Comment

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Tea pickers in Sri Lanka remove weeds from an organic tea plantation.

Current conservation policies risk accelerating biodiversity loss

Ian Bateman & Andrew Balmford

Three approaches that aim to cut the harms of agriculture — land sharing, rewilding and organic farming — risk driving up food imports and causing environmental damage overseas. An alternative approach is both effective and cheaper.

With agriculture the main driver of the habitat loss and degradation that underpin the global biodiversity crisis[1], governments worldwide have implemented policies to lessen farming's impact on the environment. Meanwhile, landowners, organizations interested in the financing of biodiversity conservation and certain non-governmental groups, including conservation bodies, have been pushing for land-use changes that benefit nature.

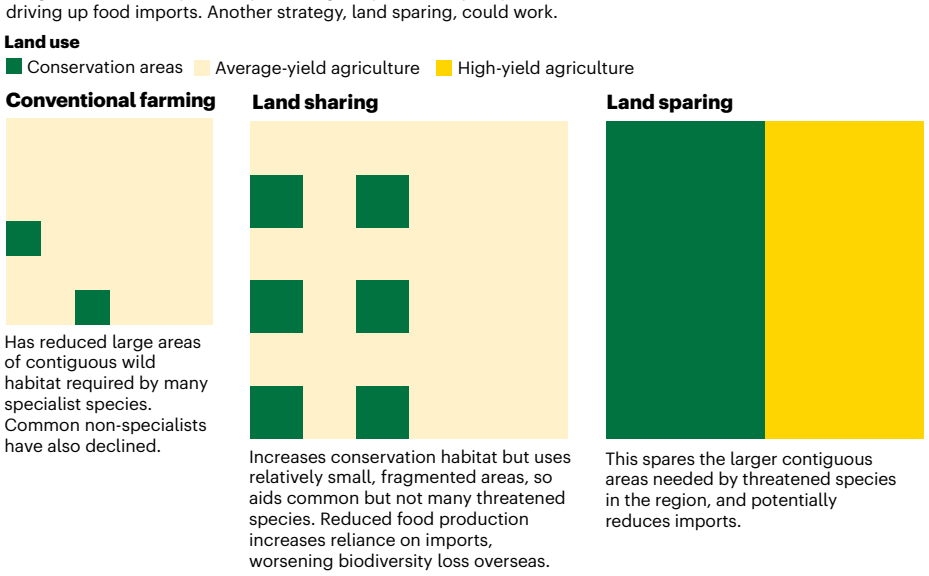
However, numerous studies show that some of today's most popular conservation policies are doing little to help those species most affected by farming. What's more, by reducing how much food is produced per unit area (yield), they are driving up food imports and thereby having an impact on wildlife overseas.

One of us (I.B.) has advised seven UK secretaries of state for the environment over the past decade; the other (A.B.) has, for two decades, led empirical work investigating how to reconcile food production with biodiversity conservation. In our view, there are many reasons for the disconnect between the science and policy.

Part of the problem is that, especially in Europe, the owners of the biggest, and often richest, farms stand to gain the most from

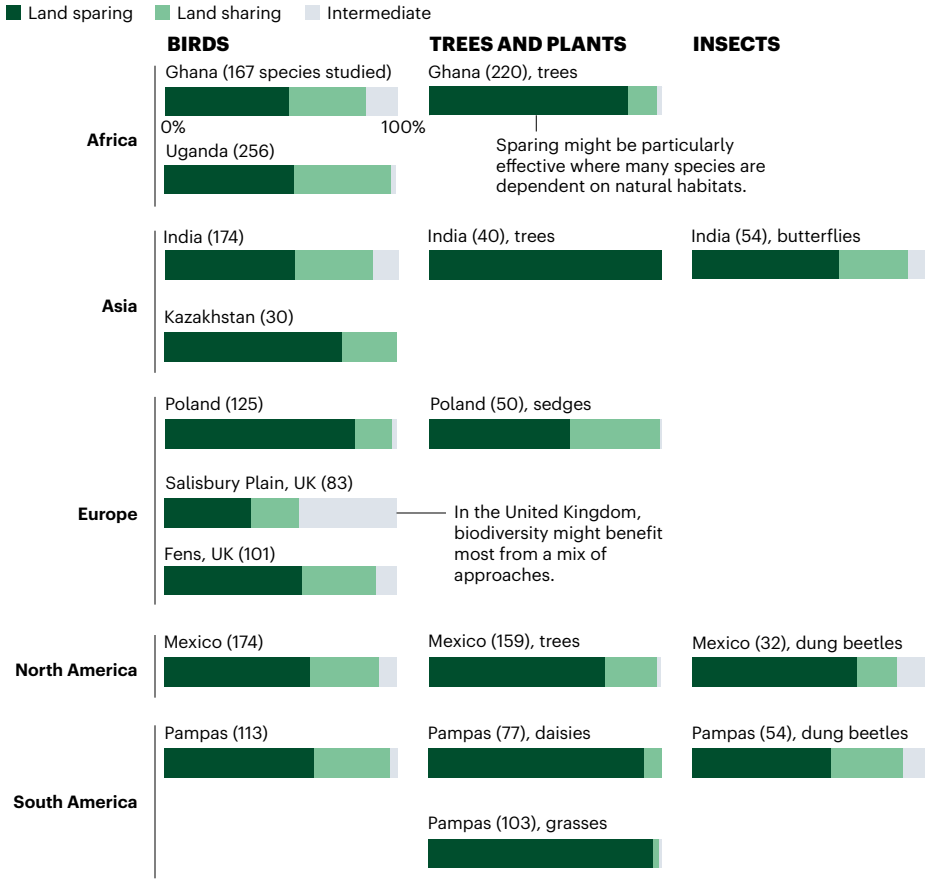
HELPING OR HARMING NATURE?

