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WHAT IS THE LAND SPARING-SHARING CONTINUUM?

This piece is a summary of the TABLE Explainer What is the land sparing-sharing continuum? *and aims to define the concept and illuminate key debates. Citations and references for the information discussed below can be found in the full explainer.*

The IPCC estimates that of the 13 billion ha of ice-free land on Earth, between 42-62%[1] is used for agriculture. The implication of these statistics is that agriculture is an important cause of habitat loss, and that a large variety of wildlife is forced to share land with food production.

In response to this, the concepts of land sparing and land sharing have emerged from debates between ecologists about how best to integrate agricultural production within a landscape, at the least possible cost to biodiversity, as illustrated in figure 1:

- A land sparing approach (figure 1b and c) focuses on higher-yielding (but often less biodiverse) farmland. This means greater productivity on less land, such that more of the remaining land can be "spared" solely for conservation.
- A land sharing approach (figure 1a) focuses on promoting biodiversity on (often) lower-yielding farmland. This does, however, leave less land available for the sole purpose of conservation.

The two concepts are stylised endpoints of a continuum of possible land use strategies. Their merits and demerits are subject to much debate; both as to which is preferable but also as regards the overall utility of these concepts as a tool for decision-making in a complex and often messy food system.

1) This figure has been updated from the original explainer. The update figure is from: Intergovernmental Panel on Climate Change. Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems. (2019).

Included in this summary

Sparing, sharing or something in between: what are the implications for biodiversity?

Criticisms of land sparing and land sharing

Land sparing-sharing addresses some, not all, questions

TABLE

Figure 1 : The three figures (a, b, and c) show the same surface area (roughly several to hundreds of square kilometres), organized according to land sharing (a), and land sparing at a farm-level (b) and land sparing at an area-level (c). Each area has a similar ratio of agriculture/wildlife land (white/green) and has distinct characteristics for biodiversity conservation and food production. Reproduced from Balmford et al., 2012.

Sparing, sharing or something in between: what are the implications for biodiversity?

Decisions about land use are based on many factors on top of biodiversity, including, in particular, economic considerations. Addressing these multiple considerations requires context specific approaches to land use and in practice, most current landscapes are not exemplars of the extremes of the land sparing-sharing continuum, but rather represent mixed and intermediate scenarios.

An example of an intermediate scenario would be arable field margins, where some native vegetation is protected (meaning at least some increase in species diversity) but at slight cost to yield. A mixed scenario might involve using an area of land both for conservation and low-yielding farming (e.g., conservation grazing), alongside a smaller area of high-yielding farmland.

Whether land sparing or land sharing is least costly to biodiversity depends on many factors, including the range of different species present, landscape features like topography, climate and previous land use, the farming techniques used, and the specific crops or livestock being farmed. A further complication is that the way biodiversity is measured can vary – it can be understood as the number of different species present in an area (species richness) but also as the size and viability of species populations (species abundance). People also have different values and opinions as to which species to prioritise in biodiversity conservation efforts (e.g., endemic species or those that fulfil important functions such as pollination). Judgements are further influenced by various scientific or lay arguments and perspectives on human-nature relationships. This complexity makes it difficult to conclude which land use strategy is theoretically optimal in different contexts.

Most empirical studies comparing land sparing and land sharing have been undertaken by conservation biologists from the University of Cambridge. These studies use data on the densities of specific wild species across a gradient of agricultural yields, from unfarmed land to high-yielding farmland, to develop density-yield curves (figure 2) that illustrate if the population of a given species would be greater under land sparing or land sparing.

Despite looking at very different landscapes (e.g., tropical forests or European farmland) these studies all reach very similar conclusions. Some species (so-called 'winners') have higher densities in farmland than in natural, zero-yielding habitat (figure 2a and b). However, the populations of most species (so-called 'losers') decline when their habitats are converted to farmland (figure 2c and d). This is particularly the case for specialist and/or endemic species which need very specific environmental conditions and so are most negatively affected by conversion of wild land to farmland. Since many of these species are often of greatest relevance to conservation

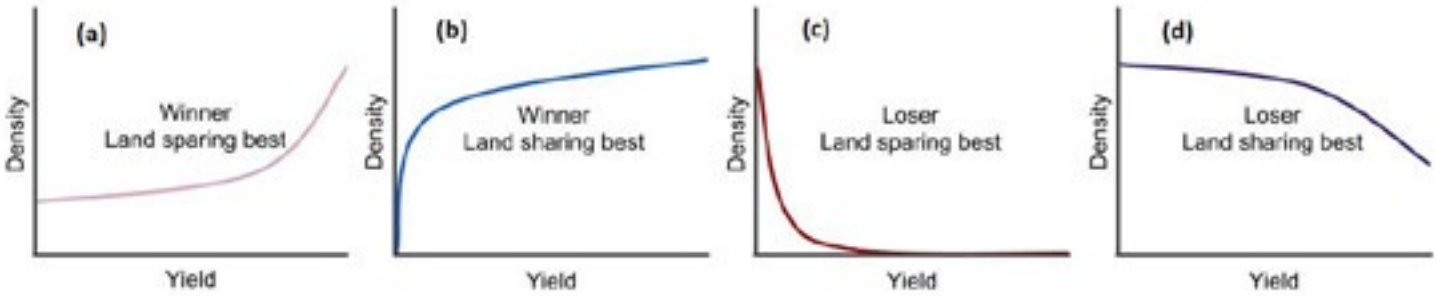

Figure 2 : Different common density-yield curves. Density refers to the density of the population of a species per unit of farmland. Yield refers to yield per unit of farmland. Adapted from Phalan et al. 2011.

efforts, a general observation for the landscapes considered by these studies is that land sparing may be preferable to land sharing for supporting viable populations of more species.

