LEUPHANA
UNIVERSITÄT LÜNEBURG

Beyond Biodiversity Conservation

Loos, Jacqueline; Wehrden, Henrik

Published in:
Sustainability

DOI:
10.3390/su10051395

Publication date:
2018

Document Version
Publisher's PDF, also known as Version of record

Link to publication

Citation for pulished version (APA):
Loos, J., & Wehrden, H. (2018). Beyond Biodiversity Conservation: Land Sharing Constitutes Sustainable Agriculture in European Cultural Landscapes. *Sustainability*, *10*(5), [1395]. https://doi.org/10.3390/su10051395

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal ?

Take down policy
If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Download date: 16. Apr.. 2024

sustainability

MDPI

Article

Beyond Biodiversity Conservation: Land Sharing Constitutes Sustainable Agriculture in European Cultural Landscapes

Jacqueline Loos [1,2] and Henrik von Wehrden [2,*]

[1] Division of Agroecology, Department of Crop Science, Georg-August University Göttingen, Grisebachstrasse 6, 37077 Göttingen, Germany; loos@leuphana.de

[2] Institute of Ecology, Faculty of Sustainability, Leuphana University, Universitätsallee 1, 21335 Lüneburg, Germany

* Correspondence: Henrik.von_wehrden@leuphana.de; Tel.: +49-4131-677-1571

Received: 7 February 2018; Accepted: 27 April 2018; Published: 2 May 2018

Abstract: While the academic land sharing–land sparing debate peaked in the recognition that neither strategy alone may offer the best solution to integrate commodity production with biodiversity conservation, the lack of integrating the local realities of people and their cultural landscapes beyond mere biodiversity conservation is hampering the knowledge transfer from our scientific discourse to the policy agenda. Here, we focus on European cultural landscapes, which represent prime examples for the success but also the fragility of social-ecological agricultural systems that benefit from land sharing. In contrast, we challenge the effectiveness of land sparing for sustainable agriculture. Moreover, we question whether and how either sparing or sharing can actually be implemented on the ground. We conclude that creating and maintaining sharing systems nowadays is a normative choice that society can take. Based on this, we caution against the ongoing prioritization of optimizing the economic benefits perceived from such systems. We highlight the limitations of economic instruments to safeguard the multifunctionality of sharing landscapes. Taken together, we suggest that deliberations on the sparing–sharing discussion ought to be moved from a limited perspective on biodiversity towards a holistic consideration of landscapes as spaces that are shaped by and satisfy manifold aspects of human well-being, ranging from cultural to materialistic needs.

Keywords: agrobiodiversity; food security; landscape multi-functionality; normative values; spatial scales

1. Introduction

Triggered by an exponential human population growth since the industrial revolution and a simultaneous increase of resource use, anthropogenic land transformations increasingly degrade ecosystems. To date, human activities have affected 75% of the Earth's terrestrial surface, and more than a third of inhabitable land is used for the production of food, fuel, and fiber [1]. At the same time, improved livelihoods and profligate ways of living further challenge the currently widely unequally distributed resource use, such as for instance through shifting dietary patterns toward more animal-based proteins and increased demands for other commodities. Consequently, an accelerated demand for agricultural products fosters agricultural intensification [2], which takes place either through the conversion of natural ecosystems or through the increase in yield output per hectare. While increased production is considered necessary to satisfy the needs of a growing human population [3], agricultural intensification is one of the main drivers of our current environmental problems [4]. For example, land conversion for agriculture causes the loss of natural vegetation, such as primary rainforests in tropical areas [5]. Increases in yield output through the use of agrochemicals

as well as heavy machinery alter agroecosystems and adjacent vegetation [6]. Especially in highly industrialized agriculture, these intensification measures lead to ecological homogenization [7]. Thus, increased agricultural productivity often happens at the expense of biodiversity, ecosystems, and their functions and usable services. The urgency to integrate societal and environmental needs sparked discussions about how to embed conservation into agriculture [8] as a means of maintaining biodiversity and navigating the trade-offs between various ecosystem functions and services, which is pivotal to safeguarding human well-being [9,10]. Thus, the need to efficiently produce commodities without harming the environment is a vital attribute of sustainable agriculture today [6,11–13].

After more than a decade of debates around how to harmonize agriculture with the environment (e.g., [14–16]), land sparing and land sharing still represent extreme endpoints of a continuum to allocate land either for commodity production or for nature conservation. Land sparing intends to set aside large areas for nature conservation, such as for example in form of protected areas, and at the same time increase agricultural output on farmland. In contrast, land sharing promotes extensive land use at regeneration rates to protect natural resources (sensu [17]). While some species may well survive in extensively used agroecosystems [18,19], other species may only occur in intact and continuous natural vegetation [20]. Thus, neither concept alone provides an ultimate solution for best conservation outcomes in all contexts [21,22]. Notably, the current scientific literature predominantly focuses on the link between agriculture and biodiversity, while more holistic views on agricultural land as platforms for people–nature interactions are underrepresented. However, agriculture affects wider scales, including ecological aspects of our environment, from local to landscape scales, economic topics such as yield, and many social facets, ranging from local identity, traditions, and aesthetic values of the people living in a landscape up to higher governance levels. In turn, agricultural practices derive from complex system interactions between the choices of farmers, market demands, environmental as well as agricultural policies, and international agendas [16]. Thus, we recall that discussions on integrating nature conservation and agriculture need to entail social and economic aspects of commodity production rather than just focus on ecological effectiveness in order to feed into sustainable agriculture (see also [22]). In this paper, we argue that the land-sharing concept offers such an integrative perspective for viable future farming, especially in cultural landscapes in Europe.

