

Web links to the author's journal account have been redacted from the decision letters as indicated to maintain confidentiality.

A reviewer attachment from the first round of review has been redacted, however all reviewer comments appear in the first round of author responses.

22nd Jan 21

Dear Dr Jeanneret,

Your manuscript titled "An increase in food production in Europe could dramatically affect farmland biodiversity" has now been seen by 3 reviewers, whose comments are appended below. You will see that they find your work of some potential interest. However, they have raised quite substantial concerns that must be addressed. In light of these comments, we cannot accept the manuscript for publication, but would be interested in considering a revised version that fully addresses these serious concerns.

We hope you will find the reviewers' comments useful as you decide how to proceed. Should additional work allow you to:

** address these criticisms (that is, either to incorporate the suggestions or provide a compelling argument why the point made by the reviewer is not valid, or relevant to the editorial threshold as outlined below)

AND

** meet our editorial thresholds as outlined below,

then we would be happy to look at a substantially revised manuscript.

In the following, we list our main editorial concerns:

** provide statistically robust support for your findings that the biodiversity loss due to expansion of agricultural land into semi-natural fragmented habitats in Europe outweigh potential gains in agricultural productivity;

** address the comments regarding sample size, statistical handling of data, and mapping land type classification;

** clearly articulate and contextualise the original contribution of your work

In addition, please supply point-by-point responses to all the reviewers' comments.

If the revision process takes significantly longer than three months, we will be happy to reconsider your paper at a later date, as long as nothing similar has been accepted for publication at Communications Earth & Environment or published elsewhere in the meantime.

We understand that due to the current global situation, the time required for revision may be longer than usual. We would appreciate it if you could keep us informed about an estimated timescale for resubmission, to facilitate our planning. Of course, if you are unable to estimate, we are happy to accommodate necessary extensions nevertheless.

We are committed to providing a fair and constructive peer-review process. Please do not hesitate to contact us if you wish to discuss the revision in more detail.

Please use the following link to submit your revised manuscript, point-by-point response to the referees' comments (which should be in a separate document to any cover letter) and any completed checklist:

[link redacted]

**** This url links to your confidential home page and associated information about manuscripts you may have submitted or be reviewing for us. If you wish to forward this email to co-authors, please delete the link to your homepage first ****

Please do not hesitate to contact me if you have any questions or would like to discuss the required revisions further. Thank you for the opportunity to review your work.

Best regards,

Clare Davis
Internal Editor
Communications Earth & Environment

EDITORIAL POLICIES AND FORMAT

If you decide to resubmit your paper, please ensure that your manuscript complies with our editorial policies and complete and upload the checklist below as a Related Manuscript file type with the revised article:

Editorial Policy Policy requirements

For your information, you can find some guidance regarding format requirements summarized on the following checklist:(<https://www.nature.com/documents/commsj-phys-style-formatting-checklist-article.pdf>) and formatting guide (<https://www.nature.com/documents/commsj-phys-style-formatting-guide-accept.pdf>).

REVIEWER COMMENTS:

Reviewer #1 (Remarks to the Author):

This is a timely study which addresses the burning issue of growing usage pressure on seminatural habitat fragments in the agricultural landscape. The paper gives a very clear, data-driven answer which hopefully will be perceived not only by the broad community of scientists, but also by policy-makers.

The paper is clearly structured and written, the applied methods appear exact and well-suited (though I am not familiar with details of all applied statistics) and the conclusions are justified and balanced.

Apparently the data are not original, at least with respect to biodiversity records (see Lüscher et al. 2016). It should be clearly stated in which other publication the data have been used.

I have inserted a few critical questions concerning methodology in the attached document. Most important is the question of how the “area of a farm” was delineated. This may be straightforward with respect to managed farmland. But which seminatural, unused habitat fragments were included and which were not? This delineation may influence all downstream analyses. In practice, farmland of certain owners is often not aggregated and compact, but interspersed by properties of different parties. For example, a small patch of shrubland owned by the community and situated between two fields cultivated by two different farmers – to which farm was it allocated, if to any? If the same patch of shrubland was surrounded by crops of a single farmer, was it then included? The approach needs to be explained in more detail.

Furthermore, it is not clear to me how you calculated the confidence intervals for the summed species decrease curve. In legend of Fig. S2 you wrote: “Confidence interval is not drawn but used to define worst and best case situations according to upper and lower bounds”. CIs for the individual curves were calculated with iNext, but as far as I know it does not allow integration over curves.

Reviewer #2 (Remarks to the Author):

I am not convinced by the paper, neither by the interest of the research question as a hot topic question, nor by the ability of the dataset to answer to the research question (as chosen by the authors).

In the title, the authors write “the increase of food production” but they are in reality focused on land use changes (or more precisely on one specific one: from semi-natural ones towards intensive arable ones). There is no information about the fact that these types of changes could really increase food production, nor that the land use changes they intend to explore would be the answer of any increase of food demand (as they pretend in their introduction). (please all the papers about diet changes or bad repartition of production, especially in agricultural economics).

The paper is thus about the impact of one specific land use change (intensification) on wild biodiversity. Another title will thus be more appropriate.

To me, this question has been broadly explored since the 90s, both theoretically for example land-sparing/land-sharing debate or with ecological intensification or with the use fragmentation/corridors of land uses, and empirically in many countries (developed –USA, Australia, France, UK, Germany at least- and developing countries – brazil, china, india and some African countries) and many taxa (bats, birds, adventices, bees ...). The conclusions found by the authors are thus perfectly in lines with the previous ones but in that sense, they are not new: many articles have already alerted about the problem they depict.

