Lewes District Council: Agriculture and Land Use

Anthesis

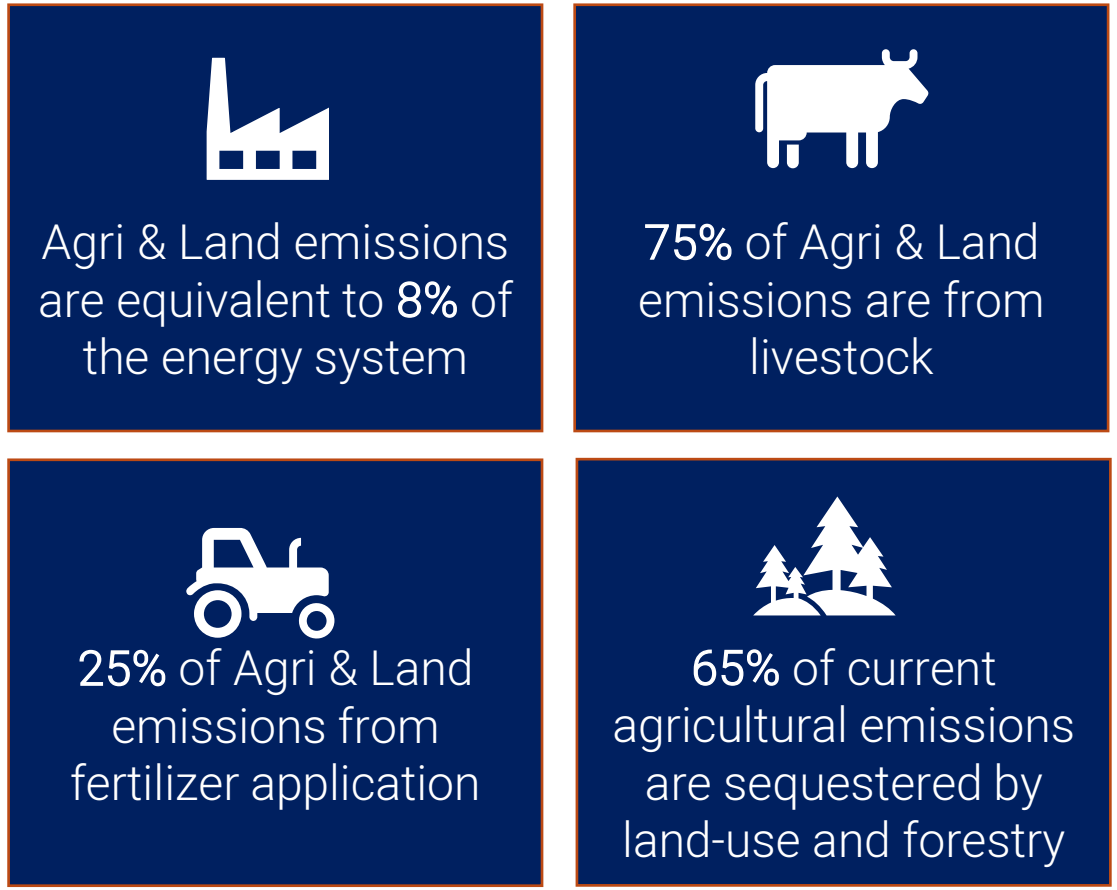
Lewes District Council: Agriculture and Land Use

Summary

Key results

- Gross emissions[1] from agriculture and land use are in excess of 37 $ktCO_2e$, approximately 8% of emissions from the Lewes energy system.
- Emissions from livestock are the dominant source of emissions from land use and agriculture, responsible for approximately 75% of gross emissions. Dairy cows are responsible for 20% of gross emissions and non-dairy cows are responsible for 61%.
- The other 25% is the result of crop and grassland emissions, typically the result of nitrous oxide emissions from fertilisers. The land also acts as a carbon sink, removing approximately 1% of gross emissions from the atmosphere.
- Using Committee on Climate Change forecasts, reducing consumption of beef, dairy and lamb could reduce gross emissions by as much as 32% compared to current gross emissions.
- Doubling the area of planted forest within the Lewes region by 2050 could reduce emissions from livestock and land by approximately 153% as compared to current gross emissions.

Estimates in numbers



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1- 'Gross emissions' are defined as emissions which have not been subjected to any offsetting against soil and biomass carbon.

Lewes District Council: Agriculture and Land Use

Introduction

This report in undertaken for Lewes District Council and seeks to supplement the Lewes Emissions Pathways report by providing additional analysis on the emissions associated with agriculture and land use in the district. This includes GHG emissions from livestock, land use, land-use change and forestry. The aims of this work are to:

1. Conduct a **more accurate calculation of the emissions** from the above sources;
2. Understand **how much carbon is sequestered** within soil and trees currently; and
3. Model **potential future emissions scenarios** for agricultural emissions Lewes district.