2. The Need to Focus on Conservation in Farmland

Given the ongoing biodiversity crisis and the continuing loss of natural areas, it is undoubtedly a necessity to preserve intact primary ecosystems, which is the laudable core of the land-sparing idea. In line with this idea and following Aichi Target 11 of the Convention of Biological Diversity to protect at least 17% of inland of terrestrial and inland water areas, the amount of protected area is currently expanding. Despite this positive trend of a growing network of protected areas, biodiversity loss continues [23], because many protected areas are dysfunctional in biodiversity conservation [24,25]. Thus, concentrating conservation efforts on protected areas alone while intensifying land use in unprotected areas faces two critical risks. First, a lack of effective conservation in protected areas might lead to the further loss of species and ecosystems. Second, reducing conservation efforts to spared land misses out on the many species that occur outside of protected areas, including farmland species [26]. Moreover, the assumed benefits of land sparing might jeopardize the multifunctionality of cultural landscapes [27] through the negative impacts of subsequent intensification measures on cultivated land [28].

In contrast to frontier agricultural landscapes [14], cultural landscapes represent "combined works of nature and humankind" that evolved over centuries of extensive, small-scale anthropogenic land use [29]. These land-sharing systems often, but not always [30], are able to maintain high rates of natural vegetation and biodiversity [31], and provide diverse ecosystem services [32]. In particular, European cultural landscapes contain natural and semi-natural landscape elements that create high spatial and temporal heterogeneity [33]. The resulting agricultural mosaics are of high nature value [34], and may contain high rates of biodiversity [31,35–37]. In this land-sharing setting, agriculture

maintains environmental goods and agricultural heritage through active human interference at low intensity rates [38–42]. Despite the complex and contested nature of the concept of sustainable agriculture [13,43], extensive land use can be considered a sustainable use of agricultural systems, with little dependence on synthetic external inputs, i.e., through closing nutrient cycles on the farm. Such a vision is building on a long-term perspective of labor management and creates fewer emissions, for instance, but also lower yields compared with intensive conventional farming. However, these extensive "sharing" systems are prone to transformation through an increasing influence of globalization pressures, which lead to land-use intensification or abandonment [44]. Agricultural intensification has led to a mechanized, fertilized, and industrial agriculture that replaces or abandons often long-existing small-scale systems [6]. The high nature value of European cultural landscapes prevails only by preserving the livelihoods of rural agricultural societies, of which small-scale farmers are the backbone [7,45]. Thus, the integration of conservation needs to target the entire cultural landscape as a sharing arena both for biodiversity conservation, as well as the maintenance of entire social-ecological systems.

3. Sparing at Small Scales Creates Sharing at a Landscape Scale

The debate still resolves around the spatial scale at which we determine sparing or sharing [21,46]. While some researchers have defined sparing as already enabling the small-scale integration of non-crop elements into agricultural land (e.g., [47,48]), others assume sparing to rely on large blocks of natural vegetation. Biodiversity schemes in the European Union, for instance, focus on the establishment of small yet diverse field margins, which are highly relevant on a meter scale, yet the impact on a scale of square kilometers is less clear. This ambiguity blurs our potential as scientists to derive meaningful direct comparisons between these extremes. Despite the entanglement of the two concepts, the presence of non-crop elements in agricultural landscapes at small scales has shown beneficial effects on biodiversity [49–51]. These beneficial effects are tightly linked to the increase of farmland heterogeneity through diversity in land-cover types. Although there has been a recognition of diversity in and around agricultural fields, and the characteristics of ecosystems are part of a multifaceted research, scale effects remain a core challenge within landscape science. What is more, many studies are building on different scales, which makes comparisons even more challenging, since ecosystems may show differing patterns in terms of alpha, beta, and gamma diversity [52]. For example, tropical forests have an almost unleveled gamma diversity, while temperate forests show an overall low biodiversity, yet may be rich in terms of ecosystem functions and services, such as the production of tree biomass and soil carbon storage [53]. While these differences are central to ecosystem function and service research, they are widely missing within the land sharing versus land sparing debate (as based on [52]). Additionally, species have different requirements toward their environment, which implies that no single conservation measure might support all of the aspects of biodiversity. Thus, the small-scale integration of non-crop patches into agricultural land may support a variety of farmland species, such as plants that require specific micro-conditions or species with high mobility, such as birds. However, other species, such as for instance ungulates in temperate ecosystems, might require larger habitats and corridors to thrive. From a landscape-scale perspective, land sharing as an integrative concept has the potential to offer environment-friendly farming within the field, while also including natural or semi-natural areas at various spatial scales [16,54].

4. Land Sharing Might Overcome Implementation Mismatches

A constant misconception of the land sparing versus land sharing debate is based on the assumption that in practice, an active decision-making process forms our current agricultural landscapes. Instead, most of the agricultural intensification at the farm scale takes place before conservation management has a say at larger landscape scales [55–57]. Even though the mostly academic reflection on sparing or sharing does not claim to be directly translatable into concrete management schemes, several challenges arise even if we would opt for either land sharing or land

sparing in a given context, mainly: how would this strategy be decided upon, and how could it be implemented? Moreover, the sparing–sharing dichotomy may evoke the impression that landscapes are managed at matching ecological and governance scales, which is rarely the case [58]. Due to its potential to include various aspects of environmental and societal aspects, we propose that a more holistic, landscape-embracing approach of land sharing might be able to overcome such mismatches. The realization of landscape-scale management for sharing might require the transformation of existing governance structures. Modern agricultural systems mostly create revenues for a large industrial complex, which only marginally invests in biodiversity conservation and thus prioritizes easily applicable approaches with little additional costs. However, such measures might be of lower value for biodiversity and ecosystem functions if they are not connected via a larger landscape target. Many of the more complex necessities of preserving corridors, mosaics, or larger areas remain unconsidered by individual actors or stakeholders. It is crucial that these conservation efforts are effective, improve the image of farming, and/or help in the marketing strategy. While no farmer may intend to harm the environment, the costs and applicability, in combination with the legal framework and given incentives, need to be taken into account as influencing factors on the land managers' everyday farming practices. From a governance perspective, it requires a well-informed identification of individuals or specific institutions that could actually set a sparing or a sharing agenda due to its complexity. We propose that the debate around sparing or sharing should thus ideally target the landscape scale, where different land-use patches can be individually managed, and the designation of spared areas can be included. This allows both farmers and conservationists to assess biodiversity and yield at the actually manageable scale [59], and enables a long-term comparison between regions. We suggest that such an approach constitutes sustainable agriculture in European cultural landscapes, which evolved as sharing landscapes, with extensive agriculture and interspersed non-crop elements [52]. However, in places where the transformation of natural vegetation toward agricultural purposes is anticipated, such an approach might lead to further fragmentation and the downsizing of natural remnants. Thus, we propose to take a step back and look at the entire agricultural production system, which requires revision in order to feed the world sustainably.