Moreover I am not convinced by the relevancy of this research question, such as presented by the authors in the introduction (a come back of the pressure on land conversion because of food demand). If it was relevant in the 90s-2000s, many agri-environmental policies have been implemented since 90s in Europe and USA for example. Even these policies exhibit limited ecological

effectiveness (and should be reformed), they exist and limit such land use conversion. It is unrealistic to believe that we will return in 2020 in similar statement of 90s-00s just because of population growth and food demand increase. If the authors really want to explore such pressure on land conversion, I think that it would look less speculative to justify it by urbanization increase. Urbanization growth is a big challenge for land use change, both for developed and developing countries. But again, it is not sure that conversion of semi natural habitat into arable land will be the main impact of such pressure (as they mention, there is no many semi-natural habitats now..)

Regarding the dataset, it is not clear to me why it is unique. Indeed this kind of research has been broadly explore between 2000 et 2010 within different European countries such as Germany, france and UK, and with different taxa (birds, butterflies, bees, adventices, bats, fungies, rogens ..). So what is different here ?

About the production of organic farming (L59) : yes but it does exist other studies which indicates the opposite, ie organic farming present similar production levels than traditional ones (different profitabilities because of the labor cost which is higher, but similar production level). So the statement chosen by the authors is biased and it would be fair to mention these other studies. FYI, this question about the bioeconomic productivity of organic farming has become very classical since 2000 (please check agro-ecology studies)

Finally I am not convinced at all by the ability to use such dataset in this European analysis : how few farms can capture the heterogeneity (in terms of habitat, production habits, political context and constraints, and of course ecosystems). Considering 12 to 20 farms per region is definitely to small to pretend explain such heterogeneity. The results they obtain can just be the effect of hazard of sampling ... I do not see how they can derive conclusion for European case. Are the authors able to increase their dataset ? Of not, I am afraid that it would be more realistic to circumscribe the objective of the research question to increase the sample per category of heterogeneity.

More specifically: L73 : on which criteria ? is it related to a bias compared to equirepartition overall the habitats ? or is it based on data from literature ?

Reviewer #3 (Remarks to the Author):

The study focuses on a potential scenario of conversion the remaining semi-natural farmland areas in Europe into productive fields driven by a possible increase in global demand for high primary production. The study utilises a unique large dataset across several regions and production systems to model the resulting losses of species unique to the semi-natural areas under three scenarios. The methodology and analysis are sound and well described. The results are well presented and the claims are novel. They are also of high interest to research and decision-maker communities. To my experience of working with both, I feel that the paper will influence empirical research and political thinking in the field of what these days can be called sustainable intensification.

There are two ways to further strengthen this important paper. First, the introduction into the aims is somewhat confusing: it would help a reader if you clearly state the main focus (aim) and then 2-3 operational objectives. Second, the wider implications of the results are lacking. Above all, do they have any relevance beyond the EU?

Though written in concise and good English, there are several sentences that need proof-reading for

clarity. I highlight a few examples below.
I hope to see the paper published in the near future.
Irina Herzon

Abstract

Rising food demand calls for increased agricultural production. – the opinions on this differ (eg much of the increase could be prevented by curbing wastes and eating lower on food chain, to which you rightly refer in the end) and most of them are based on forecasts, which may or may not materialise. I suggest re-phrasing into something as, and add “global” because this is not likely to happen in Europe: Rising global food demand is driving an increase in agricultural output (if you reference with studies looking at the actual trends), or An increase in agricultural output is forecasted due to a rising global food demand (if you reference with studies making forecasts).

Yet, this will endanger farmland biodiversity because many wild species depend on semi-natural habitats for survival. → Though this is likely to endanger farmland biodiversity because many wild species depend on semi-natural habitats for survival, a question remains, to what extent. - Such formulation would focus a reader’s attention to a specific research question you tested.

“49% of the species were unique to semi-natural habitats, which on average only made up 23% of the farmland” and “ 31 postulate a global supply of food increase by almost 30% by 2030 and around 50% by 2050 if it wants to equal the rise in global demand” – avoid starting a sentence with a number, also reference number

About half of the organic and half of the non-organic systems - About half of both organic and non-organic systems...

Abstract ends with results but it should take us beyond them, into implications, wider relevance etc. You probably can extract one sentence from these two: “The analysis supports the necessity to develop alternative solutions for sustainable food production in the future, by combining up-to-date technologies², agro-ecological approaches and best practices that minimize land use and preserve semi-natural land and biodiversity³². Because the potential for production increase is limited, a sustainable European food system will also need to reduce food waste and require diets of the European population to adapt^{1,33,34}”

Intro

A possible strategy to meet the production shortfall will be the further expansion of productive agricultural land → ... is a further expansion...

current trends continue, especially population growth and increased consumption of meat and dairy products → especially in population growth and consumption of meat and dairy products

will be the further expansion - will be further expansion OR a further expansion

conservation effort in the small scale mosaic-type European landscapes requires consideration of farmland^{16,17} – this needs some re-framing: why only small scale and mosaic? what about large scale and non-mosaic European landscapes? field margins, fallows etc. are being advocated across all European farmland, and functional biodiversity is relevant for all types of all farmland landscapes what the production gain and the biodiversity loss would be, - remove “the”

To tackle the question we first investigated the set of species that are unique to European semi-natural habitats and that would disappear in case of conversion – mention already here the data source (literature, own field data?)

