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USDA							
6		Glossary		ge	Here the paper defines ecosystem services, and outlines four different types of ecosystem services: provisioning, regulating, cultural, and supporting services. Unfortunately, the text often deviates from this definition and makes broad statements about ecosystem services as collective group. This is important because the relationships between ecosystem service and biodiversity (eg # species) are very different depending on the type of service under consideration (provisioning, regulating, cultural, or supporting services). For example, cultural services may increase fairly linearly with increases in biodiversity. However, that is not the case for regulatory or provisioning services. Many regulatory and provisioning services plateau with a relatively small number of species or functional groups, meaning more biodiversity has little impact on improving these services.		We have edited this section and avoided making broad statements about ecosystem services as a collective group. We have made these revisions with consideration that alterations in biodiversity does not necessarily have a linear relationship with all types of ecosystem services.
8		Glossary		ge	The document notes rangelands are 'indigenous vegetation'. Land on which the indigenous vegetation (climax or sub-climax) is predominantly grasses, grass-like plants, forbs or shrubs that are grazed or have the potential to be grazed, and which is used as a natural ecosystem for the production of grazing livestock and wildlife. Many rangelands have non-native species, and some of those are invasive (and are significant management burdens that are actively	Land on which the ~~indigenous~~ vegetation is predominantly grasses, grass-like plants, forbs or shrubs that are grazed or have the potential to be grazed, and which is used as a natural ecosystem for the production of grazing livestock and wildlife. 1. Remove the references to climax/sub-climax	1. We would prefer to keep this published definition of rangeland but we added a note to make the following clarification: the definition does not mean that rangeland is indigenous vegetation, but that indigenous vegetation, if the state was climax or sub climax, would be predominantly grass. It does not exclude that in reality indigenous vegetation can exist along with invasive or non-native species. 2. The following text was added:

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					addressed) and other non-native species are seeded to improve the productivity of the land (and aren't invasive), so 'indigenous' should be removed. The definition describes rangeland vegetation communities as 'climax or sub-climax' but this is a limited view, and it assumes the system is at equilibrium. Research over the past decades has shown it's more complex, and rangelands show a continuum of equilibrium and non-equilibrium states. • from the language in the document, it appears the model is assuming plant community development follows a linear trajectory, or holds steady. Therefore, changes in the expected pattern could be attributed to impact of livestock. However, it's more complicated than that (and temporal and spatial scale, and aridity, are important factors). Thus, it can be hard to tease out the relative impacts of land use (ie livestock and then specific practices) and natural variability (e.g., in precipitation) on a response variable (e.g., biodiversity). This is likely most important for the local and regional model. It may not apply to the global model (depending on the aggregation).	2. Discuss how the model will address the fact that livestock impacts on rangeland systems are not straightforward because of natural variability (e.g., year to year differences in precipitation,), time lags in forage dynamics, thresholds that create changes in community composition etc.	*"Such classification into discrete classes of grazing intensity is a simplification and will have important limitations especially in rangeland and semi-natural systems where factors that are not link to livestock production practices (aridity/precipitation, time lags in natural forage dynamics) have an important influence on the plant community composition. PSR indicators and multi-variate models disentangling the effect of those livestock and non-livestock factors will be more suited to local assessments, especially in semi-natural systems."*

