

Why is sustainable intensification important for biodiversity and the climate, and how can we measure it?

Andrew Balmford
Department of Zoology, University of Cambridge
a.balmford@zoo.cam.ac.uk



What happened to sustainable intensification?
APPG on Science and Technology in Agriculture

13 Sep 2021

Reducing the environmental impacts of farming

Farming already accounts for 20-30% of our GHG emissions and through habitat loss and simplification is overwhelmingly greatest source of threat to other species



On *demand side*, cutting waste and lowering ruminant meat and dairy consumption essential



On *supply side* two contrasting approaches

Green et al. 2005 Science 307:550

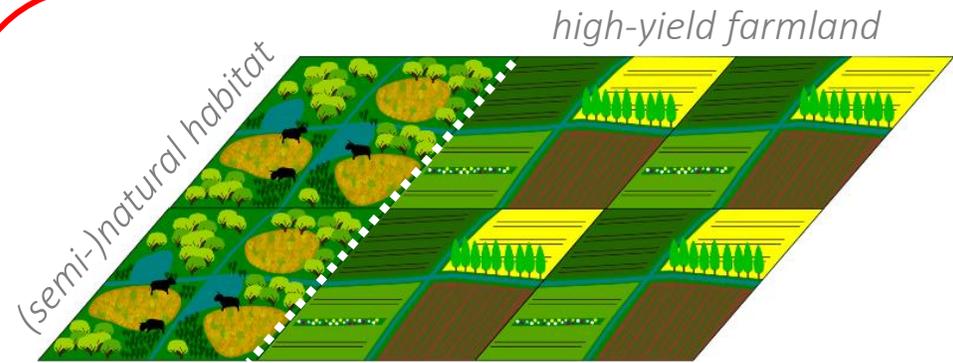
Godfray et al. 2010 Science 327: 812; Tilman et al. 2017 Nature 546: 73

Land sharing and land sparing



Land sharing – reducing chemical inputs, keeping hedgerows, etc. so more wildlife and C on farm

Reduces yields (production/area) so requires more farmland

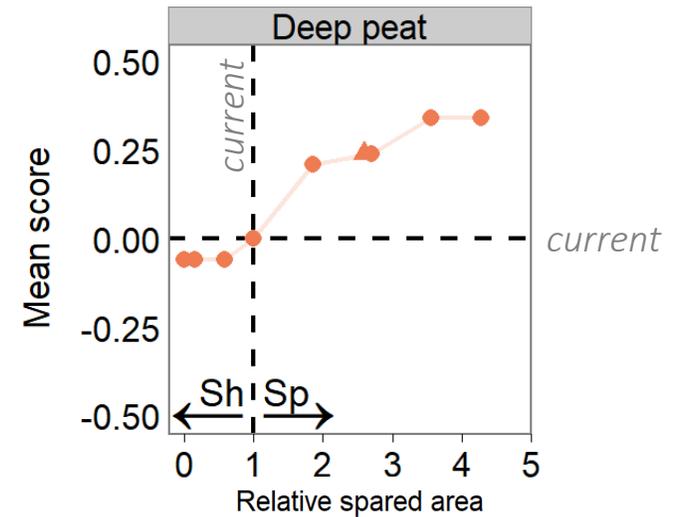


Land sparing – sustainably increasing yields on farms so need less farmland, leaving more space for nature elsewhere in landscape. Requires **sustainable yield increases** and **policies to retain/restore** natural habitat

15 years' field studies on 5 continents show **most species** decline sharply under farming and **would do best under land sparing; same true for C storage**

