Dear CFS/HLPE Secretariat,

Grateful for the opportunity to participate in this public consultation, I have submitted general comments in a collective submission (see: "Comment by transdisciplinary team of scientists working in food and agriculture systems").

In this separate submission, I provide a few supplementary notes on chapter sections sustainable intensification (2.3.2) and genetically modified organisms (3.2.6).

I am a researcher who focuses on crop genetic diversity, biotechnologies, and their impacts on agriculture and food systems in developing countries. My perspective is informed by a background in molecular biology and science writing, and PhD studies in political ecology and human geography.

Thank you,
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2.3.2. Sustainable Intensification

This section is robustly documented in terms of practices but it lacks a few critical features that would strengthen readers understanding of the place of SI in the broader sustainable development and FSN literature.

1. Need to acknowledge that sustainable intensification is rooted in a particular model [or paradigm] of agricultural development. Bernard and Lux (2017) show how agroecology and SI are situated in discursive fields in which questions about food security, diet composition, health, environmental concerns, equity, poverty and livelihoods, declining agrobiodiversity, etc. all play key roles. To simplify a very complex discourse analysis, they narrow in on questions such as "Feed the World Sustainably."

Of note, "**The starting point of the SI discourse is that food production needs to increase in order to face the growing demand today and in the future."** (Bernard and Lux 2017, p. 3)

This productionist baseline automatically distinguishes the priorities and objectives of SI from that of agroecology.

It further indicates **that SI envisions FSN as primarily a problem of food availability**, as opposed to access, utilization, stability, and agency that this report includes on Page 14 as components of FSN.

2. It would help to include a short discussion of land-sparing and land-sharing.

The Godfray et al. (2010) and Royal Society (2009) treatments of SI propose that expanding agroecological land is neither desirable nor feasible. SI thus shares many aspects of the "land sparing" agenda which deserves to be highlighted here for a few reasons:

a) Much agroecology literature contests the land-sparing framing as problematic for neglecting the ecological externalities of intensification; assuming that low-intensity agriculture is less productive; ignoring price effects over time as intensification expands supply; neglecting risks of farmer dispossession from "spared land" (Fischer et al. 2011; Perfecto and Vandermeer 2010; Chappell and Lavalle 2011).

b) Further agroecological research suggests that the sparing/sharing debate is itself problematic (eg. Fisher et al. 2008; Kremen 2016). Nonetheless, these texts firmly reject the premises upon which SI is based: that constraining land results in conservation of nature or enhances global FSN. Kremen (2016, p.52) writes:

> A "both and" framing of large protected areas surrounded by a wildlife-friendly matrix suggests different research priorities from the "either-or" framing of sparing versus sharing. **Furthermore, wildlife-friendly farming methods such as agroecology may be best adapted to provide food for the world's hungry people.**

3) There is insubstantial evidence provided to show if and how SI has produced (or will produce) FSN outcomes.

The evidence of SI's effects on FSN is heavily dependent on just the Montpellier Panel's database. But the Montpellier Panel was organized precisely to promote sustainable intensification, suggesting possible bias in the data that is not recognized in this section. The MP specifically defines SI as a paradigm that is productivist, market-oriented, and integrated into global trade regimes. Moreover, the cases are focused primarily on Africa, so it is hard to extrapolate the evidence to a global scale.

Indeed, the above literature on land-sparing/sharing suggests that SI favors labor-saving technologies and intensification strategies that may *reduce* FSN by making smallholders more vulnerable to land loss, integration in global markets, and or loss of agrobiodiversity. The fact that smallholders and peasants currently produce 53-70% of the world's food supply (and in some regions up to 80-90%) strongly suggests that any strategy that seeks to optimize inputs, close yield gaps, and improve utilization of crop varieties and breeds without transforming the political economy in which these practices are embedded will likely lead to land concentration and greater food insecurity (Graeub et al. 2016; Perfecto and Vandermeer 2010).

