Evidence to Climate Change, Environment & Infrastructure Committee 21st March 2024

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Future of Agriculture and net zero. There are different ways of looking at the future of agriculture:

1) What we do now but more efficiently, so with more productivity and less waste/ environmental impact, by developing and adopting the latest technologies, eg crop and livestock breeding, equipment, crop agronomies and targeted interventions.
2) Using the same crops and maintaining the same landscape (eg grassland) but with new uses, for example as feedstocks for grassland based biorefineries, with outputs including proteins for monogastrics (reducing the need for imported soya) as well as industrial feedstocks, platform chemicals and pharmaceuticals.
3) Development and adoption of new crops and agriculture, with new value chains complementing existing agriculture but addressing new needs and markets.

Sustainable agriculture and land management, objectives of the Sustainable Farming Scheme (SFS), are important for ensuring that future generations can continue to sustainably produce food, feed and biobased resources in Wales whilst enjoying its countryside and landscapes. At the same time humanity is having to adapt to a changing climate and mitigate the causes of it, through reducing greenhouse gas emissions. Farming is in the unique position of being both an emitter of greenhouse gases and having the opportunity to reverse past emissions through land-based greenhouse gas (GHG) removal approaches. This is also part of the reasoning behind the NFU's commitment for farming to reach net zero by 2040 (NFU, 2019), as society the negative emission contributions that agriculture can provide to compensate for the hard to decarbonise industrial sectors.

There are a number of **mega trends**, that particularly relate to agriculture and land use, which are:

- Climate change, and the challenge of adaptation, the need to reduce GHG emissions, and the opportunity for mitigation including through negative emission technologies (i.e. afforestation, peatland restoration, bioenergy with carbon capture and storage (BECCS), incorporation of biochar and use of basalt for accelerated weathering) to achieve net zero.
- Increasing diversity of crops, to increase resilience and address opportunities for improved human diet and health. In other words, moving away from the dominance of six crops on the supply of the majority of global calories. This will be facilitated by the ability to adopt technologies developed in model plants and major crops and apply them to those crops that have so far received less attention.
- Adoption of new technologies including genomics (including genomic prediction and gene editing), phenomics, AI, automation and robotics. Global population size is still increasing whilst climate change is making agriculture more challenging. The development and adoption of new technologies will be critical for the sector in continuing to provide humanity with the food and biobased natural resources it needs to sustain and improve life chances.

Most of these trends have been quite obvious over recent decades with the result that academia and industry have been helping to prepare agriculture for the future. In grassland-based agriculture, this includes forage crop (eg perennial ryegrass, red and white clover) varieties that are deeper rooting (increases crop resilience as well as reducing flood risk and run off). Deeper rooted grasses and clovers are typically more resilient to the impacts of climate change and can compaction following flooding events, as well as flooding risk, through increasing soil porosity (Macleod et al., 2013), as well as potentially storing more carbon at depth in the soil profile where microbial activity (and therefore soil respiration) is lower. In addition to such production and public good benefits, varieties with enhanced feed properties, eg the high sugar grasses can increase production (milk yield and live weight gain) and reduce the risk of nitrogen pollution. Such production gains should also deliver benefits in terms of fewer greenhouse gas emissions per unit of production. There is also an interesting and increasing opportunity to reconnect urban and rural economies that became increasingly separated following the industrial revolution.

Biomass crops as an Optional Action: the Welsh Government has accepted the CCC recommendation on tree planting, but seemingly not accepted the recommendations on biomass crops. Perennial biomass crops could reasonably be planted on some farms in lieu of trees, providing flexibility to farmers who are either restricted by tenancy agreements or looking for a more regular income stream. Perennial biomass crops (e.g. Miscanthus, short rotation coppice willow, short rotation forestry poplar) also have the potential to help decarbonise industrial sectors, for example providing carbon in the manufacture of green steel, and would therefore have the potential to feed into local supply chains within Wales. Care would be needed not to incentivise biomass crop planting on high carbon soils (as for trees). The measurement of soil organic carbon should ideally be part of any initial on-farm assessment of land suitability for biomass crops, with potentially greater benefits on those soils with lower initial carbon contents.

