Wales Centre for Public Policy
Canolfan Polisi Cyhoeddus Cymru

# How could Wales feed itself in 2035?

# Evidence Pack

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**Welsh Government** is the devolved government of Wales, responsible for key areas of public life, including health, education, local government, and the environment.

# Contents

# Cover Note

WCPP have been commissioned by the Welsh Government to provide evidence to support the work of the Wales Net Zero 2035 Challenge Group.

The Welsh Government and Plaid Cymru Cooperation Agreement committed to ‘commission independent advice to examine potential pathways to net zero by 2035’. In response to this the Wales Net Zero 2035 Challenge Group has been formed, chaired by former minister Jane Davidson. The Group’s work is scheduled to run until summer 2024 when it will present its final report. The group will look at the impact on society and the economy, considering the distribution of the costs and benefits and how any adverse effects could be mitigated. The Group is organising its work through a series of five challenge areas. More information on the work of the Wales Net Zero 2035 Challenge Group can be found at: **https://netzero2035.wales**

This evidence pack has been prepared to support the Group's initiation of work on the first Challenge Area: How could Wales feed itself in 2035? It includes an overview of key data and trends, and a discussion paper synthesising existing evidence on food systems, agriculture and land use, in the context of reaching net zero by 2035. The evidence pack was prepared as a means to stimulate discussion amongst the Group and shape the Group’s call for evidence. It does not attempt to provide any definitive views or recommendations for the Group's approval.

# Overview of key data and trends

## Emissions trends

Welsh agricultural emissions decreased by around 16% between 1990 and 2010 but have risen slightly in the last decade, partly due to increases in livestock numbers. Agriculture's contribution to Wales' total emissions increased from 13% in 1990 to 17% in 2018, as emissions fell in other sectors (UK CCC, 2020).

The land use, land use change, and forestry (LULUCF) sector in Wales has negative net emissions, because it includes forms of land use, such as woodland and peatland, that absorb and store carbon from the atmosphere, meaning that the sector as a whole acts as a carbon sink. The size of the carbon sink has approximately doubled in size compared to 1990, but has shrunk in the last decade, reflecting a lack of new tree planting. The LULUCF carbon sink only offset around 1% of total Welsh emissions in 2019 (UK CCC, 2020).

*Figure 1: Welsh agricultural emissions, 1990-2018*

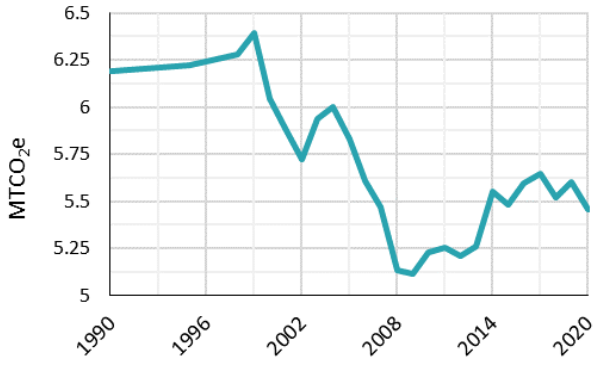
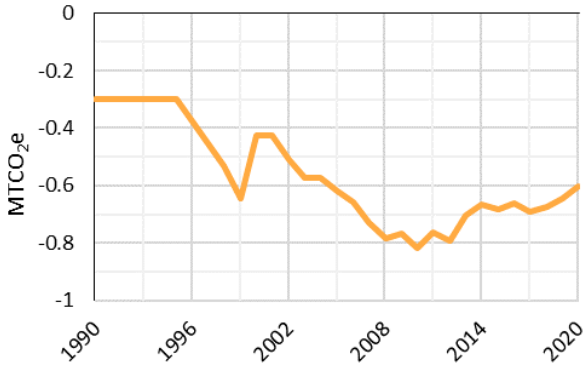



*Figure 2: Welsh LULUCF emissions, 1990-2018*




*Source: Garland et al. (2022)*

## Land classification

Approximately 20% of land in Wales is rated as grades 1-3a in the Agricultural Land Classification, defined as the 'best and most versatile' (BMV) land, which can best sustain food and non-food crops, delivering moderate-to-high yields (Keay and Hannam, 2020). Between 1939 and 2011, it is estimated that the area of BMV land in Wales decreased by 7%, with urbanisation a key driver of this change (Lewis-Reddy and Behrendt, 2020).

**At least two thirds of the 297,000 hectares of BMV land in Wales is devoted to livestock production,** including growing animal feed**.** (Lewis-Reddy and Behrendt, 2020).

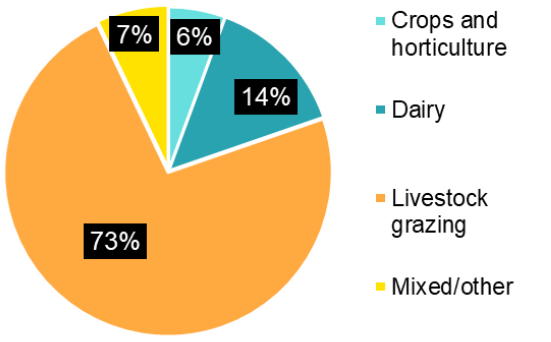
## Farming

Farming in Wales predominantly consists of sheep and cattle grazing, with just 6% of farms in Wales devoted to crops and horticulture (Welsh Government, 2022).

Livestock farms in Wales (excluding dairy) have typically relied on subsidies to generate a profit. Average income from agricultural production through livestock grazing has increased in recent years; however, 2021-22 was the first year where, on average, livestock grazing generated a profit through production alone. (Welsh Government, 2023). Around 30% of total land farmed in Wales is tenanted (Orford, 2022).