4) Need to explain SI's own conceptual evolution, from smallholder-centered to productionist "many tools" approach.

Th section is currently failing to effectively sketch the arc of SI's own evolution as a concept.

As described in Loos et al. (2014) and Bernard and Lux (2017), SI has undergone distinctive phases: The first use of "sustainable agriculture" by Jules Pretty (1997) "was used to describe the aim of raising agricultural yields while also benefitting the environment and the economy."

> **This original definition emphasized local knowledge and the development of adaptive agricultural methods suited to local conditions. The participation of smallholder farmers was considered crucial for the development and extension of more productive technologies (Pretty 1997).**

The later uptake of SI by the Royal Society (2009), Godfray et al. (2010), and Foresight (2011 – **not included in this report**) transformed the meaning of SI substantially by moving away from local approaches and instead focusing on efficiency enhancement (Lang and Barling 2012), often at a global or national scale (eg Mueller *et al*. 2012).

At this juncture, SI also began to embracer "greener" versions of conventional intensification, including biotechnology, precision agriculture, and the many market-based incentives described in the Montpellier report (2013)

Linking back to the first point above, the orientation continues to emphasize yield and production over other elements of FSN. Loos et al (2014) say: **"The main argument to promote sustainable intensification is the observation that a growing, wealthier human population is demanding more agricultural products. Current mainstream literature on sustainable intensification tends to focus on aggregate levels of food production rather than on patterns in the distribution and consumption of food."**

4) The section does not adequately describe *rejections* of SI which have taken the form of "ecological intensification" and even reclamations of "sustainable intensification"

It is true that the nomenclatures of "sustainable intensification," "ecological intensification," and "agroecological intensification" can lead to a great deal of confusion.

But the section tucks ecological intensification wholly under the umbrella of SI without recognizing that several texts have proposed ecological intensification as a rebuke to SI or as an attempt to "reclaim the term".

One reference already cited above is:

Loos, Jacqueline, David J. Abson, M. Jahi Chappell, Jan Hanspach, Friederike Mikulcak, Muriel Tichit, and Joern Fischer. 2014. "Putting meaning back into "sustainable intensification"." *Frontiers in Ecology and the Environment* 12, no. 6: 356-361.

A second is:

Tittonell, Pablo. "Ecological intensification of agriculture—sustainable by nature." 2014. *Current Opinion in Environmental Sustainability* 8: 53-61.

Tittonell explicitly states:

> "Agroecology *sensu* SOCLA (Spanish acronym for the Latin American Society for Agroecology, URL: http://www.agroeco.org/socla) is in my opinion the most conspicuous example of ecological intensification for family agriculture in terms of both technological and institutional development."

He includes organic agriculture, diversified agriculture, and agroecology as ready types of "ecological intensification" while explicitly *excluding* approaches that have evolved out of Green Revolution systems – such as the AGRA-led forms of sustainable intensification. So, there is a deep disconnect here between SI and EI.

Explaining this trajectory of SI's own conceptual evolution – from Pretty's original notion through to the current forms, and including explicit attempts to "reclaim sustainable intensification" – is critical, I suggest, to providing a more basic grasp of how SI approaches FSN. **The above literature (and that**

included in the V0) suggests that SI overly emphasizes technologies and practices linked to enhancing production with far less consideration to other aspects of FSN.

This literature also suggests **strong antagonisms exist between SI and agroecology**, in terms of the paradigms (localized/globalized agriculture, smallholder/large-holder orientation, market dependence/independence, liberalized/sovereign trade, neoliberal/post-neoliberal) that they support on a larger social-ecological scale.

5) The Wezel (2015) reference is an excellent one. Several passages from this section, however, are taken verbatim from that paper. The V0 would be stronger by bringing in a variety of literatures rather than repurposing that existing publication.

<u>*Works Cited*</u>

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Tittonell, Pablo. “Ecological intensification of agriculture—sustainable by nature.” 2014. *Current Opinion in Environmental Sustainability* 8: 53-61.