Second COMMA we investigated the potential of organic as compared to conventional farming. – potential for what, the sentence sounds incomplete

20-40% - also need references

What would the comparative loss of species in organic and non-organic systems be in case overall

agricultural production should increase by – say 10%? -> What would the comparative loss of species in organic and non-organic systems be in case overall agricultural production should increase by, say, 10%? Or “...by a certain amount/certain extend”. Or, better still, since you modelled those 10%, just write them here without “say”, also I think it should be “a comparative loss” but check with a native speaker

Your question setting is confusing: what is first and what is second?

what the production gain and the biodiversity loss would be, if the pressure on the land would increase again and (part of) the remaining semi-natural habitats were converted to agricultural fields. – this seems to be an overall objective

questions under above as I can interpret your text at this stage without reading further:

1) investigated the set of species that are unique to European semi-natural habitats and that would disappear in case of conversion, also in case of conversion being to organically or conventionally managed fields. - I added the second part here as a possible formulation; I could not understand your formulation before I read the results (potential of organic as compared to conventional farming – should have potential for something)

2) estimate a relative loss of species vs productivity gain overall, in all systems

3) investigated the potential of organic as compared to conventional farming, and on a difference farming systems (grassland vs arable vs horticulture etc.)

This would be more consistent with the way you present the results in the abstract, and seems to be logical.

The result on half farms not being able to reach the 10% target is not mentioned here as a research question, but should be.

functional taxa – why specifically functional here and not taxonomic? It seems the latter is more correct as opposite to grouping specifically on functional criteria (eg nitrogen-fixing). But below is ok: represent key ecosystem functions for agriculture...

agroecosystems on both farmland and semi-natural habitats – (most of) the latter is regarded as former (margins, fallows are certainly part of farmland) – re-phrase

To capture the heterogeneity of agriculture, regions comprised various agricultural land uses. – To capture the heterogeneity of agriculture” is redundant, it would be more valuable to see what are the “various agricultural land uses”

... were selected randomly. We surveyed – stay with either active or passive tense consistently, here you mix two

We surveyed the species richness of four taxa – I think you surveyed those organisms but only afterwards calculated/determined species richness

Habitats were categorized as either semi-natural habitats or production fields according to criteria based on Raunkiær plant life forms²⁷ and management evidence²⁸. – add a reference to your Methods where you categorized as semi-natural habitats

Yields were estimated based on structured interviews with farmers. -> Farmers provided data on yields

Fig 1 – need to mention “unique” on axis x

c) yield averaged over what? only fields? all fields for sampled farms or average in the region?

Results

compared for the same sample coverage per region²⁹ – I don’t understand to what it is compared; unique for semi-nat are compared to unique for fields is clear

Productivity (evaluated as MJ per hectare, Fig. 1c) was not related to the share of semi-natural habitats. – how analysed? But it is redundant here because it seems to be presented in the next chapter (Yield and semi-natural area in farms were not correlated to each other (Spearman’s rho =

0.095, ns))

Across the four taxa and summed over the regions, the differences between organic and non-organic systems for unique species in both semi-natural habitats and production fields, and shared species, were mainly non-significant – It is difficult to see what differences you mean. Please, check if I interpret it correctly here: the differences between organic and non-organic farms for the species richness derived from unique and shared species over all four taxa and all regions were mainly non-significant

In all study regions, the impact of converting exactly 50% of the semi-natural – how important is “exactly”?

When reading this part, I was wondering about two issues: First, how you delineate extensive production grassland and semi-natural grassland, esp. in EE countries. Second, if even such high rate of conversion 90% of the semi-natural area (assuming that 10% are unconvertible due to geomorphological constraints and poor soil quality) is realistic. To my understanding, semi-natural areas in many WE countries and arable regions are retained on poorly productive parts of land. Thus, not all can be converted to begin with and conversion can unlikely result in yield compatible with those of existing fields (which you rightly mention in discussion). More is possible for EE in extensive grassland regions.

- I found answers to both issues in Methods, but it might be good to briefly describe this already in the main text and refer to Methods.

but note that the bulk of semi-natural habitats in Spain are extensively managed olive groves, for which production was not accounted for; - why not? you do not explain this in Methods either
At individual taxa level, organic farms supported significantly more spider species – should probably ignore and focus on an overall biodiversity; too many results make this confusing. It would be better to focus on presenting the very key issue of productivity gain vs species loss. Or you can add this bit as an exception to your phrase above “Across the four taxa and summed over the regions, the differences between organic and non-organic systems... were mainly non-significant”

Table 1

For regions where 10% production increase could not be achieved due to insufficient semi-natural area available (in bold) species change was taken from scenario I (90% conversion) to calculate group means – should not this make estimates identical between two scenarios (10% more production in bold and 90% SNH converted)?

Contrasting impact of setting a goal of 10% production increase – the contrast does not come very clearly in the text. If you want to keep this sub-heading, I suggest starting with stating what and where was the contrast. Otherwise it is hidden away in the very last statement. Which is somewhat unclear “In contrast, grassland dominated regions and olive groves would be able to produce 10% more while biodiversity would be less affected – more than what and less than what?”

In case of 10% more harvestable energy needed, non-organic and organic systems showed contrasting effects – unclear what is exactly was contrasting in several results that follow
Also, the share of semi-natural habitats is higher, - where than where?