5. Agriculture in a Global System Context

Our society depends on agricultural production to survive. Most of the agricultural systems before the industrial revolution were characterized by a high input through labor, and lower outputs compared with today. While some increase in agricultural production could be achieved through an increase in labor force, mechanization and the allocation of fertilizer were instrumental in increasing agricultural yields [60]. The increasing yield triggered long-term shifts in societies, such as for instance the role and situation of farmers changing due to an altered distribution of labor force. Many would argue that much of the current neoliberal economic growth model is encouraged by large corporations that partly create dependence on fertilizer use, adapted seed material, and highly specified mechanization. These technocratic gadgets help improve yield and save working hours, and thereby increase efficiency on the farm. As a consequence, food prices on the market decrease through industrialized agriculture, often shrinking the competitiveness of less economically efficient small-scale farming, creating further negative externalities over time on our people's health and the environment [54], such as exacerbated global greenhouse gas emissions, environmental pollution, and a depletion of system components, including biodiversity [61]. While this process homogenizes agricultural landscapes, nowadays land sharing emerges as a less natural form of human–environment interactions in European rural landscapes. Instead, using land only for the highest economic benefit is a short-sighted priority that increases the inequality within societies, as merely few people eventually benefit, while the costs of negative ecological externalities affect society as a whole [62]. Institutions that would be able to manage larger landscapes and would potentially benefit from it are typically large-scale landowners and corporations.

In line with economic prioritization, financial incentives promote the integration of nature conservation in agricultural land management in order to minimize trade-offs between production and conservation. As an example, the subsidy strategy offered by the European Union aims at compensating farmers for creating small sets of biodiverse "offset" beside their intensified agricultural schemes. Typically, such financial approaches function until the incentive disappears [63]. As a result, their ecological effectiveness is limited [64], and has been criticized strongly in the past [65]. A more promising approach towards recreating the local identity of people while taking care of nature might be appealing to the human–landscape relation through stewardship schemes [66]. Furthermore, modern industrialized agriculture is based on often monopolized seed material, which in turn depends on fertilizers and pesticides to thrive. The output largely depends on distant allocations and transportation, and these teleconnections drive increases in the carbon footprint of food production, and trigger pollution and climate change [60]. All the while, the industrialization of agriculture disrupts regional social-ecological systems, and these complex ripples have been little considered in the literature to date. Modern farming is part of a wider and nested global agricultural systems; hence, analyzing smaller local systems is vital, yet understanding the nested interaction with the wider context is also relevant [45]. Under current market structures, rebound effects limit the economic rationale to maintain these extensive systems [67].

6. The Myth of Intensification for Food Security

Anticipated population growth and shifting diets are often used as an argument to produce more food on a global scale. Much of the argumentation in the line of food security and agricultural intensification assumes economic growth as an inherent ultimate goal [68]. While human population dynamics will most likely increase many of our economic problems, unlimited economic growth is unlikely to be harmonized with sustainable development [69]. Major crises such as the oil shortage (1970s), the financial crisis (late 2000s), and the recent migration crisis highlight the shocks endured by a growth-focused economy. Moreover, there is much evidence for the limited carrying capacity of our planet. Therefore, we propose that the current narrative that our agricultural production needs to serve an ever-growing population is limited in perspective, and fails to consider the holistic integrity of the planet. While more people on Earth might indeed demand more agricultural products, including animal-based food, following existing production and marketing strategies would most probably exceed the boundaries of our planet [70,71]. Global food security problems are in many cases not the result of production shortcomings [54,72], but rather stem from a wider set of system failures, including inconsiderate food speculations, mismatches in food allocation, the ignorance of complex and partly uncontrollable market dynamics, and an unrealistic estimate of the extent to which political instruments impact farmer's decisions. Thus, increasing production seems to be a tangible and relatively easily achievable target [54]. However, the amount of food that is being produced today is sufficient to feed the world [73], which demonstrates that global hunger is not a shortcoming in production, but rather a question of other aspects of the food system [74,75]. In line with many existing critics, we emphasize the need to explore sustainable alternatives to the economic growth narrative. As a counter-movement to the current intensification narrative, attempts such as La Via Campesina [76] promote and support smallholder farmers and their practices to increase food sovereignty instead. Deep system changes are required in order to create a sustainable food system with environmentally-friendly agriculture [77,78]. Instead of focusing on growth (beyond inflation correction), striving for economic equity and the inclusion of locals in decision-making processes has the potential provide more benefits to society than mere increases in production [79]. The question remains if and how such changes in society can be planned or designed. So far, and in line with other sustainability researchers, we consider many approaches to facing global challenges as corrective measures, but not as cures of the actual problems [80]. Transdisciplinary research, in combination with an increased awareness of the enmeshment of agriculture, biodiversity, and human well-being, bears the potential to engage with the facilitation process of transformation toward sustainability [81].