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32	25	5.1 Impact pathway (Cause-effect chain) and steps of the LCA 2		ge	Carrying capacity relates to equilibrium systems, but rangelands are in a continuum of non-equilibrium and equilibrium based on the space and temporal perspective.	1. remove the references to carrying capacity 2. discuss how the model will address the fact that livestock impacts on rangeland systems are not straightforward because of natural variability (e.g., year to year differences in precipitation,), time lags in forage dynamics, thresholds that create changes in community composition etc.	1. Removed. 2. Please refer to our response to your previous comment
43-44		5.4.3 Referenc e state		te	The document (P43-makes reference to comparing LCA results of livestock production to that of a reference state, with the reference state being natural vegetation or some other historic reference. The danger in this type of comparison is that livestock production may always look worse from a biodiversity impact perspective compared to a natural system, especially when land use change is the major driver of impact assessment. The interpretation, especially in the public, may be that livestock production itself is damaging biodiversity and that a "silver bullet" solution would be to curb or cease meat consumption. This interpretation might also extend to policy implications. However, in the absence of livestock production, an equivalent amount of food calories, nutrients, protein, etc. would still have to be produced, and that production will also have impacts on biodiversity, which might be more or less than the livestock impacts. Therefore, a better comparison than comparing livestock to a natural system reference state, would be to		This is an important point. It is mentioned on section 5.4.1 about the recommended LCIA model for global/regional assessments but we added : *"The recommended CFs have a limited ability to reflect beneficial impacts of livestock production on biodiversity. This is mainly because of the small number of agricultural land use and intensity classes, and use of potential natural vegetation as a reference (see section 5.4.3). A better distinction among land use intensity and management practices – including those with a positive impact on biodiversity (e.g., extensive grazing, Watkinson & Ormerod 2001) – is a priority for increasing the capability of LCA as an analytical and decision support tool for livestock products."* In section 5.4.3 on reference state we added the following clarification about PNV: *"The use of PNV as a reference state does not prevent in itself to reflect positive livestock impacts on biodiversity. However, high resolution data (both spatially and in terms of production practices) would be needed to*

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					compare livestock production to that of another agricultural system that is producing the same amount of food. Then one would compare the impacts of the two production systems. That way, one would interpret impact of food production altogether, and not if food production is worse than natural systems. This point does not seem to be raised anywhere in the document. See the paper by White and Hall (PNAS 2017 comparing animal systems to production without animals) as an example of a more appropriate comparison.		*detect systems where livestock systems achieve biodiversity levels that are similar or higher than in PNV, and currently most LCIA models do not have access to such data."* Regarding the impact of alternative ways to produce protein, the point is very valid but there needs to be a distinction between using a reference and making a comparison. The alternative agricultural system is a scenario rather than a reference, but it could be compared with the impact of livestock if the same reference is used (PNV or other). The following text was added to clarify this point: *"In most cases, using PNV, semi-natural or historic vegetation states will result in livestock having a negative biodiversity impact compared to the reference. However, it can be interesting to compare the impact of different scenarios (using the same reference), showing the relative impact of livestock compared to alternative ways to produce proteins, calories or other micro-nutrients."*
61	10-33	7.1 Interpretation of results		te	The goal is to develop guidelines for a quantitative assessment of the effects of livestock production on biodiversity and the document proposes using models (e.g. Life cycle analysis). For any model, the sensitivity of the model is critical for interpretation (e.g., the models will present a result, but what is the confidence in that result?). I expected a strong discussion of this but didn't find it. If the approach is building off past work (and it says it is), then the document should be able to lay out expectations for the sensitivity. And, if the sensitivity is expected to be really		It is difficult to set a threshold on uncertainty (confidence interval) so the document rather provides specific guidelines for measuring uncertainty and recommends to discuss results in light of this uncertainty level. We also added this sentence (in bold) to reflect your point: *"The limitations to robustness, uncertainty and applicability of the assessment results also need to be explicitly discussed. Stakeholders can provide important inputs and feedback on the interpretation of the evidence.* ***High uncertainty levels could also lead to the revision of the goal of the***

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					large under most circumstances, then that should modify the goal (e.g., the model would then be a way to organize thoughts and identify questions, rather than serve as a quantitative tool).		***assessment, for instance to move from a quantitative assessment to a qualitative evaluation of issues to be considered or overcome. "***
62	30-34	7.3	PP 1	ge	Characterizing LCA as a "standardized tool" can be misleading; the term "regional or local" is more appropriate than "non-climatic" because micro-climatic impacts can be relevant to things like biodiversity; describing uncertainty of the models is also a key challenge in communicating results.	LCA has arisen as a structured and comprehensive approach that is capable of offering objective data for use in environmental decision support; however, there is a risk for a decision-maker to assume that LCA generates simple answers to complex environmental questions, especially with regional and local impacts like biodiversity for which describing the complexity and uncertainty of models remains a challenge.	
Agriculture and Agri-Food Canada							
					On the whole, these guidelines are informative and usable.		
				Unable to find key for "type of comment" or asterisked footnote.			
1	12-13	Table of Contents			Parts need to be identified because they are referenced in the text.	Insert a heading "Part 1. About this document"	Added
	23-24	Table of Contents			Parts need to be identified because they are referenced in the text.	Insert a heading "Part 2. Methodology"	Added
5		Glossary	Characteri		The definition is confusing and difficult	Explain in more simple and	This is an official definition (ISO) but we

