LSE Sustainability Symposium: The Role of Behavioural Change Versus Systemic Change in Accelerating the Transition to a Net Zero Agri-Food Sector

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ABSTRACT

In many higher-income countries, efforts to reduce emissions in the agri-food sector, which accounts for around 30% of global emissions, have been less successful than in other sectors such as energy and transport, where technological change rather than behaviour change has played a central role in driving emissions reductions. This paper, in the context of insights from the behavioural sciences and economics literatures, explores policies that have been put in place in higher-income countries to reduce food waste and livestock emissions, two of the largest contributors to the sector's emissions, where the potential for emissions reduction is considerable and conceptually simple to articulate, but in practice has proven to be tricky. The paper suggests that, particularly with respect to livestock emissions, where a reduction in meat consumption could have considerable negative repercussions across the supply chain, a shared vision of the future of food could help to accelerate the transition to net zero.

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1 INTRODUCTION

The agri-food sector is under increasing pressure due to climate change. This is both in terms of the impacts that the changing climate is having on food production and food security, and the need for the sector as a whole to reduce its emissions. In the EU, for example, total emissions have fallen by around a third since 1990, primarily through a move away from fossil fuels towards cleaner energy sources, and through structural changes in power generation, incentivised by policies such as Europe's Emissions Trading System (EU ETS) (1). Yet progress on emissions reduction has been much slower in the agri-food sector, globally and within the EU. In the latter, whilst emissions intensity has fallen in some areas, agricultural production has increased, and total emissions have hardly changed since 2005 (2).

Bringing together insights from the behavioural sciences and the economics literatures, this paper explores the role of technological change versus behavioural change, and individual versus systemic change, in the context of reducing the agri-food sector's emissions; considers why insufficient progress has been made in reducing emissions in this sector; and evaluates whether there are opportunities to accelerate change. The paper focuses on food waste and livestock emissions, which are two of the largest drivers of the sector's emissions, and where the potential for emissions reduction is significant in theory but has yet to be achieved in practice. Reducing emissions has the potential to not only tackle climate change, but to improve health, food security, and biodiversity.

In higher-income countries, consumer-level food waste is the main contributor to food loss and waste (3). Reducing such waste could offer multi-dimensional benefits, with the potential to reduce food-related emissions, save people money, put downward pressure on prices, and increase the likelihood that there is more food available for those finding it hardest to access, thereby improving food security. Whilst there are discussions as to the extent to which some pastureland is suitable for growing crops, reducing excess meat consumption in higher-income countries nonetheless has the potential to free up some land to grow crops that people can eat; to reduce deforestation; and more broadly, to enhance habitats for pollinators and biodiversity, such as through rewilding and regeneration of pastureland.

In seeking to speed up the transition to net zero, economists have tended to focus on a 'menu of traditional policy instruments' available to policy makers (4). These include price-type instruments, such as taxes and subsidies; rights-based instruments, including tradable permits and quotas; regulation, such as technological and performance standards; and information and legal systems, including public participation, information disclosure, and voluntary agreements. Price-type instruments can create incentives for individuals to change their behaviour, mediated through the market, while well-enforced regulation-type instruments may have a more direct impact on individual behaviour (4). Both types of instruments can also drive technological change (5) which in turn can reduce the need for individual behaviour change to some extent, even if only for the short term.

Behavioural scientists have also sought to address how to tackle climate change, often concentrating on altering individual behaviour. This has been the focus of most government behavioural units, although some interventions focus on making sustainable behaviours, such as reducing food waste, easier, while a small group of interventions address 'embedding behavioural principles into laws, incentives, and infrastructure' (6). But this focus on individual behaviour change is increasingly being critiqued. For example, Chater and Loewenstein (7) suggest that 'proponents of i-frame [individual behaviour] policy, including ourselves, may have inadvertently weakened support for crucial systemic changes [s-frame]', Others also suggest that there is more evidence that structural, or systemic, interventions may be more effective than interventions aimed at individual-level behaviour change (8, 9).

The next section contextualises the issue, addressing the extent to which agri-food emissions have evolved over time, and the policies and initiatives that have either been put in place to reduce emissions from food waste and livestock, or that have been proposed. Section three discusses these policies and the possibilities for reducing emissions in the context of individual behaviour change, technology, and systemic change. Section four concludes.

