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Abstract

Three approaches to supposedly lessen the harmful impacts of agriculture -- land sharing, rewilding and organic farming -- drive up food imports and so increase environmental damage overseas. An alternative is both cheaper and more effective.

Introduction

With agriculture the main driver of the habitat loss and degradation underpinning the global biodiversity crisis¹, governments across the world have been implementing various policies designed to lessen farming's impact on the environment. Meanwhile, certain non-governmental groups (including conservation bodies), landowners and financial organisations interested in biodiversity offsets have been pushing for land use changes that benefit nature.

Numerous studies show, however, that some of today's most popular conservation policies are doing little to help those species most impacted by farming. What's more, by reducing how much food is produced per unit area (yield), they drive up food imports and so impact wildlife overseas and exacerbate global biodiversity loss.

One of us (I. B.) has advised seven UK Secretaries of State for the Environment over the past decade; the other (A. B.) has led empirical work investigating how to reconcile food demand and biodiversity conservation for two decades. In our view, there are multiple reasons for this disconnect between the science and policy.

Part of the problem is that, particularly in Europe, the owners of the biggest and often richest farms stand to gain the most from current policies. Thousands of influential individuals are lobbying to maintain the status quo in agricultural policy².

A more fundamental – and massively underrecognized – problem, however, is that both government policy and much academic debate has focused too narrowly on the local effects of a given approach rather than on its overall (often long-distance) impacts. Indeed, this tendency to ignore downstream consequences – even as far better tools and data become available to track and quantify such impacts – is causing significant problems across a range of conservation and climate policies.

It doesn't have to be this way. Modelling approaches are now being developed to enable the information that is already available to significantly improve decision making around agriculture and the environment. Using the wealth of evidence from research to guide agricultural policy could better reconcile conservation and people's need for food. But it could also pave the way for the kind of evidence-based decision making that is urgently needed across a broad sweep of environmental challenges.

In vogue

In response to the biodiversity crisis, the European Union, the United Kingdom, Japan, Mexico and other regions and countries are increasingly devoting resources to what seem like environmentally friendlier ways to use land. [ok?]

Since it was created in the 1960s, the Common Agricultural Policy or CAP has been the European Union's most expensive policy. *[note to subeditor: pls insert inline link: <https://www.europarl.europa.eu/factsheets/en/sheet/106/financing-of-the-cap>]*. More than one fifth of the budget for CAP – currently, more than €55 billion a year – is available for 'environmental improvement', and most of that spending is funnelled into 'land-sharing' schemes.

In land sharing, various approaches are used to increase biodiversity within farmland. Interventions include reducing the use of pesticides and fertilisers, adopting more diverse cropping regimes and creating small-scale habitats such as unsprayed field margins and small woodlots.

Land sharing increases population numbers for relatively common species, such as skylarks, field poppies, and already-widespread butterflies. And some highly targeted interventions do help some vulnerable species. But in the main, sharing does little for those most specialised or threatened species that need large stretches of contiguous non-farmed habitat, such as the many birds, invertebrates, plants and fungi dependent on old-growth forest. In fact, even farmland biodiversity has continued to decline under land sharing policies³, with the UK population of corn buntings, for example, falling by more than 80% since the late 1960s³.

What's more, taking land out of agriculture without lowering food demand or raising yields elsewhere in a country increases the need for imports, which means more harm to biodiversity and natural habitats further away⁵. Indeed, the European Union's crop imports in the 25 years up until 2014 generated more than 11 million hectares of habitat destruction -- an area larger than Cuba -- in some of the world's most biodiverse ecosystems, including in Brazil and Indonesia⁷ (see graphic). Even the EU's own official auditors have declared the CAP a failure in terms of its environmental policies⁴.

Besides land sharing, two other approaches have been gaining popularity in recent years, but each brings similar problems

Some conservation groups and landowners have increasingly advocated for rewilding. Here, land is taken out of farming in large, contiguous areas.

Rewilding can benefit local vulnerable or endangered species. For example, efforts to rewild the 4000 acre Ken Hill estate in Eastern England have created a refuge for the reintroduction of beaver, until recently extinct in the UK since the 16th Century. Such rewilding initiatives are obviously of national biodiversity value. However, assessments of the benefits of rewilding rarely consider offshore damages. As with land sharing, unless people change their diets or eat less, or yields are increased in the areas that are still farmed, the removal of land from productive agriculture will increase demand for food imports, and so damage biodiversity elsewhere.