Overall, two conclusions arise here. First for agricultural production to rise (the need for this is debated – see below) then increasing yield rather than converting more wild areas to farmland would be less detrimental for biodiversity. Second, to ensure land sparing does occur (see below) protected areas for endangered species must be established and/or enforced.

Criticisms of land sparing and land sharing

The land sparing-sharing perspective has been criticised for being too simplistic to properly account for the many factors that need to be considered when balancing land use and biodiversity conservation. For example, some may argue that when considering the wider picture, a land sharing and/or intermediate or mixed scenario may be preferable. However, advocates of land sparing argue that this view reflects fundamental misunderstandings of the land sparing-sharing perspective. Important points of controversy and debate include the following:

Food production or food security?

Land sparing-sharing literature is sometimes criticised for focusing on food production instead of food security (see also What is food security?).

Critics state that there is already enough food to feed everyone; but global injustice, lack of food sovereignty (see What is food sovereignty?), high levels of food waste (see What is food loss and food waste?) and feed-food competition (see What is feed-food competition?) mean that people remain hungry or malnourished (see also What is malnutrition?). Here they argue that since the roots of hunger are largely socio-economic, there is no need to increase food production, and so no need for higher-yielding farmland, meaning that improving on-farm biodiversity (land sharing) and protecting (or even expanding) areas solely for conservation (land sparing) are not necessarily in conflict. Instead of focusing on higher-yielding farming approaches (which favour large landowners), ensuring sufficient socio-economic and physical access to the means of production (i.e., secure land tenure) and high-quality food may be more beneficial for addressing hunger and malnutrition. Here, land sharing and agroecological farming practices (see also What is agroecology?) may be more beneficial for both improving access to local food and other ecosystem services (e.g., drinking water and firewood) and supporting on-farm biodiversity conservation.

Those favouring land sparing counter these arguments by stating that they focus on food production rather than food security because production is continuing to rise (whether we like it or not) and so it is necessary to identify the 'least bad' way of reducing its impacts on biodiversity. Here, they also state that higher yields can be achieved by supporting and empowering smallholder farmers. Moreover, if current consumption and production trajectories level off, higher-yielding farming may in principle allow land currently used for growing food to be released back to nature. Finally, they emphasise how land spared for biodiversity conservation also provides other valuable ecosystem services like drinking water, flood protection, and carbon sequestration.

Farming techniques or yield levels?

Critics of land sparing have argued that it roughly corresponds to intensive agriculture – in which productivity gains are generally associated with high use of synthetic fertilisers, pesticides, and irrigation. Meanwhile, they associate land sharing with organic and agroecological techniques that arguably have lower on- and off-farm environmental impacts.

Land sparing is also often thought to involve farming technologies that are unaffordable to smallholders and displace traditional livelihoods and cultures. However, land sparing advocates point out that neither land sharing *nor* land sparing a priori favour a particular form of agronomy. For example, they point to less expensive approaches available to increase on-farm productivity like intercropping or crop rotation. Moreover, both land sharing and land sparing advocates agree that we need to move away from business-as-usual intensive agriculture towards agronomic approaches (e.g., agroecology) that increase yields while reducing environmental impacts and promoting biodiversity.

It is also important to address the extent and environmental cost of potential yield-increases. For example, where yields are already high any marginal increases may arguably not be 'worth' the high environmental costs. Meanwhile, efforts to address land degradation in low-income countries – where yields are often lower – may benefit both the environment and yields.

Implications of land use change

The wider implications, both locally and internationally, of decisions around land use must also be considered (see our land use building block) For example, land sharing would be unfavourable if its practice in one location led to an expansion in the global land footprint of agriculture to make up for any shortfall in output (see our sustainable intensification explainer) – although, as noted, critics of land sparing argue that land sharing would need to take place in the context of wider needed changes to the food system, which would also involve other methods such as dietary changes. It is also argued that higher yields and more cost-effective production may not actually lead to the desired environmental benefits in a land sparing scenario. For example, higher yields may lead to higher profits and so incentivise farmers to expand their farmed area; whilst more cost-effective production may reduce food prices such that consumers buy more and stimulate increased production to meet demand (an outcome known as Jevon's Paradox). Here, the risk is that efficiency gains cause overall increases in supply and demand such that, ultimately, less, not more, land is spared for conservation. However, some research suggests that land sparing has been at least moderately effective in dampening, although not entirely countering, the expansion of the global agricultural footprint.

Finally, it is essential to note that both critics and proponents of land sparing agree that adequate governance and enforcement is needed so that areas critical to biodiversity conservation are properly spared for nature.

Land sparing-sharing addresses some, not all, questions

Within the land sparing-sharing debate, the key conclusion of empirical research is that most species (particularly specialist species) are theoretically best protected by land sparing. However, this does not fully reflect the myriad of considerations associated with land use, such as the specific area being farmed, which species to prioritise in conservation, and the value placed on nature. More broadly the politics and dynamics of land ownership and use are central influences on what land is used and how. Establishing and effectively protecting dedicated areas for conservation is often a major difficulty and currently the focus of additional debates around financing and indigenous land rights. As such, some see land sharing and/or an intermediate or mixed scenario as preferable to land sparing. To others, the land sparing-sharing continuum is simply a starting point for wider discussions around how agriculture impacts biodiversity conservation. Ultimately, land sparing and land sharing debates highlight the complexities surrounding how best to use limited resources in a complex and often messy food system.

The full report (with associated citations and references) is available at:
https://www.doi.org/10.56661/4d83249a