

**Situation Report:  
Lime Down Solar  
Farm.**

**Impact on Soils and  
Agriculture**

**EN010168**

April 2026



## Lime Down Solar Proposal – Impact on Soils and Agriculture.

### EXECUTIVE SUMMARY

- This report sets out the main agricultural issues of concern regarding the proposed Solar Energy Park at Lime Down. This report concludes that there are good reasons for protecting the Solar PV Sites and Cable Route Corridor from development where the loss of valuable productive farmland has not been shown to be necessary. Developers are asked to find and use areas of poorer quality land and seek alternative sites including brownfield land first. I am not satisfied that there has been sufficient justification for siting the proposal on BMV land or in such quantity, when other poorer land exists.
- There are inadequate safeguards in the Soil Management Plan to protect existing land drainage such that it may be damaged and consequently there is risk to the soil quality going forward, such that the likelihood that the land can and will be restored to the same ALC quality is in doubt.
- The soils are acknowledged to be at risk from compaction during operations and if it occurs will produce long term damage to soil structure and quality [**Appendix K2, Soil Thematic Maps 1q, 1s, 1t**]. The risk to soil structure, compaction, drainage and erosion on this site is also significant, with little opportunity to remedy any problems once they occur. Once damaged there is a real threat of long-term problems occurring to the soil and its productive capacity.
- There will be an impact on the local agricultural industry if this land is lost to production. The loss of productive capacity undermines UK food security and sets an unacceptable precedent for the loss of agricultural capability. This site is precisely the type of farmland government policy intends to protect from development. The reliance on food imports to the UK must be addressed and home production on farms now needs to be a priority. The loss of a sizeable parcel of productive farmland, by this Solar Farm should be avoided.
- Whilst the soils are productive and important locally and nationally, due to the high clay content these soils damage easily particularly during the construction phase, or by heavy trafficking. However, evidence shows that these soils are difficult to repair and remedy once seriously damaged and the supposed benefits of 60 years of ‘resting’ may well not materialise, once damaged. Further those soils on land that is under drained run the risk of the metal piles fracturing or puncturing land drains, especially where they are shallow.
- 240 hectares of BMV land would be lost to the proposal, this represents 33% of the entire land block. Most of land is well suited to arable and livestock agriculture and the loss to the local farming economy would be significant
- Any use of the site for low intensity livestock grazing, does little to address these concerns and will not prevent the significant loss of the arable agricultural capability. The supposed environmental benefits of the scheme are minimal and should be ignored compared to the loss of agricultural land and capability. Some solar farms are grazed with sheep, but many are simply managed by cutting, offering no agricultural benefit whatsoever.

## **1. Introduction and Background**

- 1.1. Land at Lime Down Solar Park has been submitted for planning consideration under **EN010168**. This report addresses some of the agricultural land quality issues of relevance to the application and the wider farming holdings.
- 1.2. The proposal affects approximately 717.5ha of agricultural land at the solar PV sites and **[APP-069, §17.7.12]** and 205.2 ha of agricultural land in the Cable Route Corridor **[APP-069, §17.7.13]**. The fields are currently mainly arable farmland and have been used for mainly combinable crops and there are areas of grassland. The area has been important to the historical agriculture practised locally. Farming is widely practiced in the area, and it is still very rural. Arable land has been improved through drainage and mechanised farming.
- 1.3. The Applicant acknowledges that, at least during construction, agricultural uses would cease within each of the fields within the Order Limits proposed to accommodate the Solar PV Panels, substations, BES areas, landscaping schemes and for laying the underground cables **[APP-069, §17.10.7]**. The Applicant suggests that some agricultural use may resume during the operational and maintenance phase, if the area beneath the panels is grazed by livestock. The Applicant further accepts that the land affected would no longer be available for food production **[APP-069, §17.10.14]**.
- 1.4. The evidence which I have prepared and provided is true and I confirm that the opinions expressed are my own, true and professional opinions, irrespective of by whom I am instructed.

## **2. Policy Considerations**

### **NPS EN-1**

- 2.1 Chapter 5 of NPS EN-1 addresses land use objections to renewable energy infrastructure. The most important policies for the purpose of this paper are:
  - 2.1.1 “Applicants should seek to minimise impacts on the best and most versatile agricultural land (defined as land in grades 1, 2 and 3a of the Agricultural Land Classification) and preferably use land in areas of poorer quality (grades 3b, 4 and 5) (Paragraph 5.11.12).
  - 2.1.2 Applicants should also identify any effects and seek to minimise impacts on soil health and protect and improve soil quality taking into account any mitigation measures proposed. (Paragraph 5.11.13)
  - 2.1.3 The Secretary of State should ensure that applicants do not site their scheme on the best and most versatile agricultural land without justification. Where schemes are to be sited on best and most versatile agricultural land the Secretary of State should take into account the economic and other benefits of that land. Where development of agricultural land is demonstrated to be necessary, areas of poorer quality land should be preferred to those of a higher quality. (Paragraph 5.11.34)

### **NPS EN-3**

- 2.2 Chapter 2 of NPS EN-3 addresses solar photovoltaic generation specifically. The most relevant paragraphs are as follows:

- 2.2.1 “While land type should not be a predominating factor in determining the suitability of the site location applicants should, where possible, utilise suitable previously developed land, brownfield land, contaminated land and industrial land. Where the proposed use of any agricultural land has been shown to be necessary, poorer quality land should be preferred to higher quality land avoiding the use of “Best and Most Versatile” agricultural land where possible. ‘Best and Most Versatile agricultural land is defined as land in grades 1, 2 and 3a of the Agricultural Land Classification” (Paragraph 2.10.29)
- 2.2.2 “Whilst the development of ground mounted solar arrays is not prohibited on Best and Most Versatile agricultural land, or sites designated for their natural beauty, or recognised for ecological or archaeological importance, the impacts of such are expected to be considered and are discussed under paragraphs 2.10.73 – 92 and 2.10.107 – 2.10.126” (Paragraph 2.10.30)
- 2.2.3 “It is recognised that at this scale, it is likely that applicants’ developments will use some agricultural land. Applicants should explain their choice of site, noting the preference for development to be on suitable brownfield, industrial and low and medium grade agricultural land.” (Paragraph 2.10.31)
- 2.2.4 “Where sited on agricultural land, consideration may be given as to whether the proposal allows for continued agricultural use and/or can be co-located with other functions (for example, onshore wind generation, storage, hydrogen electrolyzers) to maximise the efficiency of land use.” (Paragraph 2.10.32)
- 2.2.5 “The Agricultural Land Classification (ALC) is the only approved system for grading agricultural quality in England and Wales and, if necessary, field surveys should be used to establish the ALC grades in accordance with the current, or any successor to it, grading criteria and identify the soil types to inform soil management at the construction, operation, and decommissioning phases in line with the Defra Construction Code.” (Paragraph 2.10.33)
- 2.3 In May 2024, the government produced a Written Ministerial Statement (WMS) specifically with regard to renewable energy, best and most versatile land and food security.
- “Where the proposed use of any agricultural land has been shown to be necessary, poorer quality land should be preferred to higher quality land avoiding the use of “Best and Most Versatile” agricultural land where possible.
- For all applicants the highest quality agricultural land is least appropriate for solar development and as the land grade increases, there is a greater onus on developers to show that the use of higher quality land is necessary. Applicants for Nationally Significant Infrastructure Projects should avoid the use of Best and Most Versatile agricultural land where possible.”
- 2.4 In a recent letter 15/2/2025 the Minister of State for Energy and Net Zero (**Annex A**) stated:-
- "There has been no change to the policy on the weight attached to the use of BMV land. Planning policy and guidance makes clear that, wherever possible, developers should utilise brownfield, industrial, contaminated, or previously developed land. Where the development of agricultural land is shown to be necessary, lower-quality land should be preferred to higher-quality land (including ‘Best and Most Versatile’ land)."

### 3. Food Security and Food Imports

3.1 Nearly half of what we eat in the UK comes from abroad, and two-thirds of that has in recent years come from the EU.<sup>1</sup> In 2023, the UK was 62% self sufficient in food.<sup>2</sup> With the recent war in Ukraine and the uncertainty of supply of core commodities such as wheat, there have been both supply issues and huge price fluctuations.<sup>3</sup>

3.2 This has refocussed attention on food security in the UK and the need to protect productive farmland from development and long-term decline. The current political instability in the Middle east only exacerbates these issues.

3.3 Section 19, Agricultural Act 2020 requires the Secretary of State to lay before Parliament a report containing an analysis of statistical data relating to food security in the United Kingdom every three years. The most recent report, the United Kingdom Food Security Report 2024 observes:-

“The period of 2021 to 2024 began with continuing societal responses to and recovery from the COVID-19 pandemic alongside adjusting to a new relationship with European Union (EU) and European Economic Area trade (EEA) partners following the UK leaving the EU. Global supply chains dealt with consecutive declines and then surges in demand, in many cases driven by government infection and control measures followed by economic stimulus. Russia’s invasion of Ukraine in February 2022 transformed the world’s economic and geopolitical situation and was particularly disruptive to energy and grain supplies. This had significant consequences for global and UK food security, including widespread increase in food prices. Conflict in the Middle East further disrupted the system by altering supply routes and the navigational safety of the Red Sea, but with more limited consequences, demonstrating the ability of the global trade system to adjust to localised disruption. Extreme weather conditions in the UK and across the globe made more likely by climate change have caused further food chain disruptions but often with more localised impacts.”<sup>4</sup>

3.4 The UK has a productive agricultural sector and a domestic agri-food manufacturing industry that produces food to high standards. The amounts and types of food produced are driven by market forces and consumer demand for goods, rather than by assessment of overall quantity of food or of self-sufficiency. Many factors affect the output of domestic production, including:-

---

<sup>1</sup> Food Standards Authority, ‘Chapter 2:Going Global, food imports and their impact on the standards’ (Our Food 2021: An annual review of food standards across the UK) <<https://www.food.gov.uk/our-work/chapter-2-going-global-food-imports-and-their-impact-on-the-standards>> accessed 29 April 2026.

<sup>2</sup> National Farmers Union, ‘UK self-sufficiency must be upheld amid global instability’ <<https://www.nfuonline.com/news/self-sufficiency-day/>> accessed 29 April 2026.

<sup>3</sup> See discussion on this point in the House of Commons on 18 July 2022 <<https://commonslibrary.parliament.uk/research-briefings/cdp-2022-0147/>> accessed 29 April 2026.

<sup>4</sup> Food Security Report 2024, ‘United Kingdom Food Security Report 2024: Introduction’ <<https://www.gov.uk/government/statistics/united-kingdom-food-security-report-2024/united-kingdom-food-security-report-2024-introduction>> accessed 29 April 2026.

- The availability and suitability of land for particular forms of production.
  - Inputs such as labour, water, fertiliser, pesticides, and seeds.
  - Climate and environmental factors such as soil health and rainfall.
- 3.5 In 2024, the utilised agricultural area was 17 million hectares, covering 69% of the total UK land area. UAA is made up of arable and horticultural crops, uncropped arable land, common rough grazing, temporary and permanent grassland and land used for pigs. It does not include woodland and other non-agricultural land. The total croppable area is 6.2 million hectares.<sup>5</sup> Much of the Lime Down area is arable with grassland and, because not all UK land is suitable for cereal cropping the loss of any of this site is likely to be significant, having an impact on local farms and the wider agricultural community.
- 3.6 The Food Security Report 2024 notes that the biggest medium to long term risk to the UK's domestic production comes from climate change and other environmental pressures like soil degradation, water quality and biodiversity. I note, in particular, the following observations made:
- 3.6.1 **“Extreme weather events continue to have a significant effect on domestic production,** particularly arable crops, fruit and vegetables. Production levels fluctuate each year due to changes in both planted area and yields, with weather conditions having a significant influence among other factors.
  - 3.6.2 **The UK continues to be highly dependent on imports to meet consumer demand for fruit, vegetables and seafood,** which are significant sources of micronutrients for consumers. Many of the countries the UK imports these foods from are subject to their own climate-related challenges and sustainability risks.
  - 3.6.3 **Long term decline in the UK's natural capital is a pressing risk to UK food production.** Both productivity and sustainability of food production rely on ecosystem services provided by biodiversity, healthy soil and clean water. However, the decline in natural capital is slowing and levelling against some key indicators.”<sup>6</sup>
- 3.7 In 2019 UK cereal production (25.5mt) was the highest this century, whereas in 2020 production (19.0mt) was the second lowest largely due to bad weather. The published first estimate of the 2024 English cereal and oilseed harvest shows a 22% decrease (around 2.8mt) in harvested wheat from 2023 (see Indicator 2.1.2 Arable products (grain, oilseed and potatoes)).<sup>7</sup>This is an indicator of the effect that increasingly unreliable weather patterns may have on future production. When UK production is reduced, we are more dependent on imported commodities. The war in Ukraine has highlighted the vulnerabilities of such a strategy.

---

<sup>5</sup> Department for Environment, Food, & Rural Affairs, 'Agriculture in the United Kingdom 2024' (updated 14 July 2025), 26 < <https://www.gov.uk/government/collections/agriculture-in-the-united-kingdom>> accessed 29 April 2026.