Following this analysis, a workshop was convened for key agricultural stakeholders in Lewes to discuss the findings of the analysis and explore opportunities for collaboration to enable emissions reduction actions across the sector.

Co-benefits and considerations

Avoiding the worst impacts of climate change is complementary to many other objectives. In the context of land use in Lewes District, there are many co-benefits of taking steps to cut emissions. When deciding where and how to make emissions reductions there are many other considerations, including but not limited to:

- Future land stewardship promotions by government;
- Flood management;
- Maintaining landscape character, particularly in the context protected land, nature reserves or Areas of Outstanding Natural Beauty (if applicable);
- Maintaining and enhancing biodiversity, including connected habitats;
- Improving animal welfare;
- Balancing food production with land-use management and land-use change;
- Opportunities to work together as a wider region to make the necessary carbon reductions in a way that maximises the co-benefits while minimising potential adverse impacts.

Comparison with BEIS data

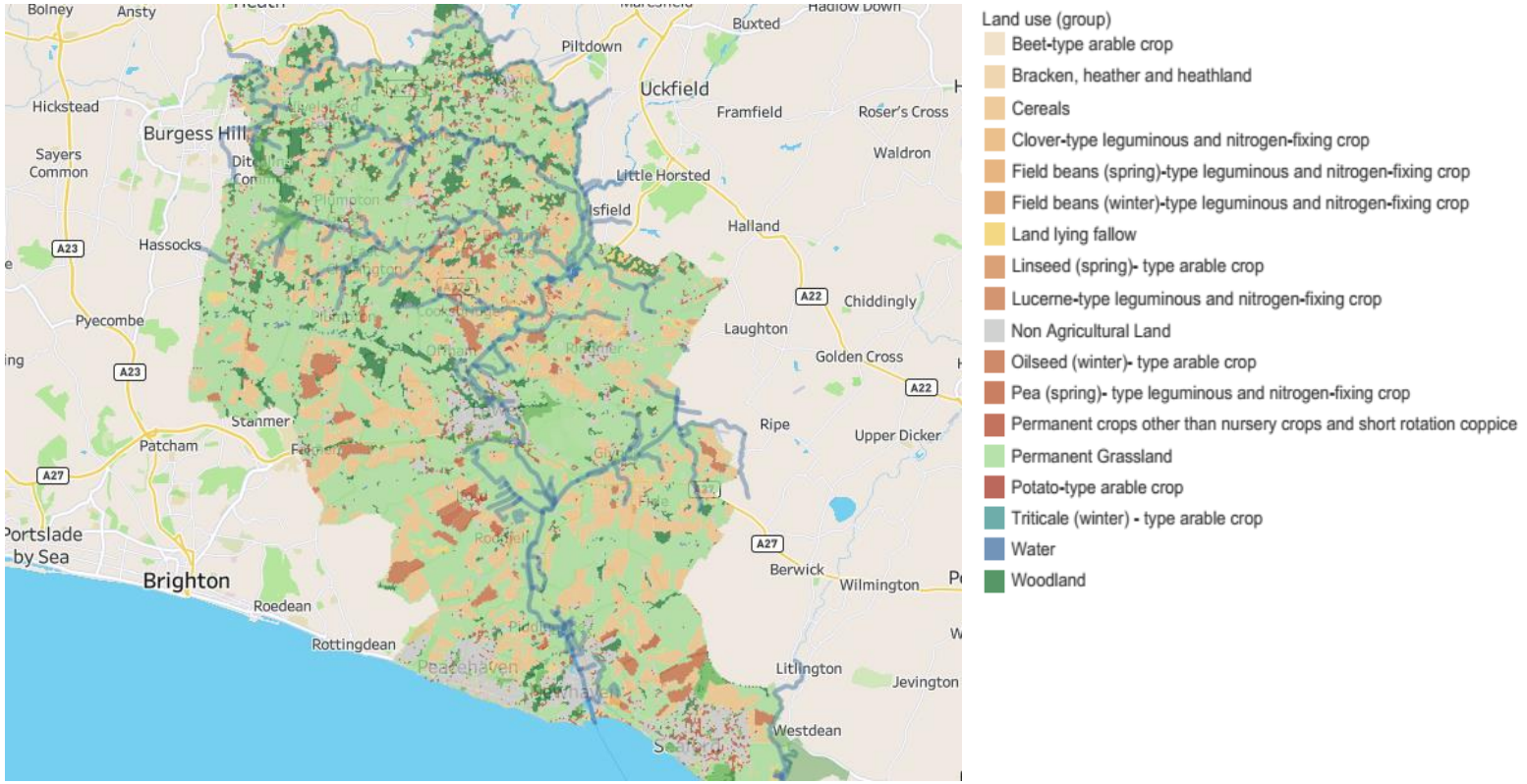
According to 2017 BEIS data, gross emissions from agriculture were 36.5 $ktCO_2$, offset by a figure of 12.7 $ktCO_2$ resulting from land use, land-use change and forestry (LULUCF).