7. Land Sharing as a Normative Choice

To this end, we recall that our agricultural production system and our thinking around conservation within this system are currently dominated by norms and paradigms that are controversial to the overarching global aim of sustainability. The sustainable management of agricultural systems demands a mode of thinking that integrates both accessible, affordable, and nutritious food production [54], and nature conservation. Within many systems, agriculture becomes an end in itself, since it mostly serves the goal of economic growth. While ending world hunger is an inherent goal of the United Nations (UN) Sustainable Development Goals, agricultural intensification interacts with many of the other Sustainable Development Goals, such as for example the preservation of water or protection of life on land. It is well understood that there are trade-offs between these diverging goals, which is why we argue that, eventually, decisions on agricultural land-use practice are normative choices. While science derives reproducible and partly transferable results, it may not provide one simple solution to real-world problems. Instead, our choices are complex, and based on an evolving research agenda. We propose that we must be aware that our results hence pave the way to an agenda-setting that may be out of context, and is not justified by the limited amount of results provided by our research. As much as we try to decrease the uncertainty of our recommendations, we propose that we should be conservative when advising policymakers and managers. We do not consider land sharing to be the silver bullet approach; however, we do propose that it is the much more conservative option, since it allows us to protect biodiversity in a way that is inherent to many cultural landscapes. More importantly, we have to understand that land sharing or land sparing are not only the active choices of single land managers. The results that we gain from research, and the management option that researchers propose, will be picked up by policymakers and managers, preferably when these options serve their needs. Thus, debates on intensification through either of these two approaches requires scientists and conservationists to reflect on their role and the role of the knowledge they produce and communicate [6,43]. Most farmers will probably not be aware of these options, and were never involved in the decision-making process. In many situations, land-use intensification is not necessarily a societal choice, but is rather a consequence of activities through few particular actors [45].

The current scientific literature suggests that conservation action should promote land sparing or sharing as a desirable management strategy, or at least decide which parts of the landscape shall be allocated to particular purposes in order to achieve a wide set of services and functions within the same landscape. Thus, land use decisions affect many components of the system, yet the people for which this has the most severe consequences are seldomly involved in the process, nor consulted regarding which land-use strategy should be implemented. We propose that society does not strive to have agricultural "deserts" with high yield, at least not when people regularly interact with or value their environment [82]. Instead, agricultural landscapes compose an important part of peoples' identity, and influence their well-being through their aesthetics and cultural elements. Thus, rather than asking only what is the better strategy for biodiversity conservation, including social parameters that represent the local reality of people is a prerequisite for sustainable land management. We assume that people in most landscapes, if given the choice, would decide against large agricultural industry [83], but aspirations might differ between stakeholders [84]. However, the question of whether land sparing or land sharing allows sufficient nature conservation and food production simultaneously remains theoretical and inapplicable if disregarding the multiple social and ecological levels of the legacies, mechanisms, and dynamics of the production system embedded into cultural landscapes. This system has the capacity to support sustainability in terms of its requirements towards social-ecological system integrity and intragenerational and intergenerational equity [85] by focusing on the questions of how humans want their landscapes to look like, and which benefits can be derived at what costs. However, given the increasing disconnect from nature [86], more sustainable agriculture is a challenge worthy of achieving. Ultimately, a landscape-embracing approach with a consideration of governance and various aspects of justice may be helpful to balance our resource use in a sustainable way.

8. Which Contribution Does "Sharing" Offer for Sustainable Agriculture?

In summary, we highlight several entry points that might harmonize the global challenges we face with a transformation process of industrial agriculture in order to work toward an integrated and sustainable agriculture:

(1) We need to be aware about the limited possibilities that arise out of a theoretical framework such as the land-sparing option. Few managers in agriculture are actually aware of the scheme, and are empowered to act on it.
(2) Scientists and conservationists need to sufficiently consider the context and scales of various organisms, habitats, and ecosystems. Biodiversity and ecosystem function research is starting to understand the contextual complexity of these interactions, yet this has rarely been included in the land sparing versus land sharing literature.
(3) Beyond land use and biodiversity, inputs and outputs should be considered in order to arrive at a more holistic analysis, including a clearer understanding of social and ecological spillover effects.
(4) Instead of being a submissive part of a growth-focused argument of an ultimately failing economical narrative, we propose that by focusing on deep shifts in mindsets of people [80], we can aid a societal change that overcomes our disconnection from the biophysical system.
(5) We cannot retreat to claiming that there is a global objective answer to the sparing–sharing question. Thus, we need to be aware of our normative goals that oppose agricultural production and nature conservation. Scientific results, for better or worse, will be used as part of a normative agenda.

Based on our reflections, we propose that sharing or sparing do not only take place in the field, but already pose an opposition of production and conservation in our way of thinking. "Sharing" not only offers a way to integrate biodiversity conservation into agricultural landscapes, but also finds its way into economic and social agendas, as it may include people as actors and stewards in the landscape. Instead of differentiating between "nature" and "culture" as two separate concepts that are to be managed, it is already acknowledged that in the Anthropocene, such a division is obliterated. Given the size of our population and considering that few untouched natural areas remain, there seems to be no alternative to sharing land that is already used by agriculture. This includes the need to maintain as much nature as possible while working on our societal demands for our well-being. However, this overarching goal of sustainability cannot be broken down to a single management decision. Aware of the global sharing situation that we already live in, we augment the idea of land sharing toward the sharing of benefits that environmentally-friendly agriculture provides, and work towards shared responsibilities for the development of our agriculture, both through our everyday decisions and global development agendas. Finally, while our debates and scientific efforts continue to ask whether land sharing or land sparing might be the right way forward to integrate biodiversity conservation with commodity production, the actual sustainability problems are not primarily linked to the question of how we conserve biodiversity, but that we take actions at various spatial, temporal, and societal scales [62,87]. In agricultural landscapes, this would encompass both the conservation of large areas with natural vegetation and a sustainable farming system [16], which at a larger scale creates a mosaic of land covers that can be considered shared landscapes. If our normative societal goal is sustainable agricultural production, then this system needs to consider the entire product chain, from people's values, labor force, and preferences to national and international policies and markets, to the biophysical conditions for farming and conservation and the trade-offs that inevitably occur when humans disrupt natural flows.