<sup>6</sup> Food Security Report 2024, 'United Kingdom Food Security Report 2024: Introduction' < <https://www.gov.uk/government/statistics/united-kingdom-food-security-report-2024/united-kingdom-food-security-report-2024-introduction>> accessed 29 April 2026.

<sup>7</sup> *ibid*, < <https://www.gov.uk/government/statistics/united-kingdom-food-security-report-2024/united-kingdom-food-security-report-2024-introduction#uk-food-security>> accessed 29 April 2026.

- 3.8 A recent report, *UK Food Security – Outlook to 2050*, raises the concern that up to 23.7% of land currently farmed could be lost from agriculture by 2050 due to competing land-use demands including housing, solar infrastructure, tree planting and carbon offsetting.<sup>8</sup> It warns that, unless agricultural productivity is significantly boosted, these trends could lead to a 32% fall in domestic food production, exposing the UK to increased import reliance and food price volatility.<sup>9</sup>
- 3.9 Far from taking farmland out of production for at least 60 years, efforts should be made to increase food production from this land.

#### 4. Loss of Productive Agricultural Land

- 4.1 Chapter 17 of the ES considers soils and agriculture [APP-069]. The survey report is attached at an Appendix 17-1 [APP-243]. I have excerpted below (Annex 1), a copy of the Applicant's Agricultural Land Classification Mapping [APP-172]. The ALC report map is a copy of the ALC map from the report. The mapping indicates that there is Grade 3a BMVAL across the Solar PV sites.
- 4.2 An extensive portion of the land comprising the Cable Route Corridor has been marked as "un-surveyed" on the ALC Mapping. The Applicant does not appear to provide any basis for this approach. I note that this general area has a higher probability of BMV as shown on the map taken from the Defra Predictive ALC (Annex 2), and therefore it is very probable that un-surveyed parts of the CRC will be BMVAL.
- 4.3 Even on the Applicant's assessment, just 33% of the land surveyed of the Solar PV Sites is poor quality [APP-243, §1.3.32].
- 4.4 Where surveys have been undertaken, they have not been conducted at the full density of 1 auger point per hectare as is recommended by Natural England and there is evidence from other ALC surveys of the presence of more BMV than found in these surveys. The ALC report confirms [APP-243]:-

"1.3.1 Soil profiles were examined using an Edleman (Dutch) auger at an observation density of approximately one per two hectares across the Solar PV Sites proposed for Solar PV Panels, one per hectare across land proposed for the BESS, and ensuring that one observation was made within the footprint of each proposed substation, amounting to 361 observations across the Solar PV Sites in total. Soil pits were also excavated to examine subsoil structures and stone content. Where access has been permissible, observations have been made within the bands of each mapped soil type along the Cable Route Corridor, as well as additional observations made at a density of one per hectare where built aspects are proposed. In total, 28 observations have been completed in the Cable Route Corridor."

---

<sup>8</sup> Dr. Derrick Wilkinson, 'UK Food Security: Outlook to 2050' (September 2025 Report), 5.

<sup>9</sup> *ibid.*

- 4.5 As a significant site over 20ha, the applicant is required to demonstrate that there is not '*poorer quality land*' available for the development. It is for the applicant to justify the use of higher quality land with the most compelling evidence. However, I note that there is a much higher presence of poor farmland elsewhere is a copy of the Provisional ALC map from Natural England (**Annex 3**). This further calls into question the appropriateness of siting a solar farm in this location.
- 4.6 The supporting planning report does not address the loss to the farm holdings or the local area of an important group of farming operations with good productivity, nor the cumulative effect. The area of land taken is significant for the local farming community and will have a major impact on tenants and farmers and their ability to continue in agricultural production due to the loss of flexibility and for the rotational cropping of certain crops.

### **Livestock Grazing Under Panels**

- 4.7 Chapter 17 suggests that during the anticipated lifespan of the Scheme of 60 years, some agricultural use may resume within the Solar PV Sites if the area beneath the panels is grazed by livestock.
- 4.8 Whilst it is perfectly possible to graze the areas under and between the panels, it is unlikely to be very cost effective for a grazier. The difficulties of rounding up livestock and handling them, together with finding sick or wounded animals amongst the panels, makes the graziers workload harder and more complex. Shepherds have found that some sheepdogs will not work well under panels as the low-level humming and buzzing irritates their acute sense of hearing. The applicant does not even offer a guarantee of ongoing grazing as part of the project.
- 4.9 The cropping of the land has been arable cropping, with mixed livestock, the loss of this land from cropping to solar would restrict its use to only sheep livestock grazing under the panels. Hay and silage making are not practicable on the grassland between panels and sheep grazing is the only realistic agricultural activity that could occur.
- 4.10 Cattle grazing is unlikely to occur amongst the panelled areas as cattle may damage the panels. Many solar sites are not actively grazed and even where grazed, it is usually at very low grazing densities.
- 4.11 The economics of moving livestock to and from the site make it more marginal. Most examples of livestock grazing are by sheep farming and solar operators do not charge much or anything for the grazing and this may make it sufficiently attractive for a local farmer perhaps with a 'flying flock' of sheep, but it is no substitute for the existing arable operations. It is widely acknowledged in the industry that many solar farms are not actively grazed and many of these only at low intensity, for ecological benefits, such that far from retaining the land in agricultural use, it is little more than a tidying up exercise. It will be even harder to achieve any ecological effect using cattle given the practicalities.
- 4.12 Land in use for solar panels is ineligible for the normal agricultural subsidies, such as the Sustainable Farming Incentive (SFI) and the Environmental Land Management Scheme

(ELMS). It does not prevent land from being managed in similar ways, but there will be no payments available to farmers (e.g. graziers) for compliance, and this would make farming less financially attractive going forward.

- 4.13 The site will have to be (re)seeded to species rich grassland, but this would logically occur after the panels have been sited on the land. Species rich grassland is difficult to establish on nutrient rich former arable land as set out in TIN 066 Arable Reversion (**Annex B**). In my experience grass does not grow well under the panels themselves and there are often areas that are dry and barren or that only host weeds species, due to heavy shading and patchy wetness.



**The Reality is that often ‘nothing’ grows under the panels,...**



**.....or that weeds grow and must be cut or sprayed.**

## **5. Damage During Construction and Operation**

### **Soils**

- 5.1 Soil is considered a finite resource that fulfils many important functions and services (ecosystem services) for society, for example as a growing medium for food, timber and other crops, as a store for carbon and water, as a reservoir of biodiversity and as a buffer against pollution.
- 5.2 The soils locally are mainly clay and heavy clay loam soils over clay at depth [**Appendix K2, Soil Thematic Map 1n**] Typically, these soils are affected by compaction, especially during the construction phase of the project [**Appendix K2, Soil Thematic Maps 1q, 1s, 1t**]. Experience from other solar sites built during poor conditions demonstrates the extent of damage that can be done. Improper handling and storage of excavated soil may also degrade its quality, reducing its fertility and biological activity. Additionally, exposed and excavated soils are more vulnerable to erosion by wind and water, which can result in sediment runoff and potential contamination of nearby watercourses.
- 5.3 It is recognised by that the soils are vulnerable to compaction during farming operations, rainfall and high Field Capacity Days which means that the land can only be farmed effectively when undertaken carefully to avoid soil damage. Specifically, The Cranfield University Cranfield University (2025) Soil site report, Extended Soil Report [**Appendix K2**] states on page 35:-

#### *SUSCEPTIBILITY TO COMPACTION*

*The use of heavy machinery such as tractors, trailers, and harvesters can initiate the production of large clods and compaction in topsoils, particularly when field operations are performed when the soil is too wet. Compaction can have many detrimental effects on crop performance and yield as well as environmental sustainability. The effects of compaction include: poor germination and seedling emergence, impeded drainage, waterlogging, and therefore anaerobic conditions all leading to increases in susceptibility of the crop and root to diseases and pests, and soil erosion (with impacts onsite in terms of soil loss as well as offsite sedimentation problems and transport of soil associated pollutants).*

- 5.4 Compacted layers within the soil will affect drainage and it may cause areas of surface ponding across a field. Soil aggregate stability can be reduced by the construction resulting in a degradation of soil physical quality. **Annex 4** shows a timelapse series of photos of a solar farm during construction.
- 5.5 As work progresses, so the soil conditions deteriorate. In more extreme circumstances, due to the need to complete works within a deadline, serious soil damage can occur. Far from improving the status of land by taking it out of production, this soil damage can permanently harm the soil's productive capacity into the longer term, which cannot be remedied and may affect the land quality in the future.
- 5.6 Many of the soils as described in the ALC and ES chapter are acknowledged as vulnerable to a range of problems associated with construction practices. These include compaction, drainage issues and erosion. The report notes that the soils stay saturated (at field capacity) for an unusually high proportion of the time for lowland England, and that permeability is low

in 3 of 4 commonest soil associations. The applicant's ALC report states [**APP-243, §1.2.10**] *"The number of Field Capacity Days (FCD) is larger than is average for lowland England (150 days) and is unfavourable for agricultural field work"*. This means that there are relatively long periods in the year when construction and trafficking on the land should be avoided.

- 5.7 This means that attempting construction in these areas is unwise, and would be difficult. Local farmers report regular problems in getting on to some fields in the winter and damage to soils is inevitable. The Applicant recognises that soil resources are sensitive to damage, but suggests it can be mitigated [**APP-243**]:

"17.10.4 Most of the topsoil and subsoils throughout the Order Limits are heavy-textured (clayey) and therefore a resource of high sensitivity in **Table 17-3**. The subsoil within the brashy limestone soil type is considered to be of low sensitivity given the high proportion of rock. The potential magnitude of change on soil resources during the construction phase is high, however with the embedded mitigation measures in place, the magnitude of change is anticipated to be low."

- 5.8 However, the actual mitigation proposed is found in Chapter 17 where it states [**APP-069, §17.9.2,**]:

"Preparation of and adherence to a Soil Resources Management Plan (SRMP); the Outline SRMP as well as the overarching Outline CEMP will incorporate good practice measures to ensure adverse effects on agricultural land and soil are minimised wherever possible. Good practice measures include, but are not limited to:

- Only handling or tracking soils that are in a dry and friable condition; and
- Ensuring topsoil and subsoils are handled separately when being stripped, stored and reinstated.

- 5.9 It is not realistic for such a construction project to only work on the soils and traffic them when outside of the 150 FCD period. It is clear from this information that the potential for damage is high.

- 5.10 Compaction caused during construction damages the soil structure and means that soil remains wet due to poor drainage. This in turn affects the fertility of the land, the type of grass and other plants that can grow and makes long term improved fertility and soil health less likely. **Annex 5** shows a series of photographs of a large solar site during construction and sort of severe damage that can occur.



## Flooding

- 5.11 The ALC and environmental assessments have failed to consider impacts on the existing land drainage, which could be severely damaged by the insertion of piles into the ground and from other construction operations, particularly trenching works. The damage to drainage systems has potential impacts on agricultural soil quality, including the risk of permanent lowering of ALC quality following decommissioning restoration. The outline Soil Management Plan barely mentions drainage and there is no plan in place to survey the existing agricultural drains to avoid damage or to anticipate problems.
- 5.12 Professor Richard Skeffington has expressed serious concern at the likelihood of increased run-off from the panels on this land and the risk of soil erosion, sedimentation and associated problems (see Appendices F1, F2, and F3 of the Written Representation). I share these concerns.
- 5.13 As water washes off solar panels, it collects on the grassy areas between the panels, along with the normal rainfall falling. As such, the un-panelled areas receive most of the rainwater, whilst the areas under the panels remain much drier, Annex 6.



#### **Flooding due to construction compaction and subsequent run off**

5.14 The Applicant states *“The existing baseline comprises intensively managed arable fields subject to trafficking, compaction and periods of bare ground, while the Scheme introduces permanent grass cover and reduced soil disturbance, improving infiltration capacity over the operational lifetime.”*

5.15 However, when machinery is used to cut the grass or clean the panels, damage to the soil can occur through excessive trafficking due to wetness. If the soil is damaged during construction, these problems will persist for the life of the project.



## **Use of Machinery in Inappropriate Conditions on silty clay-based soils**

- 5.16 Conventionally, soils would be ploughed or subsoiled to help to improve drainage or soil damage. However, once the solar farm is constructed it is not possible to remedy any damage under the panels. Between the panels, cultivations are limited due to the risk of damage to buried cables, the general narrowness and unsuitability for larger farm machinery.
- 5.17 As such once layers of soil are compacted this damage can persist for much of the life of the project and even beyond, with only limited opportunity to remedy problems. Far from resting the land and improving its status, soil quality will suffer in such circumstances.
- 5.18 Poor construction practices cannot easily be controlled by condition on such a large-scale operation. The soils at this site are acknowledged to be vulnerable to compaction damage and adequate safeguards are necessary. Soil Heath advice such as within The Environment Agency's (EA) 2019 *State of the Environment* report also estimated that, in England and Wales, soil degradation was putting 4 million hectares of soil at risk of compaction (alone).