43% of agricultural workers speak Welsh, compared to a national average of 20% (Welsh Affairs Committee, 2022)

*Figure 3: Farming types in Wales*




Very small farms (labour requirement <1 FTE) are excluded

*Source: Welsh Government (2022)*

## Marine environment

The amount of 'blue carbon' which can be sequestered by the marine environment remains largely uncertain due to limitations in the quality and availability of data. However, current estimates suggest that less than 0.1 MtCO2e is sequestered in the Welsh marine environment every year, primarily in seagrass and salt marshes. Additional carbon is stored in marine sediment: it has been estimated that around 414 MtCO2e of carbon could be stored in sediments within the Welsh marine environment; equivalent to over ten years of Welsh emissions (Armstrong et al., 2020; UK CCC, 2022).

In 2012-2013, **it is estimated that the UK fishing fleet emitted 0.9MtCO$_2$e of carbon emissions**, with disaggregated data for the Welsh fleet unavailable (Coello et al., 2015).

**In 2021, there were 249 registered fishing vessels in Wales,** representing a 5% reduction compared to the previous year. The number of registered vessels in Wales has been decreasing at an average rate of 6% per year since 2018 (Moran Quintana and Wilkie, 2022).

Less than half of the landings from Welsh-registered vessels take place in Welsh ports; similarly, less than half of total landings recorded into Welsh ports are made by Welsh-registered vessels. Focusing solely on Welsh-registered vessels landing into Welsh ports, **the industry is dominated by shellfish**: whelk fishery comprises around half of these landings (Carpenter, 2020)

## Food production and trade

In 2020, the UK imported 46% of the food it consumed (DEFRA, 2021). Comparable export statistics, and statistics for Wales were publicly unavailable.

Approximately 90,000 tonnes of red meat were produced in Wales in 2021, of which 53% was lamb, 44% was beef, and 3% was pork. Only 5% of beef and lamb produced in Wales is consumed in Wales, with the majority consumed in the rest of the UK: 35% of lamb and 15% of beef produced in Wales is exported outside the UK (Hybu Cig Cymu, 2021).

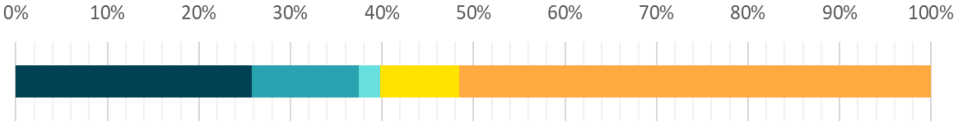
Around 2 billion litres of milk were supplied by Welsh farmers in 2020-21; of which half was processed in Wales, the other half being transported for processing in England (Gooderham, 2021).

Only 0.1% of farmed land in Wales is used for horticulture (Lewis-Reddy and Behrendt, 2020). Wales produces around 20,000 tonnes of fruit and vegetables per year, equivalent to approximately ¼ of a portion of fruit and vegetables per day per person (Wheeler, 2020).

Around 15,000 tonnes of seafood was supplied by the Welsh fishing industry in 2018 (SWAC, 2022). Wales contributes to 22% of total UK seafood exports: 100% of whelks, 90% of mussels and 90% of cockles from Wales are exported (Welsh Government, 2019a). Five species (cod, tuna, haddock, salmon and prawns) account for 60-80% of UK fish consumption and the UK is a net importer of all of these species (Uberoi et al., 2022).

## Food waste

*Figure 4: UK food waste across the supply chain, 2018*




| Farm | Manufacturing | Retail | Hospitality & food service | Consumer |
|---|---|---|---|---|
| 25% | 12% | 2% | 9% | 52% |
| 3.3 million tonnes | 1.5 million tonnes | 0.3 million tonnes | 1.1 million tonnes | 6.6 million tonnes |

*Source: WWF-UK (2022a)*

UK food loss and waste was estimated at 12.8 million tonnes in 2018. Over 50% of this occurs in households (WWF-UK, 2022a). Over two-thirds of UK household food waste is intended to be eaten, totalling 4.5 million tonnes in 2018 (Parry et al., 2020).

Of the 3.3 million tonnes of on-farm waste, fruit and vegetable waste contributed to over one third of the total amount, but only 7% of the greenhouse gas emissions. Meat and animal products have a lower wastage rate compared to fruit and vegetables (4% compared to 34%), However, meat products accounted for 74% of on-farm food waste greenhouse gas emissions (WWF-UK, 2022a).

## Dietary change

A typical UK adult diet in 2017 had a carbon footprint of 5.2kg $CO_2e$ per day. This represents a 29% decrease compared to the carbon footprint of a UK diet in 1990. Improvements in food production, as well as some changes in consumption, can be attributed to the decreasing carbon footprint of the average UK diet in recent years. (WWF-UK, 2017). When including emissions due to land-use change, the dietary carbon footprint rises to 5.8kg CO2e per day, accounting for losses of carbon stocks due to deforestation (WWF-UK, 2017).

Livewell plates illustrate dietary changes required to keep average global temperatures below two degrees, while meeting national dietary guidelines. Key changes to the typical 2017 adult diet involves reductions in sugar and meat; and increases in fish, meat substitutes, and fruit and vegetables (WWF-UK, 2017).

**-85%** sugar and confectionary
**-80%** beef and veal
**-70%** poultry
**-58%** processed meat
**-57%** cheese
**-37%** lamb
**-30%** pork

**+43%** fruit
**+59%** vegetables
**+144%** legumes and nuts
**+177%** meat replacers
**+199%** fish aquaculture

*Source: WWF-UK (2017)*

## Forestry and woodlands

Woodland cover in Wales was 15% in 2020, rising from a low point of 4% in 1918 (Collins et al., 2020). However, only 48% of woodlands are considered native, which play an important role for biodiversity, and only 14% are considered ancient and semi-natural (existing continuously since 1600 or before) (Hayhow et al., 2019).

The Welsh Government's targets for tree planting aligns with the levels set out in the CCC's balanced pathway, equivalent to planting at least 5,000 hectares per year. However, in 2020, only 290 hectares of woodland were planted in Wales and annual woodland creation has not exceeded 2,000 hectares since 1975 (Welsh Government, 2021a).