Organic farming has been around for longer, but like rewilding, it is becoming increasingly popular. Recently, both the European Union and Japan committed to making organic farming account for 25% of their food production by 2030⁷ and 2050 respectively⁸.

Although some species are likely to benefit from the removal of manufactured fertilisers and modern pesticides central to organic farming, the approach will not help those that require contiguous natural habitats. Furthermore, organic production dramatically lowers yields. Sri Lanka's recent food crisis has been attributed in large measure to the government's (now abandoned) attempt to convert the country to organic farming. [ok?] [note to subeditor: pls insert inline link: <https://foreignpolicy.com/2022/03/05/sri-lanka-organic-farming-crisis/>] According to one study, a wholesale switch to organic farming across England and Wales would cut the domestic production of food calories by 40%⁹. Again, this would lead to greater demand for food imports, and so increase pressure on production and hence biodiversity around the world.

What the science says

Fortunately, another approach could bring substantial benefit to both local and global biodiversity.

Land sparing involves lumping habitat patches together into larger blocks, alongside the adoption of lower-impact ways to boost yields within the areas that are still farmed. Together, these two actions can provide better habitat protection locally without displacing production.]

Choosing which areas to put aside for nature requires knowing the consequences of land use change for food production, but also for greenhouse gas fluxes, hydrological regimes, access to recreation, the spread of pollutants, and so on. But in relation to biodiversity, for their size, larger blocks of habitat -- which are less impacted by the drier, often windier and more variable conditions around edges -- can hold larger populations of those species that favour more natural habitats. The greater diversity of environments that arise in larger areas also support a greater diversity of specialist species¹⁰.

Meanwhile, for the areas that are still farmed, an array of techniques can help producers raise crop and livestock yields sustainably. Options include providing animals in extensive grazing systems with greater access to improved pasture, water sources and modern veterinary care; using genomic screening and gene editing to accelerate animal and crop breeding; growing high-value crops such as salad vegetables and herbs in trays that are stacked vertically; using native plants to redistribute pests away from crops; and using recirculating-system aquaculture to produce high-value products such as king prawns.

Over the past decade or so, field studies in India, Ghana, Uganda, Kazakhstan, Mexico, Colombia, Brazil and Uruguay, as well as in Poland and the United Kingdom, have all concluded that (for the same overall food output), high-yield farming combined with land sparing results in larger populations of most wild species than does land sharing¹¹. These findings, across more than 2,000 species of birds, plants and insects, are especially pronounced for those species whose narrow geographical distributions make them particularly vulnerable.

Last year, a study that involved surveying British farmers to establish what actions they would take for what payments found that delivering the same biodiversity outcomes for birds

through land sparing would cost the taxpayer just 48% of the cost under land sharing¹²; the effects on food production would be more than one-fifth lower as well. Thus, given the same budget, sparing seems to provide far greater biodiversity gains than sharing.

Other research has shown that, in comparison to land sharing, a land sparing approach can deliver significantly greater co-benefits, such as the removal and storage of greenhouse gases, and the provision of recreation areas¹³. And calculations for the United Kingdom and Poland show that in these countries, blended approaches, which combine spared land with shared farmland and high-productivity agricultural land, do even better than pure sparing, and greatly outperform both current farming and land sharing¹¹.

Because yields are increased on the land still being farmed -- which will be easier to achieve in areas where yields could be much higher than they are currently -- sparing approaches directly address food security concerns¹². Also, the need for both agricultural innovation and, in many areas, habitat restoration means that land sparing need not necessarily lower rural employment¹⁴.

Of course, yield increases do not inevitably lead to more land being available for conservation. Critics of land sparing point out that gains in yield could simply lead to rebound effects with less land being taken out of farming than expected, or even to more land being converted to farmland because of the promise of greater profits¹⁵.

The evidence suggests, however, that although individual food producers generally use yield-intensifying practices to boost their incomes, overall land use tends to decrease¹⁵. Also, policies and subsidies could be crafted to further dampen rebound effects. Farmers could be given support for innovation in exchange for reducing the area they farm, sparing land for nature. A re-assessment of data for birds and trees in Ghana and India shows that sparing would still out-perform sharing even when additional policy mechanisms to limit rebound effects are not put in place¹¹.

Land sparing

So given that land sparing could benefit more biodiversity at lower cost than other strategies, and deliver an array of co-benefits, why is it not the dominant approach being used today?