## **The Cable Route**

- 5.19 The cable route has not been fully surveyed and yet passes through areas where 75% of the land is BMV. On their own admission the applicants recognise that there will be significant disturbance to soils. Again, if they are not properly stripped, stored and handled correctly, damage is inevitable.
- 5.20 Drainage schemes on farms will be damaged by the trenching and fences ,gates and other boundary features removed. Whilst there is a stated intention to repair and reinstate all these features, it is clear from experience elsewhere that damage to land drainage can cause long term soil problems.
- 5.21 Whilst land loss should be for a time-limited period, there would be some permanent loss for infrastructure and access which is unlikely ever be remediated. Portions of the restored land are unlikely to return to the same standard and if drainage is disturbed and not correctly remedied it will cause soil problems. The additional issue of heat from the cables can lead to the drying of drought-prone soils in dry summers, leading to crop failure.
- 5.22 Without a full and detailed survey of the cable route, problem soils may have been missed and issues such as drainage incorrectly identified.

## **6. Conclusions**

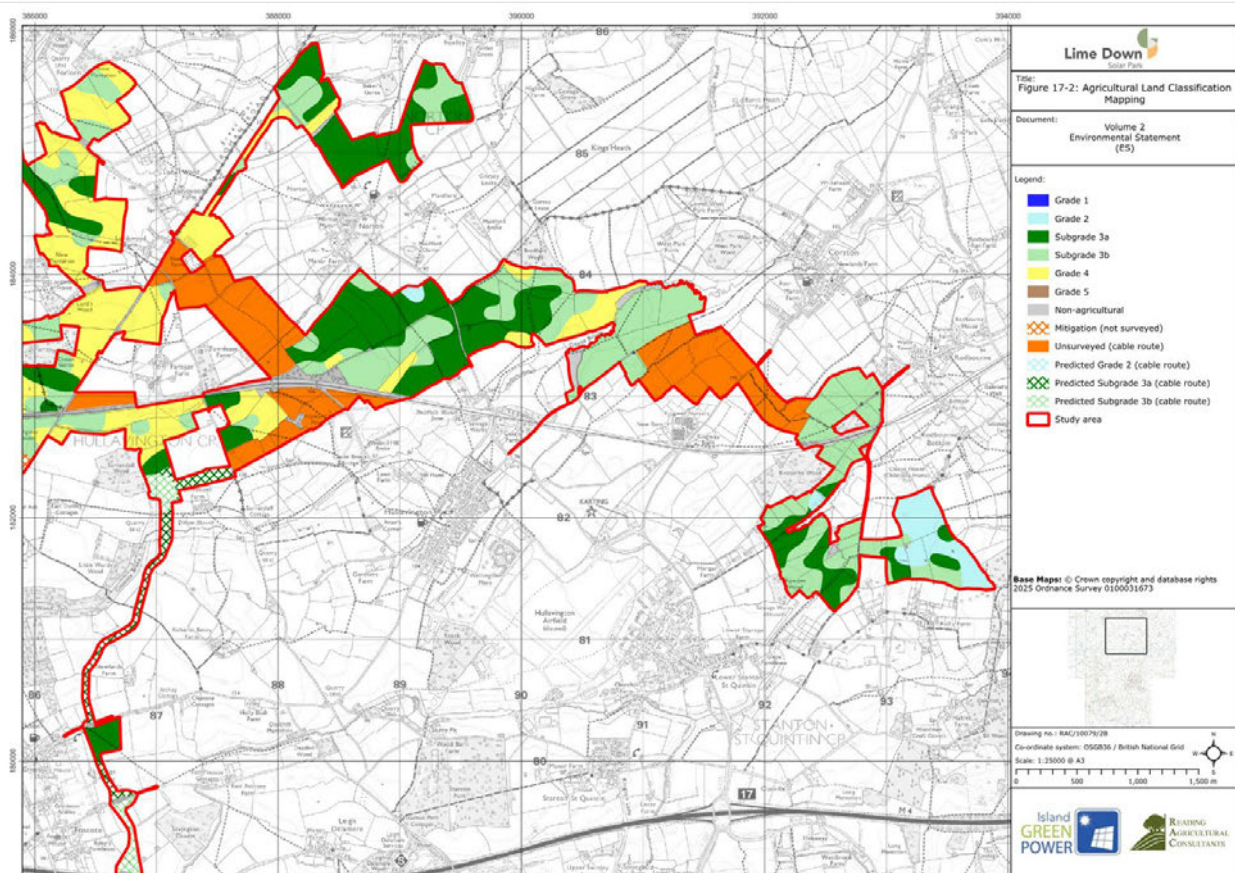
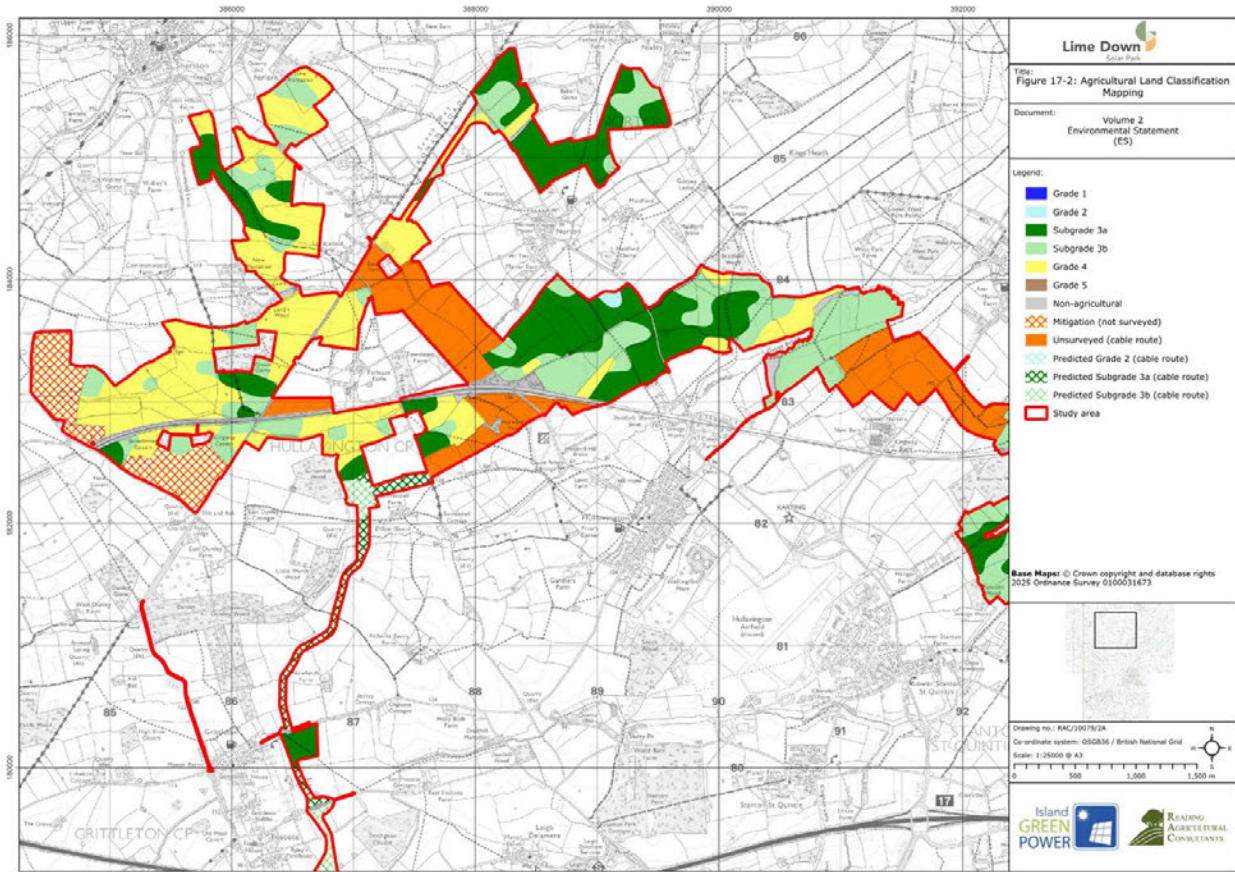
- 6.1 This report concludes that there are good reasons for protecting the Solar PV Sites and Cable Route Corridor from development where the loss of valuable productive farmland has not been shown to be necessary. Developers are asked to find and use areas of poorer quality land and seek alternative sites including brownfield land first. In my view, there has been insufficient justification for siting the proposal on BMV land or in such quantity, when other poorer land exists.
- 6.2 There are inadequate safeguards in the Soil Management Plan to protect existing land drainage such that it may be damaged and consequently there is a risk to the soil quality going forward, such that the likelihood that the land can and will be restored to the same ALC quality is in doubt.
- 6.3 The soils are acknowledged to be at risk from compaction during operations and if it occurs will produce long term damage to soil structure and quality. The risk to soil structure, compaction, drainage and erosion on this site is also significant, with little opportunity to remedy any problems once they occur. Once damaged there is a real threat of long-term problems occurring to the soil and its productive capacity.
- 6.4 There will be an impact on the local agricultural industry if this land is lost to production. The loss of productive capacity undermines UK food security and sets an unacceptable precedent for the loss of agricultural capability. This site is precisely the type of farmland government policy intends to protect from development. The reliance on food imports to the UK must be addressed and home production on farms now needs to be a priority. The loss of a sizeable parcel of productive farmland, by this Solar Farm should be avoided.
- 6.5 Any use of the site for low intensity livestock grazing, does little to address these concerns and will not prevent the significant loss of the arable agricultural capability. The supposed environmental benefits of the scheme are minimal and should be ignored compared to the loss of agricultural land and capability.

**SJ Franklin**

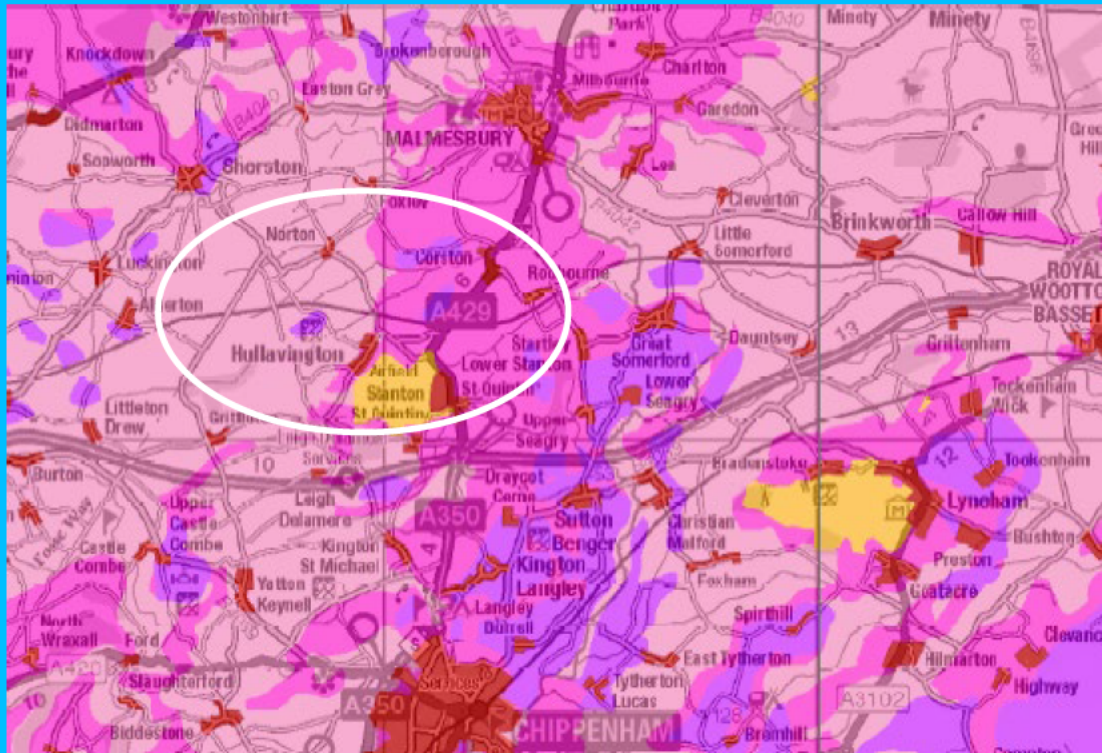
**Landscape Land and Property Ltd**

**April 2026**

# Annex 1ALC Map



## Annex 2



### Predictive BMV Land Assessment © Defra

- High likelihood of BMV land (>60% area bmv)
- Moderate likelihood of BMV land (20 - 60% area bmv)
- Low likelihood of BMV land (<= 20% area bmv)
- Non-agricultural use
- Urban / Industrial

Map of District Showing Land Grades Annex 3



Extracted from Natural England Agricultural Land Classification Map South West Region (ALC006)

| <u>Grade</u>                 | <u>Description</u>                           |
|------------------------------|--|
| 1                            | Excellent                                    |
| 2                            | Very Good                                    |
| 3                            | Good to Moderate                             |
| 4                            | Poor   |
| 5                            | Very Poor                                    |
| <u>Non-Agricultural Land</u> |  |
|                              | Other land primarily in non-agricultural use |
|                              | Land predominantly in urban use              |