Around two thirds of woodland in Wales is managed for timber products; however, lack of new planting activity means timber production is forecast to fall from 2030 to 2050. Only 4% of harvested Welsh timber is processed to be used as construction graded timber (Welsh Government, 2021a).

**Planting trees in accordance with the Welsh Government's targets (aligned with the CCC balanced pathway), would see woodland coverage in Wales increase from 15% in 2020 to 24% in 2050.**

*(UK CCC, 2020).*

## Conservation and biodiversity

A significant portion of Wales' land and sea is designated for conservation, including:

- 1078 Special Sites of Scientific Interest, covering over 12% of Wales' land area;
- 21 Special Protection Areas and 95 Special Areas of Conservation covering around 8.5% of Wales' land area; and
- 139 maritime protected areas, covering 69% of Welsh inshore waters (up to 12 nautical miles)

(Collins et al., 2020)

Natural Resources Wales (2021) were only able to assess around half of key terrestrial and freshwater features on protected sites in Wales as part of their 2020 baseline assessment, and of these only 20% of features were found to be in a favourable condition. Of the 3,902 species in Wales, 17% are threatened with extinction from Wales (Hayhow et al., 2019). In the 2019 State of Nature report, 59% of species in Wales declined and 41% showed positive trends. 30% of species showed strong or moderate decreases and 23% showed strong or moderate increases (Hayhow et al., (2019).

There has been a **52% decline** in the abundance of butterfly species in Wales since 1976 (Hayhow et al., 2019).

**Fish populations in the Celtic Sea are reportedly one of the most negatively impacted worldwide, due to overfishing and sea warming** (Crook et al., 2020). Improving abilities in monitoring marine biodiversity is an evidence priority in the Welsh Marine Evidence Strategy (Welsh Government, 2019b).

## Peatlands

Peatland covers approximately 21% of Wales' land, with 4.3% of Wales' total land area classified as deep peat (>40cm) (Dunn et al., 2021). While 69% of upland peat and 43% of lowland peat are in designated sites, extant raised peat bog is estimated to occupy no more than 60% of its original footprint (Jones et al., 2020). Peatland is an important carbon store, with a 30cm deep layer of peat storing more carbon per hectare than a tropical rainforest (Lindsay et al., 2019). However, at present around 90% of Welsh peatlands are emitting rather than absorbing carbon, due to degradation through drainage, overgrazing, afforestation, or burning (RSPB, 2020).

**Over 70% of Welsh peatlands are negatively impacted by one or more land-use activities,** such as grazing or forestry (Dunn et al., 2021).

**Around 50% of the peat area on public land in Wales is under conifer plantation** (Williamson et al., 2016). Emissions from peat under forestry in the UK are estimated to emit around 20% of total UK peatland emissions (Evans et al., 2017).

## Welsh Policy Competence

| Welsh Government Competency | Agriculture | Food | Fisheries | Forestry | Conservation |
|---|---|---|---|---|---|
| | ● | ● | ● | ● | ● |

Competency for policy relating to agriculture, food policy, fisheries, forestry, conservation, and biodiversity is predominantly devolved. Prior to Brexit, many aspects of food, fisheries, and agricultural policy were regulated at an EU level, with implementation devolved to Wales (Downing and Coe, 2018).

Fishing quotas remain reserved to the UK Government, and the total quota is then apportioned across the UK nations; however, even before Brexit, the Welsh Government could implement local catch quotas for shellfish (Carpenter, 2020). Key legislation on nature conservation, such as the Wildlife and Countryside Act 1981, exists at a UK level, however competencies relating to conservation, the protection of natural habitats, coast and marine environment, and biodiversity are devolved to Wales (Welsh Government, 2021b).