The influence of the ‘big farm lobby’ in maintaining the status quo in agricultural policy is one widely cited reason². The chief approach to allocating subsidies for land sharing - using flat rate payments per hectare of shared land - disproportionately benefits the largest and often richest farms. As a result, in the United Kingdom, the largest 12% of farms take 50% of all taxpayer subsidies; the smallest 50% of farms receive just 10%² (similar problems would affect land sparing if it were paid for via flat rates – but it is much more amenable to better approaches; see box).

In our view, however, a more fundamental and far less recognized problem confounds the application of scientific research to environmental policy – and not just in relation to agriculture.

Proposed by the Nobel Prize winning psychologist and economist Daniel Kahneman, the Focussing Illusion¹⁶ is the psychological phenomenon that focussing on one effect of a change tends to diminish all the other possible effects of that change.

The literature is replete with studies of the effects of a change on a single (often local) measure: biodiversity or carbon storage or nitrogen pollution or flooding or food production or recreation. Far fewer assessments exist of multiple outcomes or of system-wide impacts.

Historically, part of the challenge has been a lack of data and understanding. Even studies considering the multiple effects of a change in how land is used have often been locally or nationally focussed, largely because the modelling work linking the change to broader economic and environmental effects hasn't been available¹⁷. However, global trade modelling is now enabling researchers to obtain a much fuller picture of the economic and environmental effects of both policy interventions and business investments¹⁸.

Over the past five years or so, there has also been more research aimed at designing tools that allow policymakers and other stakeholders to understand the wider consequences of a change in land use.

As an example, one of us (I. B.) is involved in a project that is examining the effect of the UK Government's recent decision to fund substantial increases in national woodland cover to remove greenhouse gases¹⁹. *[note to subeditor: please insert inline link: <https://netzeroplus.ac.uk/>]* Using the Natural Environment Valuation Online Tool, *[note to subeditor: please insert inline link: <https://www.leep.exeter.ac.uk/nevo/>]* this combines information from multiple disciplines to show decision makers how such land use change will help satisfy national net zero commitments, benefit biodiversity, improve access to recreation, and so on. The tool also reveals the impact of land use change on national food production and the ongoing project links this to changes in land use and nature globally.

The research goal in such work should not be obtaining ever more detailed sources of information about all the possible effects of a proposed policy change. Rather, analyses should be extended to the point where the costs of collecting and analysing more data begin to exceed the benefits of more informed decision making. Such interdisciplinary studies and approaches that are focused on the needs of decision makers must become the norm.

Conclusions

The stakes are too high for policymakers to continue to ignore the promise of land sparing when so much research demonstrates that this is a far more effective approach than many of the current strategies being deployed.

This issue has become even more urgent since last December, when almost every country in the world agreed to help meet the Convention on Biological Diversity's goal to protect 30% of the planet's land and oceans by 2030. How exactly this 30% will be put aside (as large contiguous natural habitats or as a multitude of fragments), and how the world's people will meet their growing demand for food and other goods from the remainder of the Earth's surface, will in large part determine the biodiversity consequences of this treaty.

Yet the story about land sparing carries an even broader message: unless researchers and policymakers assess the overall, global effects of interventions aimed to address biodiversity loss and mitigate climate change, poor decisions that are unsupported by the data will at best underdeliver and at worst exacerbate these existential threats.

