENTION PLAYBOOK FOR THE FOOD SERVICE SECTOR

Attwood, S., Mercer, C., Voorheis, P., Vennard, D.

Better Buying Lab, World Resources Institute

To combat climate change and environmental degradation, a large-scale dietary shift is now needed away from overconsumption of meat, especially from ruminant livestock (beef and lamb), and towards more climate-friendly plant-rich foods. The food service industry is uniquely positioned to accelerate this shift by adopting effective behavior change interventions in their operations to influence customers' food choices when dining out. The World Resources Institute conducted a systematic scoping review and industry consultation to identify a shortlist of 'best bet' behavior change interventions to present as guidance to potential changemakers working in the food service sector. 80 eligible academic publications were subject to full-text review from an original list of 4493 located via database searches. Following data extraction and coding, a total of 57 behavior change interventions were identified from this literature. This long list was subsequently ranked by 69 industry representatives via an online survey, yielding a final short list of 23 interventions judged better than average in terms of perceived effectiveness and feasibility to implement in practice. For both criteria, the highest ranked interventions fell under the category of 'presentation' strategies targeting menu layout and design. Industry representatives judged "Use language on menus to emphasize the positive attributes of plant-rich dishes, like their flavor, origins and look-and-feel" (score 6.31 out of 7) as most effective and "List plant-rich dishes in the main body of a menu, not in a separate 'vegetarian' box or 'specials' section" (score 6.19 out of 7) as most feasible to implement in their own operations. Full results of this research will now be published as peer-reviewed industry guidance.

VEGETARIAN DIETS AND RISKS OF TOTAL AND SITE-SPECIFIC FRACTURES: RESULTS FROM THE PROSPECTIVE EPIC-OXFORD STUDY

Tong, T.Y.N., Appleby, P.N., Perez-Cornago, A., Key, T.J

Nuffield Department of Population Health, University of Oxford

There is limited prospective evidence on possible differences in fracture risks between meat-eaters and vegetarians.

Methods

In EPIC-Oxford, dietary information was collected at baseline (1993-2001) and at follow-up (≈2010). Participants were categorised into five diet groups (≈20,106 regular meat-eaters: ≥50g of meat per day, ≈9,274 low meat-eaters: <50g of meat per day, ≈8,037 fish-eaters, ≈15,499 vegetarians and ≈1,982 vegans, with minor variations in numbers for each outcome after pre-specified exclusions) at both time points. Using multivariable Cox regression, we estimated the risks of total (n=3,941) and site-specific fractures (arm, n=566; wrist, n=889; hip, n=945; leg, n=366; ankle, n=520; other main sites i.e. clavicle, rib and vertebra, n=467) by diet group over 17.7 years of follow-up, with outcomes identified through record linkage.

Results

Compared with regular meat-eaters, vegetarians had marginally higher risks of total fractures (hazard ratios and 95% confidence intervals: 1.10; 1.00-1.20) and arm fractures (1.28; 1.01-1.63), while vegans had significantly higher risks of total fractures (1.44; 1.21-1.72) and leg fractures (2.06; 1.22-3.47), and marginally higher risks of arm fractures (1.60, 1.01-2.54). For hip fractures, the risks were higher in fish-eaters (1.28; 1.03-1.59), vegetarians (1.27; 1.05-1.55) and vegans (2.35; 1.67-3.30, p-heterogeneity<0.0001) than regular meat-eaters. There were no significant differences in risks of wrist, ankle or other main site fractures by diet groups. Overall, the significant associations appeared stronger without adjustment for body mass index (e.g. 1.52; 1.27-1.81 in vegans for total fractures), and were slightly attenuated with additional adjustment for total protein (1.41; 1.17-1.69) or dietary calcium (1.32; 1.10-1.59).

Conclusions

Overall, non-meat eaters, especially vegans, had higher risks of either total or some site-specific fractures, particularly hip fractures, which may be partially related to lower body mass index or lower dietary intakes of protein and calcium in these diet groups.