Vandermeer, J. and I. Perfecto. 2005. The Future of Farming and Conservation. *Science* 308: 1257-1258.

3.2.6 Can genetically modified organisms be part of SFS for FSN?

This section takes on an incredibly challenging arena, so credit to the authors for attempting to capture some of those debates here. My overall take on this material, however, is that it mirrors the dominant opinions and perspectives in a small subset of literature, while marginalizing social scientific and civil society views, not to mention those of agroecology researchers, practitioners, and movements worldwide. Lack of any discussion of pesticides associated with the most widely used GM crops suggests that GMOs are not being evaluated as a technological *system*, which is required in order to fully assess sustainable food systems for FSN.

The V0 also includes no discussion of genomic editing, which is quickly becoming the standard in genetic engineering. The material thus feels a bit dated.

Review of section 3.26

1) Erroneous defining of important terms: "genetic engineering" "recombinant DNA" and "biotechnology."

Genetic engineering or recombinant-DNA technology permits selective gene transfer from one organism to another and between species (Bawa and Anilakumar, 2013).

The Bawa and Anilakumar piece is correctly written, but this paraphrase is not. Genetic engineering includes recombinant-DNA technology, but is a broader class of techniques; *it is not interchangeable with rDNA*. Genetic engineering has been defined by the USDA (see below), by the Convention on Biological Diversity, and by FAO Codex Alimentarius. This report should rely on those widely used and standard definitions.

Eg. The USDA defines GMO as products that result from: "manipulation of an organism's genes by introducing, eliminating or rearranging specific genes using the methods of modern molecular biology, particularly those techniques referred to as recombinant DNA techniques."

2) Line 39 suggests that: Genetically modified organisms (GMOs) were discovered in 1946 (Clive, 2011).

This is misleading. What was discovered in 1946 was *bacterial conjugation*, a natural form of horizontal gene transfer and not genetic engineering. HGT can and does occur in nature, as is now increasingly recognized in research across multiple kingdoms. The term GMO should be applied to products of genetic engineering, the first of which did not occur until the 1980s (see Heinemann 1991; Murphy 2004).

- Clive 2011 is missing in the bibliography

3) Objections to technology section (bottom of p. 76, top of p. 77) **is highly underdeveloped.**

- Prioritizes objections ('moral stances or beliefs') that downplay significant scientific concerns. The way this list is presented reinforces the hackneyed stereotype that those with concerns about genetic engineering are 'anti-science' and base their positions on belief, rather than evidence (see treatments of this in Wise 2015; Zimmerman and Eddens 2018)

- Does not mention several other social and ecological concerns, including:

  - **Risks to crop diversity and crop genetic diversity:** through displacement of native crops and varieties; through genetic contamination/cross-pollination (mentioned P 76/Line 44 but could be reiterated and categorized here); and via the advance of monocultural cropping systems that tend to correlate with uptake of GM varieties.
  - **Risks to public R&D for plant breeding.** With the elaboration of intellectual property regimes, public sector plant breeders, especially in the US and Europe, have seen radical diminishment of

access to genetic materials for breeding purposes. This has clear and direct consequences for crop breeding and, hence, FSN (see: Aoki 2008; Kloppenburg 2014; Luby et al. 2015; Howard 2015 and 2016).

- **Risks to indigenous seed systems, peasant seed systems, and informal seed economies.** This is a cultural, ethical, justice, *and food security and nutrition concern*, widely documented in the anthropology and political ecology literature (Kinchy 2012; Graddy-Lovelace 2013; Nazarea, Rhodes, and Wilkinson 2013; Campbell and Veteto 2015, Huambachano 2018)

- **Risks of the chemical associated with the GM crops.** #3 in the list suggests that it is possible to narrow the risk to the organisms. Widespread recognition of risks to humans (including farmworkers, rural communities, children in utero) and ecosystems (**including herbicide-resistant weeds and Bt resistant insect pests**) are associated with pesticides. The most common pesticide linked to GM crops is glyphosate, now classed as probably carcinogenic by the WHO/IARC. Chemicals are not even mentioned in this section which is odd for any authoritative review; *GM must be evaluated as a technological system* in order to assess its contribution to SFS for FSN. (Treatment of chemicals on Page 75 of the V0 is good; it should be better linked to this GM section).