**Example of Soil Damage During Construction – Timelapse Series Annex 4**



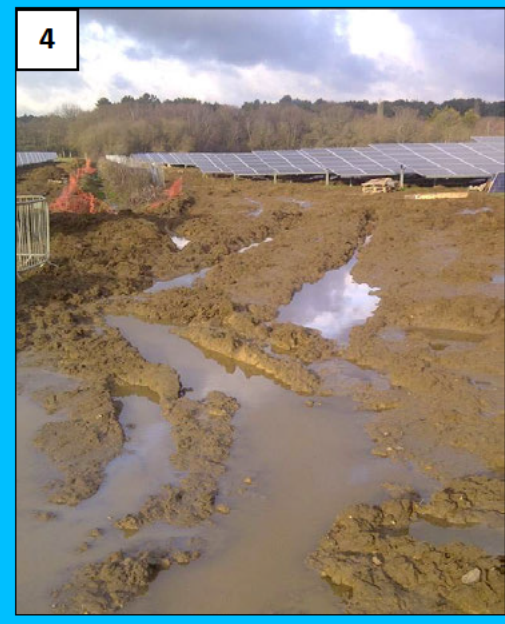
**Near commencement**



**Mid construction**



**Near completion**





Kinetic compaction & rivulets forming







### Biography

#### **Sam Franklin BSc (Hons) MSc MISOilSci PIEMA FBIAC**

#### **A Panel Member of the Agricultural and Land Drainage Tribunal**

- Sam is a Member of the Institute of Professional Soil Scientists and a Life Member of the British Society of Soil Science. He undertakes soil survey and land management work for private clients, developers, local authorities and government agencies and has worked on soil restoration, flood risk, drainage and land improvement projects, as well as Agricultural Land Classification for roads, development sites, renewable energy projects and EIA. He has been a Professional Practitioner of The Institute of Sustainability and Environmental Professionals (ISEP), since 2001.
- He has an MSc from Cranfield University, attending Cranfield advanced training in Soil Matters, Land Evaluation, Soil & Water: Principles and Management in Production Systems and soil science courses of IPSS and Lancaster University. He has given talks, demonstrations and on-farm advice on ALC, soil and water management, land drainage, rainwater harvesting and soil husbandry. Sam has worked overseas in dryland climates and is familiar with land drainage, irrigation scheduling and reservoir design.
- From a family farm, Sam has a BSc (Hons) in Agriculture from Newcastle University and has considerable practical, farm-based agricultural, horticultural and soils management experience gained on mixed, livestock, horticultural and arable units and international work. Sam is a Fellow of the Society of Agriculture (FSAG) and holds the Royal Horticultural Society Certificate in Horticulture.
- As a qualified chartered surveyor (MRICS, FAAV) and agricultural consultant he has over 35 years of experience across a wide range of property matters including both commercial and housing planning projects, compulsory purchase, new roads, pipelines and rail projects, development land, farming, property management, renewable energy, minerals, land restoration, archaeological surveys, and EIA.
- Sam has been managing director of a surveying and rural planning business since 2001 ([www.landscape.co.uk](http://www.landscape.co.uk)). Previous employment includes five years at the RSPB, work for other environmental and conservation organisations, regarding landscape restoration & management, habitat creation, minerals restoration and woodland management; all requiring detailed soils, water and environmental knowledge.
- He has undertaken soil and water management, soil husbandry and Catchment Sensitive Farming work for Natural England and since 2003 has given regular rural planning consultancy advice to Local Planning Authorities, mainly across southern, eastern and midland England; acting as agricultural, equestrian and rural resource expert, regularly attending planning committees, public inquiries, hearings and examinations in public.



Department for  
Energy Security  
& Net Zero

Rt Hon Ed Miliband MP  
Secretary of State  
Department for Energy Security & Net Zero  
55 Whitehall  
London  
SW1A 2HP

Richard Fuller MP  
House of Commons  
London  
SW1A 0AA

[www.gov.uk](http://www.gov.uk)

Our ref: MCB2025/02094  
Your ref: RF33724

17 February 2025

Dear Richard,

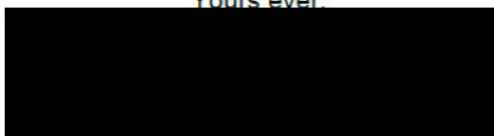
Thank you for your letter dated 3 February, regarding the use of agricultural land for solar projects.

There has been no change to the policy on the weight attached to the use of BMV land. Planning policy and guidance makes clear that, wherever possible, developers should utilise brownfield, industrial, contaminated, or previously developed land. Where the development of agricultural land is shown to be necessary, lower-quality land should be preferred to higher-quality land (including 'Best and Most Versatile' land). This was the policy of the last government, There are no plans to change this policy.

As you point out the proposed NESO connections reform also requires projects to demonstrate 'readiness' and 'strategic alignment' before receiving a firm connection offer. These criterion will be used for the purpose of allocating grid capacity.

Thank you for taking the time to write. I hope this reply is helpful.

Yours ever,



**RT HON ED MILIBAND MP**  
Secretary of State for Energy Security & Net Zero

# **Table of Contents**

|  |           |
|--|-----------|
| <b>SLD_Appendix K1 Soils and Agricultural Impact Report</b>    | <b>1</b>  |
| <b>1. SLD_Article K1 Arable Reversion</b>                      | <b>27</b> |
| <b>2. SLD_Article K1 UK Food Security - FINAL WEB Sept2025</b> | <b>35</b> |

# Arable reversion to species-rich grassland: site selection and choice of methods

The reversion of arable land to permanent grassland is a major work area funded through Environmental Stewardship. There are a number of reasons why arable land is reverted to grassland. This note focuses on the creation of species-rich grassland, that is, grassland comprising species characteristic of semi-natural grassland communities, in particular wild flowers. Other notes provide guidance on establishing a species-rich sown sward and the early management of a species-rich sward.

## Key points

- Sites must be carefully selected to ensure that their reversion to grassland delivers environmental benefits.
- Knowledge of soil type, pH and nutrient status is essential.
- Reverted swards can be very different from conventional grass leys. Productivity may be affected and the impact on the existing farming system must be considered.
- Areas of existing semi-natural habitat can be linked, creating larger, more coherent blocks. This can help species adapt to climate change.
- Additional grazing can be provided which may aid the management of other habitats, for example by allowing stocking rates to be reduced, or by making grazing of small areas of semi-natural grassland more viable.

## Why revert arable land?

Arable reversion can have a number of environmental benefits including ecological, landscape, archaeological and resource protection benefits.

### Ecological benefits

- It may provide opportunities for the re-creation of species-rich grassland and other valuable habitats such as wetland and heath.
- Habitats can be created to benefit specific species, such as wet grassland for wading birds and wildfowl.
- It can provide a buffer from fertiliser run-off and sprays, for example alongside Sites of Special Scientific Interest (SSSIs), rivers and other important wildlife areas.



Yellow-wort in re-created chalk grassland

## Arable reversion to species-rich grassland: site selection and choice of methods

### Landscape benefits

- Arable reversion can be used to unify fragmented areas of permanent grassland in open downland or hill farmland landscapes.
- An arable/grassland balance can be restored in mixed farming landscapes in small to medium sized fields.
- The lush pastoral landscape character of lowland valley landscapes can be reinforced.
- The view from a public view point can be improved, for example by reverting a highly visible field on an open hillside that perhaps contains a copse or several field trees.

### Archaeological benefits

- Arable reversion can protect archaeological features from damage caused by cultivation.
- It can also enhance the setting of a historical feature.

### Resource protection benefits

- Arable reversion to grassland can help prevent or reduce the risk of soil erosion and run off.

### Carbon storage benefits

- Carbon will rapidly accumulate in soil that has been in long-term arable cultivation when it is reverted to grassland and left undisturbed. This accumulation will continue for many decades and is valuable in combating climate change.

## Agricultural considerations

From an agricultural point of view arable reversion can be used to:

- bring less profitable areas out of cultivation, for example steeper, wetter or more remote land, or land with very poor soil;
- provide additional forage area; and
- enable wider changes to the farming system.

Often those areas, which are less profitable to cultivate, provide the greatest environmental benefits when reverted to grassland.

There is evidence that animals grazing extensively on semi-natural species-rich swards

may benefit from a higher mineral intake and lower worm burdens.

Where fencing and water supplies are being introduced, or re-introduced, capital grants or standard payments may be obtained. Such works should increase the value of the farm.

### Potential effects on productivity

Choosing to revert arable land to permanent species-rich grassland is a major decision and a long term commitment, particularly where there will be little or no fertiliser input.

Where land has been in arable cultivation for many years reversion can be followed by a period of low productivity known as the lean years. This is caused by a shortage of nitrogen and it may be many years before nitrogen builds up and the sward is as productive as permanent semi-natural grassland.

Environmental Stewardship scheme objectives and management requirements will not normally be the same as those of a conventional grass ley. Any seed sown will usually have to be selected from a list of species or agreed in advance, and the use of inorganic fertilisers is not normally permitted, although a light application of well rotted farm yard manure in the first year can, in some cases, boost organic matter content and aid establishment.

As a result, the reverted sward is unlikely to be as productive as a conventional ley. The yields of hay or silage are unlikely to be as high and the sward may not be suitable for the existing livestock system.

For example, the slow spring growth of these swards often makes them unsuitable for a sheep flock lambing in March and their lower digestibility may cause rejection by livestock, particularly sheep, that are accustomed to ryegrass/clover swards.

Livestock systems may need to be modified, for example by moving to later lambing, changing breeds and/or introducing mature cattle.

## Arable reversion to species-rich grassland: site selection and choice of methods

### Legislative implications

#### Environmental Impact Assessment (Agriculture) Regulations

At the end of an agri-environment agreement land managers wishing to return the land to cultivation or other intensive use may need to apply to Natural England for an EIA screening decision if the land has not been cultivated for more than fifteen years and it is greater than 2 ha in size.

Two categories of land could fall within the scope of the Regulations:

- **Uncultivated land** - This is land that has not been subject to physical or chemical cultivation in the last fifteen years. Physical cultivation would include ploughing, sub-surface harrowing, discing, tining etc whereas chemical cultivation is defined as any chemical enhancement of the soil through applications of fertilisers, manures or lime etc.
- **Semi-natural areas** - These include habitats such as calcareous grassland, species rich neutral grasslands, heathland, moorland and scrub (a full list can be found in Annex 1 of the EIA Guidance). For the purpose of the Regulations, Natural England will not consider land under habitat creation options under agri-environment schemes to be semi-natural for at least fifteen years after the last physical or chemical cultivation (not including any manure applied to semi-natural meadows or wetlands as part of a traditional management regime).

When a land manager applies for an EIA screening decision Natural England will make an assessment of whether the work will have a significant effect on the environment. Only where a significant environmental effect is likely will permission to proceed with the work not be granted.

A significant effect is usually considered to be a loss of more than two hectares of UK Biodiversity Action Plan (BAP) Priority Habitat or a significant population of a BAP Priority Species. Many arable reversion sites will not contain BAP Priority Habitats or Species.

In making our decision Natural England will take into account agricultural operations over the last 15 years, including ploughing and reseeded.

In most cases we will seek to retain land already in agri-environment agreements by offering to renew agreements at the end of the ten years.

By seeking to renew agreements in this way we are clearly signalling that we wish to continue the existing public investment in the protection and restoration of these habitats.

Further information is given at [www.naturalengland.org.uk/ourwork/regulation/eia/default.aspx](http://www.naturalengland.org.uk/ourwork/regulation/eia/default.aspx).

#### Countryside and Rights of Way (CROW) Act

The CROW Act seeks to give the public access to land identified by Natural England as 'open country' and 'registered common land'. The former is defined as land which appears to consist wholly or predominantly of mountain, moor, heath or down (MMHD).

The existing mapping methodology contains descriptions of MMHD and includes the requirement that the land is of an open character.

In general open country is likely to include unimproved or semi-natural grassland but exclude improved and semi-improved grassland. However, the existing maps are due to undergo a statutory review, which should be completed by 2015 and the methodology will be reviewed as part of this. For more information see [www.naturalengland.org.uk/ourwork/enjoying/places/openaccess/mapping.aspx](http://www.naturalengland.org.uk/ourwork/enjoying/places/openaccess/mapping.aspx).

After ten years in agreement it is possible that arable reversion could match the prevailing description of MMHD. Any such cases would be open to consideration during the statutory review process.

There is an ongoing requirement for the CROW maps to be reviewed within 10 years of each map issue. Any land subject to arable reversion or otherwise allowed to revert to a semi-natural

## Arable reversion to species-rich grassland: site selection and choice of methods

state is increasingly likely to become identifiable as MMHD in the future.

Any registered common land will be mapped as such for the purposes of CROW irrespective of the appearance of the land or the extent of agricultural improvement/reversion. Land may also be dedicated for public access by the owner under Section 16 of CROW.

### Ancient Monuments and Archaeological Areas Act 1979

Archaeological sites that are designated as Scheduled Monuments are of national importance and are protected under the Ancient Monuments and Archaeological Areas Act 1979.

If, after six years under grassland, a land manager wishes to return a reverted site containing a Scheduled Monument back to cultivation, they will require Scheduled Monument Consent from the Secretary of State for the Department for Culture, Media, and Sport who would be advised by English Heritage.

### Eligibility of land for arable reversion

Environmental Stewardship Scheme payments are only likely to be available to revert land that has been in arable cultivation, temporary grass ley and/or set-aside, for the 5 calendar years prior to the proposed start date of your agreement.

To qualify for funding under Environmental Stewardship arable reversion must provide environmental benefits, such as those outlined above, and meet the scheme objectives. The scheme objectives may vary between geographical areas and will need to be discussed and agreed with your Natural England Adviser.