The significant disparity in the emissions reported by BEIS and our analysis stems from the different greenhouse gases at work.

BEIS datasets considers only CO_2 emissions and neglects other greenhouse gases such as methane and nitrous oxide. These gases are emitted in significant volumes within the agriculture sector, through rearing of cattle livestock and fertilisers. Anthesis' analysis considers these gases and provides a figure for the equivalent weight of CO_2 after accounting for the more potent methane and nitrous oxide.

Lewes District Council: Agriculture and Land Use

Land



Rural Payments Agency, 2019: Crop Map of England (2017)

The single largest land use is permanent grassland, which forms about 17,100 hectares (59%) of the total. The next major land-type is arable land (including trees in hedgerows and fields) of 7,100 hectares (24%) then woodland / trees (including trees in hedgerows and fields) of 2,200 hectares (8%) and urban infrastructure (non-agricultural land) of 2,000 hectares (7%).

The map below is taken from the Crop Map of England, which mainly uses satellite data to identify land-uses and crop types; it is a snap-shot at a point in time (summer 2018) and should be considered indicative only.

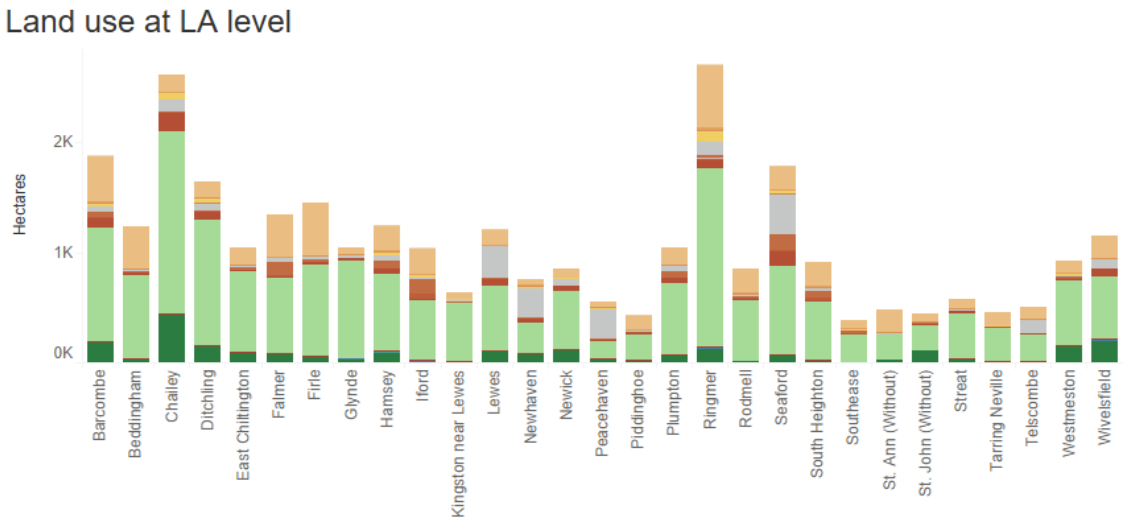
The table below summarises land use:

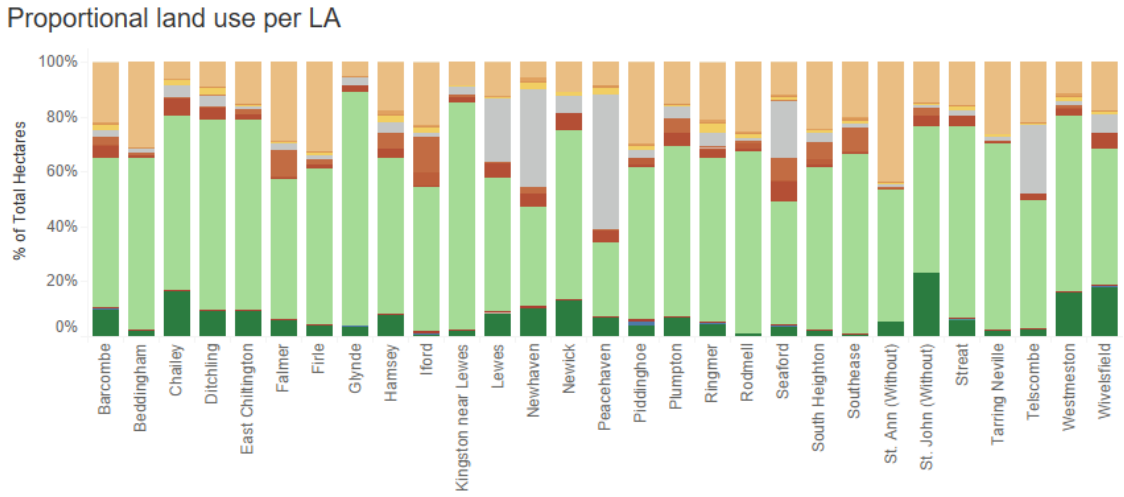
Land Use	Hectares	%
Permanent Grassland	17,100	59%
Arable	7,100	24%
Woodland (including trees in fields and hedgerows)	2,200	8%
Non-agricultural land	2,000	7%
Fallow land	500	2%
Legumes / nitrogen fixing	300	1%
Water	0	0%
Heathland	0	0%
Total	**29,206**	**100%**

Table 9: Land-use in the region

Lewes District Council: Agriculture and Land Use

Land





Land Use at Parish Level

The land area covered by Lewes District Council totals approximately 29,200 hectares, of which Ringmer LA accounts for the largest area within the district forming 2,704 hectares of land. The proportion of total hectares in Ringmer is largely made up of permanent grassland of 1614 hectares (59.7%) and arable crop growth (cereals) of 571 hectares (21.1%). This is followed closely by Chailey LA accounting for 2,609 hectares of land with 1,658 hectares of permanent grassland & 439 hectares of Woodland.

This proportion is typical across all local authorities in Lewes District Council, however, LA areas including Lewes (23.3%), Newhaven (35.4%), Seaford (20.7%) & Telscombe (25.1%) show higher proportions of urban infrastructure (non-agricultural land).

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Emissions from Agriculture & Livestock

Emissions from agriculture come from two main sources:

- Livestock production produces 75% of gross emissions. The majority comes from enteric fermentation in dairy cattle.
- Fertiliser applications produce the remaining 25%. The main sources are nitrous oxide from grassland (which has low fertiliser applications but a large total area) and wheat production (which has a high average fertiliser application rate and large area). These will vary each year if crops are rotated.

Land-use, land-use change and forestry is currently acting as a net sink of CO_2, storing 65% of the gross emissions from livestock and land each year.

The table below describes the emissions from agriculture and land:

Annual emissions	CO_2 equivalent, t	% of gross
Livestock[1]	27,500	75%
Crop and grassland (non-CO2)[2]	9,100	25%
Gross emissions	36,600	100%
Land (soil and biomass carbon)[3]	-23,900	-65%
Total	**12,700**	**35%**

Table 10: Emissions from agriculture and land. 1. Methane from enteric fermentation and manure management, plus nitrous oxide from direct manure management. 2. Nitrous oxide emissions from fertiliser (including manure) application to land. 3. Net carbon sequestration, taken from "UK local authority and regional carbon dioxide emissions national statistics." The statistics report does not provide any detail on what this is, but it may come from soil carbon returning to equilibrium following historic changes e.g. afforestation, deforestation / conversion to cropland or grassland. The estimated figures for livestock numbers & emissions are based on the Department for Environment Food & Rural Affairs: Local Authority breakdown for key crops areas and livestock numbers on agricultural holdings for 2013-2016.

A note on different greenhouse gases

The numbers in the tables are shown as CO_2 equivalents, using well-established conversion factors. Methane (93% of emissions above) is a very potent greenhouse gas which, in the short term (20 years), has 84 times the warming effect of carbon dioxide and, in the long term (100 years) has 28 times the effect. While carbon dioxide emissions are the primary cause of climate change, cuts to methane emissions have a much more immediate climate impact, helping to limit short- and long-term temperature increases. Nitrous oxide (7% of gross emissions) has 265 times the warming impact of carbon dioxide – reductions in this gas from reduced fertiliser use and manure management are also needed.

The table below shows emissions from livestock. These come predominantly from methane emissions by breeding dairy cattle, due to the large feed intake required for producing milk, and the large herd size.

Livestock type	Number	Total CO_2e, t	Per head CO_2e, t
Dairy Cattle	1,400	6,700	4.63
Non-dairy cattle	8,100	15,700	1.94
Sheep	30,100	4,000	0.13
Pigs	2,300	900	0.41
Poultry	107,600	200	0.00
Total	**149,500**	**27,500**	**0.18**

Table 11: Livestock emissions.