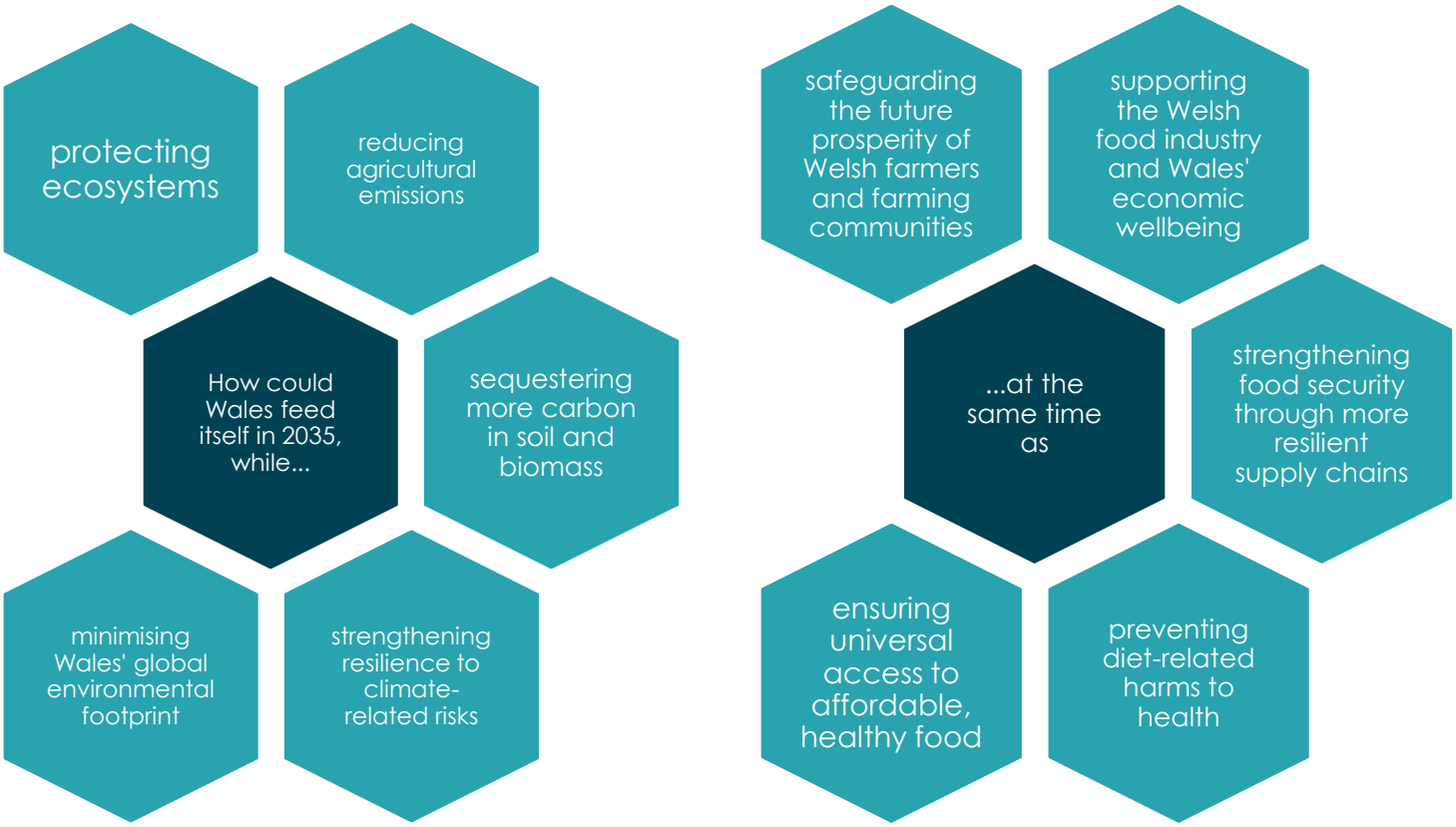
## Key Welsh bills and policies

| | |
|---|---|
| Agriculture (Wales) Bill Sustainable Farming Scheme | The Agriculture Bill establishes Sustainable Land Management as the framework for future agricultural policy, focusing on the complementary objectives of supporting sustainable food production, as well as other goals related to the climate an nature emergencies, in resilient and thriving rural communities.<br>Replacing the EU's Common Agricultural Policy (CAP), the Sustainable Farming Scheme aims to reward farmers "for the work they do to lower their carbon footprint and improve the environment, alongside the production of food." |
| National Forest for Wales Woodland Investment Grant | The National Forest for Wales aims to create areas of new woodland and restore and maintain ancient woodlands.<br>The Woodland Investment Grant provides financial support to those who want to create new woodlands, and enhance and expand existing woodlands. |
| National Peatland Action Programme | The National Peatland Action plan is a five year plan to coordinate peatland restoration action, and will also safeguard peatlands in good and recovering condition. |
| Nature Recovery Action Plan | The Nature Recovery Action plan was refreshed in 2020/21 to take into account the climate emergency, and is the National Biodiversity Strategy and Action Plan for Wales. |
| Wales National Marine Plan | The National Marine Plan sets out Welsh Government's policy for the next 20 years for the sustainable use of seas, taking an ecosystem approach to sustainable resource management which allows a thriving marine economy and healthy and resilient marine life. |
| Prosperity for All: A Climate conscious Wales | 'A Climate conscious Wales' is the Welsh Government's five year climate adaptation plan, including preventing flood risks, and risks to ecosystems and agricultural business. |

# Discussion Paper

This paper, prepared by the Wales Centre for Public Policy (WCPP), summarises evidence to support initial discussions of the Net Zero 2035 Challenge Group as the group begins to explore the question of how Wales could feed itself in 2035. This work takes place in the context of ongoing work to identify potential pathways to net zero while creating a better Wales across multiple dimensions of social, cultural, economic and environmental wellbeing (Wales Net Zero 2035 Challenge Group, 2023). The question of how Wales could feed itself in 2035 raises a range of issues related to the food system and the emissions it creates, including farming and land use emissions both within Wales and worldwide (as we discuss below), alongside multiple broader interconnected issues and considerations, Figure 1.

**Figure 1: Changes to agriculture, food systems and land use involve multiple dimensions of wellbeing**




Viewing the question holistically reveals opportunities and challenges. On one hand, the interconnected nature of many of these issues means that very often, options to tackle climate change deliver multiple broader benefits. Climate mitigation options that address food systems, such as shifting to more plant-based diets and reducing livestock numbers, can often also be beneficial for nature, or, indeed, for human health (see below). Sometimes society's challenges are so intertwined that co-benefits are built in; at other times these need to be more actively sought or imagined, through what Naomi Klein has described as 'climate justice multitasking' (de Trenlequaye, 2023). The flipside of this is that some of the interconnections depicted above

highlight areas of tension, where potential trade-offs need to be managed and minimised. For example, if the science is clear that the agricultural sector cannot achieve significant emissions reductions without reducing livestock production and an associated shift to more plant-based diets, how might this happen in a way that safeguards the future prosperity of Welsh farms and farming communities? And how do we reduce agricultural emissions and the other negative impacts of food production in Wales, without simply displacing these to other parts of the globe?

In navigating these sometimes productive and sometimes challenging interdependencies, the Net Zero 2035 Challenge Group will also need to understand how Wales *currently* feeds itself and contend with the realities of our existing land use and food systems, many of which are set out in our accompanying overview of trends. Envisaging a net zero future for Welsh farming, land use and food systems necessarily engages questions which are highly contested and politically contentious. What future role should Welsh farming play in feeding Wales (or indeed in protecting nature and enhancing natural carbon sinks)? What level of reductions in agricultural emissions can be achieved without scaling back livestock farming? Indeed, what level of reductions in agricultural emissions should we be aiming for?

These questions raise key issues and considerations which the Group will need to grapple with as it explores this challenge area. Below, we provide an overview of these, to support the Group's discussion of how to organise its work in the coming months and identify what further evidence it needs to address the question of how Wales could feed itself in 2035.