Land sharing is a popular way of altering land use to benefit nature, but it worsens the global biodiversity crisis by reducing the productivity, or yield, of farmland and driving up food imports. Another strategy, land sparing, could work.



WINNERS AND LOSERS

Numerous studies have compared how species would fare under different farming strategies. The bar charts below show the proportion of species assessed whose populations would be maximized under three types of land use.



current policies[2]. Thousands of influential individuals are lobbying to maintain the status quo in agricultural policy.

A more fundamental and massively under-recognized problem is that both government policy and much academic debate have 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 much 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 so that the information that is already available can significantly improve decision-making around agriculture and the environment. Using the wealth of evidence from research to guide agricultural policy could better reconcile conservation with people's need for food. It could also pave the way for the 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 to be environmentally friendlier ways to use land.

Since it was created in the 1960s, the Common Agricultural Policy (CAP) has been the EU's most expensive policy. More than one-fifth of the CAP budget – currently set at €56 billion (US$60 billion) a year – is available for 'environmental improvement', and most of that is funnelled into 'land-sharing' schemes.

Land sharing uses a variety of approaches to increase biodiversity in farmland. Interventions include reducing the use of pesticides and fertilizers, adopting more-diverse cropping regimes and creating small-scale habitats such as unsprayed field margins and small patches of woodland.

Land sharing increases the populations of relatively common animals and plants, such as skylarks, field poppies and the more widespread butterflies. And highly targeted interventions can help some vulnerable species. But in the main, land sharing does little for those most specialized 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, farmland biodiversity has continued to decline under land-sharing policies, with the UK population of corn buntings (*Emberiza calandra*), for example, falling by 83% since the late 1960s (ref. 3).

What's more, taking land out of agriculture without lowering food demand or raising yields elsewhere in a country increases the

SOURCE: DATA FROM MULTIPLE STUDIES; SEE REF. 9 FOR A REVIEW.

need for imports, which means more harm to biodiversity and natural habitats farther away[4]. Indeed, the EU's crop imports in the 25 years up to 2014 generated more than 11 million hectares of habitat destruction[5] – an area larger than Cuba – in some of the world's most biodiverse ecosystems, including those in Brazil and Indonesia. In 2020, even the EU's official auditors declared the CAP a failure in terms of its environmental policies (see go.nature.com/45sasew).

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

Some conservation groups and landowners have increasingly advocated for rewilding, in which large, contiguous areas of land are taken out of farming. Rewilding can benefit species that are locally vulnerable or endangered. For example, efforts to rewild 400 hectares at Ken Hill in eastern England have created a refuge for beavers, which have been extinct in the United Kingdom since the sixteenth century. Such rewilding initiatives are obviously of value to national biodiversity. However, assessments of the benefits rarely consider offshore damage. As with land sharing, unless people change their diets or eat less, or yields are increased in areas that are still farmed, the removal of land from productive agriculture will increase the demand for food imports, and so damage biodiversity elsewhere[6].

Organic farming has been around for longer. In the past few years, both the EU and Japan have committed to converting one-quarter of farmland to organic production by 2030 (ref. 5) and 2050 (see go.nature.com/43qycet), respectively. Although some farmland species are likely to benefit from the removal of manufactured fertilizers and modern pesticides, the approach will do little to help those that require contiguous natural habitats. Furthermore, organic production drastically 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 (see go.nature.com/3p2kgfq). And estimates suggest that a wholesale switch to organic farming across England and Wales would cut food-calorie output by 40% (ref. 7). Again, this would lead to greater demand for food imports, and so increase pressure on production and hence on biodiversity around the world.

What the science says

Fortunately, another approach could bring substantial benefit to both local and global biodiversity (see 'Helping or harming nature?'). Land sparing involves lumping habitat patches together into larger blocks, alongside the adoption of lower-impact ways to boost yields in the areas that are still farmed. Together, these two actions can make space for better habitat protection locally without displacing production overseas.

Choosing which areas to put aside for nature requires an understanding of 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, larger habitat blocks – which are less affected by the drier, often windier and more variable conditions at the margins – can, for their size, hold larger populations of those species that favour more-natural habitats. The greater diversity of environments that arise in larger areas also supports a greater diversity of specialist species[8].

