Shaping UK land use methodology

green alliance…

Land Use

In all scenarios, we produce enough food to at least maintain the current level of self-sufficiency in the UK. We started with all currently farmed land in the UK. We assumed land in the high-yield compartment initially yielded the average of conventional yields today. We then assumed linear change towards, in 2050, an increase in crop yields of 10 per cent and in stocking densities of 15 per cent[i]. We assumed nature-friendly farmland currently yields the same as organic farmland, but that crop yields will increase linearly to 2050 when we assume agroecology yields 90 per cent of current conventionally farmed crops[ii]. We assumed livestock stocking densities will fall according to the agro-ecology scenario modelled by the National Food Strategy. We assumed household waste would fall by 50 per cent between 2007 and 2030, in line with the Waste and Resources Action Programme's UK Food Waste Reduction Roadmap[iii] and by 60 per cent by 2050 as per the Climate Change Committee's Balanced Net Zero Scenario. We assumed removing 1MtCO2/y with BECCS required land footprints of 409ha for dedicated crops and 1091ha for sustainably managed forestry[iv].

Net Zero and land use

We assumed that the rest of the economy will follow the scenario outlined in the CCC's Balanced Net Zero Scenario. This is used to set the residual emissions across the rest of the economy which greenhouse gas removals must offset. We also assumed the per area emissions from high-yield farming would fall according to the CCC's Balanced Net Zero Scenario. We assumed agroecological farming has the per area emissions, including soil sequestration, outlined for organic land by Smith et al. (2019) and applied the same decarbonisation as laid out by the CCC as for high-yield farmland, taking account of the already lower fertiliser use on agroecological farmland. We used standard values from the literature for the sequestration provided by semi-natural habitats[v].

Nature

We modelled the outcomes of our scenarios for wild bird species in the UK. To do so we used estimates of the density of 116 bird species reported by Lamb et al. (2019) in woodland, wetland and farmland habitats in RSPB reserves. These broad range of species includes species that thrive in semi-natural habitat as well as those suited to farmland which are often used to assess the nature impacts of policies. In our model, when farmland is replaced by semi-natural habitat, we assumed the density of birds associated with the created semi-natural habitat would accumulate linearly over a twenty-year period. This analysis was limited in that we only knew bird densities in woodland and wetland habitats; other habitats, such as scrubland, would aid different species so we potentially underestimated the nature recovery occurring from semi-natural habitat creation.

In addition, we estimated the nature benefits of our agroecological farmland compartment which involves feed and nest habitats being added to the farmed landscape. We assumed that this land use would deliver the average change in bird density modelled in existing literature between low-yield and high-yield farmland in four locations in England[vi]. However, the low-yield land in these studies was not necessarily managed as we are advocating here, and indeed the studies are limited to lowland areas of England. Therefore, a key limitation of our work is not having species-specific evidence of the impacts on species of these specific management actions. In addition, we did not model the impacts of our scenarios on nature overseas; we would expect scenarios using more overseas land to have more negative impacts on nature overseas.

Farm incomes and taxpayer costs

First, we estimated the cost of paying farmers in England, Wales, Scotland and Northern Ireland to switch from focusing on food production to semi-natural habitat creation. To make this change attractive, we assumed farmers would be paid at a rate that increased their income by 20 per cent, despite withdrawal of subsidy under the Basic Payment Scheme. We assumed that all farmers would be paid at the rate required by the least-willing participant required in the scheme; this meant that in scenarios involving large amounts of habitat creation the least profitable farmers received payments that increased their income by much more than 20 per cent. Clearly, paying farmers at variable prices, depending on their personal lost income, would reduce costs.

Second, we estimated the costs of paying farmers to add nature-friendly aspects to their farm such that it became what we refer to as agroecological, nature-friendly farmland. Given this land use is presented as a viable option for those on the moderately productive farmland, we assumed it would be paid at a rate that saw their current farm income maintained despite the withdrawal of the Basic Payment Scheme. In doing so, we assumed they would add feed and nest habitats, paid at similar rates to England's Countryside Stewardship Scheme, on one third of their land. Farms that chose to enrol less land in these options would expect to see a reduction in their farm income. Again, we assumed a fixed-price scheme that paid all participants at the rate required by the most expensive farmer needed in the scheme, so in scenarios with large amounts of nature-friendly farming, the least profitable farmers today see greater increases to their farm incomes.

Our scenarios see incremental changes to the landscape such that the area of semi-natural habitat and agroecological farming steadily increases as diet change gradually frees up the required space. Therefore, if subsidies were immediately withdrawn many farmers would see their businesses become unprofitable but our scenarios may not see them paid to enter a scheme until some point in the future. Furthermore, even at 2050, some scenarios that focus on engineered greenhouse gas removal would see many of the poorest farmers facing insolvency if current subsidies are withdrawn. So, thirdly, to avoid widespread bankruptcy either in the transition to each scenario's 2050 endpoint, or in scenarios with less semi-natural and nature friendly farming, as a continuing subsidy in 2050 we top up the incomes of the least profitable 40 per cent of farms such that they at least maintain their present income in every year of the scheme. Future policy may or may not choose to take this approach.

Finally, we estimated the costs of BECCS and DACCS. We did so simply by assuming the average cost estimate for BECCS from the CCC Balanced Net Zero Scenario of £123/tCO2 in 2030, falling linearly to £93/tCo2 in 2050 and we estimated the cost of DACCS at £245/tCO2 in 2030, falling linearly to £180/tCO2 in 2050[vii]. These estimates include all associated capital costs.

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[i] Following research conducted by Systemiq for the UK's National Food Strategy.

[ii] Ibid

[iii] Waste and Resources Action Programme, 2018, Food Waste Reduction Road Map

[iv] Land footprint for dedicated crops taken from P Smith et al, 2015, 'Biophysical and economic limits to negative CO2 emissions', Nature Climate Change, issue 6, pp 42-50. Land footprint for sustainably managed forestry taken from F Kraxner et al, 2003, Biomass and Bioenergy, issue 24, vol 4-5, pp 285-296.

[v] T BradferLaurence et al, 2021, 'The potential contribution of terrestrial nature-based solutions to a national
'net zero' climate target', Journal of applied ecology, vol 58, pp 2,349-2,360; N Ostle et al, 2009, UK land use and soil carbon sequestration, Land use policy, vol 26, ppS273-S283.

[vi] For nature-friendly farmland habitats, we applied the mean response of birds to farming at lower yields in T Finch et al, 2020, 'Evaluating spatially explicit sharing-sparing scenarios for multiple environmental outcomes', Journal of Applied Ecology, vol 58, issue 3, pp 655-666 and T Finch, et al, 2020, Assessing the utility of land sharing and land sparing for birds, butterflies and ecosystem services in lowland England, Report to Natural England, ref no: NECR280, pp 1-73.

[vii] Data from Figure 2 of A Owen et al., 2022, 'Who pays for BECCS and DACCS in the UK: designing equitable climate policy', Climate Policy, 22(8), 1050-1068 which was built from data in the Committee on Climate Change, 2020, The Sixth Carbon Budget: The UK's Path to Net Zero