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			zation		to understand. It does not conform to the definition of "characterization" in the field of genetic resources.	understandable language. Explain the scope of this definition (excluding characterization of genetic resources).	added an example to make it more understandable. We believe that the definition should be general, the scope is specified later in the document.
6		Glossary	Hotspot and Hotspot (of biodiversit y)		In the field of biodiversity, "hotspot" almost always refers to an area of high diversity, at the species or genetic level. This is irrespective of the contribution to biodiversity loss. Also, high biodiversity loss can occur where diversity is lower. Should avoid new definitions that may be confusing.	Delete second sentence in definition of Hotspot. Delete entire definition "Hotspot (of biodiversity)" In text where "hotspot" is used in relation to loss of biodiversity, write directly about loss of biodiversity.	The two definitions are needed because the document brings together concepts from different scientific communities: ecology (biodiversity hotspot) and LCA (hotspot analysis). Both concepts are used in the text so we. To avoid confusion, we merged the two definitions and added a disambiguation.
7		Glossary	Pressure, State and Response Framewor k		A Pressure can only be negative whereas a "Driving Force" can be positive or negative.	Was any thought given to adding "Driving Force" indicators, or replacing "Pressure" with it?	We prefer to stick to the framework methodology (also to avoid confusion with the Driver Pressure State Impact Response, an EU version of the PSR) but the document does mention pressure and benefits.
9	17	Objective and Scope			Need to differentiate between livestock biodiversity and livestock's impact on other biodiversity.	Insert "…effects of livestock production on <u>non-livestock</u> biodiversity" Or: "…effects of livestock production on <u>the biodiversity of other biota</u>, based on …"	We added "wild" biodiversity because it is not only non-livestock but non-domestic in general (i.e. crop varieties are not included either). We also added to the third key message that *'biodiversity' in this document refers to wild biodiversity unless specified otherwise* to avoid having to write it the many many times "biodiversity" is used
10	14				Title is confusing.	Change "genetic biodiversity" to "genetic diversity"	Changed
	15				Term "livestock genetic resources" is confusing in this context.	Replace "livestock genetic resources" by "livestock genetic diversity" or "the genetic diversity of livestock"	Changed

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	15				Section reference is not accurate.	Replace “Section 3.2” by “Section 3.3”.	Corrected
	17				Improve delineation of the role of LEAP vis-à-vis the Commission.	Insert “…recorded globally by the FAO Commission on Genetic Resources for Food and Agriculture, representing …”	Added
17	1-2	TAG on Biodiversi ty			The “first” workshop is dated later than the “second” workshop.	Use correct dates.	Corrected
19	10	1.1			The role and work of the FAO Commission on Genetic Resources for Food and Agriculture should be recognized and described in the context of initiatives to address the relationship between biodiversity and livestock production.	Insert a new penultimate sentence: Moreover, the role of the FAO Commission on Genetic Resources for Food and Agriculture and the work of its Intergovernmental Technical Working Group on Animal Genetic Resources should be recognized in describing and assessing the genetic diversity of livestock.	The sentence was added to section 3.3 on genetic diversity, where the FAO CGRFA is mentioned
	37	1.2			Avoid confusion between the genetic diversity of livestock, and its impact on other biodiversity.	Insert: “…because impact on non-livestock biodiversity is at the endpoint…”	Cf response to comment on section 2. objective and scope
20	3	1.2			Need to cite another significant international agreement.	Insert: “…Convention on Biological Diversity (CBD), the Global Plan of Action for Animal Genetic Resources and the …”	Added
	5	1.2			Specify COP of which Convention, to avoid confusion with CBD.	Modify: “…after the decision of FCCC COP23 …	Added