Author Contributions: Conceptualization, Writing-Original Draft Preparation & Writing-Review & Editing: Jacqueline Loos & Henrik von Wehrden.

Acknowledgments: We thank David Williams and Patrick Venail and one anonymous referee for their helpful comments on an earlier draft of this manuscript.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. The World Bank. World Development Indicators: Agricultural Land (% of Land Area). Available online: https://data.worldbank.org/indicator/AG.LND.AGRI.ZS (accessed on 18 April 2018).
2. Tilman, D.; Balzer, C.; Hill, J.; Befort, B.L. Global food demand and the sustainable intensification of agriculture. *Proc. Natl. Acad. Sci. USA* **2011**, *108*, 20260–20264. [CrossRef] [PubMed]
3. Foley, J.A.; Ramankutty, N.; Brauman, K.A.; Cassidy, E.S.; Gerber, J.S.; Johnston, M.; Mueller, N.D.; O'Connell, C.; Ray, D.K.; West, P.C.; et al. Solutions for a cultivated planet. *Nature* **2011**, *478*, 337. [CrossRef] [PubMed]
4. Foley, J.A.; DeFries, R.; Asner, G.P.; Barford, C.; Bonan, G.; Carpenter, S.R.; Chapin, F.S.; Coe, M.T.; Daily, G.C.; Gibbs, H.K.; et al. Global consequences of land use. *Science* **2005**, *309*, 570–574. [CrossRef] [PubMed]
5. Gibbs, H.K.; Ruesch, A.S.; Achard, F.; Clayton, M.K.; Holmgren, P.; Ramankutty, N.; Foley, J.A. Tropical forests were the primary sources of new agricultural land in the 1980s and 1990s. *Proc. Natl. Acad. Sci. USA* **2010**, *107*, 16732–16737. [CrossRef] [PubMed]
6. Matson, P.A.; Vitousek, P.M. Agricultural intensification: Will land spared from farming be land spared for nature? *Conserv. Biol.* **2006**, *20*, 709–710. [CrossRef] [PubMed]
7. Tscharntke, T.; Clough, Y.; Wanger, T.C.; Jackson, L.; Motzke, I.; Perfecto, I.; Vandermeer, J.; Whitbread, A. Global food security, biodiversity conservation and the future of agricultural intensification. *Biol. Conserv.* **2012**, *151*, 53–59. [CrossRef]
8. Garnett, T.; Roos, E.; Little, D.C. *Lean, Green, Mean, Obscene . . . ? What Is Efficiency? And Is It Sustainable? Animal Production and Consumption Reconsidered*; Food Climate Research Network, University of Oxford: Oxford, UK, 2015.
9. Bennett, E.M.; Chaplin-Kramer, R. Science for the sustainable use of ecosystem services. *F1000Research* **2016**, *5*, 2622. [CrossRef] [PubMed]
10. Bennett, E.M.; Peterson, G.D.; Gordon, L.J. Understanding relationships among multiple ecosystem services. *Ecol. Lett.* **2009**, *12*, 1394–1404. [CrossRef] [PubMed]
11. Muller, A.; Schader, C.; Scialabba, N.E.H.; Bruggemann, J.; Isensee, A.; Erb, K.H.; Smith, P.; Klocke, P.; Leiber, F.; Stolze, M.; et al. Strategies for feeding the world more sustainably with organic agriculture. *Nat. Commun.* **2017**, *8*, 1290. [CrossRef] [PubMed]
12. Hobbs, P.R.; Sayre, K.; Gupta, R. The role of conservation agriculture in sustainable agriculture. *Philos. Trans. R. Soc. B* **2008**, *363*, 543–555. [CrossRef] [PubMed]
13. Velten, S.; Leventon, J.; Jager, N.; Newig, J. What is sustainable agriculture? A systematic review. *Sustainability* **2015**, *7*, 7833–7865. [CrossRef]
14. Phalan, B.; Onial, M.; Balmford, A.; Green, R.E. Reconciling food production and biodiversity conservation: Land sharing and land sparing compared. *Science* **2011**, *333*, 1289–1291. [CrossRef] [PubMed]
15. Balmford, A.; Green, R.E.; Scharlemann, J.P.W. Sparing land for nature: Exploring the potential impact of changes in agricultural yield on the area needed for crop production. *Glob. Chang. Biol.* **2005**, *11*, 1594–1605. [CrossRef]
16. Kremen, C. Reframing the land-sparing/land-sharing debate for biodiversity conservation. *Ann. N. Y. Acad. Sci.* **2015**, *1355*, 52–76. [CrossRef] [PubMed]
17. Daly, H.E. Toward some operational principles of sustainable development. *Ecol. Econ.* **1990**, *2*, 1–6. [CrossRef]
18. Verhulst, J.; Báldi, A.; Kleijn, D. Relationship between land-use intensity and species richness and abundance of birds in hungary. *Agric. Ecosyst. Environ.* **2004**, *104*, 465–473. [CrossRef]
19. Wolff, A.; Paul, J.P.; Martin, J.L.; Bretagnolle, V. The benefits of extensive agriculture to birds: The case of the little bustard. *J. Appl. Ecol.* **2001**, *38*, 963–975. [CrossRef]
20. Teillard, F.; Jiguet, F.; Tichit, M. The response of farmland bird communities to agricultural intensity as influenced by its spatial aggregation. *PLoS ONE* **2015**, *10*, e0119674. [CrossRef] [PubMed]
21. Fischer, J.; Abson, D.J.; Butsic, V.; Chappell, M.J.; Ekroos, J.; Hanspach, J.; Kuemmerle, T.; Smith, H.G.; von Wehrden, H. Land sparing versus land sharing: Moving forward. *Conserv. Lett.* **2014**, *7*, 149–157. [CrossRef]
22. Scariot, A. Land sparing or land sharing: The missing link. *Front. Ecol. Environ.* **2013**, *11*, 177–178. [CrossRef]