Discussion

We are aware that results may be affected by the specific regions, taxa considered and the snapshot character of the investigation. Still, quantified estimations on the trade-off between increased agricultural production and biodiversity loss are urgently needed and our model allows a first approximation. – I suggest moving these two reservations into a next par with limitations. Start this par with stating the two key results (at least this is how I understood them), and then extend with

the details. Something like: The key results from our large-scale study pertain to the confirmed essential contribution of semi-natural habitats to biodiversity across all Europe, and a considerable species loss for a limited production gain in many farming systems.

key functional groups – see above

the snapshot character of the investigation – meaning? maybe better “data from only one year” and our model allows a first approximation FOR EUROPE

Still, quantified estimations on the trade-off between increased agricultural production and biodiversity loss are urgently needed and our model allows a first approximation. -> Our models allow a first approximation of quantifying the trade-off between increased agricultural production and biodiversity loss

Yet, the assumption that these areas could be converted to productive fields with the same yield as existing fields, is probably overly optimistic -> However, the assumption of achieving the same yield on such converted areas than on existing productive fields is probably overly optimistic

The rest is very good, indeed!

Methods

We estimated the richness of the species pool up to the number of mapped habitats – unclear phrasing: “up to the number”?

don't comprise – do not comprise

The production of certain semi-natural habitats as e.g. olive groves in Spain was not part of the production calculation. – add a reason

In practice, in many regions it may be impossible to convert semi-natural habitat to productive land due to geomorphological constraints and poor soils, and even if land were converted, yields would be much lower than these averages. The results presented here, especially the 90% scenario, are therefore over-optimistic. – enough to have in Discussion

Revised manuscript COMMSENV-20-0541-T

“An increase in food production in Europe could dramatically affect farmland biodiversity” by Jeanneret et al.

Point-by-point response to the referees’ comments and editorial concerns

	Comments/Questions	Answers/Improvements
	“Main editorial concerns”:	
	** provide statistically robust support for your findings that the biodiversity loss due to expansion of agricultural land into semi-natural fragmented habitats in Europe outweigh potential gains in agricultural productivity;	In our opinion, and if we understand correctly the comment, statistically comparing biodiversity loss due to the conversion into agricultural fields with production gained is not relevant as these are two not comparable values. Actually, it is not a question of statistical comparison but of ethics and a philosophical issue. What is the gain in terms of production if semi-natural habitats are converted into production fields ? and what is the respective loss of biodiversity ? these are the questions the paper is addressing. It would not make much sense to say that statistically more species were lost than production gained or the other way around. However, such a comparison could be investigated through monetary translation of the production, which would be feasible, and of the value of species, which in contrast is probably irrelevant because of its ethic dimension, or, because the support of the species to the production is hardly known. This is beyond the scope of our study.
	** address the comments regarding sample size, statistical handling of data, and mapping land type classification	Done following the reviewer comments and improvement suggestions. See the following.
	** clearly articulate and contextualise the original contribution of your work	Introduction and discussion have been improved following reviewer comments. See the following.
	Reviewer #1 general comments/questions	
1.	This is a timely study which addresses the burning issue of growing usage pressure on seminatural habitat fragments in the agricultural landscape. The paper gives a very clear, data-driven answer which hopefully will be perceived not only by the broad community of scientists, but also by policy-makers.	Thanks for the very encouraging statements !

	The paper is clearly structured and written, the applied methods appear exact and well-suited (though I am not familiar with details of all applied statistics) and the conclusions are justified and balanced.	
2.	Apparently the data are not original, at least with respect to biodiversity records (see Lüscher et al. 2016). It should be clearly stated in which other publication the data have been used.	The dataset has been published in Lüscher et al. which is a data paper in <i>Ecology</i> . The analysis performed here is original and has never been published. The data have been used in cited Schneider et al. 2014 (Ref. 23) and in Lüscher et al. 2017 (<i>Int J Life Cycle Assess</i>) with other purposes, and at case study level.
3.	How the “area of a farm” was delineated ? How to deal with dispersed “fragments” ? Allocation of small patches.	All plots of every farm have been mapped (Methods) irrespective of isolated or grouped. It is fully true that in most of the cases, farms had fields and semi-natural habitats (SNH) dispersed (as usual), and not aggregated in one single piece. In the analysis performed here this has no impact as no landscape analysis had been performed, for instance investigation on the impact of the landscape configuration on species diversity in a particular plot. Such an analysis would indeed need a landscape approach and a mapping of all elements around the observation field / habitat (sectors) including those not belonging to the farm of the observation field / habitat. This is not the case in the present manuscript. All patches of the farms have been allocated to the given farms following the BioHab method (citation: Bunce et al. 2008 in <i>Landscape Ecology</i>).
4.	Not clear: Calculation of the confidence intervals for the summed species decrease curve. In legend of Fig. S2 you wrote: “Confidence interval is not drawn but used to define worst and best case situations according to upper and lower bounds”.	The confidence intervals (CI) estimated with iNEXT were summed over the four taxa (line 368 in Methods) to determine the highest (and lowest) possible estimated species richness at 50%, 90% conversion of SNH and at 10% more production, and defined in that way the worst and best situations with respect to species richness. There is no statistical comparison made of any sort with the CI here. CI are simply used to define the limits the species richness of the four taxa added can take.
Reviewer # 1 specific in-text comments		
5.	<p>Comments on the introduction, results and discussion</p> <p>1) “potential of organic as compared to conventional farming”</p> <p>2) “There are no grey and dark green areas in the figure.”</p> <p>3) “Across the four taxa and summed over the regions, the differences between organic and non-organic systems for unique species in both semi-natural habitats and production fields, and shared species, were mainly non-significant (Supplementary Table 4), which is not surprising since the two farming systems of the study were overall very similar and not significantly different with respect to main land characteristics (Supplementary Table 5).”</p>	<p>1) It is right that “potential” should be specified. We change the sentence to better define the operational objectives of the study as well.</p> <p>2) Thanks for noticing the mistake. Caption has been adapted.</p> <p>3) It is true that we may expect differences by the species richness of unique species in production fields, and this was the case for vascular plants and spiders (see supplementary Table 4, as mentioned). However, the sentence is an overall statement, including semi-natural habitat which showed no significant differences.</p>