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Soil and Biomass Emissions

The table below shows that grassland and forests act as **carbon sinks**, storing a total of about 23,900 tCO_2 per year in Lewes District Council. However, these sinks are more than outweighed by soil carbon losses arising from cropland and settlements. Such losses typically occur due to land conversions in earlier years but can also arise due to the way soils are managed.

Land type	tCO_2e
Grassland	-10,500
Forestland	-27,300
Settlements	7,900
Cropland	6,000
Total	**-23,900**

Table 12: Estimated soil and biomass gains and losses for Lewes. Source: BEIS / CEH / Ricardo.

Land use - forestry

Forestry in the UK as a whole is a net carbon sink, storing an average of 5.5 tCO_2 per hectare per year for existing woodland. Of this, about 1.3 tonnes are stored in the soil, 2.9 tonnes in trees, and 1.3 tonnes in dead wood and leaf litter. Applying this average to the total area of forestry in the Lewes area would give net storage of about 21,730 tCO_2 per year; compared to 27,300 t for Lewes currently in the table above. Additional data on forest age and type would be needed to better estimate the actual contribution of current forestry to net emissions.

Carbon stocks by land use

Understanding existing carbon stocks can help prioritise areas for action – for conservation of existing stocks or for additions through land-use management or change. Carbon is stored in several "pools" – the key ones being soil and above-ground biomass (trees, crops and other plants). The balance of total carbon between these pools depends on the type of land – woodland stores relatively more carbon in above-ground biomass (trees) than cropland or grassland, for example.

Habitat	tC per ha				tCO_2 per ha
	Soils (15cm)	Vegetation	Soils (100 cm)	Vegetation & Soils (100 cm)	Vegetation & Soils (100 cm)
Dwarf shrub heath	88	2	218	220	799
Coniferous woodland	90	70	185	255	935
Broadleaf, mixed woodland	73	70	150	220	808
Neutral grassland	69	1	130	170	628
Improved grasslands	67	1	116	117	431
Arable and horticulture	47	1	95	96	351

Table 13: Carbon stocks by land-use type. Adapted from Natural England, 2012 and Open University 2018 . Carbon in soils to 100cm is extrapolated from 15cm using ratios calculated from Natural England 2012.