23. Hill, R.; Miller, C.; Newell, B.; Dunlop, M.; Gordon, I.J. Why biodiversity declines as protected areas increase: The effect of the power of governance regimes on sustainable landscapes. *Sustain. Sci.* **2015**, *10*, 357–369. [CrossRef]
24. Di Minin, E.; Toivonen, T. Global protected area expansion: Creating more than paper parks. *Bioscience* **2015**, *65*, 637–638. [CrossRef] [PubMed]
25. Watson, J.E.M.; Dudley, N.; Segan, D.B.; Hockings, M. The performance and potential of protected areas. *Nature* **2014**, *515*, 67–73. [CrossRef] [PubMed]
26. Juffe-Bignoli, D.; Burgess, N.; Bingham, H.; Belle, E.; De Lima, M.; Deguignet, M.; Bertzky, B.; Milam, A.; Martinez-Lopez, J.; Lewis, E. *Protected Planet Report 2014*; UNEP-WCMC: Cambridge, UK, 2014; Volume 11.
27. De Groot, R.S. Environmental functions as a unifying concept for ecology and economics. *Environmentalist* **1987**, *7*, 105–109. [CrossRef]
28. Mastrangelo, M.E.; Weyland, F.; Villarino, S.H.; Barral, M.P.; Nahuelhual, L.; Laterra, P. Concepts and methods for landscape multifunctionality and a unifying framework based on ecosystem services. *Landsc. Ecol.* **2014**, *29*, 345–358. [CrossRef]
29. UNESCO. Cultural Landscapes. Available online: https://whc.unesco.org/en/culturallandscape/ (accessed on 17 April 2018).
30. Williams, D.R.; Alvarado, F.; Green, R.E.; Manica, A.; Phalan, B.; Balmford, A. Land-use strategies to balance livestock production, biodiversity conservation and carbon storage in Yucatán, Mexico. *Glob. Chang. Biol.* **2017**. [CrossRef] [PubMed]
31. Bignal, E.M.; McCracken, D.I. The nature conservation value of european traditional farming systems. *Environ. Rev.* **2000**, *8*, 149–171. [CrossRef]
32. Dittrich, A.; Seppelt, R.; Vaclavik, T.; Cord, A.F. Integrating ecosystem service bundles and socio-environmental conditions—A national scale analysis from germany. *Ecosyst. Serv.* **2017**, *28*, 273–282. [CrossRef]
33. Mander, Ü.; Helming, K.; Wiggering, H. Multifunctional land use: Meeting future demands for landscape goods and services. In *Multifunctional Land Use*; Springer: Berlin, Germany, 2007; pp. 1–13.
34. Šálek, M.; Hula, V.; Kipson, M.; Daňková, R.; Niedobová, J.; Gamero, A. Bringing diversity back to agriculture: Smaller fields and non-crop elements enhance biodiversity in intensively managed arable farmlands. *Ecol. Indic.* **2018**, *90*, 65–73. [CrossRef]
35. Wilson, J.B.; Peet, R.K.; Dengler, J.; Pärtel, M. Plant species richness: The world records. *J. Veg. Sci.* **2012**, *23*, 796–802. [CrossRef]
36. Di Giulio, M.; Edwards, P.J.; Meister, E. Enhancing insect diversity in agricultural grasslands: The roles of management and landscape structure. *J. Appl. Ecol.* **2001**, *38*, 310–319. [CrossRef]
37. Poschlod, P.; Bonn, S. Changing dispersal processes in the central european landscape since the last ice age: An explanation for the actual decrease of plant species richness in different habitats? *Acta Bot. Neerlandica* **1998**, *47*, 27–44.
38. Babai, D.; Molnar, Z. Small-scale traditional management of highly species-rich grasslands in the carpathians. *Agric. Ecosyst. Environ.* **2014**, *182*, 123–130. [CrossRef]
39. Baur, B.; Cremene, C.; Groza, G.; Rakosy, L.; Schileyko, A.A.; Baur, A.; Stoll, P.; Erhardt, A. Effects of abandonment of subalpine hay meadows on plant and invertebrate diversity in transylvania, romania. *Biol. Conserv.* **2006**, *132*, 261–273. [CrossRef]
40. Rouget, M.; Richardson, D.M.; Cowling, R.M.; Lloyd, J.W.; Lombard, A.T. Current patterns of habitat transformation and future threats to biodiversity in terrestrial ecosystems of the cape floristic region, South Africa. *Biol. Conserv.* **2003**, *112*, 63–85. [CrossRef]
41. WallisDeVries, M.F.; Poschlod, P.; Willems, J.H. Challenges for the conservation of calcareous grasslands in northwestern europe: Integrating the requirements of flora and fauna. *Biol. Conserv.* **2002**, *104*, 265–273. [CrossRef]
42. Daugstad, K.; Rønningen, K.; Skar, B. Agriculture as an upholder of cultural heritage? Conceptualizations and value judgements—A norwegian perspective in international context. *J. Rural Stud.* **2006**, *22*, 67–81. [CrossRef]
43. Kuyper, T.W.; Struik, P.C. Epilogue: Global food security, rhetoric, and the sustainable intensification debate. *Curr. Opin. Environ. Sustain.* **2014**, *8*, 71–79. [CrossRef]
44. Henle, K.; Alard, D.; Clitherow, J.; Cobb, P.; Firbank, L.; Kull, T.; McCracken, D.; Moritz, R.F.; Niemelä, J.; Rebane, M. Identifying and managing the conflicts between agriculture and biodiversity conservation in europe—A review. *Agric. Ecosyst. Environ.* **2008**, *124*, 60–71. [CrossRef]