	<p>I cannot follow this reasoning, since high levels of pesticide application are suspected to be a main driver of the decline of insect abundance and biodiversity.</p> <p>4) Fig. 2 Legend: i) colours are not correct. ii) "percentage of the total semi-natural area" 5) Fig. 3 Legend: colours are not correct.</p>	<p>4) i) Thanks for noticing the mistake again: colour description for regions has been adapted. ii) Corrected: "percentage of the total farm area". 5) Thanks again and sorry for this repeated mistake.</p>
6.	<p>Comments on the methods</p> <p>1) I don't believe they were randomly selected. Usually, only a small percentage of farmers is willing to participate in such studies. Thus, I guess you used a carefully preselected set of localities.</p> <p>2) Usually, farmland is not compact, but properties of single farms are distributed across the landscape, with fragments of land owned by other farmers or public agencies interspersed. How did you deal with this situation?</p> <p>3) How did you sample in habitats with a high vegetation structure? Did you collect spiders exclusively from the soil surface?</p>	<p>1) Actually regions were delimited with approximately the double number of farms, and selected 12 to 20 farms randomly from this pool. We asked for participation. In case of a negative response, we asked neighbours from the pool till we got 12 to 20 participants depending on the region. We add this explanation.</p> <p>2) See point 3.</p> <p>3) Yes, only from the soil surface.</p>
Reviewer #2		
7.	<p>Manuscript's title is questioned: not food but land use changes.</p>	<p>We do not agree as the manuscript shows the food (in MJ) that could be produced by conversion of semi-natural habitats (SNH) into production fields, and not only the surface of crops that could be gained. So, this is not only a land use change issue even if this is the start of the process.</p>
8.	<p>"Land use changes" would not necessarily be the answer to any increase of food demand.</p>	<p>The manuscript explains (introduction) that the conversion of SNH into production fields is one possible and plausible answer to an increase of food demand. The diet change is mentioned in the discussion as one way of minimizing the possible conversion.</p>
9.	<p>Land-sparing / Land-sharing debate and novelty of the data analysis.</p>	<p>We don't think the debate is closed. And the data analysis presented here does not pretend to close it. The data here show how far a conversion of SNH into production fields would jeopardize the species richness of taxa without substantially increase the production. The fact is that a very important part of the biodiversity is fully depending on the SNH.</p>
10.	<p>Agri-environmental schemes that prevent conversion of SNH into production fields. And effect of urbanization.</p>	<p>As we agree that the danger of urbanization for biodiversity is big, we are far less sure that the agri-environmental schemes would protect biodiversity forever and everywhere. When it goes to global economics, political situations can reverse on a short-term and agri-environmental schemes be questioned. And if not, our data shows that food production cannot be an argument to abandon part of or full agri-environmental</p>

		schemes, as it is very often argued. We mentioned the important role of agri-environmental schemes in the introduction.
11.	Unique dataset ?	The dataset is unique in that it combines biodiversity and production data recorded together with standardized methods in farms across Europe. Furthermore, we are not aware of such a dataset and such an analysis published elsewhere, showing the trade-off between the potential loss of species and food production due to competition for land in real farms.
12.	Organic farming production ? So the statement chosen by the authors is biased and it would be fair to mention these other studies.	We do not contest that organic farming can be as productive as conventional farming under certain conditions (often with high intensity as organic farming can be intensive as well) and certain crops. Here we simply mentioned that overall, organic farming usually reaches lower yield. This is exactly what is done by writing “(...but see ...)” and citing Seufert et al. 2012 and Ponisio et al. 2015), line 63.
13.	Heterogeneity captured by a few farms ?	We agree. We do not pretend investigating the entire heterogeneity of European agriculture. That would be pretentious. So, we removed the first part of the sentence line 72 “To capture the heterogeneity of agriculture ...” which was a bit too ambitious.
14.	L73 : on which criteria ? is it related to a bias compared to equirepartition overall the habitats ? or is it based on data from literature ?	“The recorded species were group as (i) unique to semi-natural, ...”. This means that the recorded species (from the field) were grouped as unique to semi-natural habitats if they were uniquely found in the semi-natural habitats in the dataset. The same applied for the unique species to production fields. The species found in both habitat were grouped in the third group of species, the shared species.
Reviewer #3		
15.	The methodology and analysis are sound and well described. The results are well presented and the claims are novel. They are also of high interest to research and decision-maker communities.	Thanks a lot for these considerations !
16.	The introduction into the aims is somewhat confusing: it would help a reader if you clearly state the main focus (aim) and then 2-3 operational objectives.	Thanks for the comment. As the focus seems to be clearly stated L51-54, we have adapted the text to come up with better operational objectives L56-62, however.
17.	The wider implications of the results are lacking. Above all, do they have any relevance beyond the EU?	
18.	<u>Re-phrasing the abstract:</u> - Food demand and increased agricultural production - Endanger farmland biodiversity ... - Avoid starting sentences with numbers - Make the end of the abstract wider than pure results	Thanks for the improvement suggestions we are happy to implement: - Done, “An increase in agricultural output is forecasted due to a rising global food demand” - Done to focus reader’s attention - Done: “About half of the species ...”, and “A FAO report ³¹ ...”