Lewes District Council: Agriculture and Land Use

Soil Carbon

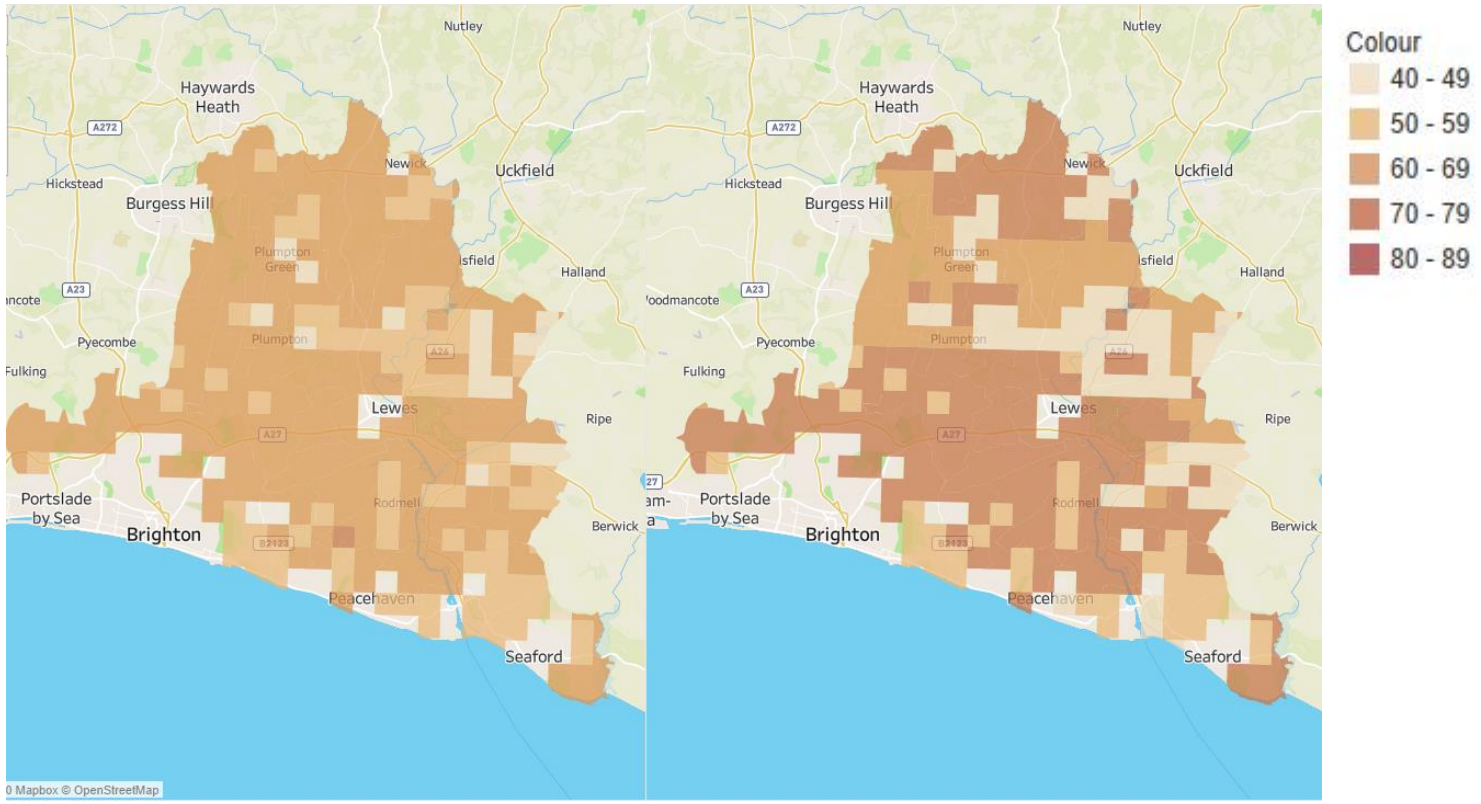

Figure 8: Estimated soil carbon stocks to 15cm based on land-cover type (land-use) and soil characteristics. Source: Countryside Surveys 2007 and 1978. The map is lower-resolution than the CROME and the underlying land-uses in this map don't always correspond to those in CROME.

The maps opposite show estimated soil carbon to 15cm in the area in 1978 and 2007. The numbers (tonnes of carbon per hectare) are broadly comparable to the first column of the table above. The areas with higher carbon stocks correspond largely with areas designated within the Countryside Surveys as improved grassland (as carbon stocks are estimated using this designation).

Total soil carbon in the top 15cm for the area, based on the above data, is estimated to be 1.8 million tonnes carbon, equivalent to 6.7 $MtCO_2$. Extrapolating this to a depth of 100 cm gives approximately 3.9 million tonnes carbon stored, equivalent to 14.5 $MtCO_2$.

Above-ground carbon

Using the values in Table 13 above and applying them to the broad land-types within the Crop Map of England gives an estimated 23,900 tonnes of carbon (23.9 $MtCO_2$) stored in vegetation. The majority is within Grassland, using an area of 18,800 hectares.

Lewes District Council: Agriculture and Land Use

Emissions Reductions Scenarios

The UK Committee on Climate Change (CCC) provides several scenarios for how changes in land-use and agriculture can contribute towards the UK's emissions reductions targets. These are set at low, medium and high ambitions. These represent business-as-usual, adoption of currently-available measures, and more radical and novel measures respectively. Only the medium and high ambition measures are considered here.

Dietary Change

This scenario includes a reduction in the national consumption of dairy, beef and lamb of 20% (medium) and 50% (high) by 2050. Some of this is replaced by increased consumption of pork and chicken. This is modelled here as a 20% or 50% reduction in cattle numbers, and the same reductions in grassland and associated fertiliser applications. Pig and chicken numbers increase by 20% under both ambition levels.

Grassland is reduced by about 3,866 and 9,667 hectares respectively in the medium and high scenarios. While more crops will be needed to replace some of the animal products, gains in productivity should mean little additional cropland is needed.

Afforestation

For this report, the equivalent area of grassland freed by dietary change is converted to forestland over the period to 2100. The forest management plan used by the CCC is followed – a mix of native broadleaved and conifer woodlands which are managed to provide some fuel and harvested wood products.

The grassland area is planted at a constant rate per year to the year 2100, equivalent to 48 hectares per year (medium) and 120 hectares per year (high). Grassland is assumed to be replaced by woodland to provide a simple scenario for the purposes of these calculations.[1] **Planting 9,667 hectares of woodland would be a significant increase in the existing area of woodland within Lewes, which is currently 2,200 hectares.**

Greenhouse gas emissions reductions

The table below shows average annual emissions reductions associated with these scenarios between now and 2100.

