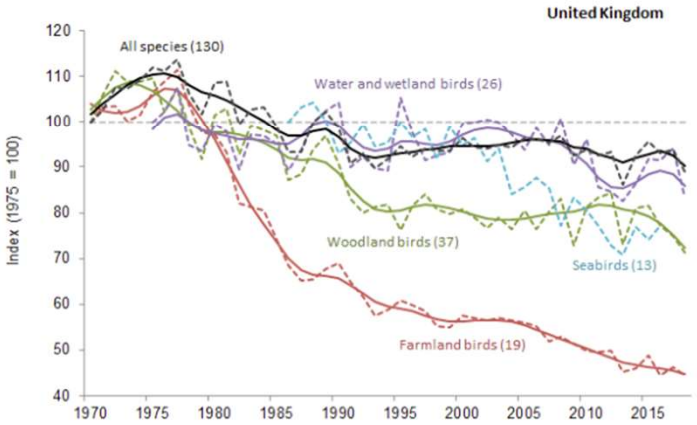


Nick Hanley, University of Glasgow

Valuing externalities in agriculture

outline

- Externalities and public goods generated by farming: a problem of non-market valuation
- Examples of approaches, negative externalities (water pollution, greenhouse gas emissions)
- Examples of approaches, positive externalities (biodiversity)
- animal health considerations
- Links to natural capital accounting
- Links to productivity measurement

- Externalities: negative or positive

- Producer➔ producer
- Producer➔ consumer

- Link to supply/stock of public goods

Examples of approaches, negative externalities (water pollution, greenhouse gas emissions)

Water pollution due to farming (diffuse pollution, NPS):

- use of Revealed Preference methods to estimate impacts on recreation (change in consumers' surplus);
- use of Stated Preference methods for wider impacts (eg low flows, water colour, pathogens in bathing waters) – estimation of mean WTP for change in water quality

Examples of approaches, negative externalities (water pollution, greenhouse gas emissions)

- Water pollution:
- use of Revealed Preference methods to estimate impacts on recreation;
- use of Stated Preference methods for wider impacts (eg low flows, water colour, pathogens in bathing waters)

- Climate change (GHG emissions):

➔ use of production function approaches combined with shadow cost of carbon (Shadow Cost of Carbon)

Examples of approaches, positive externalities (biodiversity)

- Economic value of changes in a biodiversity index are made up of

(i) direct effects on utility – mainly non-use values;

(ii) indirect effects, via the roles of biodiversity in ecosystem functioning.