## A note on interpreting the question

'How could Wales feed itself in 2035' appears to be a simple question, but it is open to differing interpretations and, by extension, implications for the work of the Group:

- There's a literal interpretation, which invites us to ask if Wales *can* feed itself and focus on assessing Wales' potential for self-sufficiency.
- Then there's a more figurative interpretation, which understands the question to mean something more like 'how does the food and farming system in Wales need to change to achieve net zero and better support the wellbeing of current and future generations'.

We think the latter interpretation is a more useful and generative way of understanding the question and have proceeded on this basis. Importantly, this does not preclude any exploration of the benefits of bringing Welsh food production and consumption into closer alignment, or of seeking to create shorter supply chains or encourage and foster more localized forms of food production. Such benefits can be considered and sought without self-sufficiency being identified as a primary objective in itself. They may, indeed, be an important part of the picture of imagining a net zero food and farming system that better delivers for Wales' current and future wellbeing.

# Key considerations

1. Despite falling by 11% since 1990, agricultural emissions in Wales have increased since 2016 and are dominated by livestock farming, with direct methane emissions from livestock alone making up 61% of agricultural emissions in Wales (Garland et al., 2023, WCPP analysis). Emissions from the management and use of manure contribute an additional 14% of Welsh agricultural emissions (ibid); further livestock-related emissions sources include the release of carbon from peatland, land conversion, and the existing land footprint of livestock agriculture, with its associated carbon opportunity cost (Reisinger et al., 2021).

2. **Agriculture is also a significant source of air, soil and water pollution, with a range of consequences for biodiversity and human health.** Agriculture is the second biggest contributor of reported river pollution incidents in Wales (after the water industry); of these, around half come from dairy farming (Welsh Government, 2021c). Agriculture is also responsible for 81% of ammonia pollution, which has been rising in the UK since the early 2000s, due to a reversal in the trend of reductions in fertiliser use, increased slurry spreading and an increase in emissions from cattle (Guthrie et al., 2018). Ammonia pollution contributes around half of some kinds of fine particulate matter air pollution, which has particularly serious impacts on respiratory and cardiovascular health, contributing to various chronic conditions such as heart attacks, cerebrovascular disease, chronic obstructive pulmonary disease (COPD), asthma and lung cancer (Wyer et al., 2022). Ammonia pollution also impacts on biodiversity, both via a direct toxic effect on vegetation and through changes in species composition due to nitrogen deposition, which can result in the loss of sensitive and rare species and habitats (Guthrie et al., 2018). Indeed, agriculture as a whole has been the main driver of biodiversity loss in Wales in recent decades, with biodiversity trends in farmland birds declining by 54% since 1970 (Hayhow et al., 2019). While these trends are concerning, they also point to the potential for identifying measures to tackle agricultural emissions and agricultural pollution in tandem, leading to improvements in biodiversity and human health.

3. **Reducing agricultural emissions will require a reduction in livestock farming as well as changes in farming practices to mitigate livestock emissions (IPCC, 2023, IPCC, 2022, Reisinger et al., 2021).** Demand-side approaches emphasising a global shift towards healthier, more sustainable diets and reductions in meat and dairy consumption (Poore and Nemececk, 2018; Steenson and Buttriss, 2021) have major implications for Welsh farming, given that livestock and livestock products currently account for 86% of Wales' agricultural output, and 76% of Wales' utilised agricultural area is grassland for livestock grazing (which also represents the most common type of farm holding in Wales after undifferentiated small farms) (Devenish, 2022). For this reason, sector representatives tend to advocate for a greater focus on supply-side measures to mitigate livestock emissions without the need to scale back on livestock production (see for example NFU, 2019). However, existing assessments of supply-side

mitigation options, which include changes to animal feed and interventions to increase livestock and pasture productivity, indicate that these alone will not be sufficient to achieve significant cuts to agricultural emissions (Leahy et al., 2020; Henderson et al., 2020); overall it is *what* we farm more than *how* we farm that drives the climate consequences of Welsh agriculture (Kim et al., 2020). Moreover, while options to increase production efficiency can lead to reduced emissions per unit of product (such as meat or milk), the production of inputs to facilitate this can indirectly drive further absolute emissions along the feed supply chain (Beauchemin et al., 2020); productivity improvements can also create economic incentives for livestock farmers to simply increase production and/or expand into marginal land (Reisinger et al., 2021). To be effective in driving absolute reductions in emissions, any reductions in the emissions intensity of livestock production must therefore be combined with measures to limit overall demand and/or land use (Phalan, 2018).

4. **Reductions in livestock farming are beneficial not only for driving down absolute agricultural emissions – they are also essential to relinquish land required for carbon sequestration.** 85% of the land used by UK agriculture is taken up by livestock systems, either directly for grazing or indirectly for the production of animal feed (de Ruiter et al., 2017). For Wales this figure is likely to be significantly higher given that 86% of our agricultural land is used directly for grazing; the global land footprint of Welsh livestock farming will be higher still when imported feed is taken into account (WWF-UK, 2022b). Releasing some of this land for other, more carbon efficient uses (such as afforestation or agroforestry) could enable significant additional mitigation from agricultural landscapes (Willett et al., 2019, Smith, et al., 2020). Thus, reducing demand for livestock not only combines with supply-side options to reduce absolute agricultural emissions, but also creates new opportunities for the use of finite land resources in the context of net zero. Every credible model for achieving emissions neutrality requires agricultural land to be relinquished, so that it can be used in ways that enhance our natural carbon sinks (largely woodlands and peat bogs) and compensate for residual emissions elsewhere in the economy (National Food Strategy, 2021). Freeing up the additional land that will be required – without compromising food security – will only be possible through shifts in demand towards not only less emissions-intensive but also less land-intensive food production systems (Hayek et al., 2020).