Other approaches to reconnecting urban and rural economies include the adoption of controlled environment agriculture, including the potential to produce food in cities using vertical farming approaches and/ or the ability to use low grade waste heat and CO2 from industry in protected cropping (McDonald et al., 2023), as well as providing feedstocks for green construction materials.

Approaches to implementation of net zero targets. In the SFS a provisional target of 10% of land has been devoted to woodland. Afforestation is one approach discussed by IPCC, UK Climate Change Committee (CCC), and National Infrastructure Commission, other approaches for GHG removal that are typically also highlighted include bioenergy with carbon capture and storage (BECCS) and peatland restoration. Recently it has been indicated that the 10% woodland target within the scheme may be subject to change to include 'equivalent measures'. Such flexibility would be welcomed. A more flexible approach is also consistent with the concept of Stabilisation (or Princeton) Wedges, where the task of tackling the scale of climate change can only be achieved by identifying a range of measures that collectively achieve the target which is unachievable by a single approach alone (Pacala & Socolow, 2004). It will though be important to start with a definition of what terms of equivalence are required. Potential elements of a definition, and other factors to consider, might include:

- Likelihood of permanence of land use change, e.g. woodland maybe more permanent than other land uses, but standing trees are also at risk of fire, storm, disease and drought. Bioenergy may be less permanent as a land use, but geological storage through CCS could be substantially more permanent.
- Not all land is equal, with factors being land classification, climate, topography, farm business specifics including size. The land most suited to horticulture (typically best and most versatile, BMV) for example should be prioritised for that use, especially in Wales where the area is relatively small (approx. 297,000ha, 20% of total land, Keay & Hannam, 2020).
- What are the counterfactuals, for example the impacts will typically be very different for grassland vs arable land use transitions.
- Risk of double counting with other targets and whether additionality is required (e.g. peat restoration might give equivalent reductions in carbon emissions, but can be assumed to occur elsewhere within carbon budgets.
- Extent to which equivalence maps onto hectares (e.g. elements of existing targets in carbon budgets are based on areas as opposed to any carbon equivalence).
- There is the possibility to stack some GHG removal approaches such as perennial biomass crops and biochar to increase the benefit per land area, but there can be trade-offs, eg from planting trees on upland shallow peat. Land use transitions, including afforestation, will typically also result in carbon deficits for a number of years, depending on the starting carbon content of the soil and the agricultural system (eg Paul et al., 2002; Upson et al., 2016; Renna et al., 2024), so some locations will be more likely to achieve the desired benefits whilst others, eg in high organic matter soils (such as grassland) and shallow peat are more likely to be deleterious.

- To what extend may farmers who already have greater than 10% woodland cover encouraged to maintain this woodland, and/or that excess tradeable to offset farmers that don't plant trees or adopt other approaches to tackling climate change.
- Equivalent benefits also apply to biodiversity (e.g. production forestry is very different to mixed native broadleaf forestry). For some habitats, degree of permanence also significantly impacts biodiversity benefits, with permanence typically being associated with greater biodiversity. However, a mixture of land uses and stages of transitions between them is also important.

The Challenge of developing funding support structures. There is a challenge for running agricultural support structures, such as the proposed SFS, which include some of the examples above and:

- The need to have annual payments to support farmers and rural businesses when environmental targets have benefits that will take many years and even decades to accrue but can be lost within a small number of years. This is particularly true for UA7 of the SFS. Many measures that might be supported under OAs and CAs would also require support for periods of 3-5 years minimum.
- The challenge when measures could potentially contribute to sustainable land management, but there is a lack of evidence that they will, either because the data hasn't been gathered yet under relevant conditions (climate, soils, wider environment) or they are fundamentally very difficult to validate with the tools we currently have other than expensively and over long periods of time (eg soil carbon). There is also a need to develop proxy methods for delivery of sustainable land management that allows the monitoring of direction of travel and ideally that farmers themselves can use and so see relatively rapidly feedback on the interventions made. There is the potential to incentivise the development of innovative monitoring devices, tools and services as a means for achieving this.
- How will existing natural capital including stored carbon in forestry or on grassland, and biodiversity be treated compared to new schemes to accumulate it.
- What will be the consequences of changing land use on the wider rural community now and for future generations.