### Site objectives

Assess the existing environmental interest of the land and consider how it may be affected by arable reversion. The land may already be of value for rare arable plants or farmland birds, in which case other options such as continuing with

the existing arable regime, or entering the land into Environmental Stewardship Scheme arable options may be more appropriate.

Consider which environmental features could be protected or enhanced by arable reversion. For example, there may be archaeological features on the site or adjacent wildlife habitats. A field which has been under set-aside may have developed a sward of botanical interest. A field which is poorly drained may have potential for habitat creation for wading birds and wildfowl.

### Selecting sites for species-rich grassland

Site selection is very important where the objective is to create species-rich grassland. This is a very difficult habitat to create and there have been many failures. A decision key to help identify the potential of a site for creation of species-rich grassland is shown in the *Higher Level Stewardship Farm Environment Plan Manual*, Third Edition March 2010, p.36. It is reproduced at the end of this note. The main factors to consider are:

- soil nutrient status and pH;
- weed burden;
- location; and
- management options.

#### Soil nutrient status and pH

Knowledge of soil nutrient status and pH is very important for setting site objectives and it provides a valuable baseline for judging progress and diagnosing problems. It is essential for assessing the potential of a site for the re-creation of species rich habitats. The most important aspects are:

- When trying to create botanically diverse habitats, soil phosphorus (P) status is critical. Where available P is high, growth of grasses and white clover is likely to be vigorous, making it difficult for wildflowers to compete.
- For other objectives, for example wet grassland creation for birds, protection of archaeological features, or buffering important wildlife areas, soil P will not be as important.

## Arable reversion to species-rich grassland: site selection and choice of methods

In general when attempting to create species-rich grassland P index:

- 0 is ideal;
- 1 is satisfactory;
- 2 is marginal; and
- 3 or above is unsuitable.

Knowledge of soil total nitrogen (N) status is useful for judging the history of a field, and the likelihood of problems of low productivity. Total soil N is closely related to organic matter. Low organic matter and total N indicate long term arable cultivation.

Knowledge of soil pH and inherent soil type assists with determining an appropriate seed mix and target vegetation type.

If a soil analysis is not available, it should be determined using the methods outlined in Technical Information Note TIN035 *Soil sampling for habitat recreation and restoration in agri-environment schemes*. Further guidance on interpreting soil analysis results is given in Technical Information Note TIN036 *Soils and agri-environment schemes: interpretation of soil analysis*.

### Weed burden

Weeds can be a major obstacle to successful arable reversion. Species such as common couch, broad-leaved dock, stinging nettle and creeping thistle can be very difficult to eradicate and may cause problems with sward establishment.

The use of herbicides once the sward is established may be detrimental to any desirable plant species that have colonised or been sown. The weed burden must be reduced to a manageable level prior to arable reversion being undertaken and entry into an agri-environment scheme may have to be delayed until this has been achieved.

Methods of reducing the weed burden are outlined in Technical Information Note TIN067 – *Arable reversion to species rich grassland: establishment of a sown sward*.

### Location

In terms of location, the best fields to select are those which are adjacent to existing species-rich grassland or are linked to such grassland by the movement of livestock and/or machinery.

Linkages to other semi-natural habitats on the farm are also important. Isolated sites surrounded by arable land or improved grassland are unlikely to be colonised by desirable plant species or to be used by a wide range of associated invertebrates and mammals.

### Management options

The management options available on a site may determine the site objectives and the suitability of the site for reversion. For example the establishment and maintenance of species-rich grassland will be much easier if livestock form part of the management.

Livestock, in particular cattle, play an important role by trampling in seed and creating patches of bare ground where it can germinate and establish without too much competition. This is important for both increasing the diversity of grassland and maintaining it.

Livestock are also important where sites are being managed for birds. Creating the right sward structure for ground-nesting birds is very difficult using mechanical means alone.

### Choice of methods

The most appropriate method for establishing a sward will depend on a number of considerations, including:

- the objectives;
- the time scale for establishment;
- the location in relation to important wildlife habitats; and
- the availability of suitable seed.

### Natural regeneration

Allowing the sward to regenerate naturally is a low cost method and may be attractive where one or more of the following apply:

## Arable reversion to species-rich grassland: site selection and choice of methods

- The soil seed-bank contains species typical of the target vegetation type. This will often only occur when the field has been in semi-natural grassland within the last three to five years.
- The field has fragments of species-rich grassland within it, or such swards are immediately upslope or upwind and/or livestock move between the two areas.
- The field is under set-aside and has already been colonised by a range of desirable species.
- The field is wet or seasonally inundated, as species will colonise during the flooding period.
- The import of seed is to be minimised (for example on sites close to an SSSI or other existing areas of semi-natural grassland) and/or there is no appropriately sourced seed available for sowing.
- There is archaeological interest and cultivation needs to be minimised.

However, natural regeneration has many drawbacks, including:

- There is a longer period of low productivity and/or poor quality herbage for livestock.
- It is usually a slow process taking at least five to ten years and the results are unpredictable.
- There is a greater risk of soil erosion and nutrient leaching.
- There is a greater risk of weed problems.

Therefore, it is recommended that natural regeneration should only be undertaken on sites with the greatest potential where there is high commitment to success.

Natural regeneration can be supplemented with oversowing or spreading hay in order to add additional seed and speed up sward establishment. See Technical Information Notes TIN063 – *Sward enhancement: diversifying grassland by spreading species-rich green hay* and TIN064: *Sward enhancement: diversifying grassland by oversowing and slot seeding*

### Sowing a seed mix

This is the quickest means of establishing a sward and is the method used on most arable reversion sites. The seed mixture sown on any

particular site should be determined by the site objectives, proximity to existing semi-natural grassland and other factors such as soil type and future management. Information on establishing a sown sward is provided in Technical Information Note TIN067: *Arable reversion to species rich grassland*.

Grass swards are sometimes established on set-aside by under-sowing in the preceding arable crop. The resulting sward will usually include a high proportion of species such as ryegrass and white clover which would not be suitable for semi-natural grassland. As a result, the sward may have to be ploughed up or sprayed off and reseeded with a suitable seed mix.

### Spreading hay

Spreading hay can be an effective method of establishing a sward. Freshly cut 'green hay' taken from nearby species-rich grassland is a good means of introducing a range of local wildflower and grass species and can be cheaper than buying a commercial seed mix.

'Green hay' is herbage which is cut at, or just before, the hay stage and which is collected immediately without prior wilting or turning. It is preferable to dry hay as it contains higher numbers of seed from a wider range of species. Dry hay is dominated by grass seeds.

Spreading hay may be a good method where there is archaeological interest and disturbance to the ground needs to be minimised. Although bare ground is necessary, there is no need to create a fine seed bed prior to spreading hay.

Information on hay spreading to enhance existing grassland is given in Technical Information Note TIN063 – *Sward enhancement: diversifying grassland by spreading species-rich green hay*.

### Further information

Natural England Technical Information Notes are available to download from the Natural England website: [www.naturalengland.org.uk](http://www.naturalengland.org.uk). In particular see:

## Arable reversion to species-rich grassland: site selection and choice of methods

- Technical Information Note TIN067: *Arable reversion to species rich grassland: establishment of a sown sward*
- Technical Information Note TIN068: *Arable reversion to species rich grassland: early management of the new sward*
- Technical Information Note TIN035: *Soil sampling for habitat recreation and restoration in agri-environment schemes*
- Technical Information Note TIN036: *Soils and agri-environment schemes: interpretation of soil analysis*
- Technical Information Note TIN038: *Seed sources for grassland restoration and re-creation in Environmental Stewardship*
- Technical Information Note TIN060: *The use of yellow rattle to facilitate grassland diversification*
- Technical Information Note TIN063 – *Sward enhancement: diversifying grassland by spreading species-rich green hay*
- Technical Information Note TIN064: *Sward enhancement: diversifying grassland by oversowing and slot seeding*

For further information contact the Natural England Enquiry Service on 0300 060 0863 or e-mail [enquiries@naturalengland.org.uk](mailto:enquiries@naturalengland.org.uk).

This note does not supersede prescriptions in agri-environment scheme agreements. If there is any conflict between the information in this Technical Information Note and your agreement please contact your Natural England Adviser.

### Authors and contributors

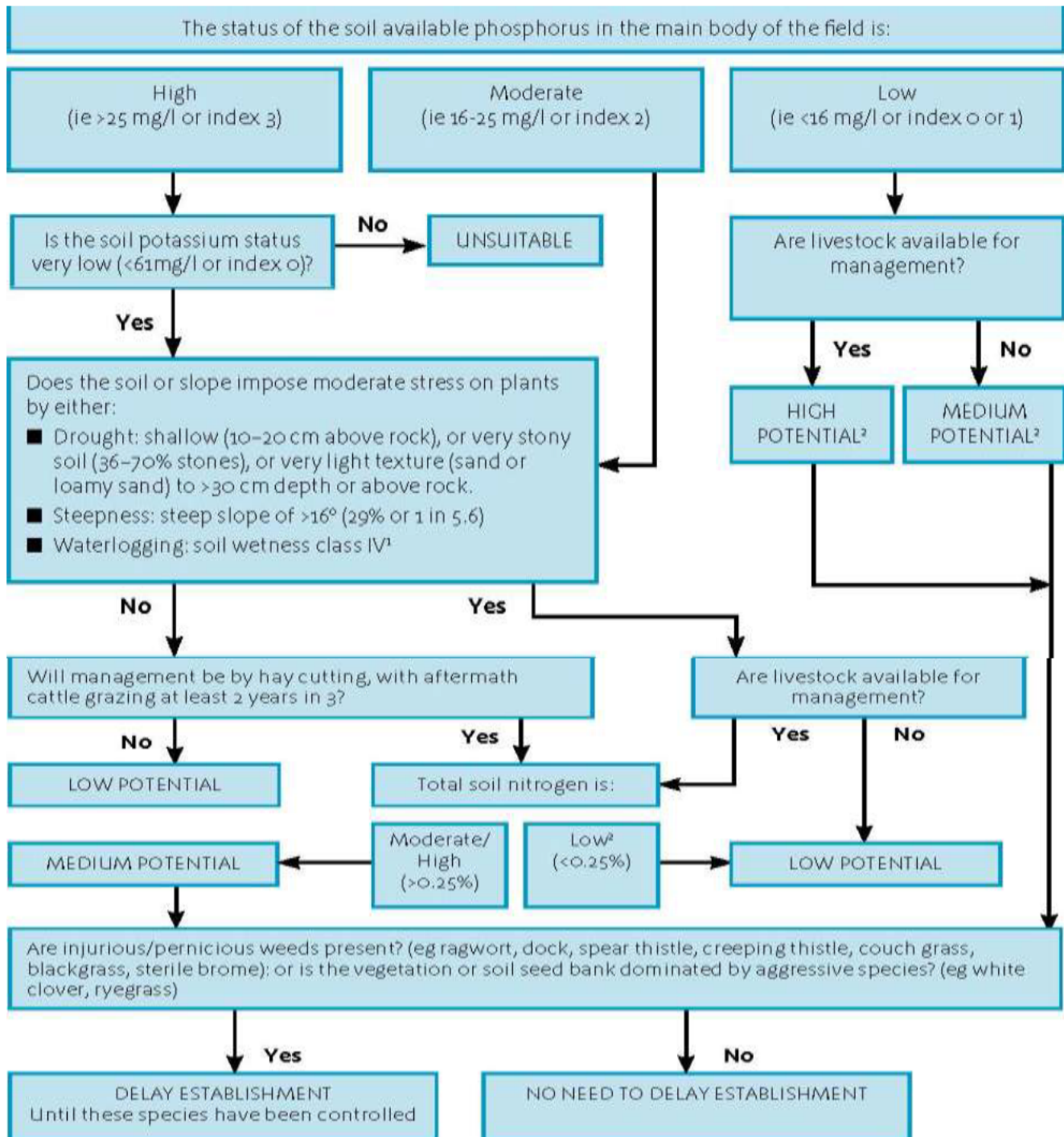
This Technical Information Note was previously published as RDS Technical Advice Note 21. It was prepared by a number of staff including Morwenna Christian and Steve Peel. Editor Susie Smith, photograph Dave Smallshire.

You may reproduce as many individual copies of this note as you like, provided such copies stipulate that copyright remains with Natural England, 1 East Parade, Sheffield, S1 2ET.

© Natural England 2010

## Arable reversion to species-rich grassland: site selection and choice of methods

Key to the potential of arable land for reversion to species rich grassland taken from *Farm Environment Plan (FEP) Manual* Third Edition February 2010



<sup>1</sup> Soils with wetness class IV are waterlogged for long periods in winter.

<sup>2</sup> Soils low in total soil nitrogen (<0.25%) are likely to give a very unproductive sward and the land manager should be warned of this.