For areas that are still farmed, an array of techniques can help producers to 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' aquaculture systems 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[9] 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 sharing (see 'Winners and losers'). These findings, across more than 2,000 species of bird, plant and insect, are especially pronounced for those species with narrow geographical distributions, which make them particularly vulnerable.

Last year, a study that surveyed UK farmers to establish what actions they would take, for what payment, found that delivering the same biodiversity outcomes for birds through land sparing would cost the taxpayer just 48% of the cost under land sharing; the impact on domestic food production would also be 21% lower under land sparing[10]. Thus, for the same budget, sparing seems to provide much greater biodiversity gains than does 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 recreational areas[11]. And calculations for the United Kingdom and Poland show that blended approaches, which combine spared land with shared farmland and high-productivity agricultural land, do even better in these countries than does pure sparing, and greatly outperform both current farming systems and pure sharing approaches[9].

Because sparing increases yields on the land still being farmed (and this is more easily achieved wherever there are big gaps between current and potential yields), these approaches can help to address food-security concerns[10]. Also, the need for both agricultural innovation and, in many areas, habitat restoration means that land sparing need not adversely affect rural employment[12].

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 profits[13].

The evidence suggests, however, that although individual food producers generally use yield-intensifying practices to boost their incomes, overall land use tends to decrease[13]. These benefits could be increased by policies and subsidies crafted to dampen rebound effects; farmers could be given support for innovation in exchange for reducing the area under cultivation. A reassessment of data for birds and trees in Ghana and India shows that

The devil is in the detail

Subsidies are used to persuade landowners to make changes to benefit nature, but subsidy design determines how effective they are.

Flat-rate subsidies pay farmers a set amount per hectare for conservation. This common approach channels the majority of subsidies towards the largest, and often richest, farms. Such schemes also fail to incentivize farmers to do more than the minimum stipulated in policy documents and often penalize those who go further. For example, if UK farmers plant trees on their land (and do not fell them at least every ten years), that land is removed from the tax exemptions accorded to 'productive' farmland (see go.nature.com/468wrzb).

A better approach would be to pay rewards not for the amount of land farmers devote to 'nature improvement', but for the expected outcomes. For this, farmers would be free to propose actions to address a specific environmental problem and to state what payments they would accept in return. Modelling is then used to predict benefits. By comparing these expected outcomes with the costs required by each farmer, decision makers can choose those farms and actions that deliver the best value for money[19].

sparing would still outperform sharing even when policies to limit rebound effects are not put in place[9].

A matter of focus

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

The influence of the 'big farm' lobby in maintaining the status quo in agricultural policy is one widely cited reason[14]. The chief approach to allocating subsidies — using flat-rate payments per hectare of shared land — disproportionately benefits the largest (and often richest) farms. As a result, in the United Kingdom, 12% of farms take 50% of all taxpayer subsidies, whereas half of all farms share just 10% of those subsidies[2] (see 'The devil is in the detail').

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

The 'focusing illusion'[15], proposed by the Nobel-prizewinning psychologist and economist Daniel Kahneman, is the psychological phenomenon that focusing on one effect of a change tends to diminish our perception of all the other possible effects of that change. The literature is replete with studies of the effects of a change in terms of a single (often local) measure: biodiversity or carbon storage, nitrogen pollution or flooding, food production or recreation. 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 plural effects of a change in how land is used have often been locally or nationally focused, largely because the modelling work linking the change to broader economic and environmental effects hasn't been available[16].

Global-trade modelling, however, is now enabling researchers to obtain a much fuller picture of the economic and environmental effects of both policy interventions and business investments[17].

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 to examine the full effects of the UK government's decision, in 2020, to fund substantial increases in national woodland cover to remove greenhouse gases[18]. The Natural Environment Valuation Online tool (www.leep.exeter.ac.uk/nevo), which will be used in this project, combines information from multiple disciplines to show decision makers how such a change in the way land is used will help to satisfy England and Wales's net-zero-emissions commitments, benefit biodiversity, improve access to recreation and so on. The tool also shows the impact of changes in land use on domestic food production, which can then be linked to changes in land use and biodiversity globally.

The goal of research on system-wide impacts should not be to obtain ever more detailed sources of information about all the possible effects of a proposed policy change. Rather, analyses should be extended to the point at which the costs of collecting and analysing more data begin to exceed the benefits of more-informed decision-making. Such interdisciplinary studies and approaches that focus on the needs of decision makers must become the norm.

The stakes are too high for policymakers to continue to ignore the promise of land sparing when so much research demonstrates that it is a much more effective approach than many of the strategies being deployed. This issue has become even more urgent since last December, with the adoption of the Convention on Biological Diversity's goal of protecting 30% of the planet's land and oceans by 2030. Exactly how this 30% will be put aside (as large contiguous natural habitats or as a multitude of fragments), and how the world's growing demand for food and other goods will be met from the unprotected remainder of Earth's surface, will in large part determine the biodiversity consequences of this ambitious commitment.

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

A wildflower margin next to a harvested Dutch wheat field — an example of land sharing.

GETTY

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