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2 CLIMATE CHANGE AND THE AGRI-FOOD SECTOR

Agriculture currently is estimated to be responsible for around 12% of global emissions (2021 data). But the agri-food sector as a whole, including production, processing, transport, and packaging, accounts for a far larger share of emissions, with 2022's emissions estimated to be around 16.2 billion tons, accounting for 29% of total GHG emissions (10). These emissions variously come from crop and livestock activity within the farm (approximately 48%); land use change (19%); and pre- and post-production activities (33%). Until around 2020, agriculture emissions had been increasing each year (from around 14 billion tons in 1990 to 17 billion tons in 2019 (11)), although recently they appear to have fallen, albeit only by a small amount, to an estimated 16.2 billion tons in 2022 (Figure 1).

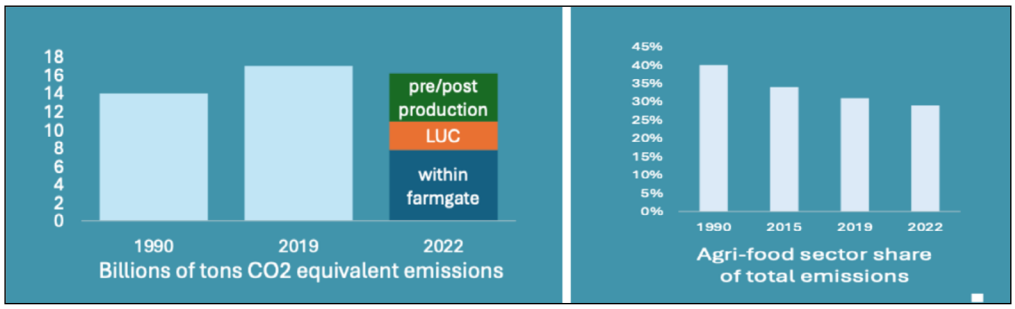


Figure 1 Contribution of Agrifood Systems to Global Emissions.

LHS shows absolute emissions and whether from within the farmgate, due to land use change, or linked to pre and post production; RHS shows sectoral share of emissions. Source. FAO data, https://www.fao.org/faostat/en/#data.

Food waste and the raising of ruminants account for a large share of the agri-food sector's emissions. Livestock are estimated to be responsible for between 12% and 19.6% of all anthropogenic greenhouse gas emissions (12, 13). Approximately 80% of all agricultural land (including pastures and cropland) is used for meat and dairy production, while less than half of the global production of cereals is directly consumed by humans (14). Waste is found across global supply chains from farm to fork, with around 30% of food produced for human consumption being lost or wasted. Not only is this worth around $1 trillion US, but it accounts for around 8–10% of total GHG emissions (15, 16, 17). The stage at which the loss and waste occurs in the sector, however, varies geographically. In higher-income countries food waste tends to be more 'late stage', whether discarded by retailers or consumers (3), while in lower-income countries, waste and loss tend to be at early stages, often due to a lack of adequate storage facilities, inefficient transport, and poor handling (18).

2.1 OPTIONS FOR REDUCING LIVESTOCK EMISSIONS

Conceptually there are a number of ways that emissions linked to livestock, especially cattle, can be reduced. One approach, deceptive in its simplicity, is for people to consume less animal protein (and dairy), switching instead to more plant-based, or even insect, proteins. Insects are an important protein source in some parts of the world, offering both high nutritional value and environmental benefits (19). But it is likely to be hard for countries culturally used to eating meat to adapt to a fully plant-based (or insect-based) diet that contains the full range of amino acids and essential minerals (20).

A reduction in meat consumption requires explicit behavioural change which could be achieved through regulation; a 'meat tax'; or nudges, perhaps linked to climate, health, biodiversity, or animal welfare. In higher-income countries, calls for a meat tax have grown, often framed around reducing emissions from ruminant livestock (21). Such a tax can be appealing in theory, at least to many environmental economists. If implemented as a Pigouvian tax, a levy designed to make producers and consumers bear the full social cost of their activities, it would provide incentives for producers to reduce methane emissions, consumers to cut their meat consumption, and entrepreneurs to develop alternatives, whether lab grown meat, or insect or plant-based proteins. That is, the tax can drive both behavioural change by consumers and technological change by producers.

Redistributing revenue from the tax could motivate people to support it. Economists have estimated that if redistribution were 'in the form of uniform lump sum payments at the end of each year perhaps, most people on low incomes would have more money than before the

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tax reform' (22). In contrast, Lee et al. (23) suggest that the tax would not raise revenue in the UK but would cost the economy almost £250 m per year, with just £101 m of social benefit through reduced emissions. The discrepancy in findings is driven in part by assumptions over the cost of carbon. The latter assume a cost of carbon at £41 per ton of CO_2 equivalent, which is arguably too low, suggesting Lee et al.'s findings understate considerably the potential benefits of a meat tax.

