**Written evidence submitted by the Institute for Sustainable Resources (ISR) and Centre for Biodiversity and Environment Research (CBER)**
**15th December 2022**
**House of Commons Environmental Audit Committee**
**Inquiry: Environmental Change and Food Security**

**The UCL Institute for Sustainable Resources' (ISR)** mission is to generate knowledge that promotes the sustainable use of natural resources globally. ISR's multidisciplinary team produces innovative research on a range of sustainability topics including resource efficiency, circular economy, eco-innovation and low carbon societies.

**The UCL Centre for Biodiversity and Environment Research (CBER)** is one of the world's leading research and training centres in ecology and biodiversity science, addressing fundamental questions at the interface of biodiversity and environmental change, as well as the value of biodiversity for human economies.

We welcome the opportunity to submit evidence to this important inquiry and would be happy to provide additional information or further testimony should it be helpful to the inquiry. Please contact Kathy Page (Katherine.page@ucl.ac.uk) and Amy Godfrey (amy.godfrey@ucl.ac.uk).

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## Section 1: Climate change and food security: projected effect, risks, and mitigation

### *1. What are the main risks posed to future UK food security from projected climate change and biodiversity loss pathways?*

Given the UK's high dependence on food imports, climate change and biodiversity loss pose fundamental risks to UK food security. Climate change and biodiversity loss are likely to affect both the primary production of food, but also many post-production aspects such as the processing, storage, and transportation of commodities[1].

Fruit and vegetables stand out as particular cause for concern since this is a food group which is important for health but has a high vulnerability to climate change and biodiversity loss. For instance, projected pollinator declines put at risk fruits, vegetables, and other foods which are dependent on pollination to grow and develop[2]. Globally, we are already losing 3-5% of fruit, vegetable and nut production per year through lack of pollinators, with the economic crop production value being as much as 30% lower in some countries than if pollinators were abundant[3].

As other countries become more food insecure, they are likely to become less willing to export their food supplies, meaning less trade to the UK, and food-supply risks - in 2022 over 20 countries have closed their borders to exports as a result of food shortages stemming from climate and conflict[4].

High temperature and humidity are likely to reduce the longevity and affect the storage and transport requirements of perishable items such as fresh fruit and vegetables[5].

***2. Where does the UK's food come from? On the current climate change trajectory, how will these regions be affected by climate change and what will the impact on UK food security be?***

As part of the Sustainable and Healthy Food Systems (SHEFS) project, members of CBER and ISR have been researching the impacts on biodiversity of food produced and consumed in the UK and its global trade partners. Since 2000, the UK has imported fruits and vegetables from 137 countries of the world (with major fruit and vegetable imports including: Italian and Portuguese tomatoes, grapes from Turkey and Greece, greencorn from Serbia, and oranges from South Africa (data sourced from[6])).

The UK imports fruit and vegetables from four countries which are particularly vulnerable to climate change with respect to food (Notre Dame Global Adaptation Initiative (NDGAIN) score >0.7 for vulnerability for food (UK score = 0.207, scale runs from 0 to 1 with higher scores indicating increased vulnerability)[7]): **Chad** (e.g. green beans, grapes, aubergines, mushrooms), **Niger** (e.g. bananas, watermelons, lemons, limes, grapefruit), **Somalia** (e.g. onions, green beans, cauliflowers, tomatoes) and **Timor-Leste** (e.g. pineapples, oranges, apples, cherries) (data sourced from[6]).

Further, some of the commodities that the UK are importing are projected to be exposed to important changes in biodiversity at their sites of production, biodiversity changes themselves driven by climate change. In particular, emerging findings from work currently ongoing at CBER as part of the GCRF TRADE Hub, shows that commodities grown in tropical areas, such as cocoa, banana, or soybean, are likely to be some of the most exposed (in their country of production) to changes in biodiversity driven by climate change. The UK imports significant quantities of agricultural commodities from these areas, including: soybean produced in Brazil; bananas from Colombia, the Dominican Republic and Costa Rica; rice produced in India; coffee from Indonesia; cocoa from Côte d'Ivoire, *et cetera*. Changes in biodiversity at the sites of production could put the supply chains at risk. Indeed, changes in biodiversity could affect ecosystem services (notably, pollination, pest control), increasing the susceptibility of the crops to both current and emerging diseases and pests and reducing yields.

Although beyond the scope of our particular expertise, it should be remembered that the UK also sources food from wild populations, e.g. fish, seafood, and that these sources are vulnerable to climate change, overexploitation and pollution.