Land sharing and land sparing in UK

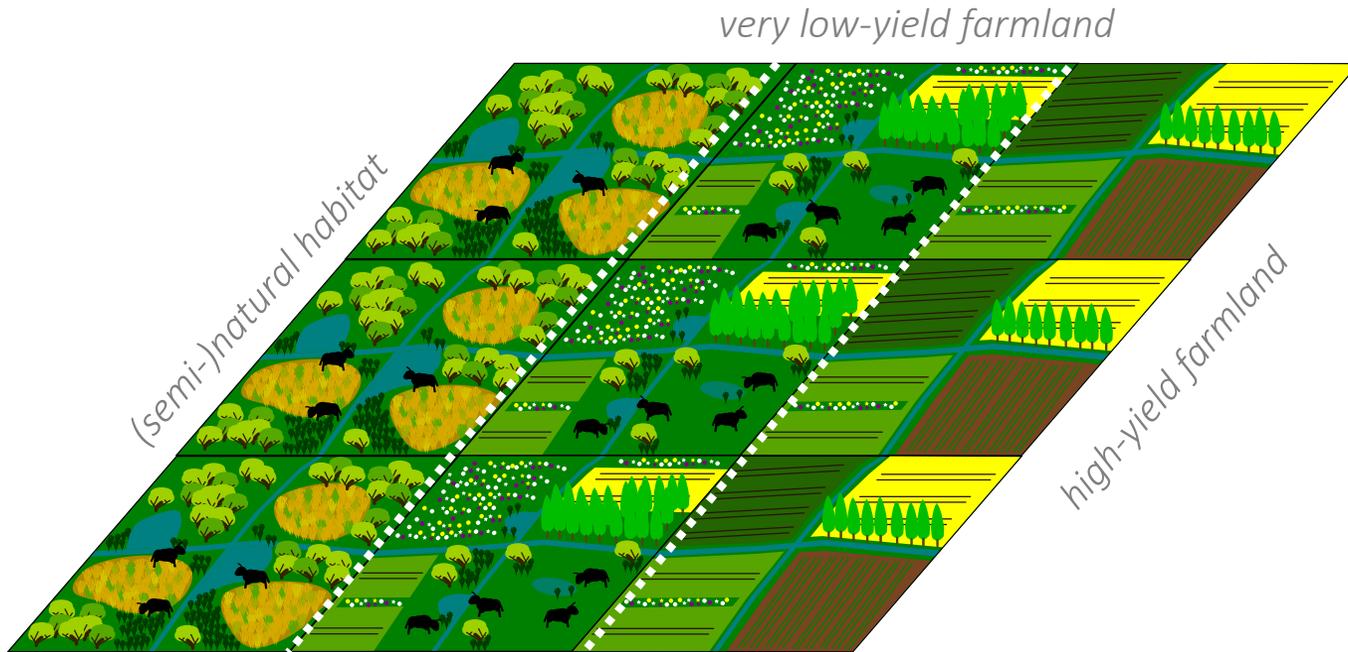
Scenarios comparing mean scores for increasing birds, reducing GHG emissions and N and P export, and boosting outdoor recreation



In several cases **3-compartment sparing** better still

In both regions overall **outcomes maximised by much higher yields and more sparing** than present; spatial configuration also important

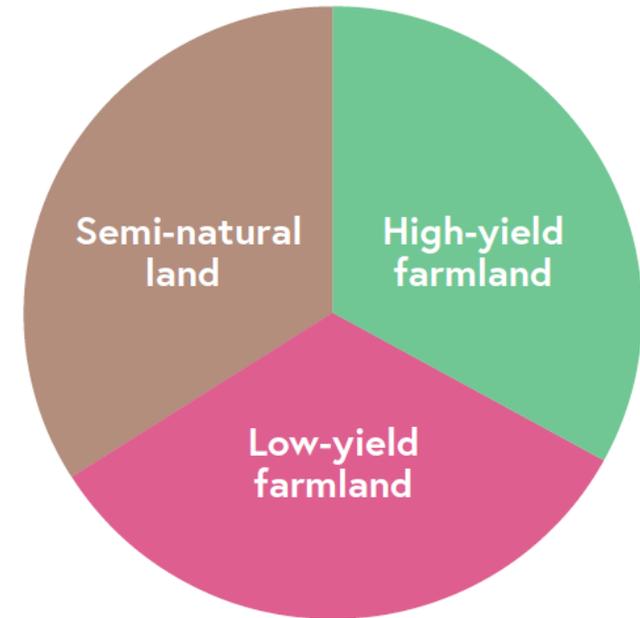
3-compartment sparing



Accommodating more species by sustainably increasing yields and assigning some unused land to (semi-) natural habitats and **some for very low-yielding farmland**

Feniuk et al. 2019 Proc. R. Soc. Lond. B. 286: 20191483

Finch et al. 2020 J. appl. Ecol. 57: 985



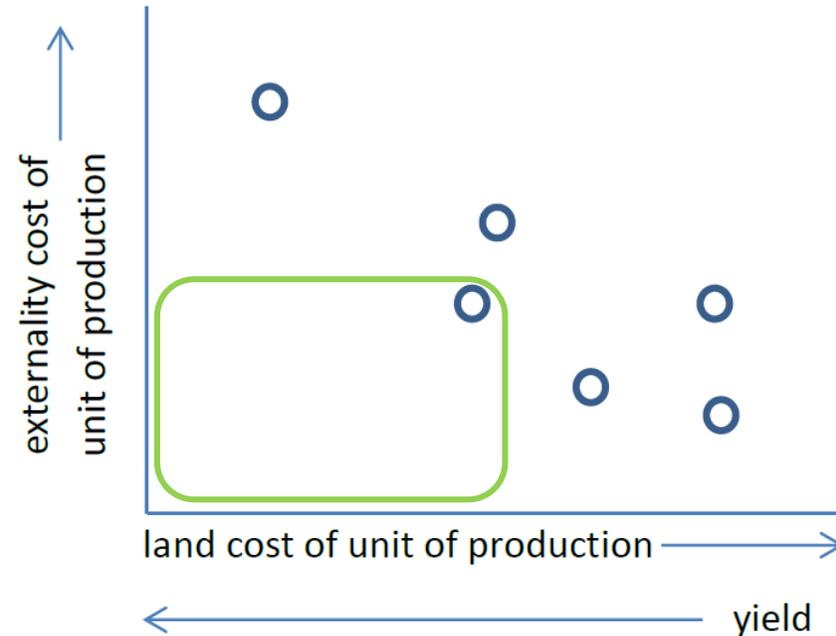
nationalfoodstrategy.org

endorsed in general terms by National Food Strategy but sizes and yields in each compartment key and **yet to be resolved**