These calculations notwithstanding, there is insufficient understanding of how lower-income households in particular would adjust their consumption in the event of a meat tax, even with a cash rebate at the end of the year. For example, households might end up spending more on meat and less on fruits and vegetables. Households might eat more processed meat, which can have greater negative health impacts; eat meat from lower-welfare livestock; or more broadly eat lower-quality meat (24). In the context of a sugar tax, ignoring such a 'quality response' to a price increase has been shown to overstate the positive health or environmental impact of the tax (25, 26). Moreover, tax and lump sum redistribution is not always popular with the general public, despite tending to be popular with economists (27, 28).

Finally, a tax does not necessarily address the root causes of emissions. While two cows might belch the same quantity of methane, one might be raised on pastures not suited to growing crops whilst the other might be fed on soy that was grown on land that was converted from tropical forest. As such, a Pigouvian methane tax might not be efficient when all factors are considered.

Very few countries have actually sought to implement some version of a meat tax. In 2022, New Zealand proposed a carbon tax on farmers, focussed on methane from livestock, although it was never implemented after a change in government. The Danish government has introduced a livestock emissions tax (29), which comes into force in 2030, and starts at $40 per ton of methane and increases to around $100 in 2035. Farmers can avoid the tax if they cut their emissions by 40% of current average. Farmers can also be paid $100 per ton if they reduce emissions from nitrogen fertilisation; and there are policies to restore forests and protect peatlands. This policy is too new to know whether it will work and whether it can be replicated.

Regulation is an alternative policy instrument, but similarly, few countries have taken this approach to reduce livestock emissions. The Netherlands, albeit primarily in response to concerns over nitrogen's impact on biodiversity and water quality rather than climate and methane, is introducing a cap on herd size when farm ownership changes hands (30).

Beyond these examples, the policy landscape tends to be dominated by voluntary initiatives and technical solutions. New Zealand introduced a national target for reduced methane emissions, though the target has been lowered since its original setting in 2019 (31). Ireland's Food Vision 2030 strategy includes a target of 10% reduction for biogenic methane by 2030 from a 2018 baseline and emphasises breeding programmes to select low-methane traits in livestock.

Yet technical solutions have, to date, tended to prove ineffective and/or costly. For instance, it is possible to reduce ruminant methane emissions whether through dietary changes, feed additives, vaccines, or genetic selection. While some estimate such interventions could reduce methane emissions by between 20% and 50% (32), others suggest that 'technologies to safely and consistently reduce enteric methane emissions are practically non-existent at the scale required' (33). Nor are technological fixes guaranteed to be accepted by the public. Lab-grown meat is perhaps the most obvious transition, but it is likely only to become a reality at scale with significant regulatory and tax incentives and may still be resisted by consumers. And even if feasible, recent estimates suggest that the footprint of such meat is currently higher than for conventional livestock, due to the need for a 'highly refined growth medium' (34).

Finally, per capita meat consumption in a number of higher-income countries is already falling, without explicit price or regulatory policies (35). In the UK, meat consumption fell by 14% between 2012 and 2022. This was, in the main, not out of climate concern, but due to a number of factors, including the cost of living crisis (36); health concerns, in particular the possible links between high consumption of processed red meat and cardio-vascular disease and some cancers; environmental concerns that include climate and deforestation; and animal welfare concerns (37, 38). Europe as a whole has similarly seen a fall in meat consumption, though overall a more modest decline, with considerable heterogeneity across countries.

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2.2 EFFORTS TO REDUCE FOOD WASTE

Targets combined with regulations and nudges appear to be the preferred policy mix in many countries with respect to reducing food waste. Some countries, including Australia and Norway, are explicitly aligning policies with the United Nations' Sustainable Development Goal 12, which aims to 'ensure sustainable consumption and production patterns', and 'to halve per capita global food waste (39) at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses' by 2030 (40). For example, Norway committed to reducing food waste by 50% by 2030 through a voluntary agreement that covers the whole food value chain. Nudging, including encouraging households to throw away less food, has been recommended by the Norwegian Food Waste Committee (41).