	CO2e, t net emissions reductions per year		% of current gross emissions[3]	
Scenario	Medium	High	Medium	High
Dietary change (grassland) - change to 2100	-300	-800	-1%	-2%
Dietary change (livestock) - change by 2050	-4,300	-11,000	-12%	-30%
Dietary change (subtotal)	**-4,600**	**-11,800**	**-13%**	**-32%**
Planting forests on saved land	-21,700	-56,100	-59%	-153%
Total	**-26,300**	**-67,900**	**-72%**	**-186%**

Table 14: Emissions reductions from the two scenarios. 1. This is the average annual savings from the reductions in cattle and sheep and associated grassland use by 2050. 2. This is the average annual net carbon sequestration over the period to 2100 in biomass and soil. 3. Gross emissions are used here as the impact on current sequestration (and net emissions) is not known.

With medium ambition the measures can reduce gross emissions in this sector by about 72%. With high ambition, emissions can be reduced by 186%.

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1 - The overall UK woodland mix is used here (using the published CCC numbers), which includes a much higher proportion of conifers than would normally be planted in England or Wales. This will likely overstate carbon storage as faster-growing conifers tend to store more carbon under the scenarios analysed. In practice, where and on what type of land woodland is planted depends on a variety of factors including the suitability of the land and the aim of providing connected habitats for biodiversity promotion.

Lewes District Council: Agriculture and Land Use

Emissions Reductions Scenarios

Final changes	Hectares change		% change in land	
	Medium	High	Medium	High
Grassland	- 3,866	- 9,667	-23%	-57%
Woodland	3,866	9,667	172%	431%

Final Changes	% Change		Hectares Change	
	Current %	High %	Current	High
Agricultural	27%	27%	7,800	7,800
Permanent Grassland	59%	25%	17,100	7,400
Heathland	0%	0%	5	5
Forestry	8%	41%	2,200	11,900
Non-agricultural land	7%	7%	2,000	2,000

Soil Carbon Stocks	C, t	CO2 equivalent, t
Top soil 15cm	1,819,061	6,669,891
Deep soil 100 cm	3,946,113	14,469,082

Local Authority case studies:

Land Quality Strategy for Oxford (2014) – Oxford City Council
The Land Quality Strategy was implemented to address land contamination/remediation planning & control, promote sustainable land remediation practices & landowner compliance, & develop a land quality database in the Oxford area.
(see https://www.oxford.gov.uk/download/downloads/id/581/land_quality_strategy.pdf)

Land Quality Strategy (2018-2023) – Southampton City Council
To ensure legal compliance and enforcement of legislation & government guidance on land contamination, & council land acquisitions/development sites. Also, to provide information to the public/developers & promote redevelopment of brownfield sites within the area.

The Soil Association (UK) suggest seven areas for farmers/government to increase soil organic matter levels in UK arable and horticultural soils, with a target of 20% over the next 20 years:

1. *Increase the amount of plant and animal matter going back onto fields*
2. *Improve soil health monitoring across the UK*
3. *Encourage soil organisms – both those that build up soil and those that release nutrients*
4. *Cover up bare soil with continuous plant cover*
5. *Bring more trees onto farmland*
6. *Reduce soil compaction from machinery & livestock*
7. *Design crop rotations to improve soil health*

(see https://www.soilassociation.org/media/4672/7-ways-to-save-our-soils-2016.pdf)

Agriculture & Land Use Workshop

Overview

To explore current land use practices and initiatives and identify opportunities for the agricultural sector business and landowners in Lewes to support the district's emissions reduction goals, Lewes District Council convened a workshop for key local stakeholders in the sector.

Aims of the session:

1. Get a shared understanding of the climate emergency background and the role of agriculture & land use
2. Understand the evidence base for taking action to reduce emissions
3. Explore potential actions for maintaining and increasing natural capital across Lewes
4. Highlight specific barriers and enablers to taking action
5. Identify opportunities for collaboration

The following pages collate the feedback from the session and highlight the key findings.

Taking action locally

- Financial constraints were highlighted as the key barrier to local landowners and agricultural businesses taking action to support emissions reduction.
- Many action areas were seen as intrinsically linked and may then counteract e.g. reducing livestock may actually be counter-productive. It will be important for landowners to consider these actions holistically and alongside biodiversity impacts.
- There is a demand from young people to get involved with farming and landownership, and an opportunity to tap into this market to support net zero ambition as they are quite engaged on the topic.
- Help support distribution of farmers market to increase access – link in with community wealth project
- Is it possible to create a virtual local food market, enable wider accessibility to wider audience to source local food produced
- Campaigns to encourage people to waste less, use less
- Capacity to incentivize behavior through planning – local development order which allows certain types of development in the context of carbon storage e.g. if it has tress it goes through quickly
- Planning – building standards, certainly have policies that have carbon sequestration in development. Monitoring impact of planning applications