SESSION 3

CHAIR: Dr Alexandra Sexton

[Nelson Mandela Lecture Theatre]

1. **Consumer Acceptance of Cultured Meat: A Systematic Review**
Christopher Bryant and Julie Barnett (University of Bath)
2. **In Search of a Structure to Come: A Meaning System of Cultured Meat in Finland?**
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3. **'Promising the earth': the coverage of cultured meat in the US and UK elite media, 2013-18**
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6. **Testing the effects of environmental labelling on food selection using an experimental online supermarket platform**
Christina Potter et al. (University of Oxford)

CONSUMER ACCEPTANCE OF CULTURED MEAT: A SYSTEMATIC REVIEW

Bryant, C., Barnett, J.

Department of Psychology, University of Bath

Cultured meat grown in vitro from animal cells may become available to consumers within a few years. This new technology has the potential to realise many benefits relative to conventional meat production, including in sustainability, animal welfare, and public health. However, concerns have been raised about whether cultured meat will appeal to consumers. We present a review of the empirical evidence on consumer acceptance of cultured meat. We find that, while rates of acceptance vary across surveys, some demographics including men, younger people, and politically more liberal people, are more open to cultured meat. We find that most consumers recognise animal welfare benefits, and many recognise environmental benefits, whereas relatively few perceive personal benefits. Food safety appeared to be the most prominent concern, and is likely linked to perceived unnaturalness. Consumers also express doubts about the taste, texture, and price of cultured meat. Quantitative research has demonstrated that measures of acceptance are sensitive to positive and negative information provision, different descriptions and framings of cultured meat, different names for cultured meat, the perceived popularity of cultured meat amongst others, and personal familiarity with cultured meat. Further research has explored consumer opinions of cultured meat across different countries, finding that acceptance seems to be higher in Asia than the United States, and higher in the United States than Europe. We synthesize this research to present a view of how different consumers conceptualise cultured meat, what issues they are concerned about, what benefits they value, and how their views are shaped by different presentations of the technology.

IN SEARCH OF A STRUCTURE TO COME: A MEANING SYSTEM OF CULTURED MEAT IN FINLAND?

Ryynänen, T., and Toivanen, A.

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The concept of “post farmed animal bioeconomy” describes novel activity in the food sector where the conventional animal products and their production methods are replaced with the alternatives. Cellular agriculture or technologies using cell cultivation to produce agricultural products such as cultured meat, is an example of this novel bioeconomy in action. However, cultured meat is not available on the marketplace and consumers have not tried it yet. Meanwhile, the media presents increasingly novel foods and the related technologies to consumers leaving them wondering about product attributes, new technologies and the science contextualising these innovations. Although the media publicity of and consumers’ perceptions about cultured meat is already studied, people’s reactions to cultured meat are still rather unknown. Our paper presents an on-going research: the purpose is to examine the currently developing meaning system of cultured meat and to identify the themes the people tend to attach to cultured meat. The data consists of 743 naturally occurring comments (i.e. not influenced by the researchers) about cultured meat from the Finnish news audiences. The second author collected the material from the web and the related social media sites including a news article (N=11, 2013-2019) about cultured meat and a free text box for the readers to leave their comments. The developing meaning system of cultured meat will be analysed later in detail. However, the preliminary classification of the topics and the key themes revealed that the tone of people’s opinions ranged from anticipatory positive to fearfully pessimistic. Examples of positive themes include increased animal well-being, human health, sustainable production and full utilisation of novel technologies whereas negative comments revolved around the quality or originality of the product, distrust towards technically tuned foods and overall justification for producing something inferior to the conventional meat or unsustainable compared with vegan alternatives.

The research is part of a project “Cultured meat in post-animal bioeconomy - changing relationships between humans and farmed animals” funded by the Kone Foundation 2019-2022 (grant no: 201802185).

‘PROMISING THE EARTH’: THE COVERAGE OF CULTURED MEAT IN THE US AND UK ELITE MEDIA, 2013-18

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‘Cell-based’, ‘cultured’ or lab-grown’ meat has attracted a considerable amount of interest in recent years as an early-stage technology. While scholars are mapping new investment in the field, an updated analysis of the media coverage since 2013 is missing.

Despite uncertainty surrounding the future benefits, risks, and downsides of cell-based meat, news media may already be playing a key role in contributing to the (over-) promissory discourses around it, stressing the potential benefits to the environment, health, animal welfare and feeding a growing

population. In particular, we assess the critique made by Stephens et al. (2018, p 161)* that the abundance of ‘aspiration rhetoric’ surrounding cell-based meat is ‘fueled largely by corporate and media actors’, which ‘has made for <...> an at times prematurely optimistic discourse’.