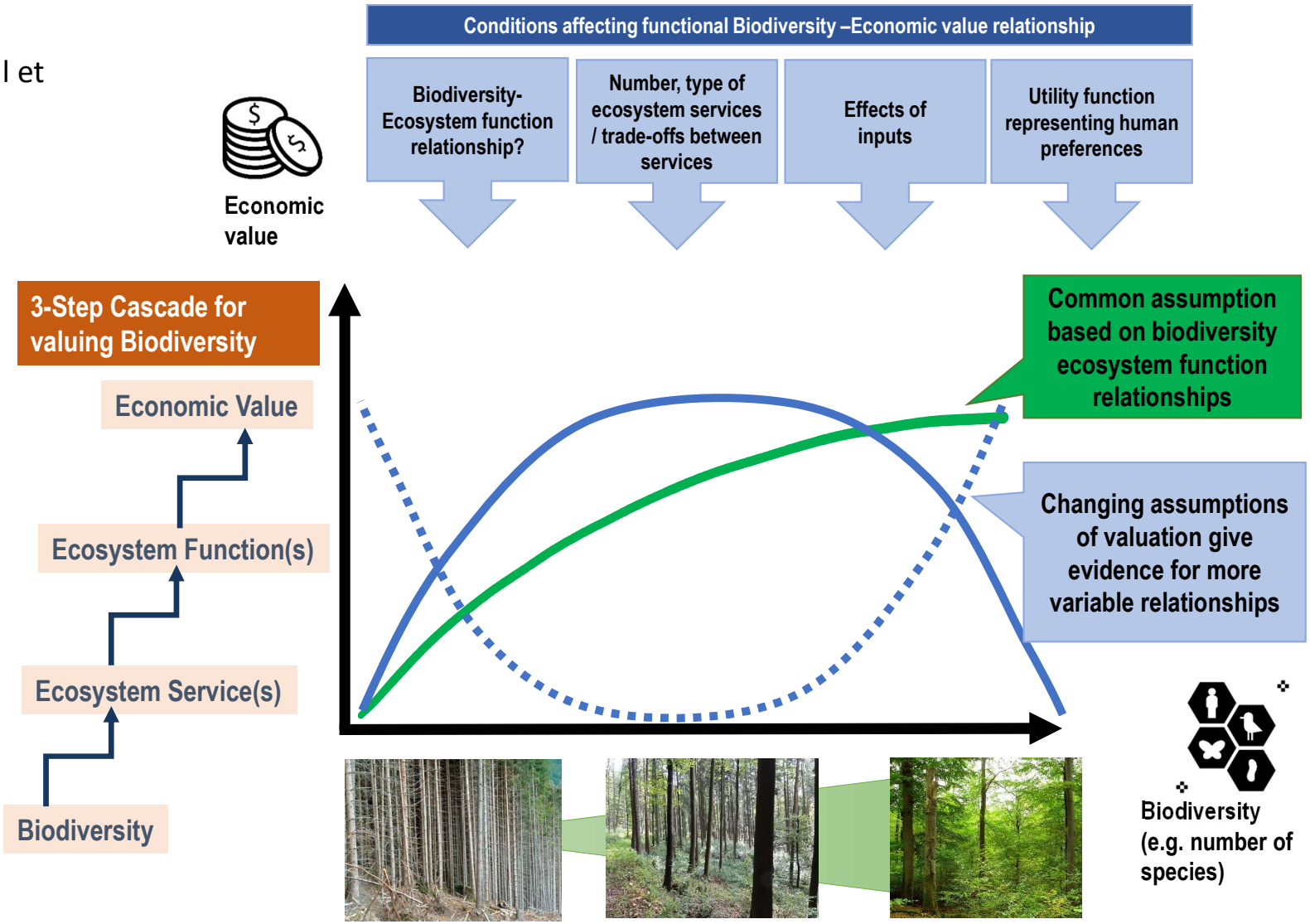
(Hanley and Perrings, Annual Reviews, 2019)

- *Note: multiple indicators of biodiversity available, which to choose to use in valuation context?*

The big problem

- Each dollar value of agricultural output may be associated with very different impacts (positive and negative) on biodiversity
- Impacts on a given biodiversity index (eg UK Farmland Bird index) of a given agricultural production system may vary enormously due to variations in other drivers of biodiversity eg landscape-level effects and meta-populations.
- Economic value of biodiversity can vary with production intensity in a highly non-linear way (eg Paul et al, *Science Advances*, 2020)

Source: Paul et al, 2020



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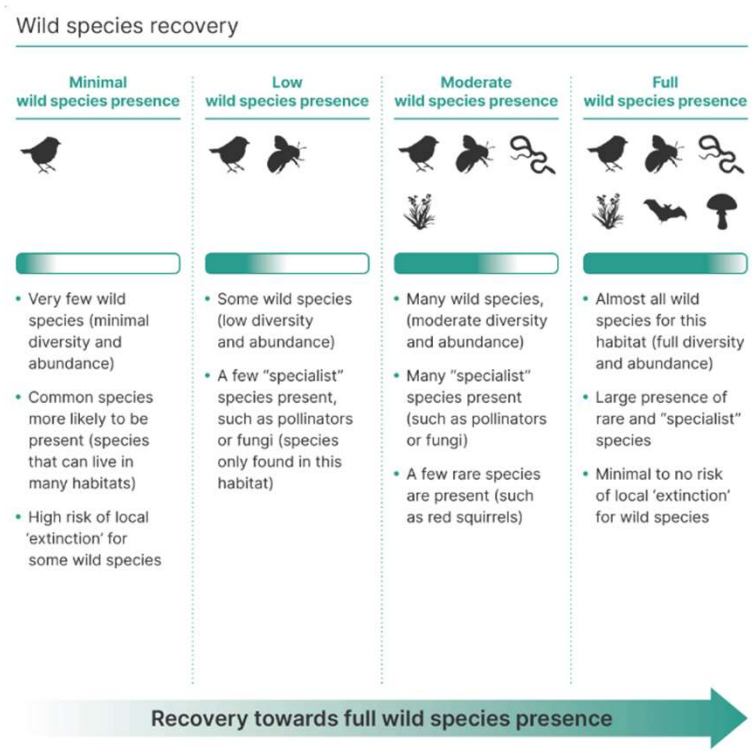
- Economic value of biodiversity can vary with production intensity in a highly non-linear way (eg Paul et al, *Science Advances*, 2020)
- Nevertheless, we can estimate taxpayer WTP values for specific prospective changes in biodiversity