***3. How do existing UK food production, import and export practices contribute to climate change and biodiversity loss?***

A 2022 analysis undertaken by researchers at CBER and ISR shows that over 90% of the UK's consumption-based biodiversity footprint comes from overseas[8]. The three main food types that contribute to these high biodiversity costs are (i) Fruit, Vegetables & Nuts (FVEG), (ii) Products of Cattle (PCAT) (i.e. bovine meat products) and (iii) Other Crops not elsewhere classified (OTCR), e.g. tea, coffee, cocoa, spices (Figure 1)[9]. The biodiversity loss driven by UK food imports occurs predominantly in Africa and Central & South America (Figure 1).

79% of the greenhouse gas (GHG) emissions associated with UK food consumption originate in Western Europe (62% from within the UK itself). GHG emissions are highest for processed food, food waste disposed of in landfill and animal-derived products (Figure 2)[9]. Processed food is particularly high in part due to the high quantities consumed in the UK –

the category includes a wide range of foods, e.g. sandwiches, sauces, ready-meals, pizza, frozen vegetables, fruit juices.

The **UK's consumption-based biodiversity footprint per capita for Fruit, Vegetables & Nuts is the 8th highest in the world**, the per capita footprint for Products of Cattle the 15th highest and the per capita footprint for Other Crops the 17th highest[8].