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21	5	2.2			Avoid confusion between the genetic diversity of livestock, and its impact on other biodiversity.	Insert: "…quantitative assessment of the impacts of livestock production on non-livestock biodiversity, based on …"	We used "wild biodiversity"
	22	2.2			Need to make explicit the complementarity of guidelines with the FAO Commission on Genetic Resources.	Add a new paragraph something like : These guidelines are complementary to the work of the FAO Commission on Genetic Resources for Food and Agriculture in describing the genetic diversity of livestock, and can be used along with them in assessing the relationship between livestock and biodiversity comprehensively. References: FAO. 2015. *The Second Report on the State of the World's Animal Genetic Resources for Food and Agriculture*, edited by B.D. Scherf & D. Pilling. FAO Commission on Genetic Resources for Food and Agriculture Assessments. Rome (available at http://www.fao.org/3/a-i4787e/index.html). FAO. 2007. *Global Plan of Action for Animal Genetic Resources and the Interlaken Declaration* FAO Commission on Genetic Resources for Food and Agriculture	This was added as a key message to section 3.3 on genetic diversity.
	25	2.3			Avoid confusion between the genetic diversity of livestock, and its impact on other biodiversity.	Insert: "… links between livestock production and non-livestock biodiversity …"	Cf response to comment on section 2. objective and scope
	34	2.4			"poultry" involves several species, so "six species" is not accurate	Delete "…the six main livestock species (i.e. …" or replace the word "species" by "kinds" or "animals".	We kept "species" but used "chicken"

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22	14	3.1	Key messages box		Inconsistency between this key message and the corresponding one in the Summary of Key Messages on page 9. The last sentence of the 3rd bullet point is missing.	Resolve inconsistency. Either add the additional sentence in both places, or delete it in both.	Corrected
	30	3.1			Avoid confusion between the genetic diversity of livestock, and its impact on other biodiversity.	Insert: "…result in a reduction in non-livestock biodiversity."	Cf response to comment on section 2. objective and scope
23	1	3.1			Avoid confusion between the genetic diversity of livestock, and its impact on other biodiversity.	Insert: "…farmed habitats that can impact non-livestock biodiversity …"	Cf response to comment on section 2. objective and scope
	4	3.1			Avoid confusion between the genetic diversity of livestock, and its impact on other biodiversity.	Insert: "Non-livestock biodiversity is also generally higher…"	Cf response to comment on section 2. objective and scope
	17	3.1			Avoid confusion between the genetic diversity of livestock, and its impact on other biodiversity.	Insert: "Adverse impacts on non-livestock biodiversity can be associated with …"	Cf response to comment on section 2. objective and scope
24	8	3.2	Key messages box		Inconsistency between this key message box and the corresponding bullets in the Summary of Key Messages on page 9. A bullet point on temporal trade-offs is missing.	Resolve inconsistency. Either add the additional bullet point in both places, or delete it in both.	Bullet added in both places
25	2-3	3.2	Figure 2. Conceptu al ecosyste m service framework for a livestock production system.		Agree with Carl Lessard that it would be useful to include the "Conceptual framework of the ecosystem service "cascade" model" here.	Insert Figure 1 on page 5 of document CGRFA-17/19/11.2/Inf.1 "Review of Methods for Identification and Valuation of the Ecosystem Services Provided by Livestock Breeds"	We will use the figure you mention as the new basis for this figure To be done when revising the figure

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27	13	3.3	Title		The term "genetic diversity" was used on page 22 line 17, why not use it here? Moreover, genetic diversity of livestock is not just "breeds", it also includes animals that are not identified as breeds.	Change to "Genetic diversity of livestock"	Done
	25	3.3			Add more context, by acknowledging that genetic diversity of livestock resulted from the domestication of wild species and changes in their genes made by humans.	Add a sentence at the beginning of the paragraph something like: "Livestock resulted from the domestication of wild ancestor species, few of which exist today. Differentiation of livestock breeds resulted from selective breeding by humans, for human needs."	Your sentence was added
28	1	3.3			Name of report is not accurate. Reference is missing from Section 9 (see comment on page 84 below).	Use the correct name of the report: "The Second Report on the State of the World's Animal Genetic Resources for Food and Agriculture (FAO, 2015)"	Corrected
	17	3.3			Add a paragraph relating to methods for identification and valuation of ecosystem services provided by livestock breeds and their production systems, in order to further show the complementarity between the Commission and LEAP on farm animal biodiversity.	Add a paragraph something like: During its 17th Session in February 2019, the FAO Commission on Genetic Resources for Food and Agriculture took note of a review of methods for identification and valuation of the ecosystem services provided by livestock breeds. This review defined the role of livestock production systems, and livestock breeds in particular, in the delivery of ecosystem services; outlined the main steps involved in valuing these services; identified potential ecosystem services provided by livestock breeds and associated agro-ecosystems; and	Your paragraph was added – very useful thank you