45. Timmer, C.P. The macro dimensions of food security: Economic growth, equitable distribution, and food price stability. *Food Policy* **2000**, *25*, 283–295. [CrossRef]
46. Ekroos, J.; Ödman, A.M.; Andersson, G.K.; Birkhofer, K.; Herbertsson, L.; Klatt, B.K.; Olsson, O.; Olsson, P.A.; Persson, A.S.; Prentice, H.C. Sparing land for biodiversity at multiple spatial scales. *Front. Ecol. Evol.* **2016**, *3*, 145. [CrossRef]
47. Egan, J.F.; Mortensen, D.A. A comparison of land-sharing and land-sparing strategies for plant richness conservation in agricultural landscapes. *Ecol. Appl.* **2012**, *22*, 459–471. [CrossRef] [PubMed]
48. Hodgson, J.A.; Kunin, W.E.; Thomas, C.D.; Benton, T.G.; Gabriel, D. Comparing organic farming and land sparing: Optimizing yield and butterfly populations at a landscape scale. *Ecol. Lett.* **2010**, *13*, 1358–1367. [CrossRef] [PubMed]
49. Chandler, R.B.; King, D.I.; Raudales, R.; Trubey, R.; Chandler, C.; Chavez, V.J.A. A small-scale land-sparing approach to conserving biological diversity in tropical agricultural landscapes. *Conserv. Biol.* **2013**, *27*, 785–795. [CrossRef] [PubMed]
50. Loos, J.; Dorresteijn, I.; Hanspach, J.; Fust, P.; Rakosy, L.; Fischer, J. Low-intensity agricultural landscapes in transylvania support high butterfly diversity: Implications for conservation. *PLoS ONE* **2014**, *9*, e103256. [CrossRef] [PubMed]
51. Monck-Whipp, L.; Martin, A.E.; Francis, C.M.; Fahrig, L. Farmland heterogeneity benefits bats in agricultural landscapes. *Agric. Ecosyst. Environ.* **2018**, *253*, 131–139. [CrossRef]
52. von Wehrden, H.; Abson, D.J.; Beckmann, M.; Cord, A.F.; Klotz, S.; Seppelt, R. Realigning the land-sharing/land-sparing debate to match conservation needs: Considering diversity scales and land-use history. *Landsc. Ecol.* **2014**, *29*, 941–948. [CrossRef]
53. Gamfeldt, L.; Snäll, T.; Bagchi, R.; Jonsson, M.; Gustafsson, L.; Kjellander, P.; Ruiz-Jaen, M.C.; Fröberg, M.; Stendahl, J.; Philipson, C.D. Higher levels of multiple ecosystem services are found in forests with more tree species. *Nat. Commun.* **2013**, *4*, 1340. [CrossRef] [PubMed]
54. Ponisio, L.C.; Kremen, C. System-level approach needed to evaluate the transition to more sustainable agriculture. *Proc. R. Soc. B* **2016**, *283*, 20152913. [CrossRef] [PubMed]
55. Liu, J.; Tian, H.; Liu, M.; Zhuang, D.; Melillo, J.M.; Zhang, Z. China's changing landscape during the 1990s: Large-scale land transformations estimated with satellite data. *Geophys. Res. Lett.* **2005**, *32*. [CrossRef]
56. Braimoh, A. Seasonal migration and land-use change in ghana. *Land Degrad. Dev.* **2004**, *15*, 37–47. [CrossRef]
57. Medley, K.E.; Okey, B.W.; Barrett, G.W.; Lucas, M.F.; Renwick, W.H. Landscape change with agricultural intensification in a rural watershed, southwestern Ohio, USA. *Landsc. Ecol.* **1995**, *10*, 161–176. [CrossRef]
58. Pelosi, C.; Goulard, M.; Balent, G. The spatial scale mismatch between ecological processes and agricultural management: Do difficulties come from underlying theoretical frameworks? *Agric. Ecosyst. Environ.* **2010**, *139*, 455–462. [CrossRef]
59. Ekroos, J.; Leventon, J.; Fischer, J.; Newig, J.; Smith, H.G. Embedding evidence on conservation interventions within a context of multilevel governance. *Conserv. Lett.* **2017**, *10*, 139–145. [CrossRef]
60. Dorninger, C.; Abson, D.J.; Fischer, J.; von Wehrden, H. Assessing sustainable biophysical human-nature connectedness at regional scales. *Environ. Res. Lett.* **2017**, *12*, 055001. [CrossRef]
61. Tsiafouli, M.A.; Thébault, E.; Sgardelis, S.P.; Ruiter, P.C.; Putten, W.H.; Birkhofer, K.; Hemerik, L.; Vries, F.T.; Bardgett, R.D.; Brady, M.V. Intensive agriculture reduces soil biodiversity across europe. *Glob. Chang. Biol.* **2015**, *21*, 973–985. [CrossRef] [PubMed]
62. Salles, J.M.; Teillard, F.; Tichit, M.; Zanella, M. Land sparing versus land sharing: An economist's perspective. *Reg. Environ. Chang.* **2017**, *17*, 1455–1465. [CrossRef]
63. de Snoo, G.R.; Herzon, I.; Staats, H.; Burton, R.J.F.; Schindler, S.; van Dijk, J.; Lokhorst, A.M.; Bullock, J.M.; Lobley, M.; Wrbka, T.; et al. Toward effective nature conservation on farmland: Making farmers matter. *Conserv. Lett.* **2013**, *6*, 66–72. [CrossRef]
64. Batary, P.; Dicks, L.V.; Kleijn, D.; Sutherland, W.J. The role of agri-environment schemes in conservation and environmental management. *Conserv. Biol.* **2015**, *29*, 1006–1016. [CrossRef] [PubMed]
65. Pe'er, G.; Dicks, L.V.; Visconti, P.; Arlettaz, R.; Baldi, A.; Benton, T.G.; Collins, S.; Dieterich, M.; Gregory, R.D.; Hartig, F.; et al. Eu agricultural reform fails on biodiversity. *Science* **2014**, *344*, 1090–1092. [CrossRef] [PubMed]
66. Raymond, C.M.; Bieling, C.; Fagerholm, N.; Martin-Lopez, B.; Plieninger, T. The farmer as a landscape steward: Comparing local understandings of landscape stewardship, landscape values, and land management actions. *Ambio* **2016**, *45*, 173–184. [CrossRef] [PubMed]