To test the robustness of this observation, we ask the following research questions:

1. Who or what are the most common news pegs for prompting the mainstream media to cover cultured meat issues?
2. Who is being given space by the media to discuss cultured meat?
3. What are the most common promissory and cautionary narratives used to shape the discussion?
4. To what extent do the news articles show positive, neutral/balanced, or negative sentiments towards cultured meat?

In order to seek answers to these questions, detailed content analysis was conducted on 244 articles from the print and online versions of 12 US and UK legacy media outlets from 1 January 2013 (to include the year when the first lab-grown burger was launched) to the end of March 2019. Early results suggest that much of the coverage is indeed prompted by the industry, and key voices are often marginalised. The media treatment of cell-based meat is overwhelmingly positive.

* Stephens, N., et al. (2018). Bringing cultured meat to market: Technical, socio-political, and regulatory challenges in Cellular Agriculture. *Trends in Food Science & Technology*, 78, 155 -166

HOW NOT TO: REDUCE FOOD DISGUST

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Insects are a more sustainable and nutritious alternative to conventional livestock. However, consuming them is perceived as disgusting among the Western population. This study investigated the effectiveness of educational information to reduce disgust towards eating insects. Participants (n = 104) attended the lab for two test sessions on separate days. In the first session their ad libitum intake of falafels was measured in order to control for individual differences in meal size. In the second session they were asked to evaluate, and eat, different falafels which some were led to believe contained mealworm flour.

There were four conditions, which differed according to information provided in a short passage:

- 1) Control – participants informed falafels contain chickpeas.
- 2) Mealworm – participants informed falafels contain mealworm flour.
- 3) Mealworm + education – participants informed falafels contain mealworm flour and various nutritional and environmental benefits of entomophagy were summarised.
- 4) Threat – participants informed falafels contain chickpeas and that the experiment would include an experience of mild pain (to control for general negative arousal).

Importantly, the falafels were the same for all participants and did not contain mealworm flour. Disgust was measured using: tactile sensitivity, liking for and desire to eat the falafels, latency to eat and amount of falafel consumed. Contrary to prediction, participants in the Mealworm + education condition showed significantly greater disgust (lower liking, desire to eat and intake) than those in

the Control condition, whereas these measures did not differ significantly between the Control and Mealworm conditions. These findings could be attributed to the Mealworm passage normalising the cooking of mealworms thus transforming them into ‘food’, while the rational arguments included in the Mealworm + education passage were insufficient to reduce the deep-rooted, irrational, disgust response. These results suggest that using rational educational arguments to reduce food disgust towards entomophagy is relatively ineffective.

WHAT’S THE BEEF?: THE PROBLEMATISATION OF MEAT EATING AND SUSTAINABLE DIETS

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This paper examines the recent debate about meat eating and sustainable diets. More specifically, we consider meat eating as a ‘hot topic’ debated in public discourse in response to the publication of the EAT-Lancet Commission (2019) ‘Food in the Anthropocene’ report. This report called for a radical shift and reduction in the amount of meat, particularly red meat, we consume as a society to reverse negative food system impacts on the planet. The report sparked significant public debate. Using Twitter data and analysis of newspaper articles, we analyse the report and the response its recommendations generated. As well as examining this specific moment of meat eating problematisation, we consider also strategies of responsabilisation proposed to address the problem, including counter-strategies that contest the science behind the publication, differentiating, for example, between different systems of meat production or challenging the nutritional logic of reduced meat diets.

The ‘sustainable diets’ concept (Mason and Lang, 2017) raises important questions regarding the ethics of food production consumption, including entanglements with humans and nonhumans and the social and political implications of transitioning to food choices where we eat less meat and more plant-based alternatives. The case study raises wider questions about planetary boundaries and ethics and accountability in agri-food governance. This includes consideration of the way food politics is evolving in the public sphere, particularly the role of social media as an arena of interaction that generates debate and in some cases leads to direct confrontation between ethical values, social norms and sustainability choices.