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						reviewed the main methodologies for identifying and valuing ecosystem services in specific socio-economic and biophysical contexts. Reference: FAO (2019). Review of Methods for Identification and Valuation of the Ecosystem Services Provided by Livestock Breeds. Document CGRFA-17/19/11.2/Inf.1, FAO Commission on Genetic Resources for Food and Agriculture	
32	14	5.1			Avoid confusion between the genetic diversity of livestock, and its impact on other biodiversity.	Insert: "…resulting impacts on non-livestock biodiversity …"	Cf response to comment on section 2. objective and scope
34	6	5.1			Avoid confusion between the genetic diversity of livestock, and its impact on other biodiversity.	Insert: "…indicators of impacts on non-livestock biodiversity…"	Cf response to comment on section 2. objective and scope
39	4	5.3			Undefined term "cause-shall chain"		Corrected to 'cause-effect'
41	14-17	5.4.1			Difficult to understand. Undefined term "Section O"	Explain what "Section O" is. Give the final figure and units of the example in Canada, to provide better understanding. Is it high or low impact?	Cross reference corrected to section 5.2.1. The final unit was added and reference to a case study on this method was added for better understanding.
48	27	6.1.3			Appendix 4 does not give a "list of pressure categories."	Change text to "An overview of the categories of pressures and benefits on biodiversity derived from livestock can be found in Appendix 4."	Text changed
54	15-16	6.2	Key guidelines		The bullet points on these two lines are in fact one, not two. Also, this bullet is missing from the Summary of key	Reunite these two bullet points into one. Include this bullet point in the Summary	corrected

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13	33-40		box Summary of key messages and guidelines		messages and guidelines.	of key messages and guidelines.	
55	5-15	6.2			Terminology: “invasive alien species” is the generally used term, rather than “exotic species” (see CBD https://www.cbd.int/invasive/)	Change to “invasive alien species” in this paragraph (line 5 twice, 9, 11). Follow through everywhere in the guidelines, e.g. Table 2 (page 59) and Appendix 5 (page 105).	We replaced every occurrence as suggested
57			Table 2		There are more than one (and up to three) “Regulatory constraints and extrinsic value” indicators but only one response is suggested.	Separate the “Regulatory constraints and extrinsic value” indicators into two or three.	Separated into 2
			Table 2		There are two “Wildlife habitats” indicators but only one response is suggested.	Separate in two: “Habitats are inventoried (mapped)” and “Habitats are protected”	We prefer to keep it as one because the two are interdependent: mapping is necessary to protect, but not enough on its own
58			Table 2		There are three “Degraded soil” indicators, but only one response is suggested.	Separate in three.	The general philosophy of this indicator list is to keep the number of indicator categories to the minimum (for the sake of simplicity and feasibility) but within each category to propose different specific indicators. Those are somehow redundant but one or the other may be selected because it is more relevant to a specific context, more adapted to an assessment goal or constraint.
59			Table 2		There are three “Species richness or diversity” indicators, but only one response is suggested.	Separate in three.	See response to previous comment
59-60			Table 2		There are three “Landscape heterogeneity” indicators, but only one	Separate in three.	See response to previous comment