# FOOD SECURITY

## Outlook to 2050



**September 2025**

Lead author:



(former NFU and CLA chief economist)



# Contents

|   |    |
|---|----|
| Executive Summary .....   | 3  |
| Key Messages.....   | 5  |
| Introduction .....  | 6  |
| Historical Trends: Resilience in a Shrinking Landscape .....              | 7  |
| Projections to 2050: Overview of Farmland Changes.....                    | 9  |
| Land Use Implications of Solar Farms and Net-Zero Energy Transitions..... | 9  |
| Population Outlook and Food Demand .....                                  | 10 |
| Implications for Net Imports of Food Supplies.....                        | 10 |
| Aggregate Metrics: Visualising the Pathways.....                          | 11 |
| Discussion .....  | 13 |
| Appendices .....  | 15 |
| Scenarios .....   | 15 |
| Explanatory Note on LSTM Forecasting.....                                 | 15 |
| Bibliography .....  | 17 |

Science for Sustainable Agriculture (SSA) is a policy and communications platform, providing a focal point for information, comment and debate around the role of science and innovation in modern, sustainable agriculture and food production. Supported by an independent advisory group of political, scientific and industry leaders from a range of sectors and backgrounds, SSA's aim is to promote a conversation rooted in scientific evidence, rather than ideology.

Science for Sustainable Agriculture provides a platform for like-minded individuals and organisations to champion and explain the vital role of science and technology in safeguarding our food supply, tackling climate change and protecting the natural environment, as well as to expose, comment on and challenge unscientific positions or policy decisions in relation to sustainable agriculture.

Further information about Science for Sustainable Agriculture is available at [www.scienceforsustainableagriculture.com](http://www.scienceforsustainableagriculture.com)

# Executive Summary

## *Farmland losses risk UK food security crisis*

This report examines prospects for UK food security to 2050, based on historical land use and agricultural production trends. The analysis was led by former NFU and CLA chief economist [REDACTED].

The report draws on an analysis of official UK government data for the past 25 years to establish historical trends in agricultural land use, yields and aggregated food production.

Using AI-assisted economic modelling (Long Short-Term Memory (LSTM) forecasting), the analysis then uses these historical trends to develop forward-looking projections, based on a range of scenarios in terms of land use policies and population growth.

The report finds that, over the past 25 years, we have been losing farmland at a significant rate (771,000 hectares or 4.4%), placing downward pressure on our food production capacity.

Since 2000, while UK agricultural production per hectare has increased by 15% due to yield improvements, the overall rise in aggregated food production was limited to 10% because of the decline in farmland area. As the UK population increased from 59 million to 68 million, this equated to a 5% fall in domestic food production per capita, and a 12% decline in self-sufficiency in primary agricultural products over the period.

Importantly, the 25-year analysis also points to declining trends in both domestic agricultural yields and food production over the past 10-15 years. This can be attributed to a range of climate, market and policy-related factors, including challenges of extreme weather, rising farm input prices, loss of key crop protection products, tighter restrictions on input use, and a greater focus on production-limiting farm policy incentives.

Looking forward, the analysis predicts that full implementation of Government land use policy targets for housing, renewable energy, habitat restoration, agri-environmental measures and tree planting over the next 25 years will dramatically accelerate the rate of farmland loss and constrain productivity gains, placing even greater strain on the nation's ability to feed itself.

In a worst-case scenario, up to 23.7% (3.965 m/ha) of the current Utilised Agricultural Area (UAA) could be at risk, with most of it (80%) arable rather than livestock land.

In a high net migration scenario with a UK population of 80 million in 2050, and without radical farming and land use policy change to boost agricultural yields on our more productive farmland, the amount of food produced on UK farms is projected to fall by over 32% (or by 39% per capita).

Expressed on an 'all foods' basis, a 32% reduction in UK primary agricultural production implies that domestic food security levels could fall significantly from 60% at present, dramatically increasing our dependence on food imports.

The overriding conclusion is that if we wish to capture the many benefits of the environmental measures being integrated into farming and land management policies, while maintaining the transition to net zero through carbon sequestration and renewable energy, **it is imperative that we find new and innovative ways to improve agricultural yields on farmland remaining in production to protect domestic food security.**

This will require better co-ordination of policies across government departments with responsibilities for agriculture, the environment, biodiversity, climate change mitigation, energy production, food security and trade.

It will also require changes to the way government support is allocated so that measures to increase domestic agricultural production sustainably on our most productive farmland are prioritised.



*We are struggling to keep up with the loss of farmland over the past 25 years, and new competing demands for land over the coming years to address a range of environmental concerns, along with rising demand for food from a growing population, mean we must find new and innovative ways of producing more food from what land we have. For too long food production has been ignored, and the loss of farmland poses a very serious risk to domestic food security.*

*Yield improvements have not kept pace with rising demand for many products, which has meant increased reliance on food imports. With planned new farming and land use policies and the transition to renewables for the net zero ambition, farmland losses are set to accelerate and domestic production will fall even further behind the demands of a rapidly growing population. If we are to continue with these environmental and net zero policy objectives, yield improvements on the land remaining in production are the only way of protecting our food security.*



**[REDACTED]**, lead author



# Key Messages

## Agricultural land is being lost at a significant rate:

- Over the past 25 years we have lost some 771,00 hectares of agricultural land, around 4.4%.
- By 2050, in the best-case scenario (Business-as-Usual, BAU), which continues trends over the past 25 years, the UK could lose a further 835,000 hectares of agricultural land, about 5% of the current area.
  - Of that, 316,000 hectares of arable land would be lost, about 5.8%, and 519,000 hectares of livestock land, about 4.6%.
- In the worst-case scenario (Maximum, Max), incorporating full implementation of the government's environmental and net-zero ambitions, the UK could lose nearly 3.965 million hectares of agricultural land, about 23.7%.
  - Of that, 3.165 million hectares would be arable land, and 800,000 hectares of livestock land. over 260% above 2024 levels, depending on the scenario and population growth.

## Domestic food production could fall by up to 32% by 2050:

- Without substantial yield improvements, using the trends in agricultural production over the past 25 years and projecting forward to 2050, in the best-case scenario, home-grown food production could fall by over 7%.
- Factoring in population changes in the worst-case scenario, incorporating full implementation of the government's land use, environmental and net-zero ambitions, UK food production could decline by as much as 32%, or 39% per capita, by 2050.
- On an all-food basis, this implies that domestic self-sufficiency in food could fall significantly from 60% at present, dramatically increasing our dependence on food imports.

## Food supplies set to become increasingly reliant on imports:

- In either case, **the direction of travel is clear**, and without a radical rethink of food, environmental and land management policies, the UK looks set to be increasingly reliant on imported food over the coming years, with worrying implications for domestic food security.
- To maintain current levels of food supplies per capita, net imports could increase dramatically, ranging from nearly 160% to over 260% above 2024 levels, depending on the scenario and population growth.

# Introduction

The UK's agricultural landscape has always been changing but, over the past 25 years from 2000 to 2024, the rate of change has been accelerating as it adapts to diverse pressures. This AI-assisted report poses a critical question:

## ***Will the UK be able to feed itself in another 25 years, by 2050?***

While many factors will influence the course of events over the coming years, this report focuses on the two overriding issues concerning domestic food security:

## ***How much farmland do we have, and how much food do we produce with that land?***

Looking back over the past 25 years, the report analyses official statistics from Defra's *Agriculture in the UK* annual reports to quantify changes and trends in areas of arable and livestock land, and the production and supplies of food products. It reveals a modest decline in land used for farming (UAA) over that period, and reveals a mixed picture of adaptation and vulnerability amongst the various foods produced that led to a 12% fall in food self-sufficiency<sup>1</sup>.

Looking forward to 2050, the report then uses the detailed official government historical data from the past 25 years and the environmental, land use and net-zero policies currently advocated by the UK government to estimate projections to 2050, with a focus on the aggregate domestic supply and demand for food<sup>2</sup>.

While the discussion of historic food production reviews where we were at the start of the historic reference period and currently, the forecasts use *all* time series data, not just the start and end points. Rather than simple linear forecasting, such as drawing a line through the two points, this paper uses the more complex Long Short-Term Memory (LSTM) method that specifically takes account of the many non-linear issues, like weather and policy changes, affecting agricultural production.

Using LSTM forecasting we consider three potential futures<sup>3</sup>: Business-as-Usual (BAU) Forecast: continues historical trends with modest productivity gains; Moderate (Mod) Scenario: assumes a moderate implementation of the various policies currently proposed by the government; and Maximum (Max) Scenario: assumes the most ambitious implementation of those policies. For a view on the change in demand for food that can be expected over the next 25 years, for each scenario we also consider how the UK population is likely to grow.



<sup>1</sup> Domestic agricultural production as a percentage of total supply of agricultural products, calculated on a tonnage basis, from AUK Chapters 7 and 8.

<sup>2</sup> While this approach conceals the many significant differences between foods, it provides a useful overview of outlook for domestic food security.

<sup>3</sup> See Appendices for notes on LSTM forecasting and the three outlook scenarios.

# Historical Trends: Resilience in a Shrinking Landscape

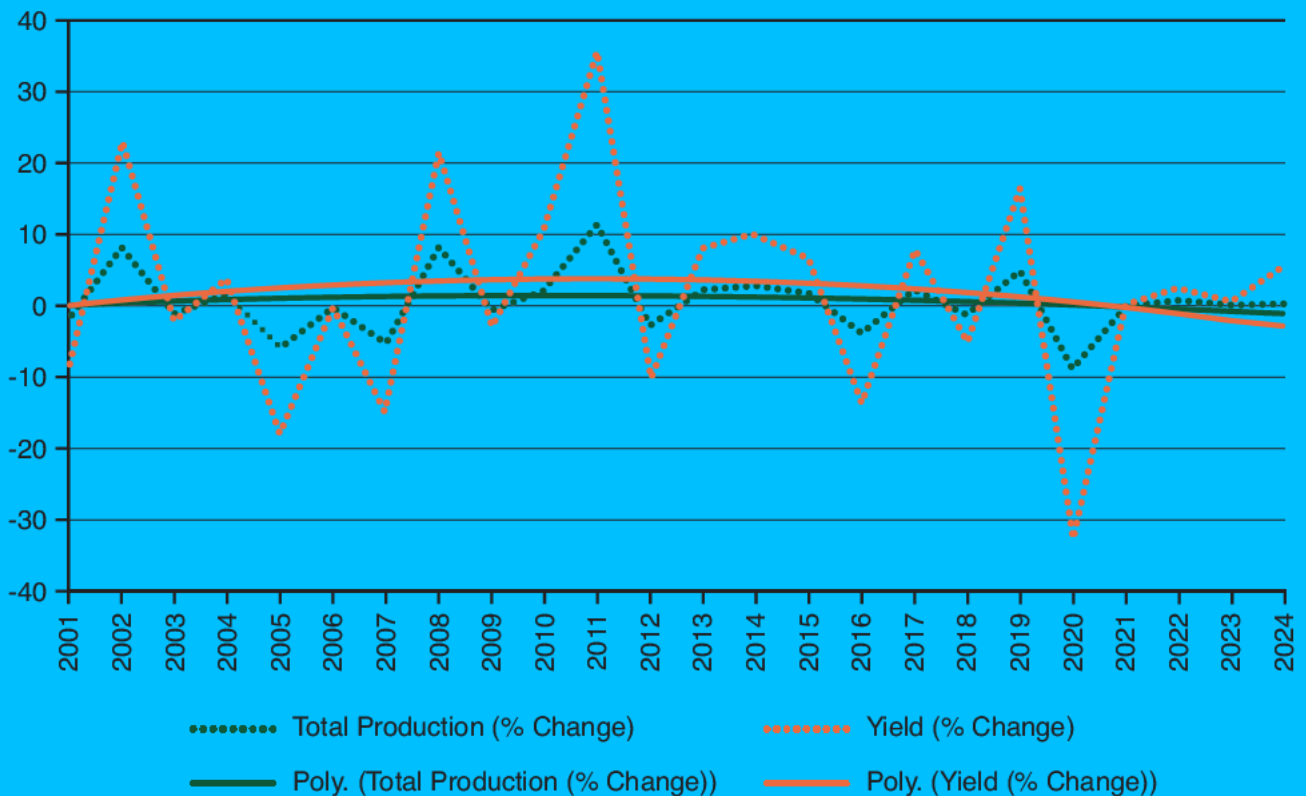
From 2000 to 2024, UK agriculture showed modest resilience despite a shrinking Utilised Agricultural Area (UAA). The UAA, covering arable fields, grasslands, and rough grazing, fell by about 4.4%, from 17,531 thousand hectares to 16,760 thousand hectares, a loss of 771 thousand hectares. This decline, at an average annual rate of -0.19%, was driven mainly by woodland expansion, urban development, and agri-environmental policies, reflecting a shift toward greater focus on reducing the environmental impact of agriculture.

The UAA's composition shifted unevenly. Arable land, used for crops like wheat, vegetables, and oilseeds, declined by 3.23%, from 5,605 thousand hectares to 5,424 thousand hectares, losing 181 thousand hectares. Livestock land, including improved and permanent grassland and rough grazing, declined faster, by 5.0%, from 11,926 thousand hectares to 11,336 thousand hectares, a loss of 590 thousand hectares. This slightly increased arable land's UAA share from 32.0% to 32.4%, and reduced livestock land's share from 68.0% to 67.6%.

Despite the fall in UAA, sectoral productivity gains led to an overall increase in production per hectare of about 15%, from 2.87 tonnes per hectare in 2000 to 3.3 tonnes per hectare in 2024. This contributed to a 10% rise in total domestic production, from 50,357 thousand tonnes to 55,365 thousand tonnes. Per capita production, however, declined from 853 kilograms to 814 kilograms, as the population grew by 15%, from 59 million to 68 million.