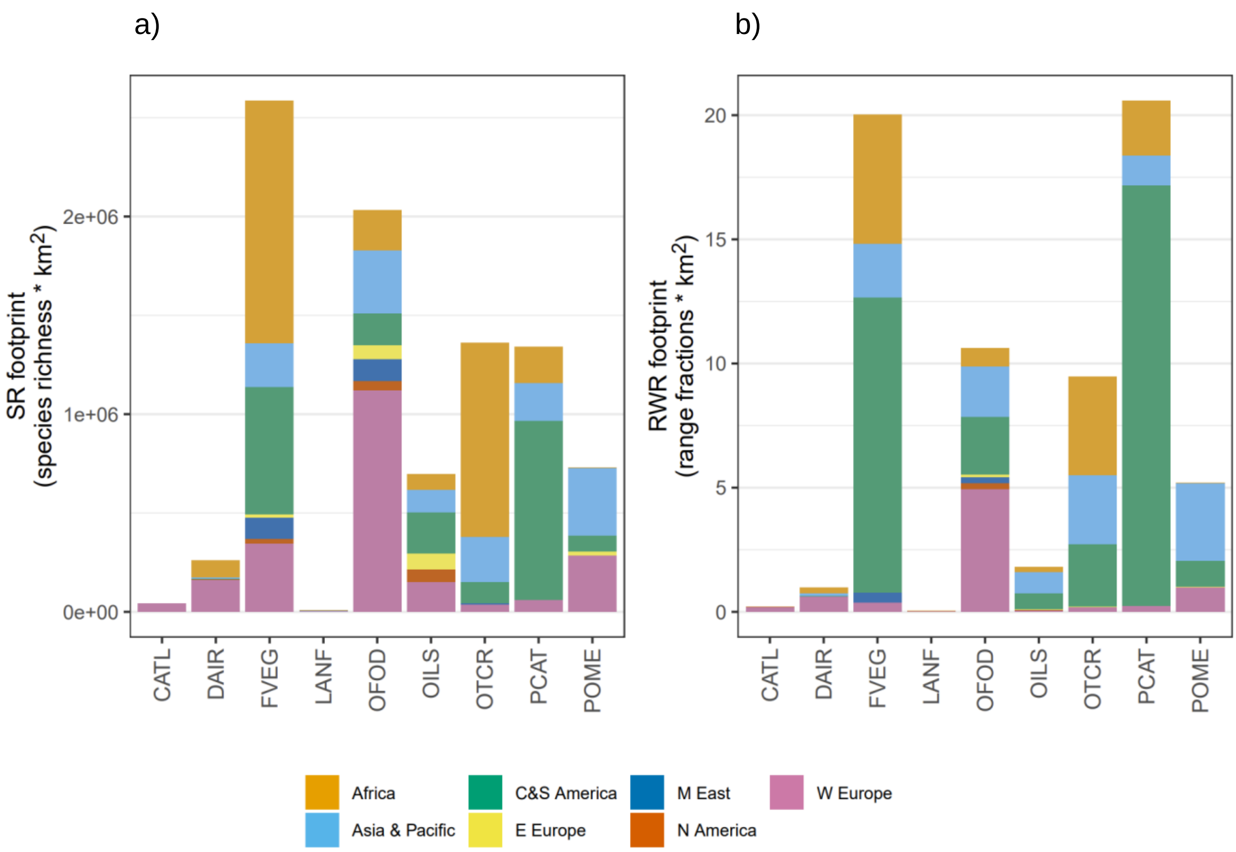


**Figure 1.** The UK's consumption-based biodiversity footprint measured by a) species richness and b) rarity-weighted richness. CATL = Cattle; DAIR = Dairy products; FVEG = Fruit, vegetables & nuts; LANF = Food waste for treatment: landfill; OFOD = Food products not elsewhere classified, e.g. sauces, pizza, biscuits; OILS = Oil seeds, OTCR = Crops not elsewhere classified, e.g. cocoa, coffee, tea; PCAT = Products of meat cattle; POME = Meat products not elsewhere classified, e.g. meat of sheep, goat, horses. The biodiversity footprint was assessed using two different metrics, loss of (i) species richness and (ii) rarity-weighted richness. Species richness has the advantage of being an intuitive measure since it is simply the count of species that occur within an area. However, species richness represents only one dimension of biodiversity and does not change if a rare species is replaced by a common species. Rarity-weighted richness weights species counts by the inverse of their geographic range size. Geographic range size is directly correlated to extinction risk and so the rarity-weighted richness gives greater weight to rare species. The analysis shows that while the two biodiversity metrics broadly agree, they reveal different priorities for footprint reduction. For Fruit, Vegetables & Nuts, for example, the species richness footprint is highest in Africa whereas the rarity-weighted richness metric captures the higher numbers of rare, small-ranged species in Central & South America. The units of the two metrics reflect both the biodiversity richness and the land area of the relevant crop/pasture areas and, for interpretation purposes, are best used as a relative measure. For

example, the rarity-weighted richness footprint of Fruit, Vegetables & Nuts is approximately five times greater than that of Oil Seeds.

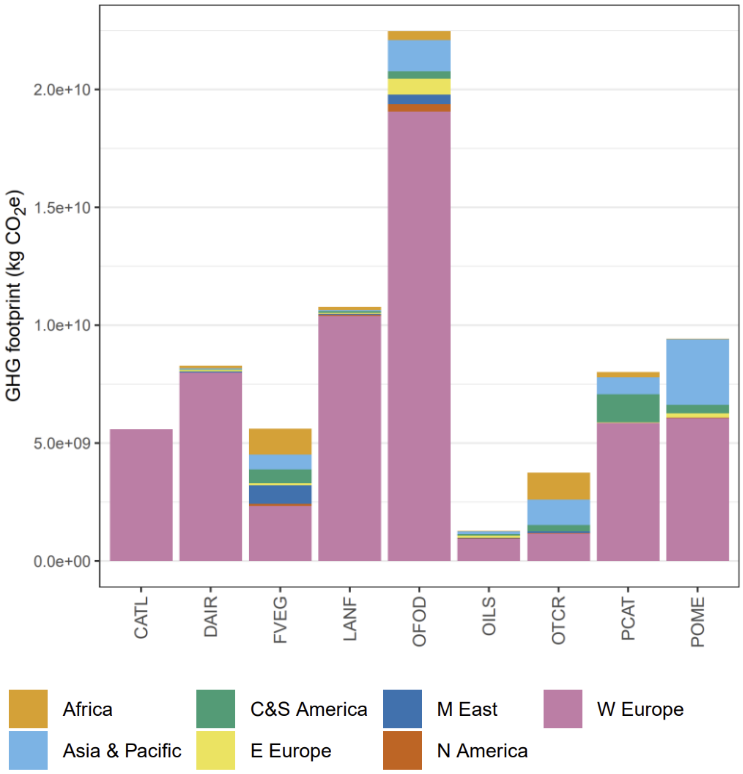


**Figure 2.** The UK's consumption-based greenhouse gas (GHG) emission footprint in kg $CO_2$e. CATL = Cattle; DAIR = Dairy products; FVEG = Fruit, vegetables & nuts; LANF = Food waste for treatment: landfill; OFOD = Food products not elsewhere classified, e.g. sauces, pizza, biscuits; OILS = Oil seeds, OTCR = Crops not elsewhere classified, e.g. cocoa, coffee, tea; PCAT = Products of meat cattle; POME = Meat products not elsewhere classified, e.g. meat of sheep, goat, horses.

Reducing consumption of cattle products from C&S America offers an effective pathway for cutting both the UK's imported biodiversity and GHG emission footprint as well as simultaneously improving dietary health in the UK: a win-win-win. For example, the UK's total consumption-based rarity-weighted biodiversity footprint could be reduced by 10% simply by halving imports of C&S American cattle products.