5. **While demand-side approaches (for example changes in diet) are critical to achieving net zero, changes in patterns of domestic consumption have limited scope to influence livestock farming in Wales.** Welsh livestock farming is an export industry – with 95% of Welsh beef and lamb products currently purchased and eaten in other countries (Hybu Cig Cymru, 2021) – constraining the potential for dietary change in Wales to influence Welsh agricultural emissions (Jones et al, 2023). This underlines the significance of the forthcoming Agriculture (Wales) Bill and associated development of the Sustainable Farming Scheme (SFS) as key mechanisms for the Welsh Government to shape land management practices in Wales. The SFS has already met with objections from farmers and farming bodies for delinking agricultural subsidy payments from food production (Welsh Government, 2020); conversely, it has been

broadly welcomed by conservation and environmental groups in Wales as a critical opportunity to support the Welsh farming sector to transition to low-emissions, nature-positive agricultural practices (Williams, 2019). However, it is difficult to determine the extent to which the SFS in its current form will lead to a reduction in agricultural emissions; climate-related provisions in the SFS are largely focused on increasing carbon sequestration on farmland, rather than reducing emissions from farming.

6. **While a necessary part of achieving emissions reductions, reducing livestock farming requires major change in how land is used and managed in Wales, and this is seen by some as a threat to the future prosperity of Welsh farms and farming communities.** Economic conditions are already challenging for the sector; farm incomes in Wales are highly variable, with many farmers susceptible to changes in prices for meat and milk products. In four out of the last five years of the Welsh Farm Business Survey, on average almost every category of livestock farm (other than dairy farms) made losses on agricultural production – because costs of inputs exceeded the value of outputs generated – with subsidy payments amounting to between a quarter and a third of farm incomes (Welsh Government, 2023, WCPP analysis). While this potentially makes the forthcoming SFS an important mechanism for influencing agricultural emissions trends, there is also a need to ensure that any changes to agricultural support align with and are part of broader efforts to ensure a 'just transition' for livestock farmers, a challenge which has been underexplored in both research and policy (Blattner, 2020). This will also need to take into account and assess the extent to which livestock farmers' options for diversifying into other types of food production are limited by the (current and future) climatic and geographic conditions of Wales and find ways to counter a common argument that there is 'little other economic use' than livestock grazing for the 79% of Welsh land categorised as Less Favoured Area (LFA) under the previous EU subsidy regime (Harries, 2019). Alongside 'farming for carbon', the development of Wales' bioeconomy and linked increases in demand for plant feedstocks have been identified as promising avenues in this regard (Thornton and Donnison, 2019). However, while the change in the specialisation of Welsh upland farming from mixed arable and livestock to exclusively livestock production is a relatively recent phenomenon in historical terms (Williams, 2019), it is also important to recognise how the future of livestock farming as a 'way of life' engages some deeply held beliefs about identity, culture and the Welsh language for many rural communities, making this a particularly sensitive issue in Welsh politics.

7. **Existing modelling of mitigation pathways for Welsh agriculture involves varying levels of agricultural emissions continuing beyond 2050, so that Wales only reaches net zero by enhancing natural carbon sequestration, largely through afforestation.** The UK Climate Change Committee's balanced pathway modelling emphasises a 'land sparing' approach (UK CCC, 2020), where increased yields on farmed land reduce the area of farmland needed to meet food demand, thus freeing up more land for biodiversity conservation and carbon sequestration; this contrasts with a 'land sharing approach', characterised by integrating food production, carbon sequestration and biodiversity conservation on the same land, increasing the amount of

farmed land but reducing the intensity of agriculture (Redhead et al., 2020). More recently, the Welsh Government has commissioned additional modelling of net zero pathways for land use and food systems, partly to take into account the specific biophysical constraints for agriculture in Wales and potentially differing views on land use transformations between the Welsh Government and the UK CCC (Jones et al., 2023). This models both a land sparing scenario and the land sharing scenario apparently favoured in current Welsh Government proposals for the SFS (Welsh Government, 2020), with emissions from land use shifting to higher net sequestration in both scenarios; in the former as large areas of pasture are freed up for restoration to natural land and in the latter as a result of conversion of intensive to extensive grassland coupled with afforestation (Jones et al., 2023).

8. **The evidence is clear that while some species fare well on low intensity farmland, 'land sparing' is more beneficial for biodiversity than 'land sharing'.** While it has more recently been applied in the context of net zero and carbon sequestration, the land sparing-sharing framework originated outside climate research and policy, as a model for evaluating the impacts on wildlife conservation of these different ways of using land to produce food. There is a growing body of empirical research testing the conservation impacts of these approaches: all existing studies find that land sparing approaches are substantially more beneficial for wildlife species, and that land-sharing approaches have serious limitations for overall biodiversity conservation (Phalan, 2018) because wildlife-friendly agriculture still damages most biodiversity and requires more land to provide the same amount of food (Balmford, 2021). However, the notion of land sparing has become politically contentious in Wales and the discussion around it is increasingly polarised, partly because as a result of being entangled with other, controversial concepts such as 'rewilding' (Cuttress, 2022). Rather than seeing land sparing and land sharing as mutually exclusive, a more promising way forward might be to consider them as representing different repertoires of techniques for food production, land use and nature conservation, some of which are likely to be more effective or appropriate depending on a range of individual contextual factors including farm scales and land classification (ibid). Thus, while there may be a significant role for 'land sharing' regenerative and agroecological practices in Wales' future food and farming system, we also need to recognise that these approaches tend to produce lower yields (typically 20-40% lower), using more land to produce less food, and must still be balanced against the need to relinquish farmland for other uses including habitat restoration and sequestering carbon (National Food Strategy, 2021). Indeed, evidence suggests that the best broad outcomes for nature, food production and carbon sequestration are likely to result from contextually-appropriate combinations of non-farmed natural habitats, low intensity and high intensity farmland (Finch et al., 2019).