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					response is suggested.		
64	31	7.3			Improper term	Change "…most often bared by rural producers" to "…most often borne by rural producers…"	Corrected
65	4-5	8.1	Key guidelines box		The 1st bullet reads "Biodiversity data should either be aligned with … and be scalable" (our emphasis). This is bad grammar. However, "Summary of Key Messages and Guidelines" 1st bullet on page 14 reads "Biodiversity data shall be aligned with … and/or be scalable…"	Either: delete "either" or change "and" to "and/or".	We deleted "either"
68	27	8.3	Data Quality Assessme nt		Incomplete	Somewhere in Section 8.3 the issue of data validation (quality control) should be discussed, i.e. whether data were collected by competent individuals or examined by subject authorities. This could be discussed in sub-sections 8.3.2, 8.3.5 or 8.3.6. Data that has been authoritatively validated has greater reliability. This is particularly relevant to taxonomic identification. Consideration should be given to adding a bullet on data validation in the Key Guidelines box.	Good point, all criteria should be assessed by authoritative organizations so this was added at the beginning of section 8.3
69	12	8.3.1			Incomplete	Insert: "…it does not provide information on the abundance of the species or its genetic diversity, only …"	This is true but a bit out of topic. This text focuses on the difference between presence/absence vs. abundance data at species level.
84	1	9. Referenc es			A reference cited in several passages (notably page 28, line 1) is missing from the list of References.	FAO. 2015. The Second Report on the State of the World's Animal Genetic Resources for Food and Agriculture, edited by B.D. Scherf & D. Pilling. FAO Commission on Genetic Resources for Food and Agriculture Assessments.	Added to the list of references

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						Rome (available at http://www.fao.org/3/a-i4787e/index.html).	
95-112		Appendic es			The word “Appendix” does not appear before the title of each Appendix (1 through 7).	Include the word “Appendix” before the number/title of each Appendix. This will make it easier for readers to Find appendices electronically which are referenced in the main text.	Done
107		Appendix 5			Indication of the quantitative nature of the indicator on “Share of imported feed” is not included.	Identify the “Share of imported feed” indicator as Qt (quantitative).	Done
108		Appendix 5			Groups involved in “Measures to promote connectivity identified and implemented” is incomplete.	Include scientists, geographers and local/regional land planners in the list of groups who should be involved.	Added
110	17	Appendix 6			Not clear what “A diversity of crops and crop varieties is grown” has to do with landscape connectivity. Could argue it might be positive or negative for wildlife movement.	Either explain more clearly or delete.	Title was renamed to landscape connectivity **and heterogeneity**. As explained in appendix 5, farmland are mosaic landscape and crop diversity can provide a diversity of food/habitat resources to wild species
112		Appendix 7			Incomplete	Add DAD-IS as a global source of data for breeds of livestock (already mentioned on page 10 line 21, p.25 l.21, p.26 l.4-7; see http://www.fao.org/dad-is/en/)	Added
112		Appendix 7	Table A7: The Biota of Canada Informatio n Network		First, the acronym is not in conformity with the title of the data source. Second, my browser reported that connection was refused to the URL given in the Table	Is it worthwhile maintaining an inaccessible data source in this Table? On the other hand, the Biological Survey of Canada operates an ongoing project, "The Biota of Canada"	We removed the entry and in the end chose not to reference your publication because it is not an open database

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			(BCIF)		(http://www.durable.gc.ca/group/biota/index_e.phtml) or any version of it.	(although no "network" is indicated). In 2019 they published "*The Biota of Canada: Terrestrial Arthropods*", which is a regional source of data but not however specifically related to the impact of livestock (see https://zookeys.pensoft.net/issue/1251/)	
Aarhus University							
30	7-10	4.2		g	I think this is not right. More methods are available within LCA that focus on the impact of different emissions on biodiversity rather than land use *per se*- see eg http://publications.jrc.ec.europa.eu/repository/bitstream/JRC46650/jrc46650.pdf Also the STEPWISE procedure was used (Journal of Cleaner Production 28 (2012) 168-176) and more recently the Recipe procedure- see https://www.rivm.nl/en/life-cycle-assessment-lca/recipe and the PEFCR regarding Feed for food producing animals p 95-96 https://ec.europa.eu/environment/eussd/smgp/pdf/PEFCR_feed.pdf Section starting line 21 seems contradicting section starting line 7	Biodiversity assessments in LCA rely on a few currently available models that estimate the impact of different emissions on species richness. Along with these models – but not integrated in the assessment – some methods focus on impacts through land use; the latter, however, consider broad land use classes (e.g., biodiversity impact of grassland vs. cropland);	We used your text and also added a citation to the ReCiPe methodology.
30	12-14	4.2		te	Though, at least one new publication do present more detailed land use classes in relation to biodiversity for LCA. Knudsen et al 2017 Characterization factors for land use impacts on	Section needs to be rewritten	Good point, what we meant was that no existing LCA models available at global scale was available to assess the effect of detailed land use/production practices. We made this more clear and precise outlining that local CFs can be developed to assess the impact