		- Done, sentence added: "Our findings emphasizes the urgent need of developing sustainable food ...".
19.	<p><u>Re-phrasing and adapting the introduction:</u></p> <ol style="list-style-type: none"> 1) English proofing 2) Small-scale mosaic European landscapes 3) "... potential of organic as compared to conventional farming ...". 4) Clarification of the research questions: <ol style="list-style-type: none"> i) "what the production gain and the biodiversity loss would be, if the pressure on the land would increase again and (part of) the remaining semi-natural habitats were converted to agricultural fields". – this seems to be an overall objective. ii) Consistency of the research questions with result presentation. 5) "functional taxa – why specifically functional here and not taxonomic? It seems the latter is more correct as opposite to grouping specifically on functional criteria (eg nitrogen-fixing)." 6) "agroecosystems on both farmland and semi-natural habitats – (most of) the latter is regarded as former (margins, fallows are certainly part of farmland) – re-phrase". 7) "To capture the heterogeneity of agriculture" is redundant, it would be more valuable to see what are the "various agricultural land uses". 8) Passive vs active 9) Organisms vs species richness 	<ol style="list-style-type: none"> 1) All done 2) It is true that conservation effort requires entire farmland of Europe to be considered of course. The meaning here is the comparison with the global biodiversity conservation issue, worldwide, "While large wilderness areas are prioritized globally..." let's say tropical forest for instance. In that, European landscapes are comparatively (added in the sentence to emphasize the comparison, then) "small-scale and mosaic-like", we thought. 3) This sentence has completely been modified "Second, we compared organic to conventional farming with respect of the loss of species and the production gain by conversion". 4) Research questions: <ol style="list-style-type: none"> i) Yes, this is the overall objective. We then have re-phrased the research questions so that this appears clearly as an overall objective. ii) Thanks a lot for the suggestion. We have re-formulated the research questions accordingly. 5) "functional" is mentioned to emphasize the importance of investigating those taxa with respect of agroecosystems. It is true that functional should not be mentioned, at least not alone, because our study does not show any functional aspects of the taxa investigated. So we add "taxonomic" at the first place. 6) Agreed. Re-phrased: "on both production areas and semi-natural habitats". 7) That's true, we improved by naming the land uses "from arable to grassland, mixed, horticulture and permanent crops" and removed "To capture the heterogeneity ...", also because it was a bit too ambitious as noticed by reviewer 2. 8) Done 9) Done

<p>10) Reference to Methods 11) "Farmers provided data on yields" 12) "Fig 1 – need to mention "unique" on axis x" 13) c) yield averaged over what? only fields? all fields for sampled farms or average in the region?</p>	<p>10) Done 11) Done 12) Not clear to us. Probably means on "y axis" on fig 1c but as the figure shows shared species (medium green bars) "unique" for the y axis would not fit. 13) In fig 1c the average yield per field of the sampled farms is shown. Caption adapted. Calculation is explained in Methods under "Estimating production gain". The average is a weighted average by the area of the corresponding crop types.</p>
<p>20. <u>Re-phrasing and adapting the result section:</u> 1) compared for the same sample coverage per region²⁹ – I don't understand to what it is compared; unique for semi-nat are compared to unique for fields is clear. 2) Yield, productivity not correlated with SNH proportion, redundancy of the statement. 3) "Across the four taxa and summed over the regions, the differences between organic and non-organic systems for unique species in both semi-natural habitats and production fields, and shared species, were mainly non-significant" – "It is difficult to see what differences you mean. Please, check if I interpret it correctly here: "the differences between organic and non-organic farms for the species richness derived from unique and shared species over all four taxa and all regions were mainly non-significant". 4) "In all study regions, the impact of converting exactly 50% of the semi-natural – how important is "exactly"?" 5) When reading this part, I was wondering about two issues: i) First, how you delineate extensive production grassland and semi-natural grassland, esp. in EE countries. ii) Second, if even such high rate of conversion 90% of the semi-natural area (assuming that 10% are unconvertible due to geomorphological constraints and</p>	<p>1) Yes, exactly, percentage of species unique to SNH compared to percentage species unique to production fields. Such comparisons must be done "for the same sample coverage", namely for the same proportion of the species richness sampled of the estimated total number of species. If not there is a bias by the comparison. For more details, see Chao and Jost (2012). 2) Thanks for the remark. We removed the statement from the first result section to the second one. 3) Yes, this is correct. But we think it is helpful to specify the statement for unique species to SNH and production fields. 4) Not important -> removed. 5) i) Important issue, indeed. Our approach is described within the Methods section under "Categorization as production fields and semi-natural habitats", as you mention it. Basically we used plant species observed and management evidence. More details are given in the cited references Herzog et al. (2012 and 2017), and Bunce et al. (2008). As this is already mentioned in the last paragraph of the introduction with reference to the Methods, we waived in order not to overload the text. ii) This is true and this is the reason why we discussed the point in the discussion section.</p>