While there has been considerable volatility in both production growth and yield improvements over the past 25 years, the polynomial trend lines for both show that they have been slowing over the past 15 years. This suggests that sustaining production will require significant new innovations to boost yields, as farmland loss continues, or we risk a serious deterioration in food security.

## Productivity changes

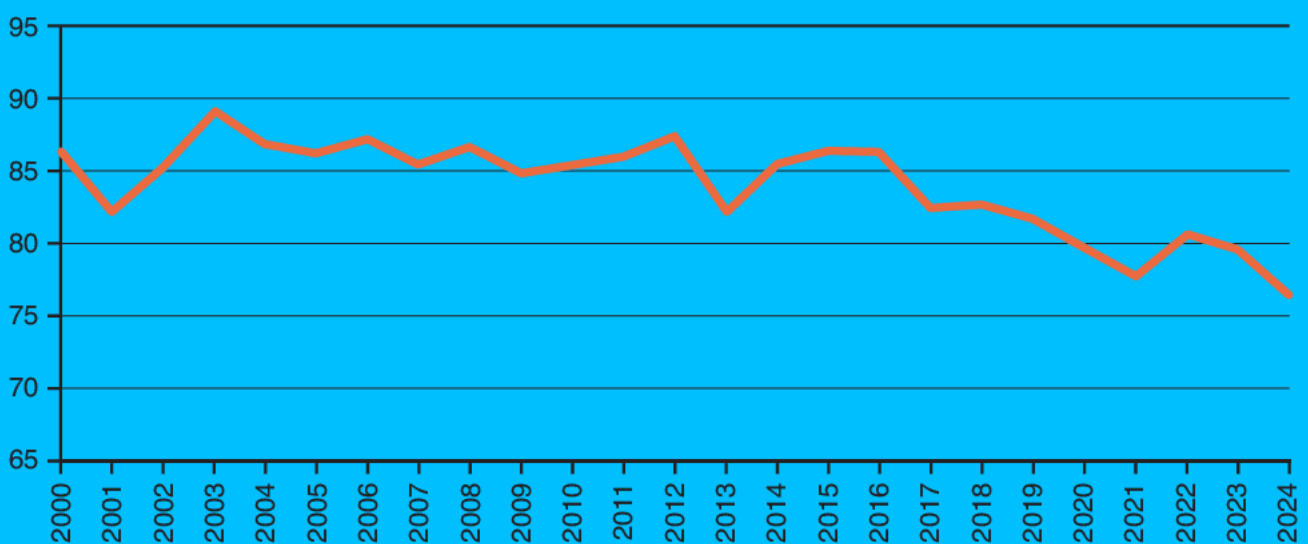


The Common Agricultural Policy 2008 Health Check and associated environmental regulations (e.g. Nitrate Vulnerable Zones and environmental stewardship schemes) are considered to have played a role in slowing UK agricultural yield growth by reducing productive land and limiting fertiliser inputs, directly affecting output. Other climate, market and policy-related factors in recent years, such as challenges of extreme weather, rising farm input prices, loss of key crop protection products, further restrictions on input use, and production-limiting subsidy incentives, are also likely to have contributed to the slowdown in productivity growth over the past 10-15 years.

However, the impact has varied by region and crop – arable farms in eastern England faced more constraints than livestock farms in upland areas. Quantitatively, analysis of DEFRA data suggests that UK average cereal yields increased by just 0.5% annually from 2010-2020, compared to 1-2% in the 1990s.

Total domestic supply<sup>4</sup>, adjusted for net imports, showed growing reliance on international trade. Net imports increased by some 17,131 thousand tonnes between 2000 and 2024, supporting a rise in total new supply from 58,364 thousand tonnes to 72,496 thousand tonnes. This ensured diverse food access despite domestic production constraints. Supply per hectare of UAA rose from 3.33 tonnes to 4.33 tonnes, and per capita supply rose from 989 kilograms to 1066 kilograms due to the increased imports.

#### UK Food Self-Sufficiency<sup>5</sup> 2000-2024 (%)



Analysing the correlation between the reduction in UAA and the decline in domestic food self-sufficiency suggests that there is an important relationship between UAA and food self-sufficiency. Specifically, the Pearson correlation coefficient<sup>6</sup> of 0.687 indicates that nearly half (47.2%) of the decline in self-sufficiency is explained by the loss of UAA. Other climate, market and policy-related factors, as discussed above, are likely to account for the remaining decline.

<sup>4</sup> Total domestic supply is total domestic production less exports plus imports. Strictly it also includes net stock changes but they are usually small and are ignored here. Total domestic supply is used in this report as a proxy for total domestic consumption, and as an indicator of the changes in net imports needed to ensure domestic food supplies meet demand.

<sup>5</sup> Domestic agricultural production as a percentage of total supply of agricultural products, calculated on a tonnage basis.

<sup>6</sup> The Pearson correlation coefficient (r) measures the strength and direction of the linear relationship between two variables like food self-sufficiency and UAA, with r ranging from -1 to 1. A value of r = 1 indicates a perfect positive linear relationship, r = -1 a perfect negative linear relationship, r = 0 no linear relationship.

# Projections to 2050: Overview of Farmland Changes

Looking forward to 2050, on current trends another 835,000 hectares of farmland will be lost. In the worst case scenario, with the maximum implementation of environmental and net zero plans, nearly a quarter of all farmland could be lost (3.96 million hectares), with most of it being arable rather than livestock land.

## Agricultural Land Areas by Type

|                           | 2000   | 2024   | 2050         |              |              |
|---------------------------|--------|--------|--------------|--------------|--------------|
|                           |        |        | BAU Forecast | Mod Scenario | Max Scenario |
| Total UAA ('000 ha.)      | 17,531 | 16,760 | 15,925       | 15,084       | 12,795       |
| Arable Land ('000 ha.)    | 5,605  | 5,424  | 5,108        | 4,315        | 2,259        |
| Arable % of UAA           | 32.00  | 32.40  | 32.10        | 28.60        | 17.65%       |
| Livestock Land ('000 ha.) | 11,926 | 11,336 | 10,817       | 10,769       | 10,536       |
| Livestock % of UAA        | 68.00  | 67.60  | 67.90        | 71.40        | 82.34        |

Arable land continues to face pressures for housing and infrastructure, but also faces new environmental policy driven pressures, including from afforestation, biodiversity renewal, carbon sequestration, biofuels, and solar farms. Livestock lands, by contrast, can often more easily align with practices such as low-impact grazing, re-wilding and carbon sequestration, and are often less suited to alternative uses such urban and energy projects.

## Land Use Implications of Solar Farms and Net-Zero Energy Transitions

Solar farms and net-zero initiatives, key to the government's energy strategy, pose serious demands on farmlands. The latest data indicate that ground-mounted solar farms currently occupy some 15,580-21,200 hectares of land, with over 2,500 hectares on productive farmland<sup>7</sup>.

Projections suggest that solar farms could cover 50,000 hectares in moderate scenarios or 150,000-200,000 hectares in extremes, targeting 70-90 gigawatts by 2050. Agrivoltaics, combining panels with grazing or crops, could mitigate 20-50% of losses. However, land sparing – dedicating prime land to higher-yield farming and non-prime areas to solar – may be more effective in safeguarding food production while improving biodiversity.

According to studies by the Climate Change Committee and DEFRA, other net-zero energy sources, like bioenergy crops, could repurpose a further 200,000-500,000 hectares, accelerating UAA loss compared to the historical rate of 771,000 hectares over the past 25 years. This risks further constraining the farmland area available for food production.

<sup>7</sup> The CPRE (Countryside Charity) recently reported that 59% of England's largest operational solar farms (each over 30 MW) are located on productive farmland, with 31% of their total area (approximately 827 hectares) classified as "best and most versatile" (BMV) land (Grades 1, 2, and 3a).

# Population Outlook and Food Demand

While the available farmland is a key high-level measure of our ability to produce food, population growth can be used to estimate future food demand.

The UK's population is projected to grow from 68 million in 2024 to 75 million (Baseline) or 80 million (High Migration) by 2050, based on ONS projections and net migration trends.

These outlooks significantly shape food demand, and point to intensifying pressures on a shrinking agricultural land base.

In the Baseline scenario, a 10.3% population increase drives proportional food demand growth. With production projected to decline 7-32%, per capita production falls from 814 kg to 686-499 kg, and per capita supply drops from 1066 kg to 933-880 kg.

The High Migration scenario, with a 17.6% population rise, heightens demand even further. Per capita production decreases to 644-468 kg, and supply falls to 875-825 kg.

These outlooks significantly shape food demand, and point to intensifying pressures on a shrinking agricultural land base. Both scenarios underscore rising import dependency, amplifying reliance on volatile global markets, risking supply chain disruptions, and likely increasing food prices.

## Implications for Net Imports of Food Supplies

With up 80 million people to feed in the UK by 2050, in parallel with an increasing global population, food supply challenges will be intense, requiring substantial import increases and posing significant risks for domestic food security.

Sustaining 2024 per capita food supply levels could require dramatic increases in net imports by 2050 in all scenarios. The consequential supply chain risks and price volatility threaten lower-income groups in particular. A policy approach focused more on land-sparing could mitigate this by intensifying domestic production on prime agricultural land, reducing import needs while still releasing land for biodiversity and climate change mitigation objectives.

**Estimated % Change in Net Imports Required to Maintain 2024 Per Capita Supply Levels in 2050 (thousand tonnes)<sup>8</sup>**

|                             | BAU Forecast |         | Mod Scenario |         | Max Scenario |         |
|-----------------------------|--------------|---------|--------------|---------|--------------|---------|
|                             | '000 tonnes  | %       | '000 tonnes  | %       | '000 tonnes  | %       |
| <b>Baseline (75m)</b>       | 26,588       | 159.70% | 29,236       | 175.60% | 38,643       | 232.10% |
| <b>High Migration (80m)</b> | 31,303       | 188.00% | 33,951       | 203.90% | 43,358       | 260.40% |

Current environmental land management policies and net-zero transitions promise localised environmental gains but risk undermining domestic food security and simply exporting the environmental costs of these domestic policy choices. Similarly, demographic pressures, especially high migration, demand policies linking population and resource planning.

<sup>8</sup> Percentage change calculated relative to 2024 net imports (16,646 thousand tonnes).

# Aggregate Metrics: Visualising the Pathways

Projections to 2050 extend historical trends, factoring in policy-driven land use changes. The business-as-usual (BAU) scenario assumes trend continuation with modest productivity gains. Moderate and maximum ambition scenarios incorporate farmland losses to meet current sustainability targets, including for afforestation, habitat restoration, and the provision of renewable energy.

The table below summarises the key changes to the UK food security outlook suggested by this analysis.

**UK Agricultural Aggregate Metrics: 2000-2024 and Projections to 2050**

|   | 2000     | 2024     | 2050         |              |              |
|---|----------|----------|--------------|--------------|--------------|
|   |          |          | BAU Forecast | Mod Scenario | Max Scenario |
| Population – Baseline (million)             | 59       | 68       | 75           | 75           | 75           |
| Population – High Migration (million)       | 59       | 68       | 80           | 80           | 80           |
| UAA (thousand hectares)                     | 17,531   | 16,760   | 15,925       | 15,084       | 12,795       |
| Total Production (thousand tonnes)          | 50,357.5 | 55,364.9 | 51,489.42    | 44,291.98    | 37,426.79    |
| Production per hectare of UAA (tonnes/ha)   | 2.87     | 3.3      | 3.23         | 2.94         | 2.93         |
| Production per Capita – Baseline (kg)       | 853.52   | 813.9    | 686.53       | 590.56       | 499.02       |
| Production per Capita – High Migration (kg) | 853.52   | 813.9    | 643.62       | 553.65       | 467.83       |
| Total New Supply (thousand tonnes)          | 58,364.4 | 72,496.3 | 70,000.00    | 68,000.00    | 66,000.00    |
| New Supply per Capita – Baseline (kg)       | 989.23   | 1,066.12 | 933.33       | 906.67       | 880          |
| New Supply per Capita – High Migration (kg) | 989.23   | 1,066.12 | 875          | 850          | 825          |

In the BAU scenario, the Utilised Agricultural Area (UAA) declines from 16,760 thousand hectares in 2024 to 15,925 thousand hectares by 2050, and total production decreases from 55,365 thousand tonnes to 51,489 thousand tonnes due to land constraints, despite efficiency gains. Total new supply falls slightly to around 70,000 thousand tonnes, with imports trying to cover shortfalls. Per capita production worsens as population growth outpaces output, especially under high migration.

The moderate (Mod) scenario intensifies land reductions, with UAA falling to 15,084 thousand hectares and production decreasing to 44,292 thousand tonnes. Per-hectare production falls further and import reliance grows, with net imports potentially more than doubling to 29,236–33,951 thousand tonnes.

In the Maximum (Max) scenario, aggressive net-zero and biodiversity policies drive a steep UAA decline to 12,795 thousand hectares, a 23.7% reduction<sup>9</sup>. Production plummets 32.4% to 37,427 thousand tonnes, with arable land shrinking dramatically to 2,259 thousand hectares. Net imports surge to meet demand, heightening exposure to global market risks and further threatening food security.