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					biodiversity in life cycle assessment based on direct measures of plant species richness in European farmland in the 'Temperate Broadleaf and Mixed Forest' biome. Science of the Total Environment, Vol 580, pages 358 - 366		of production practices.
National Cattlemen's Beef Association							
Overall				ge	In general, NCBA supports the guidelines and its overall support of inclusion of biodiversity in LCAs. These guidelines will allow LCAs to have a more complete picture of the positive and negative outcomes of systems.		
19/overall	22 - 32			ge	NCBA is concerned with the black/white approach to intensive v. extensive systems. We suggest you more strongly acknowledge the within system complexity that most ruminant meat production systems in the world are mostly extensive with potentially an intensive (i.e. confined) portion of the animal's life. Therefore it is not simply black or white, but optimization comes within this mixed production system framework of ruminant meat production.		Very good point, we added this text to section 3.1 (on impacts and opportunities in extensive vs. intensive systems) about the interlinkages between extensive and extensive phases in beef production: *"In ruminant systems and beef production in particular, intensive and extensive systems are very often interlinked within the same supply chain. Grassland-based (extensive) cow-calf operations produce calves that are then sold to be fattened in confined (intensive) systems to produce the final product, i.e. meat. Increasing the biodiversity performance will thus require an integrated, supply chain perspective as well as specific solutions targeting the extensive and intensive phases of the production cycle."*
				Ge	NCBA strongly supports the development of localized characterization factors for biodiversity that can capture the beneficial aspects of livestock		We added a sentence to section 4.2 on assessment scale to highlight the opportunity to develop local CFs: *"Finally, data collected in the context of PSR*

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					production and precise enough to reflect management differences, beyond essential presence or lack of livestock, extensive v. intensive.		*assessments can also be used for the development of local characterization factors and specific LCA models that would be able to differentiate between management intensities and practices (e.g. Knudsen et al. 2017, see also section 5.4.2).“*
43	27 - 38			Ge	NCBA is concerned over your use of “potential natural vegetation” as the suggested reference state. Due to this concern we would not support the recommendation of PNV in the characterization factors as the baseline reference state.		On this aspect, see also our response to USDA’s comment on reference state. The document does not recommend the use of PNV or of any specific reference, but stresses that: “*The reference state decision has important implications for the results. Both the reference state and these implications should be reported and discussed, especially when using different methods*” However, as indicated in the document: “*The main LCIA model recommended in this document for global/regional assessments (Chaudhary and Brooks 2018) use the PNV as a reference state.”* This is because this method is consistent with UNEP-SETAC recommendations, and because PNV provide a sort of equal treatment to all regions for global assessment, whereas different references may be relevant to different regions when doing regional assessment. In any case, this LCIA model is not the only recommendation, the use of more specific regional assessments/development of local CFs is encouraged and the most important point is to discuss the choice and consequence of a specific reference state.