	<p>poor soil quality) is realistic. To my understanding, semi-natural areas in many WE countries and arable regions are retained on poorly productive parts of land. Thus, not all can be converted to begin with and conversion can unlikely result in yield compatible with those of existing fields (which you rightly mention in discussion). More is possible for EE in extensive grassland regions. I found answers to both issues in Methods, but it might be good to briefly describe this already in the main text and refer to Methods.</p> <p>iii) “but note that the bulk of semi-natural habitats in Spain are extensively managed olive groves, for which production was not accounted for”; - why not? your do not explain this in Methods either.</p> <p>6) “At individual taxa level, organic farms supported significantly more spider species – should probably ignore and focus on an overall biodiversity.</p> <p>7) “For regions where 10% production increase could not be achieved due to insufficient semi-natural area available (in bold) species change was taken from scenario I (90% conversion) to calculate group means” – should not this make estimates identical between two scenarios (10% more production in bold and 90% SNH converted)?</p> <p>8) “Contrasting impact of setting a goal of 10% production increase” sub-heading ?</p> <p>9) “In contrast, grassland dominated regions and olive groves would be able to produce 10% more while biodiversity would be less affected” – more than what and less than what?</p> <p>10) “In case of 10% more harvestable energy needed, non-organic and organic systems showed contrasting effects” – unclear what is exactly was contrasting in several results that follow</p> <p>11) “Also, the share of semi-natural habitats is higher”, - where than where?</p>	<p>In order not to overload the main text, we decided to keep the simple reference to the Methods for these issues.</p> <p>iii) Thanks for noticing this. It is true that large part of the SNH in Spain were extensively managed olive groves with a certain production which should ideally have been removed from the calculation of the increase due to the conversion. This is why we added “... means that the increased production is overestimated”. However, the production increase is mostly due to the large SNH area occurring there (see Fig. 1c). In addition, it was impossible for other regions e.g. extensively used grassland in CH, to get production data. We wanted then to stick to the same definition over the study regions. We added a short explanation in the Methods section.</p> <p>6) As suggested, we removed the sentence.</p> <p>7) Actually, group means of species loss per land use types have been calculated with the total available SNH area converted (see Supplementary Table 7 for details per region). So, this sentence has been removed from the legend of Table 1.</p> <p>8) We kept the sub-heading and emphasized the contrast between the arable and grassland systems by adding a sentence to begin the second paragraph.</p> <p>9) Thanks for the correction. “more than the current production” and “less than for the arable systems” added.</p> <p>10) The contrasting effect is that non-organic systems tend to lose more species than the organic ones in both cases of reaching the goal of 10% increased production or not. To emphasize this, we showed the species loss in both situations and both farming systems.</p> <p>11) Thanks for the correction again: “... higher in grassland than in arable systems...” added.</p>
21.	Re-phrasing and adapting the discussion section:	

<p>1) “We are aware that results may be affected by the specific regions, taxa considered and the snapshot character of the investigation. Still, quantified estimations on the trade-off between increased agricultural production and biodiversity loss are urgently needed and our model allows a first approximation.” – I suggest moving these two reservations into a next par with limitations. Start this par with stating the two key results (at least this is how I understood them), and then extend with the details. Something like: The key results from our large-scale study pertain to the confirmed essential contribution of semi-natural habitats to biodiversity across all Europe, and a considerable species loss for a limited production gain in many farming systems.</p> <p>2) “The snapshot character of the investigation...” – meaning? maybe better “data from only one year”.</p> <p>3) “... and our model allows a first approximation” FOR EUROPE</p> <p>4) “Still, quantified estimations on the trade-off between increased agricultural production and biodiversity loss are urgently needed and our model allows a first approximation”.</p> <p>5) “Yet, the assumption that these areas could be converted to productive fields with the same yield as existing fields, is probably overly optimistic” -> However, the assumption of achieving the same yield on such converted areas than on existing productive fields is probably overly optimistic.</p> <p>“The rest is very good, indeed!”</p>	<p>1) Thanks for the suggestion. We re-phrased the beginning of the section as proposed and moved the reservations into the next paragraph with the other limitations.</p> <p>2) Changed as suggested.</p> <p>3) “... for Europe.” added.</p> <p>4) Changed for “Our models allow a first approximation of quantifying the trade-off between increased agricultural production and biodiversity loss”.</p> <p>5) We re-phrased as proposed.</p> <p>Thanks a lot for the very encouraging statement !</p>
<p>22. <u>Re-phrasing and adapting the Methods section:</u></p> <p>1) “We estimated the richness of the species pool up to the number of mapped habitats” – unclear phrasing: “up to the number”?</p> <p>2) “don’t comprise” – do not comprise</p> <p>3) “The production of certain semi-natural habitats as e.g. olive groves in Spain was not part of the production calculation.” – add a reason</p>	<p>1) “We estimated the richness of the species pool for the total number of mapped habitats...”.</p> <p>2) Done.</p> <p>3) Done. We added in the Methods section “The reason is that data on production for semi-natural habitats were mainly not available and/or negligible, e.g. extensively used grassland in CH or in HU, and we decided to apply the same treatment to all the</p>

<p>4) “In practice, in many regions it may be impossible to convert semi-natural habitat to productive land due to geomorphological constraints and poor soils, and even if land were converted, yields would be much lower than these averages. The results presented here, especially the 90% scenario, are therefore over-optimistic.” – enough to have in Discussion</p>	<p>regions. Consequently, in case of olive groves in Spain the effective increase in production is overestimated.”</p> <p>4) We decided to keep the sentence because it goes together with the next “ On the other hand ...”.</p>
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19th May 21

Dear Dr Jeanneret,

Your manuscript titled "An increase in food production in Europe could dramatically affect farmland biodiversity" has now been seen by our reviewers, whose comments appear below. In light of their advice I am delighted to say that we are happy, in principle, to publish a suitably revised version in Communications Earth & Environment under the open access CC BY license (Creative Commons Attribution v4.0 International License).