Agriculture & Land Use Workshop

Summary

The following actions were discussed to identify key barriers and enablers to support the net zero ambition across the agricultural sector in Lewes

Action areas	Barriers	Enablers
Agroforestry	• May be difficult to move machinery around so suitable for a smaller number of farms.	• Recreational value and co-benefits.
Increasing efficiency of operations	• Slow uptake could be a challenge -> could look at this at a district level, what enablers might there be at a local level. • May be more costly.	• Technology has a huge role in this, knowledge sharing could be an enabler.
Resource use efficiency/Circular economy (related to 25% arable emissions – introduce mixed farming values)		• Would be making best use of resources in the district, multiple benefits
Regenerative economy	• Don't see income streams at the moment – woodland carbon code but not an equivalent carbon code – no mechanism to reward them for this – this is a key thing missing.	• May be sitting on carbon sinks (but this has got to pay to make it work) • Carbon as tradable unit – agriculture is good at supplying to a market demand • Could the national park come up with a structure? Ways to incentivise • Potential to reduce other sector's carbon emissions – look at this as a direction of travel and incentivise this (may not make sense for agriculture alone but could be the case if carbon offset) • Could responsibility be given to the individual landowner (i.e. polluter pays)

Agriculture & Land Use Workshop

Action areas	Barriers	Enablers
Carbon Tools for emissions measurement	• The risk is that everyone looks at the same assets so double counting – farmer or district 'claiming' that offset. Need to capture this and what contribution people are making. • Actually quite complicated/complex – but there must be ways of assisting, Process has to be whole end to end (compelling argument to incentive). • Need to address the issues around the carbon the farmers have grown – none of the toolkits take account for that. Feeling that farmers are penalised for the carbon they bring but not credited for the carbon sequestered.	• There is a lack of data on emissions in the sector, measurement is key to managing practices going forward, and is an opportunity to engage landowners. • There are several tools already out there, opportunity to simplify the process and identify the best tools on the market. • There are lots of engaged farmers but is this too complicated/ do farmers have enough resource. • There is a role for education/research institutions to enable these tools to be used effectively.
Tree planting/woodland planting	• There is no market for a woodland product of any value so the only value/incentive for this is sequestration – more could be done on a local level. • A lot of hardwood in the UK is imported so there is an opportunity to source more locally.	• Biodiversity benefits of woodland resource. • There is a need for viable cashflow to maintain jobs/operation so has to be some kind of incentivisation. • Opportunity to look at the industry and outputs at a county level or Sussex-wide.
Knowledge sharing	• Actions and next steps need to be specific to individual landowners and farmers as there are big differences across each stakeholders land. • There is a lack of knowledge and understanding of the impacts in some cases.	• Knowledge exchange is progressing in the right direction, an element of this is trying to track the knowledge sharing and networks. • NFU are looking to produce some guidance for local authorities. • Identifying best practice is a tried and tested approach. • The Agriculture and Horticulture Development Board (AHDB) could be a key stakeholder to enable this.
Promote local produce	• The local farmers market is struggling. • There is an issue around access to good food. • Local food has a higher price point, which is not always accessible to all.	• National parks have potential online food market. The local food portal for the national park is just a directory at present and could be enhanced to use as an online market. • Market for this could incentivise farmers to adopt different practices. • IT solutions exist for small business so people have pivoted – e.g. Bucky Box

Agriculture & Land Use Workshop

Working better together

- There is an opportunity for local landowners and agriculture businesses to share knowledge and best practice.
- Challenges were currently being faced by the local stakeholders in being able to accurately and easily measure their carbon footprint. There is an opportunity for LDC to partner with local networks to identify the best tools available and provide support in how best to measure emissions consistently.
- The National Trust was identified as a potential partner to help promote tools identified by the NFU to introduce the tools and highlight those which are easy to use and robust.
- LDC should seek to work with other councils with similar rural profiles and climate commitments to influence greater ambition at national government level such as energy and planning policy which could help them achieve local goals.
- A need to get more feedback from farmers was identified, this could be through some pre-existing groups such as SDNP cluster groups?
- There are a number of different advisors in the sector such as the EA, Natural England, Wildlife trust – with potentially conflicting requirements on landowners– clearer messaging on the standard approach would be beneficial.

Next Steps

There is an opportunity for using current national or local forums to share knowledge and develop a common understanding more widely across landowners and agricultural business on best practice. LDC could support this by collaborating with local colleges and industry experts, demonstrating leadership and enabling policy development to support sustainable farming practices. Improving the accuracy of calculations the local agricultural emissions through more consistent use of measurement tools could follow this work.

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