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CIPAV Foundation							
18	36	1.1.		ge	The positive impact of extensive livestock doesn't apply to areas where the forest has been replaced with pasture (which is a common case in the Neotropics). (Nepstad et al. 2008 "Interactions among Amazon land use, forests and climate: prospects for a near-term forest tipping point"). In some cases, conventional cattle ranching simplifies ecosystems by promoting grass monoculture as the main food source (eg. forest to pasture). This affirmation only applies to some specific biomes as natural grasslands.	For instance, extensive livestock grazing can be the only way to maintain semi-natural grassland habitats hosting a unique pool of wild species and providing key ecosystem services (e.g., in temperate grasslands, Pogue et al. 2018; or in tropical grasslands, Overbeck et al. 2007). However, it does not apply to areas where the forest has been replaced with pasture (Nepstad et al. 2008). Nepstad, D.C., Stickler, C.M., Soares-Filho,B. & Merry, F. 2008. Interactions among Amazon land use, forests and climate: prospects for a near-term forest tipping point. Phil. Trans. R. Soc. B 363: 1737-1746	We used your addition but added "where the forest has been **recently** replaced"… because those systems with positive impact in Europe for example used to be forest thousands of years ago but biodiversity has adapted to these open habitats since then.
19	28	1.2.		ge	Intensification can also be achieved with the increase of biomass production by introducing shrubs and trees (silvopastoral systems) that can also enhance the provision of environmental services (Chará et al. 2019. "Silvopastoral Systems and their Contribution to Improved Resource Use and Sustainable Development Goals: Evidence from Latin America").	However, changing to high input and intensively managed systems intensification could result in higher impacts on biodiversity because of the associated habitat changes (e.g. natural to improved pastures, grassland to feed crops) and negative effects of water withdrawal, pesticides or inorganic fertilizers. Nevertheless, intensification can also be achieved with the increase of biomass production by introducing shrubs and trees (silvopastoral systems) that can also enhance the provision of environmental services. (Chará et al. 2019).	Good point, your sentence was added to section 3.1 when discussing challenges and opportunities in extensive vs. intensive systems. The end of the paragraph already acknowledges this (we could add the citation to MacDonald 2004 if you could provide the full reference): *"On the contrary, extensively managed grassland-based systems can provide crucial biodiversity habitats, but with higher GHG emissions per unit of product compared to intensively managed systems because these 'units of product' usually focus on food or proteins and do not take into account other social and ecosystem services"*

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						On the other hand, extensively managed natural grassland-based systems can provide crucial biodiversity habitats, but with higher GHG emissions per unit of product compared to intensively managed systems because these 'units of product' usually focus on food or proteins and do not take into account other social and ecosystem services (MacDonald 2004). Chará, J., Reyes, E., Peri, P., Otte, J., Arce, E. & Schneider, F. 2019. Silvopastoral Systems and their Contribution to Improved Resource Use and Sustainable Development Goals: Evidence from Latin America. FAO, CIPAV and Agri Benchmark, Cali, 60 pp.	
56		6.2.	Table 2	te	There is suggested to include additional indicators of ecological function. Dung beetles, for example, have been receiving a fair bit of attention as indicators of land-use change (Spector 2006 "Scarabaeine dung beetles (Coleoptera: Scarabaeidae: Scarabaeinae): an invertebrate focal taxon for biodiversity research and conservation") and pasture health (Davis et al. 2004 "Scarabaeine dung beetles as indicators of biodiversity, habitat transformation and pest control chemicals in agro-ecosystems"). (Giraldo et al. 2011 "The adoption of silvopastoral systems promotes the recovery of ecological processes regulated by dung beetles in the Colombian Andes").	To include additional indicators, for example: • Amount of soil removed by dung beetles from around each dung ball as a result of dung being incorporated into the soil. For this is possible to scrape from the soil surface or take the soil over the manure and weigh it in situ (Giraldo et al. 2011). • Measure of structural complexity (vegetation). Stand scale indicators. For example: tree diameter (McElhinny et al. 2005).	Thank you for those useful suggestions, we added them to the extended list of indicators (Appendix 6). This is because we want to keep the shortlist of indicator to the minimum and to a certain level of generality, otherwise there is the risk to include too many specific things: dung beetles but also earthworms etc…; structural complexity in trees but also in the sward (grassland) etc…

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					On the other hand, to use indicators to describe and monitor biodiversity are often inaccurate at the scale of a patch or stand of vegetation. The lack of precision at this finer scale is because within any broad environmental classification, such as a bioregion, environmental domain, or vegetation community, biodiversity can be highly variable as a result of past natural disturbance or modification by humans. Stand scale indicators are critical for explaining this additional variation (McElhinny et al. 2005 “Forest and woodland stand structural complexity: Its definition and measurement”).	Giraldo, C., Escobar, F., Chará, J. & Calle, Z. 2011. The adoption of silvopastoral system promotes the recovery of ecological processes regulated by dung beetles in the Colombian Andes. Insect Conservation and Diversity. 4:115-122 McElhinny, C., Gibbons, P., Brack, C. & Bauhus, J. 2005. Forest and woodland stand structural complexity: Its definition and measurement. Forest Ecology and Management 218: 1-24	

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