- **Risk of transition to monoculture/industrial production systems.** This risk deserves to be underlined on its own as shorthand for many problems that correlate with monoculture. Notably, the whole point of this report is to promote innovations for *sustainable* agriculture and to move away from industrial systems. Yet to date, and I return to this point below, GM crops have been largely developed to expand the reach of industrial agriculture into geographies and among communities that currently practice low-external input agriculture and in some cases, agroecology (see IPES 2017a "From Uniformity to Diversity" extract below).

- In addition to what might be classed as "risks" there is the very well-documented correlation of introduction of genetically modified crops and accelerated consolidation of the seed and agro-chemical sectors since the mid-1990s (Howard 2009, 2016; IPES-Food 2017b "Too Big to Feed"; Agri-Food Atlas 2017).

- See also congressional oversight hearing looking into the subject of consolidation in the U.S. seed and agrochemical industry (many Congress members expressed resignation as to its inevitability) (Senate Judiciary Committee (2016).

Text-specific issues on the points already provided (Point #2):

> "This could affect the progress of scientific research as well as affecting farmer practice **if intellectual property rights imposed constraints**, with the corollary argument that allowing ownership of GMOs is necessary to stimulate private sector investment."

"If" implies a hypothetical. There is very strong evidence that IPR already imposes such constraints. Peer-review research on this topic from fields including rural sociology, law, anthropology, STS, and geography includes: Kloppenburg 1988/2004; Posey 1996; Mascarenhas and Busch 2006; Aoki 2008; Kinchy 2012; Howard 2015 and 2016; Luby et al. 2015.

> "Concerns that GMO technology many be dangerous and have unintended ecological consequences, including on human health."

> While it is possible that the authors consider humans to be ecological beings, as stated, this sentence is confusing. Human health is not generally considered a sub-category of ecology.

4) Current use of GM technology –

- Section uses confusing terms ("most commonly used" and "most common type of insect resistant crop") **rather than clearly delineating whether "common" means land area under production (ha), production value ($$), number of farmers, or some other metric.**

- Section also **overemphasizes Bt while paying less attention to herbicide resistant crops (HR)** which are grown over more land area and have had considerably wider ecological and social consequences.
- Relatedly, **there is no mention of glyphosate**:
    - which is now applied to 89 percent of U.S. corn crop and 94 percent of the soybeans, as well as with dozens of other crops (Benbrook 2016).
    -To date 18.9 billion pounds (8.6 billion kilograms) of glyphosate have been used globally. Glyphosate use has risen almost 15-fold since so-called "Roundup Ready" genetically engineered crops were introduced in 1996 (Benbrook 2016).
- Especially given that WHO/IARC has classified glyphosate as a "probable carcinogen", the health risks associated with herbicide use on this scale should not be left out of the HLPE report.

Supporting references from IPES Uniformity to Diversity report (p16) that link pesticide use, monoculture cropping and genetically modified crops:

> The **mass pesticide usage** associated with the development of specialized large-scale mono-cropping has engendered risks of its own, with major implications for long-term productivity. The first case of resistance to pesticides was discovered in the 1960s (Gould, 1991). Since then, pests, viruses, fungi, bacteria and weeds have been adapting to chemical pest management faster than ever. **Having recourse to additional chemicals to tackle these resistance problems risks setting in place vicious cycles of further adaptation and resistance** (Pollinis, 2015).
>
> This trend has been increasingly documented with regard to **genetically modified (GM) crops**, and particularly the monocultures associated with the 'Roundup Ready' model of herbicide-tolerant crops and accompanying glyphosate treatments. There are currently some 210 species of herbicide-resistant weeds, many of which can be linked to GM crops (Heap, 2014). The 'treadmill' of increasing pesticide use and increasing resistance not only fails to address the underlying problem of pest resistance and its threat to yields, but also brings mounting costs for farmers (see Section 1.a.iii).