9. **One of the features of global food systems is that in any given country, there can be varying degrees of connection and disconnection between domestic food production and its associated emissions and biodiversity impacts, and domestic food consumption and diets.** This disconnection is fairly profound in Wales, because not only is much of the food we eat imported, much of the food we produce is also

exported and eaten elsewhere (Sanderson Bellamy and Marsden, 2020). As indicated above, this gives action to address Welsh diets and consumption much less influence on the emissions and biodiversity impacts of food production in Wales– so that, theoretically, transformational change in how Wales 'feeds itself' could occur without necessarily limiting emissions from Welsh livestock farming, if livestock products continued to be exported at current rates. The flipside of this dynamic is that it arguably justifies placing greater emphasis on consumption emissions and on the biodiversity impacts of the food we import from other countries, particularly if we have an interest in minimising Wales' global environmental footprint. In relation to the aims of the Group, we suggest that a focus on both production and consumption emissions and impacts is required, in ways that address the implications of how and how much these currently diverge.

10. **Incorporating a focus on consumption emissions reaffirms the significance of diet change in Wales to climate mitigation, and brings a range of broader co-benefits back into view.** Farming and food systems comprise the second largest emitter of greenhouse gases in the global economy; half of the world's habitable land is used for agriculture, of which 77% is used to graze livestock or grow animal feed, despite meat and dairy providing just 18% of the global calorie supply. Agriculture, especially livestock farming, is still the main cause of land use change worldwide, with 2.1 million hectares of deforestation per year driven by pasture expansion for beef (National Food Strategy, 2021). While we have been unable to find this figure for Wales, 35% of total UK GHG emissions are associated with food systems; although this is difficult to quantify, at least a third of these are linked to overseas production (Forbes et al., 2021). On top of these global climate and biodiversity impacts, our diets are taking a massive and increasing toll on our health: on average, over half of the calories consumed in the UK are from ultra-processed foods, 80% of which are unhealthy (Access to Nutrition Initiative, 2019). According to the Institute for Health Metrics and Evaluation (IMHE), our diets underpin four out of the top five risk factors for healthy years of life lost to illness, disability and death (IMHE, 2021). Diet-related risks are also a major driver of burgeoning health inequities, with higher rates of obesity and diet-related diseases in more deprived areas and increasing disparities in childhood obesity, partly attributable to differences in diet (Munro et al., 2020). One of the major drivers of this is a food system in which healthy, nutrient-rich foods are three times more expensive than processed foods (Food Foundation, 2020) and in which the poorest 20% of households with children would have to spend almost half of their income after housing costs on food in order to meet healthy eating guidelines (Scott et al., 2018). Unequal access to healthy food must also be understood in the context of rising food insecurity, with recourse to food banks rising and one in five people in Wales reporting fears about running out of food due to lack of funds (Sanderson Bellamy and Marsden, 2020); if growing numbers of households are struggling to afford food, their reliance on cheaper, less nutritious and more calorie-dense food is exacerbated (Scott et al., 2018).

11. **These problems are all acute, but their entanglement in food systems also creates opportunities for 'climate justice multitasking'.** The evidence clearly shows that for

the sake of planetary and human health, global diets must converge towards much higher proportions of plant-based foods, such as those based on coarse grains, legumes, fruits and vegetables, and nuts and seeds, with significant reductions in consumption of meat (especially red meat) and little to no consumption of ultra-processed foods (Food and Land Use Coalition, 2019; IPCC, 2023, National Food Strategy, 2021). Food systems interventions that address diet change and seek to expand access to sustainable, healthy foods therefore have significant potential to combine climate mitigation with a range of broader benefits for nature, human health and societal inequality.

12. **As well as the food we eat, the food we produce in Wales is currently far from the balance of food sources found in sustainable, healthy diets.** As set out above, agriculture in Wales is dominated by livestock farming; just 3% of farm holdings in Wales are dedicated to crops and horticulture (not including undifferentiated very small farms), while the amount of fruit and vegetables grown in Wales annually amounts to just a quarter of a portion per person per day on average. Capacity for expanding production of crops and horticulture is influenced by a range of biophysical factors including climactic, topographical and soil conditions, which constrain agricultural production to varying degrees. Just over half of Wales' land area is classed as ALC grades 4 and 5 (poor and very poor), with severe limitations that restrict range and levels of yields and where yields are highly variable. In contrast, only 20% of land is classed as BMV (best and most versatile agricultural land) (Keay and Hannam, 2020). However, the other factor to consider in understanding Wales' capacity to expand production of crops and horticulture is the relative intensity of horticultural production. Across the UK, about 1% of total land area is devoted to horticulture, providing 57% of the UK's vegetable requirements (DEFRA, 2021). In Wales, production of fruit and vegetables takes up less than 0.1% of the total land farmed; while at least two thirds of our approximately 300,000 ha of BMV land is devoted to livestock production (Lewis-Reddy and Behrendt, 2020).

13. **Climate change will affect the viability of land for food production and disrupt global food systems (IPCC, 2019), which raises questions of food security.** Even in the most optimistic scenarios, global conditions for agricultural productivity are expected to worsen as a result of climate change. It is expected that Wales will see some climate-related improvements in the first half of the century followed by an overall deterioration of land-quality by 2080, mainly as a result of changes in rainfall (Keay and Hannam, 2020). This creates a need to consider questions of Wales' food security in the context of climate-related risks to agricultural productivity within Wales and beyond, including the likelihood of disruption to global supply chains as a result of increases in crop pests, livestock diseases and extreme weather events (Tzachor, 2019). However, there is strong evidence for scaling up and optimising practices to advance adaptation to climate change throughout the food system. Supply-side options include increasing soil organic matter and erosion control, improvements to cropland, livestock and grazing land management, and genetic improvements for tolerance to heat and drought, alongside diversification as an essential strategy to reduce food security risks (Pretty et al., 2019).