Box: The devil is in the details

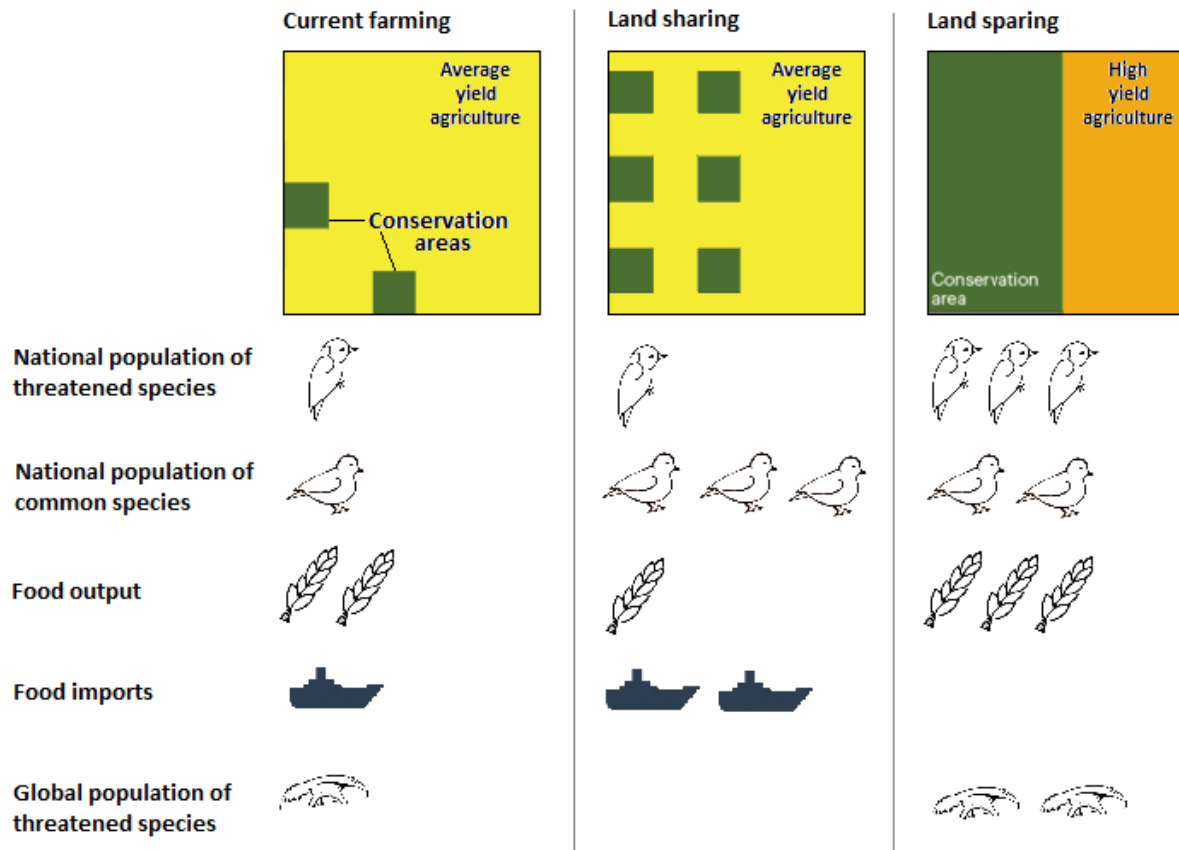
How exactly subsidies are used to persuade land owners to make changes designed to benefit nature will help determine how beneficial those actions actually are.

Flat rate payments for land sharing exacerbate inequity by disproportionately benefitting the largest and often richest farms. They also fail to incentivize farmers to do more than the minimum stipulated in policy documents. In fact, such schemes often penalise those who go further. If UK farmers plant trees on their land to increase biodiversity, for example, that land becomes ineligible for farm subsidies and is removed from the tax exemptions accorded to 'productive' farmland.

A better approach – which could be used in both land sharing and land sparing – would be to reward farmers, not for the amount of land they devote to 'nature improvement' but for the expected outcomes of their actions. Farmers could be asked to specify what action they could take to address a specific environmental problem, for example, and what they would accept in payment for undertaking it. Models could then be used to predict the environmental consequences of those actions, taking into account the cost. Such information would allow decision-makers to choose the proposed actions that deliver the best value for money²⁰. Farmers could improve their prospects of being chosen by offering better outcomes and/or reducing what they charge improving outcomes for biodiversity and taxpayers.

Conservation policies that harm or help nature.

Current intensive farming practices have reduced wild habitats and harmed biodiversity. However, conventional 'land sharing' conservation policies do little for the most threatened species, increase reliance on food imports and so drive global biodiversity losses. 'Land sparing' policies raise food output on farmed land, sparing land for threatened species and reducing imports and overseas biodiversity loss



Text for each column:

Current farming techniques have very significantly reduced the large areas of contiguous wild habitat required by what specialist species who are consequently threatened with extinction. Remaining conservations areas are small and fragmented such that common farmland-tolerant species have declined. Average yields mean that there is some reliance upon imports which degrade overseas environments threatening species globally.

Land sharing increases conservation habitat but only in terms of relatively small, still fragmented areas. the number. This aids common farmland-tolerant species but does not help threatened specialist species. Furthermore, the reduction in farmed area reduces food output and increases reliance on imports. This increases degradation and biodiversity loss overseas.

Land sparing adopts low-emission high yield farming techniques allowing more food to be produced on less land. This spares the larger contiguous areas needed by specialist threatened species. It also reduces imports, relieving pressure on overseas habitats and biodiversity.

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