Example: UK farmland biodiversity

- Study by Eftec for UK DEFRA
- Context: on-going reform of UK agricultural policy and biodiversity conservation policy
- Biodiversity outcomes values: wild species recovery in 12 specific habitats
- How delivered: changes in farming practices and other conservation measures



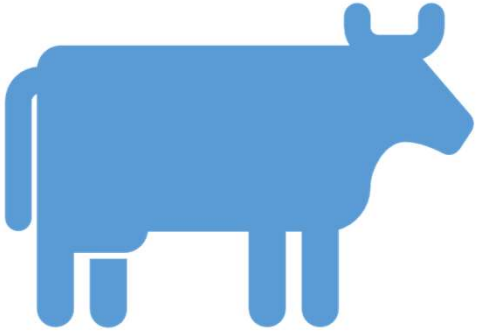
Information provided to respondents

	Scenario A	Scenario B	Scenario C
Upland oakwood	Moderate wild species presence	Full wild species presence	
Species recovery in upland oakwood by 2042	Low wildlife presence → **Moderate wildlife presence**	Moderate wildlife presence → **Full wildlife presence**	No change in species recovery actions in upland oakwood by 2042
Amount of upland oakwood improved	22,000 Hectares *About 50.0% of total upland oakwood in England*	11,000 Hectares *About 25.0% of total upland oakwood in England*	
Sites targeted by recovery actions	Small sites	Medium sites	
Increase in household expenditure due to recovery actions for upland oakwood in England	£10 per year (£0.83 per month) *Amount from 2023 to 2042*	£75 per year (£6.25 per month) *Amount from 2023 to 2042*	No additional cost

Choice card examples

Livestock health

- Does spending on livestock health inputs generate externalities?
- Yes, for infectious diseases, higher spending on biosecurity by any one farmer can lead to lower health costs to a neighbour or a farmer connected by markets
- For zoonotic diseases, the third party beneficiaries could be consumers
- For diseases with wildlife reservoirs, higher spending on controlling this reservoir also results in gains to other farmers which the agent cannot benefit from
- Mendes et al (2021): means that privately-optimal spending on livestock disease control is less than socially-optimal level
- But how best to reflect these externalities in productivity measures? (note: argument also holds for plant health)



Shadow prices for natural capital

- Compatibility with natural capital accounting: shadow prices of *changes in natural capital* (eg soils, aquifers, pollinator populations) need to reflect:
  - (i) discounted value of changes in utility over time;
  - (ii) substitutability of different assets within the natural capital stock;
  - (iii) effects of reducing stock of each specific asset on the functioning of the ecosystem, and thus the value flows from all other assets (Fenichel and Abbott 2014; Yue et al, 2017).
- Shadow prices should reflect proximity to tipping points
- Shadow price is the change in the present value to society, in terms of wellbeing over time, of holding one more unit of natural capital in situ.

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- Shadow prices should reflect proximity to tipping points
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- Relate to externalities through their partial impacts on the flow of benefits from these natural capital assets (eg pesticide use ➔ loss of pollinators ➔ loss of food production values from given location over time)

Concluding thoughts

- Agricultural activity generates a wide range of externalities, both positive and negative
- Relevant from viewpoint of social return from land use
- Methods exist to estimate these external benefits and costs in monetary terms (** welfare values – consistent with CBA **)
- But how to do this across whole of agricultural sector in a way which is feasible, robust and transferable?

Concluding thoughts

- Agricultural activity generates a wide range of externalities, both positive and negative
- Relevant from viewpoint of social return from land use
- Methods exist to estimate these external benefits and costs in monetary terms (** welfare values – consistent with CBA)
- But how to do this across whole of agricultural sector in a way which is feasible, robust and transferable?
- *And is this consistent with a distance function / undesirable outputs approach (abatement costs as damage costs)?*

"… the shadow prices of by-products should reflect the private costs that producers would face to reduce pollution by one unit" (OECD, 2022, page 28)

➔ *This is NOT how most of the academic work on valuing externalities has proceeded. Rather, we have focused on preference-based welfare measures of damage costs.*

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