TESTING THE EFFECTS OF ENVIRONMENTAL LABELLING ON FOOD SELECTION USING AN EXPERIMENTAL ONLINE SUPERMARKET PLATFORM

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The environmental impacts of foods are highly variable. To enable consumers to make environmentally informed purchases, they need relevant information about the environmental impact of food products. In this experimental study we examine the individual and combined effects of two types of eco-labels: (i) a multi-indicator logo comprising four environmental indicators (greenhouse gas emissions, water scarcity, water pollution, and biodiversity loss) and (ii) a total environmental impact score. This factorial randomised controlled trial will test whether these labels enable consumers to select foods with lower environmental impacts.

Methods

UK adults who are not vegetarian or vegan will be invited to take part in an experimental online supermarket study. Participants will be randomly allocated to one of four groups whereby all products on the supermarket platform are displayed with (i) a product-specific multi-indicator environmental sustainability logo, (ii) a product-specific total environmental score logo, (iii) a combination of both logos, or (iv) no logo (control). Participants will be asked to select items to complete a pre-specified 10-item shopping task. The list will contain items from food categories that will allow participants to select between higher and lower impact products for each item. The store offers around 25,000 products and closely mimics the style of a major UK retailer. The study will be completed in September 2019.

Results

We will present results from the trial based one-way ANOVA to assess differences in the total environmental impact score of the shopping basket between each of the four groups. We will also examine differences in the nutrient profile and total cost (in £) of the shopping basket between groups.

Conclusions and implications

This experiment will assess whether environmental labelling alters food choices and provide preliminary evidence of the type of labels that may be most effective in changing purchasing behaviours.

SESSION 4

CHAIR: Dr Michael Clark

[Seminar Room A]

1. **Appraising the socio-ecological role of pasture-fed beef - as part of the UK food system and in the context of a warming planet**
Claire Waterton and Dr Lisa Norton (Lancaster University)
2. **Food system “tracers” to analyse healthy and sustainable food systems: tracing milk in India**
Kerry Ann Brown et al. (LSHTM, University of London)
3. **Environmental effects of livestock production in Europe – exploring regional differences**
Marja Roitto et al. (University of Helsinki)
4. **Sustainability of dairy specialization in Ireland depends on land use consequences and diet change context**
Rémi Prudhomme et al. (National University of Ireland)
5. **How Bad Is It? A Systematic Review of the Sustainability of Beef Production in Seven Leading European Countries**
Lana Repar et al. (University College Cork)
6. **The greenhouse gas impacts of converting livestock farming in England and Wales to organic methods**
Laurence Smith et al. (Cranfield University and Royal Agricultural University)

APPRAISING THE SOCIO-ECOLOGICAL ROLE OF PASTURE-FED BEEF - AS PART OF THE UK FOOD SYSTEM AND IN THE CONTEXT OF A WARMING PLANET

Waterton, C., and Norton, L.
Lancaster University

In this paper we outline the socio-ecological methods and preliminary findings of the UK GFS programme’s “SEEGSLIP” project (“Sustainable and Ecological Grazing Systems – Learning From Innovative Practitioners”). The research (2018 - 2021) aims to understand and evaluate the methods of farmers who have changed their production systems in order to produce beef on a 100% grass/pasture diet (no grain or other feed in the diet). The certification body for this kind of production – Pasture for Life Association (PfLA) – supports farmers producing in this way and claims multiple benefits of a 100% grass/pasture diet in ruminants, including: improved soil fertility, carbon capture, increased flood and drought resilience, efficient land use, decrease in fossil fuel use, support of biodiversity, animal welfare and benefits to human health. Our preliminary ecological and sociological field results from PfLA certified farms across the UK will be explored in this presentation with reflections on each of the above issues. The paper will consider the way in which the farmers’ innovations in pasture and cattle management usher in a substantially altered set of relationships on the farm, involving changes in landscape, ecology, and the social, technical and capital supports within the system. At a time when eating red meat is high on the public agenda regarding health and environmental issues, we aim to open up for discussion the potential role for pasture-fed beef as a way of addressing planetary warming, biodiversity loss and ethical/healthy meat consumption.

FOOD SYSTEM “TRACERS” TO ANALYSE HEALTHY AND SUSTAINABLE FOOD SYSTEMS: TRACING MILK IN INDIA

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A challenge for Indian policy makers is to minimise the environmental footprint of milk consumption and production, whilst protecting public health and social welfare. The aim of this work is to trace the ‘journey’ of milk through the Indian food system to help inform policy implementation/options that can enable a healthier and more environmentally sustainable and equitable food system.