67. Desquilbet, M.; Dorin, B.; Couvet, D. Land sharing vs land sparing to conserve biodiversity: How agricultural markets make the difference. *Environ. Model. Assess.* **2017**, *22*, 185–200. [CrossRef]
68. Godfray, H.C.J.; Beddington, J.R.; Crute, I.R.; Haddad, L.; Lawrence, D.; Muir, J.F.; Pretty, J.; Robinson, S.; Thomas, S.M.; Toulmin, C. Food security: The challenge of feeding 9 billion people. *Science* **2010**, *327*, 812–818. [CrossRef] [PubMed]
69. Jorgenson, A.K.; Dietz, T. Economic growth does not reduce the ecological intensity of human well-being. *Sustain. Sci.* **2015**, *10*, 149–156. [CrossRef]
70. Machovina, B.; Feeley, K.J.; Ripple, W.J. Biodiversity conservation: The key is reducing meat consumption. *Sci. Total Environ.* **2015**, *536*, 419–431. [CrossRef] [PubMed]
71. Stoll-Kleemann, S.; Schmidt, U.J. Reducing meat consumption in developed and transition countries to counter climate change and biodiversity loss: A review of influence factors. *Reg. Environ. Chang.* **2017**, *17*, 1261–1277. [CrossRef]
72. Vandermeer, J.; Perfecto, I. A landscape approach to integrating food production and nature conservation. In *Food Production and Nature Conservation*; Routledge: Abingdon, UK, 2016; pp. 153–172.
73. Holt-Giménez, E.; Shattuck, A.; Altieri, M.; Herren, H.; Gliessman, S. *We Already Grow Enough Food for 10 Billion People . . . and Still Can't End Hunger*; Taylor & Francis: Abingdon, UK, 2012.
74. Loos, J.; Abson, D.J.; Chappell, M.J.; Hanspach, J.; Mikulcak, F.; Tichit, M.; Fischer, J. Putting meaning back into "sustainable intensification". *Front. Ecol. Environ.* **2014**, *12*, 356–361. [CrossRef]
75. International Assessment of Agricultural Knowledge, Science and Technology for Development. *Global Report: Agriculture at a Crossroads*; Island Press: Washington, DC, USA, 2009.
76. Martinez-Torres, M.E.; Rosset, P.M. La vía campesina: The birth and evolution of a transnational social movement. *J. Peasant Stud.* **2010**, *37*, 149–175. [CrossRef]
77. Badgley, C.; Perfecto, I.; Cassman, R.; Hendrix, R. Can organic agriculture feed the world? *Renew. Agric. Food Syst.* **2007**, *22*, 80–85. [CrossRef]
78. Horlings, L.G.; Marsden, T.K. Towards the real green revolution? Exploring the conceptual dimensions of a new ecological modernisation of agriculture that could 'feed the world'. *Glob. Environ. Chang.* **2011**, *21*, 441–452. [CrossRef]
79. Ikerd, J. The economic pamphleteer: Land use planning for sustainable food systems. *J. Agric. Food Syst. Commun. Dev.* **2016**, *2*, 3–5.
80. Fischer, J.; Dyball, R.; Fazey, I.; Gross, C.; Dovers, S.; Ehrlich, P.R.; Brulle, R.J.; Christensen, C.; Borden, R.J. Human behavior and sustainability. *Front. Ecol. Environ.* **2012**, *10*, 153–160. [CrossRef]
81. Abson, D.J.; Fischer, J.; Leventon, J.; Newig, J.; Schomerus, T.; Vilsmaier, U.; von Wehrden, H.; Abernethy, P.; Ives, C.D.; Jager, N.W. Leverage points for sustainability transformation. *Ambio* **2017**, *46*, 30–39. [CrossRef] [PubMed]
82. Williams, K.J.; Cary, J. Landscape preferences, ecological quality, and biodiversity protection. *Environ. Behav.* **2002**, *34*, 257–274. [CrossRef]
83. Kaltenborn, B.P.; Bjerke, T. Associations between environmental value orientations and landscape preferences. *Landsc. Urban Plan.* **2002**, *59*, 1–11. [CrossRef]
84. Howley, P. Landscape aesthetics: Assessing the general publics' preferences towards rural landscapes. *Ecol. Econ.* **2011**, *72*, 161–169. [CrossRef]
85. Gibson, R.B. Beyond the pillars: Sustainability assessment as a framework for effective integration of social, economic and ecological considerations in significant decision-making. *J. Environ. Assess. Policy Manag.* **2006**, *8*, 259–280. [CrossRef]
86. Ives, C.D.; Giusti, M.; Fischer, J.; Abson, D.J.; Klaniecki, K.; Dorninger, C.; Laudan, J.; Barthel, S.; Abernethy, P.; Martin-Lopez, B.; et al. Human-nature connection: A multidisciplinary review. *Curr. Opin. Environ. Sustain.* **2017**, *26–27*, 106–113. [CrossRef]
87. Hummel, D.; Jahn, T.; Keil, F.; Liehr, S.; Stiess, I. Social ecology as critical, transdisciplinary science-conceptualizing, analyzing and shaping societal relations to nature. *Sustainability* **2017**, *9*, 1050. [CrossRef]

© 2018 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (http://creativecommons.org/licenses/by/4.0/).