Delivering land sparing

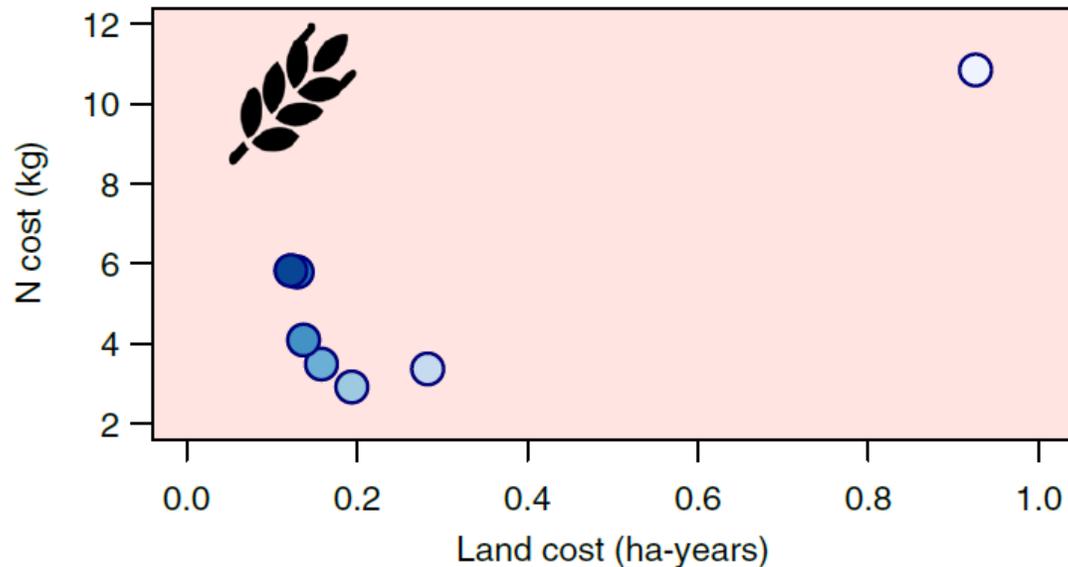
Requires incentives and/or regulations for retaining/restoring natural habitat; **and** identifying and then supporting ways of increasing yields sustainably

Plots comparing externality costs of alternative production systems can help identify sustainable ways of increasing yields – but ***need to express costs per unit production***

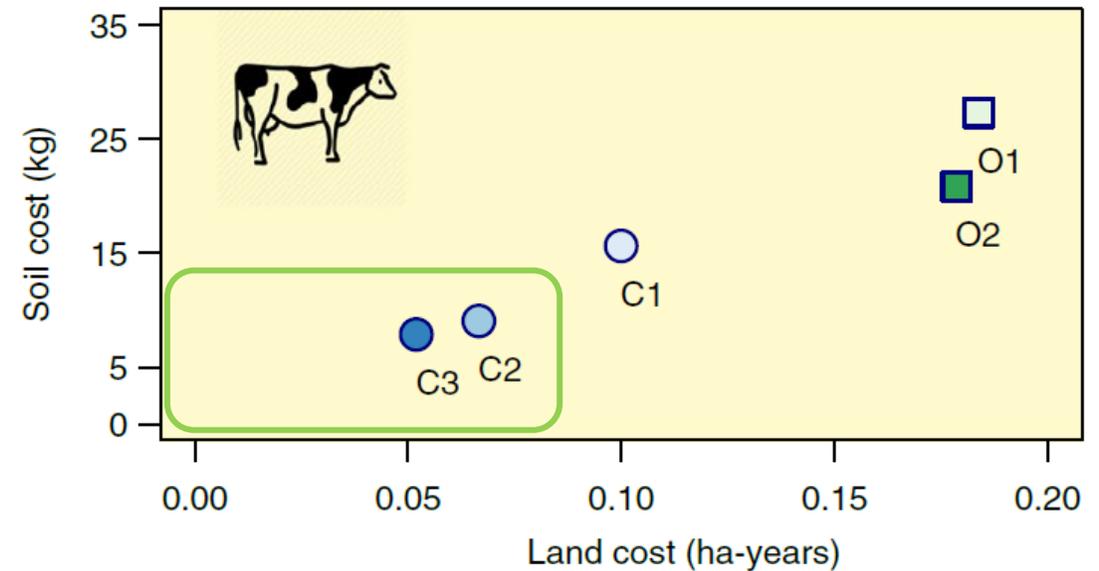


Some cost-cost plots for UK farming

wheat – N-loss cost vs land-use cost



dairy – soil-loss cost vs land-use cost



expressed per unit production, externality costs are not necessarily higher (and can be lower) for high-yield (= low land-use) systems, but appropriate data rarely reported