China has taken a multi-pronged approach to reducing food waste, beginning in the 2020s, including legislation, public awareness campaigns, and technological approaches. Prior to these efforts, approximately 6% of the country's food production was discarded, with half of that being wasted pre-prepared meals. Under the Anti-Food Waste Law 2021, restaurants can be fined for excessive waste, while the 'Clean Your Plate' campaign encourages citizens to finish food rather than discarding it. China has also sought to utilise waste, both to produce biogas, and to improve storage and agriculture methods. Much of its efforts address specific elements of Chinese culture, where over-ordering has been a display of hospitality.

Supermarkets have been blamed in part for food waste in higher-income countries (42). For example, supermarkets may reject what they consider less than perfect, or 'wonky', produce (sometimes implicitly blaming the shopper in the process). Even small imperfections can result in crops being left in fields unharvested, or supermarkets can switch to a cheaper supplier, again leaving crops unharvested and uneaten (43). Pre-packaging of fruits and vegetables, buy one get one free offers, too-stringent best before and use by dates, can all lead to food being wasted in supermarkets or in homes. The UK government has considered a policy of mandatory reporting of food waste for large businesses, and there is evidence that such mandatory reporting can help businesses cut costs (44). Away from government, apps have been introduced, including one called 'Too Good To Go".

UNEP's Food Waste Index report finds that '[o]nly four G20 countries, Australia, Japan, UK, and USA, and the European Union, have food waste estimates suitable for tracking progress to 2030' (45). WRAP estimates that around a quarter of food produced in the UK is 'lost or wasted' each year, worth £21bn (46). England does not have mandatory targets for reducing food waste (47). Yet, overall the UK has been one of the more successful countries, having reduced food waste by 31% (15). Industry has adopted voluntary agreements to reduce food waste, and supply chain waste has been estimated to have been reduced by around a fifth between 2007 and 2021 (48).

3 DISCUSSION

To achieve a rapid reduction in emissions in the agrifood sector may, at first glance, appear particularly tricky. The global population is growing, there is a need to maintain a sufficient food supply, and rates of food insecurity and undernutrition are already higher than they would have been without the effects of climate change to date (49). Both how food is grown and what people eat will have to change considerably if net zero targets are to be achieved and if populations are to be food secure.

Reducing emissions from food waste and livestock should have the potential for climate and food security gains. As section 2 demonstrated, countries have alighted on a range of methods to motivate changes in behaviour and technological innovation. Regulatory standards for meat and dairy farms have been set; taxes have been used to deter methane emissions; cap-and-trade programmes have allowed farmers to sell carbon credits; while information policy and nudges can be used to motivate people to change their behaviour. Yet to date, focussing particularly on higher-income countries where most people are food secure, emissions linked to the agri-food sector have hardly been falling, suggesting that the variety of environmental policy instruments that could and are being used are not sufficiently effective.

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In the energy and transport sectors, technology has done much of the heavy lifting. For example, innovations in wind and solar power and batteries have enabled a switch to renewable energy, more efficient energy systems, and electric vehicles. As such, considerable emissions reductions are occurring without people having to change their behaviour. This has not proven the case in the agri-food sector, despite there being some tangible efforts to increase production efficiency. But nor are technological fixes, at least in the short to medium term, likely to be sufficient in the agri-food sector, while there has been insufficient individual behavioural change.

Given this reality, it is not surprising that more attention is being paid to the need for systemic change, and how it can be achieved. Chater and Loewenstein write that 'with the best of intentions, proponents of i-frame policy, including ourselves, may have inadvertently weakened support for crucial systemic changes' (7). They also argue that corporate interests may have 'deflected pressure for systemic change by reframing social problems in i-frame terms'. One starting point to redress the balance, that can increasingly be found in the literature and policy discussions, is the need for a shared vision. For example, a report commissioned by the UK's Climate Change Committee proposed that '[t]he UK needs a coherent vision of what its future food system might look like;' and that '[m]ore political leadership is required to facilitate and communicate Net Zero compatible diets' (50). To date there has been a reluctance among governments to explicitly articulate pathways to net zero agri-food emissions and a vision of what such a world might look like.

A shared vision is likely to be particularly important in the context of reducing livestock emissions. Meat consumption remains prevalent in part due to its practicality as a source of nutrient-dense caloric intake, and many people like to eat meat. Reductions in meat consumption may generate significant negative downstream effects for farmers and other stakeholders across the supply chain. Further, in the UK as in other countries, many of our cultural references relate to what we eat and how our countryside looks, both of which are likely to be affected by a transition away from meat consumption. A shared vision might address to what extent and how grazing animals and the landscape they have historically been a part of are valued; whether to encourage rewilding of some land that is currently pasture; and whether to reject intensively factory farmed meat and imports of lower-quality and lower-animal welfare meat, taking explicit account of how to protect lower-income households. Discussions over a shared vision might address affordability, what replaces the nutrients we get from meat, and what our meals might look and taste like.