Another way that agricultural priorities can be considered is in terms of land functions, so that in typically lowland areas the land use will be dominated by production-based agriculture, whilst in the uplands it will be more dominated by environmental management and conservation. The area in between represents the greatest challenge in identifying the most appropriate patchwork of agricultural production and environmental services to adopt and/ or support. This has been referred to as the squeezed middle in Scotland (Slee et al., 2014) and this intermediate zone is one where diversification approaches can also be appropriate to support production (Donnison & Fraser, 2016).

Use of Carbon Calculators. It is desirable that a standard carbon calculator is used in schemes such as SFS, in order to minimise confusion amongst farmers and wider society. Key features from a technical perspective would be that: a) it must allow cross referencing with IPCC emissions categories in order to provide data useful to Welsh Government when calculating carbon budgets; b) it takes account of where carbon accounting is done according to tier 1, 2 and 3; c) identifies the ways in which a carbon footprint calculation differs from GHG accounting principles; d) is transparent in its underlying calculation methods; e) allows some comparison with carbon footprint calculators that may arise from other sectors (e.g. supermarkets wishing to report on their scope 3 emissions, future targets within the Red Tractor scheme). The farming sector has the rare opportunity, compared to many other industries, to both decrease its own emissions and to help mitigate climate change further, for example through land based renewable electricity generation or land-based carbon sequestration. This is to be welcomed but care will be needed though in distinguishing offsets with other IPCC categories from the need to decrease agricultural emissions per se according to the IPCC definition of the sector.

The benefits of sustainable land management go far beyond agriculture, and this provides routes for additional funding into farming. For example, where measures such as peat restoration, deep rooted grasses or perennial biomass crops, result in improved flood resilience, this could potentially come out of budgets allocated to flood prevention, and measures improving access to the countryside could come from health budgets. This also provides the opportunity for measures to be compared for cost effectiveness at delivering impact, eg where work on a catchment reduces flood risk downstream could be compared with the cost of installing flood defences in a town.

Scale at which benefits are delivered and measured. Collaborative actions; eg flood risk needs to be tackled at the level of a catchment (regardless of what proportion of farmers in the area are already in a scheme such as SFS), creating wildlife corridors to address habitat fragmentation in particular landscapes will require collaboration between specific landowners, water quality improvements are also best addressed at catchment level. Priorities will need to be made such as for example, where the benefits of flood mitigation benefit a greater number of households, this would be expected to be preferred over an equivalent scheme that benefit relatively few households.

Concluding comments. We live in a time of change, where global population is still increasing (but approaching a plateau), where the impacts of climate change are having significant impacts on where and how successfully we can grow food, and where the energy sources that have driven our economy for the last century and longer (i.e. fossil fuels) need to be transitioned because their use results in geologically stored carbon being released to the atmosphere. Agriculture and land use is unique in that although it is an emitter of GHG, it also has the ability to be the only realistic solution for tackling climate change through GHG removal approaches in the period to 2050 which is the timeframe that really matters to humanity having a chance of achieving climate change targets such as those set at recent COPs. Alongside this there is a once in a generation opportunity to develop an agricultural support scheme (ie post CAP) for current and future generations. Such a scheme needs to be sufficiently attractive and flexible enough to the farming sector to ensure that the aims of the SFS are also realised for current and future generations. If this can be achieved there is a real opportunity of incentivising sustainable land management practice at scale for the benefits of farmers and society, that goes far beyond the agriculture sector in terms of its benefits.

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