A case study design and multiple data collection methods are used to analyse the food system from diverse perspectives. These methods included a scoping [grey/white] literature review of milk policies and value chain analyses; qualitative semi-structured interviews with key actors; and community engagement via photovoice participatory action research. Data are combined using thematic analysis and a coding template based on three a priori areas: i) current policy context; ii) current policy coherence & alignment across health, environment, equity objectives; iii) future policy opportunities.

Preliminary results support the complex challenges and opportunities that arise from India being the largest producer of milk in the world. Public health policies such as food-based dietary guidelines encourage domestic milk consumption as an efficient means of achieving sufficient population calcium intake, especially in childhood and adolescence. Agricultural policies support dairy production and the associated beneficial employment and income generating opportunities, particularly for marginal and women farmers. There is a growing concern, however, as to how the dairy industry can negate negative environmental impacts, such as chemical pollution (antibiotic, pesticide, fertiliser use), risks to bio-/genetic-diversity, overuse of resources (water) and GHG/carbon emissions.

Further analysis will inform transformative labs, system dynamics modelling and multi-criteria mapping analysis, where key actors will identify feasible opportunities for aligning policy goals, such as considering how changes in milk production and consumption can inform sustainable food-based dietary guidelines or help to achieve multiple state/national/international Sustainable Development Goals.

ENVIRONMENTAL EFFECTS OF LIVESTOCK PRODUCTION IN EUROPE – EXPLORING REGIONAL DIFFERENCES

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Environmental impact of livestock production varies across different regions in Europe due diverse agricultural management practices and livestock production systems. The specialization and intensification of European farming systems during last decades has increased productivity but also led to increased pressure on the environment. The combination of high productivity, efficient land use, low greenhouse gas emissions and low pressure on local environment seems to be difficult to meet. Netherlands has efficient production per unit of agricultural land, but environmental pressure such as ammonia emissions, nutrient surpluses and use of pesticides are also high per unit of land. Various methods have been developed for evaluation and quantification of environmental effects of livestock production, such as agri-environmental indicators and life cycle assessment that is used to quantitatively model environmental effects of products over all stages of its life cycle. Comparison and ranking of the systems or countries depend on selected impact category and which functional unit is used. Special attention has been paid on the greenhouse gas emissions of livestock sector, whereas, for example, biodiversity, soil carbon sequestering, land use and land use change and ecotoxicity are less studied.

The aims of this study is to compare environmental effects of livestock production in selected European countries that differ in number, density and distribution of the livestock species. In addition, we evaluate differences between production systems. We pool environmental and production data and use two different frameworks for evaluating environmental impact of the agriculture and more specifically livestock production 1. Driving forces–Pressures–State–Impact–Responses framework (agri-environmental indicators) and 2. Life cycle assessment analyses. We use principal component analysis to identify the main factors of pressure caused by livestock production and test two clustering methods (K means and fuzzy C means) for grouping the regions. The initial results will be discussed in this talk.

SUSTAINABILITY OF DAIRY SPECIALIZATION IN IRELAND DEPENDS ON LAND USE CONSEQUENCES AND DIET CHANGE CONTEXT

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The Food Wise 2025 seeks to double the value of Ireland's agri-food exports between 2014 and 2025, with a focus on the dairy sector. Meanwhile, Ireland faces a major challenge to meet international commitments on climate change, and has set an ambitious target of "carbon neutrality" in the agriculture, forestry and other land use (AFOLU) sector. The SeQUESTER project is exploring pathways to reach sustainable "carbon neutrality" by 2050. One of these pathways involves the specialisation of livestock towards dairy production, minimizing beef production. This could potentially reduce emissions per calorie produced whilst allowing for alternative land uses

(CCAC 2019), such as afforestation to increase carbon sequestration. However, this specialisation could lead to negative side effects, such as high nutrient surpluses on intensive specialised dairy farms and the possible displacement of beef production to countries with high emissions intensities per kg of beef produced. Currently, the global demand for beef is much higher than the world meat production from dairy cattle, but this could change by 2050 depending on long-term trends in diet and development of 'lab meat'.