In the academic literature, a meat tax has been described as 'inevitable' (21, 51, 52). Yet meat taxes have also been criticised as a seemingly simple solution to a complex problem (53), where even accurately measuring livestock emissions is tricky. If people are nudged to change their meat consumption behaviour, at some point an effective nudge would come up against the reality that structural changes would be needed somewhere along the food chain, and this would likely cause friction. Given this, it is almost certain that a combination of nudges and price or regulation policies would be needed (4, 54). More broadly, each emissions reduction intervention considered in the literature has different implications not just with respect to ease, the need for individual behaviour change and consumer acceptance, political trust, and potential size of gains; but also, with respect to any co-benefits or broader positive and negative health implications from changing how we source protein; and up and downstream impacts. A shared vision for the future might help to provide much needed context and nuance; and might encourage policy instruments to be considered not in isolation, but as part of a more complex transition that needs actively managing.

A shared vision may be less important in the context of food waste, insofar as a consensus may already exist. Most people would like to see less food waste (55), so behavioural strategies such as nudges to reduce food waste are likely to be aligned with people's preferences. Farmers should not be directly harmed, and consumers would not in the main be asked to change what they eat. But while no new or unproven technologies are required, reducing waste is effortful, there are no simple solutions or quick fixes to reducing food waste, and considerable consumer behaviour change is required (56).

Even though it might seem hard to disagree with a future where there is less food waste, an explicit shared vision that takes into account access to food for the lowest-income households might still be needed, particularly as there could be unintended food insecurity consequences from a reduction in food waste, especially in the short term during the transition period. For

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example, in the UK a considerable charitable sector 'industry' has grown around redistributing surplus food to those experiencing food poverty. During a transition to a low food waste society, food poverty could increase if 'surplus' food were no longer available to be distributed by charities to lower-income households, but access to affordable food was not yet available. More broadly, transitions linked to systemic change are often ignored in the academic literature and policy discussions.

4 CONCLUSION

For a food-secure planet in the future, the agri-food sector as a whole needs play its part with respect to reaching net zero; and reducing emissions from food waste and excess meat consumption can contribute to both climate change mitigation and adaptation. Done well, a transition to net zero can drive healthier diets and a healthier population, taking pressure off national health services; it can help a country to be less nature and biodiversity-depleted; it can have positive implications for animal welfare; and it can save people money. But such a transition will require considerable adjustments in our diets, what our countryside looks like, and even what it means to be a farmer. Done badly, lower-income households could end up eating fewer healthy meals and eating more ultra-processed foods, farmers and farming could be harmed, and there could be deficiencies in diets across the board.

It can be tempting to look for relatively simple solutions. In particular, economists have shown convincingly that, in theory, a meat tax can reduce methane emissions and be progressive, thereby helping the transition to net zero and benefitting lower-income households. But reality tends to be messier and less predictable than models might suggest. Successful transitions from a sub-optimal norm, such as smoking in public places, have required multiple policy instruments, combining taxes, regulations, and behavioural nudges, particularly during the transition phase to the new normal.

As is the case for many policy choices linked to tackling climate change, the challenges faced in speeding up the transition to net zero differ with regard to where the technical difficulty lies, to what extent behaviour change is required versus technical breakthroughs, and the efficacy and distributional impacts of the policy instruments driving the transition. The example of reducing meat consumption is just one where there is a choice between individuals having to change what they do (with considerable potential negative impacts on those, in this case farmers, supplying the consumption good) or hoping for a technological fix. But technological fixes, even when they exist and are cost effective, are rarely complete substitutes for more direct behaviour change. For example, even if livestock could be reared without emitting methane, there would still be the environmental consideration of where feed is sourced, in addition to any potential animal welfare and human health considerations. And there still appears little appetite for lab grown meat, suggesting there will be little demand for Margaret Atwood's ChickieNobs in the near future.

Finally, speed matters. Governments that try to change consumer or producer behaviours too quickly may face frictions that derail their efforts. Move too slowly and net zero targets are missed. A shared vision, that is country specific, explicitly addresses the need for systemic change, understands that some stakeholders could be harmed, and recognises the importance of actively managing any transition pathway linked to net zero, may offer a practical way forwards.

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COMPETING INTERESTS

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