On the demand side, shifts to healthier, sustainable diets and reductions in food loss and waste contribute to adaptation by reducing land area requirements for food production and associated food system vulnerabilities (IPCC, 2019). Indeed, recent modelling in response to food supply disruptions from the Russia-Ukraine conflict found that a transition to more plant-based diets in the UK and EU would compensate for all production deficits from Russia and Ukraine while yielding improvements in water use, greenhouse gas emissions and carbon sequestration (Sun et al., 2022).

14. **While in this paper we are not considering Wales' potential for self-sufficiency, there are reasons to explore opportunities for localising food production and shortening supply chains.** Supply chains in Wales' farming and food system have become longer and more complex in recent decades, with power becoming more concentrated as agri-food businesses have become vertically integrated. The result of this reconfiguration of the food landscape is that corporate food processers and retailers now wield disproportionate influence on other parts of the food system and capture a disproportionate share of profits, in ways that hit the pockets of both local producers and Welsh consumers (Sanderson Bellamy and Marsden, 2020). Food system interventions to re-localise food production and support local supply chains may therefore have the potential, with the right policies in place, to generate multiple benefits for the local economy, the environment, and the health and wellbeing of the population.

15. **Further options for reducing food systems emissions include reductions in food waste and changes to the packaging of food products.** In 2018, approximately 9.5 million tonnes of food in the UK was wasted by manufacturing, retail, hospitality, food services, and households; amounting to an estimated 5% of total UK territorial emissions (WRAP, 2021) Significant amounts of food waste also occur on farms, equivalent to around 7% of food intended for consumption (WWF-UK, 2022b). While measures targeted at consumer food waste are critical, as consumers are responsible for over half of all food waste, food waste reduction elsewhere in the supply chain also has potential to drive emissions reductions, as waste occurring at the end of the food supply chain is undoubtedly influenced by practices at earlier stages (WRAP, 2021; WWF-UK, 2022b). Research examining the environmental impacts of food in Europe suggests that, on average, around 3% of the climate impact of packaged food comes from the packaging process itself (BOKU, 2020). The impact from packaging is likely to be larger in cases where the packaging is proportionately heavier, or where portion sizes are smaller. There is a close relationship between food packaging and food waste: optimising packaging types can extend the shelf lives of products and reduce retail food waste, and optimising packaging size to better reflect consumer consumption can help reduce domestic food waste (BOKU, 2020). Changes in food storage behaviour could also contribute to reductions in domestic food waste, with UK survey data highlighting significant gaps in knowledge (Roberts and Downing, 2020).

16. **An important consideration for the Group will be the powers and policy levers available to the Welsh Government to influence land use, farming and food systems.** The Senedd has the legislative competence to pass laws relating to a broad range of relevant areas including nature conservation, forestry and fisheries, agriculture,

horticulture, animal health and welfare, and rural development. As discussed above, reform of agricultural support following the UK's exit from the EU creates an opportunity for the Welsh Government, with the development of the SFS affording the potential to address many long-standing challenges associated with the previous EU subsidy regime; regarded by environmentalists as incentivizing environmentally degrading farming practices and by farmers as being overly bureaucratic and punitive (Marshall et al., 2022). This could enable the development of new approaches to paying for public goods associated with land management and environmental stewardship (Energy, Planning and Rural Affairs Evidence and Scenarios Roundtable Sub-Working Group, n.d.). Alongside this, there may be opportunities to further support the development of ecosystems markets in Wales via Payment for Ecosystem Services (PES) schemes and carbon investment models (ibid) and explore ways to facilitate a larger role for private sector finance in supporting the farming transition (Green Finance Institute, 2022). However, there are also key relevant powers reserved to the UK Government; trade, for example, is not devolved, and the Senedd's legislative competence does not extend to the prohibition and regulation of imports and exports. This highlights the need to consider the ways in which our food economy is integrated in both UK-wide and international networks (Sanderson Bellay and Marsden, 2020), and take account of the risk of simply outsourcing the environmental impacts of the food we consume in Wales to other countries (National Food Strategy, 2021).

# Conclusion and future lines of enquiry

The task ahead for the Group is complex. There are multiple, entrenched and densely interconnected challenges in Wales' land use, farming and food systems, but there are also opportunities to significantly change these, and fragile but precious grounds for hope. Inevitably, given the complexity of the terrain and our own time and resource constraints, there are significant gaps in the overview above, and areas which merit more in-depth attention than we have been able to provide. For example, we have been unable to give detailed consideration to marine environments, or to the specific dynamics of land use and carbon sequestration where this does not directly influence food systems. Of course, the Group now faces its own version of this challenge, and must decide where and how to focus its efforts with the limited time and resources available as it seeks to answer the question of how Wales could feed itself in 2035. As a starting point, the below are offered as potential lines of enquiry that could merit further investigation in accelerating delivery of net zero to 2035 through the lens of the Well-being of Future Generations (Wales) Act 2015:

- How could / should the Welsh Government reform of agricultural support to shape food production alongside other objectives for land management? Are the current plans for the SFS sufficient to drive the changes needed to achieve net zero? How might plans be adjusted to accelerate change?
- A reduction in livestock farming is needed. The Welsh Government has done a lot of engagement with the sector to shape the SFS. What would a just and democratic approach to managing this change look like?
- What approaches should be taken to change dietary habits given:
    - The structural and socio-cultural barriers that exist to healthy eating;
    - The need for changes in behaviours both at the individual level and across the food system (including producers, processors and vendors); and
    - The limited extent to which the Welsh Government can influence domestic (within UK) and international trade in food produce?
- How will climate change affect the 'needs' for land use? In terms of both what land is productive, and what we need the land to 'do' (for example will water scarcity mean we need more reservoirs)? Will there be concerns in the future about food security? What could the Welsh Government be doing now to prepare? How should this influence decisions about land use now?
- How can the financial sector be mobilised to support the changes needed?
- What are the implications of including the marine environment in the scope of this challenge area and what would this look like?

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