In this paper, we explore the national and global environmental trade-offs resulting from the specialisation of Irish livestock production, including: (i) reduced AFOLU emissions; (ii) enhanced carbon sequestration through afforestation on spared land; (iii) increased nutrient surpluses associated with dairy intensification; (iv) international GHG and nutrient "leakage" via international displacement of beef production. We focus on the influence of wider diet and land use contexts on these trade-offs by evaluating environmental outcomes for different specialization scenarios using a consequential life cycle assessment framework (Styles et al. 2015), and including downstream carbon implications of harvested wood products (IPCC 2006) and emissions associated with additional beef production outside Ireland (FAO 2018). The study emphasizes the importance of combining both supply and demand side measures to avoid pollution displacement and/or pollution swapping in livestock climate mitigation strategies.

References:

CCAC. 2019. Annual Review 2019. Climate Change Advisory Council. Dublin. ISBN: 978-1-84095 – 848-5.

FAO. 2018. 'Global Livestock Environmental Assessment Model'.

IPCC. 2006. 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Agriculture, Forestry and Other Land Use. <http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.html>.

Styles, David, James Gibbons, Arwel Prysor Williams, Heinz Stichnothe, David Robert Chadwick, and John Robert Healey. 2015. 'Cattle Feed or Bioenergy? Consequential Life Cycle Assessment of Biogas Feedstock Options on Dairy Farms'. <https://doi.org/10.1111/gcbb.12189>

HOW BAD IS IT? A SYSTEMATIC REVIEW OF THE SUSTAINABILITY OF BEEF PRODUCTION IN SEVEN LEADING EUROPEAN COUNTRIES

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Agriculture continues to underperform in relation to sustainability goals, despite its key role in global food production, the state of consumers' health and the economy. The latest data show that agriculture contributes to 11% of greenhouse gases and 92% of ammonia emissions in Europe, with the beef sector globally responsible for approximately 105 kg of CO₂eq per 100g of protein. Furthermore, none of the EU countries are likely to achieve their targets for reducing carbon emissions by 2020. France, Germany, United Kingdom, Italy, Ireland, Poland and Spain are the main players in the beef sector and account for 80% of European beef production, therefore developing sustainability policies across these countries needs to account for country and sector dependent characteristics.

The aim of this study was to determine the sustainability levels of beef production in the leading countries to allow for a macro view of sustainability across the European beef sector. A systematic review, using a PRISMA protocol, was undertaken to examine studies reporting results of the environmental, economic and social impact of beef production in the leading European countries

across three databases between 2017-2019. An initial search recorded 4,179 published works, which was reduced to 34 original studies included in this current study, following the application of specific eligibility criteria. The aggregated data showed that sustainability levels in the leading European countries were moderate across the triple bottom line. The United Kingdom showed the most consistent sustainability levels in beef production, while France had the lowest levels. This study concludes that the European beef sector requires more efficient measures for achieving sustainability at both an individual country level and at a European level. This is especially important for current and future European trade deals and market opportunities, since consumer insight trends reveal a strong demand for more sustainable production practices.

THE GREENHOUSE GAS IMPACTS OF CONVERTING LIVESTOCK FARMING IN ENGLAND AND WALES TO ORGANIC METHODS

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Livestock farming is particularly implicated within UK Government commitments to net-zero greenhouse gas (GHG) emissions. Commentators have therefore called for a shift to lower-meat diets and there has been a growing interest in the GHG mitigation potential of low-input livestock systems such as organic farming. We therefore assessed the extent to which a 100% shift to organic farming could contribute to GHG reduction in England and Wales, using linear programming and Life Cycle Assessment.

Overall livestock product outputs fell sharply compared to a non-organic baseline. Beef and sheep production increased, potentially leading to a conflict with national dietary recommendations, while monogastric outputs fell sharply. Direct GHG emissions from livestock were reduced under organic farming, but when the increased overseas land use required to compensate for shortfalls in domestic supply was factored in, net emissions were greater. Enhanced soil carbon sequestration could offset only a small part of the higher overseas emissions under most scenarios.

There are undoubted local environmental benefits to organic livestock farming, however these benefits need to be set against the requirement for an expansion in agricultural production areas. As well as increased GHG emissions from compensatory changes in land use, there are substantial opportunity costs from reduced availability of land for other purposes, such as greater C storage under woodland. A widespread conversion to organic farming is therefore infeasible without substantial changes to national diets and/or organic farming systems, if net-zero is to be achieved.