As part of the SHEFS project, academics at the ISR have been researching the biodiversity impacts of food produced and consumed in the UK. We are currently **developing a crop-specific measure of biodiversity put at risk** by a given amount of crop produced. This measure is comparable across countries and enables us to consider the biodiversity put at risk in general by a particular crop, but also by the amount a country imports/consumes of a given crop. For instance, tomatoes grown in the UK have a relatively low biodiversity impact potential while tomatoes imported into the UK can have a higher production-based biodiversity footprint. (NB Other sustainability measures, such as water stress due to irrigation and GHG emissions via heated greenhouses, refrigeration etc, must be considered too, complicating the picture.)

**Section 2: UK preparedness: government and market**

***2. How can the UK ensure that enough water is available for crop growing while preventing unsustainable levels of abstraction that can impact the ecology and resilience of our rivers, wetlands and aquifers?***

- Improve water use efficiency (e.g. prevent losses through leaking pipes or evaporation in storage).
- Improve crop water productivity (e.g. change crop type or cultivar to require less water; adapt practices to improve yield per unit water consumed).
- Reduce water demand by reducing food waste and by reducing demand for water intensive crops (i.e. adapt diets).
- Reduce water demand by switching from feed requiring irrigation to feed that does not or, better yet (because of inefficiency in livestock), switch feed crops to those that can be directly used for human food.
- Assess water debt to determine how sustainable the water use of a given crop in a particular area is using the 'water debt repayment time' indicator[10,11].

**Section 3: Securing a sustainable food supply**

***3. What role could a reduction in meat and dairy consumption play in improving food security and what measures could the Government take to capitalise on the trend to plant-based diets?***

Within the UK, CBER research from the SHEFS project has shown there is huge potential for biodiversity gains and climate-change mitigation via conversion of grazing land to horticulture and natural land cover[12]. For example, converting just 5% of UK grazing land to horticulture would produce sufficient calories to free up a further 18% of grazing land to be converted to natural land resulting in >10% increase in habitable area for almost 500 UK species. Furthermore, it would increase vegetable production to allow the recommended per capita portion of 400g of fruit and vegetables to be consumed daily.

Since climate change is largely responsible for the risk to the UK's supply chains, any dietary shift that reduces GHG emissions will also improve food security. The UK's consumption of meat and dairy products carry a high embedded GHG footprint.

Additionally, any shift that makes more efficient use of land per dietary unit of energy (i.e. shifting land use from pasture to crops that directly feed humans) will increase food security.

The UK government could adjust agricultural subsidies to encourage the conversion of grazing land to horticulture and/or natural land. The government should also raise public awareness of the environmental and health benefits of a plant-based diet.

***5. Is there research and development the Government could be to provide food security solutions?***

Since climate change is largely responsible for the risk to the UK's supply chains, the most effective and reliable solution for UK food security is to limit future average global temperatures, and the risk of extreme weather events, by rapidly reducing GHG emissions.

We would therefore advise the Government funds developments that mitigate climate change, e.g. cheap and quick renewable energy sources such as onshore wind and solar, home insulation, investment in UK electricity network infrastructure and the promotion of plant-based diets. (This latter point would also reduce the UK's reliance on imported food.) The UK should also fund developments that push strongly for co-ordinated global climate action. Food security will be further jeopardised should the UK continue to fund or support new fossil fuel projects since this support a) increases GHG emissions and b) disincentivises emerging economies to transition to green energy.

With respect to funding research directly related to UK food security, we already have the fundamental knowledge to enact significant change. The UK could produce much more food domestically were it to convert land used for pasture and fodder crops to grow food which can feed people directly. The UK's overseas food supply is vulnerable - further research can give us more detail about this vulnerability but it will not change the fact that the only solution is to mitigate climate change. Diversification of supply chains may increase resilience but cannot guarantee it.

One aspect of food security that we do not know enough about is the risk that biodiversity loss poses to agricultural systems, both in the UK and in the places where much of the food we import is grown. We suggest the Government fund research to investigate feedbacks between biodiversity and food systems and risks from biodiversity change to food production. As well as refining our understanding of threats we have already identified, the outcome of such research is likely to reveal more risk to the global food system. This means that acting pre-emptively now to halt/reverse global biodiversity loss would be strongly advisable, even before the increased scientific precision and understanding of synergies and feedbacks that such research would deliver.

In other words, funding of scenario-based research to explore possible futures for the UK food system and food security is of value but will not change the fact that the UK has to dramatically reduce its consumption of animal-derived products.

Research considering the environmental impacts of UK diets and consumption on its international trade partners is also important in order to ensure a just and sustainable supply chain. The current impacts of UK consumption often occur far from its shores with environmental costs such as biodiversity loss, water debt and GHG emissions embedded within the supply chain. These costs are not paid for by UK importers or consumers. Legislation is urgently required to prevent such externalisation of costs else biodiversity loss and climate change will make such sources of food import far less productive.

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