We therefore invite you to revise your paper one last time to address the remaining concerns of our reviewers. At the same time we ask that you edit your manuscript to comply with our format requirements and to maximise the accessibility and therefore the impact of your work.

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Best regards,

Clare

Dr Clare Davis
Associate Editor
Communications Earth & Environment

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REVIEWERS' COMMENTS:

Reviewer #1 (Remarks to the Author):

Thank you for the detailed responses to the referee comments. In my view, the manuscript is now ready for publication.

Reviewer #2 (Remarks to the Author):

The authors made significant changes to precise some statements introduction/discussion as well to clarify their methodology. As the scope perfectly fits with the scope of the journal and the topic is of high interest, I recommend to publish this article.

Reviewer #3 (Remarks to the Author):

The author team has done good work on addressing the editorial concerns. One issue remained not addressed, though, and a few further minor corrections are still needed. A professional linguistic check of the final version would be justified.

I still think that a publication in a journal of this standing requires setting the results into the international /global perspective. To what extent have the results relevance beyond the EU? This was not addressed in the revision letter.

Minor edits:

Our findings 42 emphasizes (REMOVE PLURAL) the urgent need of developing sustainable food production systems in order to minimize land use and 43 preserve semi-natural land and biodiversity. – this statement is quite vague and leaves one with more questions: objective of minimising land use (FOR AGRICULTURAL PRODUCTION?) is usually interpreted as intensification of land use (eg through agronomic improvement of less productive areas) while preserve semi-natural land – often interpreted as allowing for more extensive land use on such semi-natural land (eg extensive grazing); agricultural/farmland biodiversity or overall?

question we first investigated the set of species that are unique to European semi-natural habitats and that would 59 disappear in case of conversion to production fields, and related that loss to the production gained by the conversion³⁸, 60 also in case of conversion being TO organically or conventionally managed fields

A report by the FAO 31 183 postulates a global supply of food increase by almost 30% by 2030 and around 50% by 2050 if it wants to equal the 184 rise in global demand. – unclear phrasing

The key results from our large-scale study pertain to the confirmed essential contribution of semi-natural habitats 225 to FARMLAND biodiversity across all Europe, and a considerable species loss for a limited production gain in many farming 226 systems IF SEMI-NATURAL HABITATS ARE CONVERTED TO PRODUCTION FIELDS.

First, Wwe are aware that results may be dependent on regions and taxa considered and that having onley one year data sets generalisation constraints.

reasonable, but this could hardly be in form of typical arable products such like AS cereals due to unfavorable 259 topography, climate and soil conditions. (“such like” is colloquial).

Author response to comments of reviewer #3

Reviewer #3 (Remarks to the Author):

“The author team has done good work on addressing the editorial concerns. One issue remained not addressed, though, and a few further minor corrections are still needed. A professional linguistic check of the final version would be justified.”

Comment	Response
“I still think that a publication in a journal of this standing requires setting the results into the international /global perspective. To what extent have the results relevance beyond the EU? This was not addressed in the revision letter.”	We add a sentence within the discussion section: “Application to biomes elsewhere with very large natural or semi-natural areas would be critical as biodiversity might be difficult to estimate with the conventional methods used here.”

Minor edits:

“Our findings 42 emphasizes (REMOVE PLURAL) the urgent need of developing sustainable food production systems in order to minimize land use and 43 preserve semi-natural land and biodiversity. – this statement is quite vague and leaves one with more questions: objective of minimising land use (FOR AGRICULTURAL PRODUCTION?) is usually interpreted as intensification of land use (eg through agronomic improvement of less productive areas) while preserve semi-natural land – often interpreted as allowing for more extensive land use on such semi-natural land (eg extensive grazing); agricultural/farmland biodiversity or overall?”	This is part of the original abstract that has been replaced by the editorial proposition which is clearer with respect to the issue mentioned here.
“... question we first investigated the set of species that are unique to European semi-natural habitats and that would 59 disappear in case of conversion to production fields, and related that loss to the production gained by the conversion38, 60 also in case of conversion being TO organically or conventionally managed fields...”.	“to” added.
“A report by the FAO 31 183 postulates a global supply of food increase by almost 30% by 2030 and around 50% by 2050 if it wants to equal the 184 rise in global demand. “– unclear phrasing	Changed to “A report by the FAO 31 postulates a global needed supply of food increase by almost 30% by 2030 and around 50% by 2050 to equal the rise in global demand.”.
“The key results from our large-scale study pertain to the confirmed essential contribution of semi-natural habitats 225 to FARMLAND biodiversity across all Europe, and a considerable species loss for a limited production gain in many farming 226 systems IF SEMI-NATURAL HABITATS ARE CONVERTED TO PRODUCTION FIELDS.”	“farmland” added. “if semi-natural habitats are converted to production fields” added.
“First, Wwe are aware that results may be dependent on regions and taxa considered and that having onley	We replaced “such like” by “such as”.

<p>one year data sets generalisation constraints. reasonable, but this could hardly be in form of typical arable products such like AS cereals due to unfavorable 259 topography, climate and soil conditions." ("such like" is colloquial)."</p>	
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