<sup>9</sup> This aligns with the Committee on Climate Change, (2020), *Land use: Policies for a Net Zero UK*. <https://www.theccc.org.uk/publication/land-use-policies-for-a-net-zero-uk/> which suggested that one-fifth of agricultural land (approximately 20%) must be repurposed by 2050 to meet net zero goals.

# Discussion

This report has provided a high-level overview of some of the key issues affecting the UK's food security. It has used official government data covering land use, yields and food production for the past 25 years to develop forward-looking projections to 2050, adjusted to take account of the land use implications of the environmental and net zero policies currently favoured by the government. The detailed numbers in these forecasts are not as important as the direction of travel and orders of magnitude they suggest. The key message is a clear warning of increasingly insecure food supplies, and that a radical rethink of the UK's agricultural, environmental and net zero policies is urgently required.

As Mark Twain famously said: "buy land, they're not making it anymore". With growing demand for farmland and an increasing population, the only way to ensure food security is to use the land we have as wisely and as productively as possible. To do that, farming and other land use policies must be led by the evidence, which means that a closer and more detailed analysis of the issues raised in this report is now needed.

The pressures on arable land are especially severe, and more detailed examinations of the impacts of government land use and net zero policies on the production of particular crops, including cereals, broad acre vegetables and fruits, should be undertaken as a matter of urgency.

The potential loss of up to 23.7% of agricultural land over the next 25 years – for nature restoration, carbon sequestration and renewable energy in particular – implies that a greater focus on land sparing, rather than land sharing, is needed in land use policies coupled with a greater focus on supporting the adoption of new technology and techniques that can both improve productivity and contribute to reducing the environmental footprint of the land remaining in agriculture.

Land sparing and land sharing are two contrasting approaches to balancing agriculture and biodiversity conservation, with differing impacts on agricultural yields and output:

## **Land Sparing**

Involves applying advanced production technologies and techniques on a smaller area of agricultural land to optimise yields. By delivering higher yields per unit area, larger areas of natural habitat can be spared for biodiversity conservation and the delivery of other environmental goods and services.

## **Land Sharing**

Integrates biodiversity conservation within agricultural landscapes through wildlife-friendly practices, such as agroforestry or mixed cropping, across larger areas of agricultural land. This approach often leads to lower yields per unit of area compared with land sparing policies, as it prioritises ecological objectives over food production, thereby requiring more land to be used to produce the same amount of food.

These are not mutually exclusive policy options, and some commentators have made the case for a 'three-compartment approach' to land use policy, allowing for an evidence-based combination of high-yield production, low-input farming, and nature restoration.

However, this is not reflected in current farm support policies. The continuing focus on land sharing options in government policy, encouraging farmers to adopt production-limiting agri-environmental measures, is likely to further aggravate the declining trend in food production and yield per hectare, with potentially serious consequences for UK food security.

The overriding conclusion of this analysis is that to deliver on biodiversity and nature recovery targets, while maintaining the transition to net zero through carbon sequestration and renewable energy, the consequential impact on food supplies of taking more farmland out of production must be compensated by focusing on scientific innovation to improve agricultural yields.

This will require better co-ordination of policies across several government departments with responsibilities for agriculture, the environment, biodiversity, climate change mitigation, energy production, food security and trade. It will also require changes to the way government support is allocated so that measures to increase domestic agricultural production on our most productive farmland are prioritised.



# Appendices

## Scenarios

The Business-as-Usual (BAU) Forecast, Moderate (Mod) Scenario, and Maximum (Max) Scenario in the “UK Food Security – Outlook on 2050” report are based on distinct assumptions about future agricultural trends, land use, and policy implementation, derived from historical data (2000-2024) and government ambitions for net-zero emissions and biodiversity. Below is a brief explanation of each:

**BAU Forecast:** Assumes a continuation of historical trends (4.4% UAA decline, 13.2% production drop from 2000-2024) with modest productivity improvements. UAA falls 5% to 15,925 thousand hectares by 2050, with arable land dropping 5.8% to 5,108 thousand hectares and livestock land 4.6% to 10,817 thousand hectares. Production declines 7% to 44,137 thousand tonnes, reflecting ongoing land loss (e.g., urban sprawl, woodland expansion) and climate variability, offset somewhat by efficiency gains in conventional farming practices. Net imports rise by 148.3-214.5% to compensate for shortfalls, assuming stable trade patterns.

**Mod Scenario:** Assumes a balanced intensification of environmental policies (e.g., tree planting, peatland restoration), accelerating UAA decline to 15,084 thousand hectares. Arable land drops 20.4% to 4,315 thousand hectares (28.6% UAA share), while livestock land falls slightly to 10,769 thousand hectares (71.4% UAA). Production decreases to 41,489 thousand tonnes due to greater land reallocation for carbon storage and bioenergy crops, with per-hectare productivity stable under conventional methods. Net imports increase 192.9-259.0% to meet demand, reflecting heightened trade reliance.

**Max Scenario:** Envisions aggressive implementation of net-zero and biodiversity targets (e.g., widespread afforestation, 150,000-200,000 hectares for solar farms). UAA declines 23.7% to 12,795 thousand hectares, with arable land dropping 58.4% to 2,259 thousand hectares (17.65% UAA share) and livestock land 7.1% to 10,536 thousand hectares (82.34% UAA share). Production falls 32.4% to 32,082 thousand tonnes, with modest productivity increases but significant land loss. Net imports rise by 351.4-417.5%, exposing the UK to global market volatility.

All scenarios assume population growth (75 or 80 million), driving higher supply needs and increasing import dependency.

## Explanatory Note on LSTM Forecasting

LSTM (Long Short-Term Memory) forecasting is a machine learning technique that uses LSTM neural networks to predict future values in time series data. Compared to traditional methods like ARIMA, LSTMs better handle non-linear, long-term, and multivariate patterns. They are a strong choice for agricultural forecasting because:

- **Captures Long-Term Dependencies:** LSTMs excel at modelling long-term patterns and dependencies in sequential data, ideal for capturing multi-year trends like crop cycles or climate impacts over 25 years.
- **Handles Non-Linearity:** Agricultural production is influenced by non-linear factors (e.g., weather, market dynamics, soil conditions). LSTMs can model complex, non-linear relationships effectively.
- **Adapts to Seasonality:** LSTMs can learn recurring seasonal patterns (e.g., annual harvests or planting seasons) inherent in agricultural data.
- **Robust to Noise:** Agricultural time series often have noise from unpredictable events (e.g., droughts, pests). LSTMs are robust to such irregularities due to their memory cells that prioritise relevant information.

- **Flexible Input Handling:** LSTMs can incorporate multivariate inputs (e.g., rainfall, temperature, prices), which are critical for accurate agricultural forecasting.

To project UK agricultural production to 2050 in this report, Grok 4 followed these steps using Long Short-Term Memory (LSTM) forecasting:

#### 1. Data Collection and Preprocessing:

- **Input Data:** Collected data from 2000-2024 in DEFRA's Agriculture in the United Kingdom (AUK) reports, covering Utilised Agricultural Area (UAA), arable/livestock land, and production for ten food products (e.g., wheat, beef). Integrated weather data (rainfall, temperature), disease records (e.g., cabbage stem flea beetle), and policy changes (e.g., environmental schemes) to capture non-linear effects. This used the commentaries in the AUK reports and a other sources.
- **Data Preparation:** Cleaned and normalised data to a 0-1 range, segmented into 5 to 10-year sequences for input-output pairs. Aligned weather/disease data with production timelines, quantified policy impacts as inputs, and handled missing values via interpolation/imputation.

#### 2. LSTM Model Design:

- **Architecture:** Designed a multi-layered LSTM with memory cells (forget, input, output gates) to model long-term dependencies and non-linear patterns. Included multivariate inputs: weather (seasonal precipitation/temperature), disease prevalence, and policy-driven land use changes.
- **Sequence Length:** Chose 5 to 10-year sequences to capture trends, seasonality, and disruptions from weather, diseases, and policies, leveraging LSTM's suitability for noisy agricultural data.

#### 3. Training the Model:

- **Training Process:** Trained the LSTM on 25-year data using backpropagation through time, optimising mean squared error with Adam<sup>10</sup>. The model mapped inputs (e.g., weather anomalies, disease impacts, policy shifts) to production outputs.
- **Scenario Integration:** Adjusted inputs for BAU (5% land loss), Moderate (20.4% arable loss), and Maximum (23.7% UAA loss) scenarios, incorporating policy impacts (e.g., afforestation, solar farms) and projected weather/disease trends.

#### 4. Forecasting:

- **Prediction:** Predicted 2050 metrics (UAA, production, per capita supply) by processing recent sequences and forecasting forward, accounting for non-linear impacts like extreme weather, diseases, and policy-driven land reductions.
- **Output Adjustment:** Adjusted outputs for population growth (75/80 million) and import needs, aligning with scenario-specific land and productivity constraints.

#### 5. Validation and Output:

- **Validation:** Validated using cross-validation, ensuring robustness against weather, disease, and policy noise. Evaluated accuracy with RMSE.
- **Results:** Produced projections, e.g., 7% production drop in BAU (44,137 thousand tonnes) or 32.4% in Max (32,082 thousand tonnes), as per the report.

<sup>10</sup>Optimising mean squared error (MSE) with Adam refers to the process of training a machine learning model by minimising the MSE loss function using the Adam optimisation algorithm. This is essentially a means fine-tuning the LSTM to reduce prediction errors for agricultural production by efficiently navigating the complex, non-linear data landscape using adaptive gradient updates.

# Bibliography

- Buckwell, A. (2019). *Summary report – CCC land use advisory group: Policies for agriculture, forestry and land use*. Committee on Climate Change.  
<https://www.theccc.org.uk/wp-content/uploads/2020/01/Professor-Allan-Buckwell-2019-Summary-report-CCC-land-use-advisory-group.pdf>
- Climate Change Committee, (2020), *Land use: Policies for a Net Zero UK*,  
<https://www.theccc.org.uk/publication/land-use-policies-for-a-net-zero-uk/>
- Climate Change Committee. (2023). *Seventh Carbon Budget: Land Use Report*.  
<https://www.theccc.org.uk/publication/seventh-carbon-budget/>
- Collas, L., et al. (2023). *Land sparing outperforms land sharing for birds in disturbed cultural landscapes*. *People and Nature*.  
<https://besjournals.onlinelibrary.wiley.com/doi/full/10.1002/pan3.10422>
- CPRE, CPRE, *Two-thirds of mega solar farms built on productive farmland, 13 July 2025*.  
<https://www.cpre.org.uk/news/two-thirds-of-mega-solar-farms-built-on-productive-farmland/>
- Department for Energy Security and Net Zero. (2021). *Net Zero Strategy*.  
<https://www.gov.uk/government/publications/net-zero-strategy>
- DEFRA. (2024). *Agriculture in the United Kingdom (1999-2024)*.  
<https://www.gov.uk/government/collections/agriculture-in-the-united-kingdom>
- DEFRA. (2024). *Land Use Framework Analytical Annex*.  
[https://consult.defra.gov.uk/land-use-framework/land-use-consultation/supporting\\_documents/LU\\_analytical%20annex.pdf](https://consult.defra.gov.uk/land-use-framework/land-use-consultation/supporting_documents/LU_analytical%20annex.pdf)
- Finch, T., et al. (2023). *Spatially targeted nature-based solutions can mitigate climate change and nature loss but require a systems approach*. *One Earth*, 6(10), 1388–1400  
[https://www.cell.com/one-earth/fulltext/S2590-3322\(23\)00444-X](https://www.cell.com/one-earth/fulltext/S2590-3322(23)00444-X)
- Grantham Research Institute on Climate Change and the Environment. (2025). *Submission to the UK Department for Environment, Food & Rural Affairs: Response to the Land Use in England open consultation*.  
<https://www.lse.ac.uk/granthaminstitute/publication/submission-to-the-uk-department-for-environment-food-and-rural-affairs-response-to-the-land-use-in-england-open-consultation/>
- One Earth Journal. (2023). *Net Zero Pathways for UK Land Use*.  
[https://www.cell.com/one-earth/fulltext/S2590-3322\(23\)00444-X](https://www.cell.com/one-earth/fulltext/S2590-3322(23)00444-X)
- ONS. (2022-based). *National Population Projections*.  
<https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/bulletins/nationalpopulationprojections/2022based>
- Royal Society. (2023). *Multifunctional Landscapes*.  
[https://royalsociety.org/-/media/policy/projects/living-landscapes/des7483\\_multifunctional-landscapes\\_policy-report-web.pdf](https://royalsociety.org/-/media/policy/projects/living-landscapes/des7483_multifunctional-landscapes_policy-report-web.pdf)
- UK Government. (2024). *Net Migration Statistics*.  
[https://assets.publishing.service.gov.uk/media/681ccc47e26cd2f713d87112/Net\\_Migration.pdf](https://assets.publishing.service.gov.uk/media/681ccc47e26cd2f713d87112/Net_Migration.pdf)
- UKRI. (2024). *Land Use for Net Zero Hub*.  
<https://www.ukri.org/what-we-do/our-main-funds-and-areas-of-funding/browse-our-areas-of-investment-and-support/land-use-for-net-zero-hub/>



[www.scienceforsustainableagriculture.com](http://www.scienceforsustainableagriculture.com)