5) Addressing food FSN for vulnerable groups

- Recognition of Moseley (2017) and Stone and Glover (2017) is good. The framing and treatment, however, oddly marginalizes the importance of their interventions. Moseley (2017) argues that a GMO approach is not only part of a narrow, industrial approach (as this text suggests); he argues that it actually *invites* vulnerability and risk:

> **"investing in GMO-seed technology represents a significant financial risk for many small famers in variable rainfall environments, let alone the volatility of markets where farmers must sell all or part of their harvest if they are to cover their input costs. A more viable approach to helping the poorest of the poor increase production and meet food needs is informed by agroecology".**

- There is no mention that the 2016 National Academies' Report on GE (Genetically Engineered Crops: Experiences and Prospects**) found that genetically modified crops have not contributed to measurable increases in crop yield or even "readily identifiable economic benefits" for many**

farmers. The NAS authors acknowledge that given the considerable uncertainty around emerging GE technologies' potential future impact on yield, and the fact that feeding the world involves "much more than simply increasing crop production," GE products themselves are unlikely to offer an advantage for FSN.

- An analysis by *The New York Times* using United Nations data similarly showed that **the United States and Canada have gained no discernible advantage in yields — food per acre — when measured against Western Europe, a region with comparably modernized agricultural producers like France and Germany** (Hakim 2016).

- Notably, the same *Times* investigation (using FAO and USGS data) found that:
"At the same time, **herbicide use has increased in the United States**, **even as major crops like corn, soybeans and cotton have been converted to modified varieties. And the United States has fallen behind Europe's biggest producer, France, in reducing the overall use of pesticides, which includes both herbicides and insecticides**" (Hakim 2016).

6) Health impacts (Page 79/Line 42) – The current treatment is overly reductionist. These health impacts need to include the health effects of chemicals designed to work with GM crops. Arguably it could even consider health repercussions that result from loss of crop biodiversity, and the nutritional consequences associated with increased consumption of industrial meat, processed foods, and high-fructose corn syrups – all linked to the expansion of genetically engineered soy, corn, and canola.

7) Relationship to Agroecology (page 79) –

- Illogical sentence: "Despite the uptake of GM technology, and the many reports in the scientific literature on the risks and benefits of GM, there is public mistrust in GM technology (Andreasen, 2014)."

Uptake says nothing about whether or not public trust does (or should) exist. Many reports in the scientific literature include both risks and benefits, so mistrust is a non-sequitur.

- More importantly, I suggest, this section lacks any recognition of

> **a) the substantial literature from agroecology science, practitioners, and social movements** argue explicitly against the need for genetically modified crops to sustain agriculture in the long-term or to promote food security and nutrition (see a few references below)**;**
> **d) recognition that agroecology principles (eg. in foundational Altieri and Gliessman texts relied upon in Chapter 1)** affirm "conservation of local genetic resources,
> design of polycultures and crop rotations"; these are implicitly and often explicitly described in contrast to GMOs (see Table in Martínez-Torres and Rosset below).
> **b) research from social and natural sciences on antagonisms that exist between models that support GM development and agroecology development (eg. Vanloqueren and Baret 2009; see more below);**
> **c) recognition of historical development of agroecology;** in many places, AE as a science, practice, and movement emerged in resistance to Green Revolution interventions (Gliessman 2013); for many, it continues today in resistance to what are seen as Second Green Revolution development pathways, which include genetic engineering and gene editing (Holt-Gimenez and Altieri 2013; Moseley 2017).

A limited list of peer-review and grey literature:

International assessments

- IAASTD (2008) - The UN-led International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) is a landmark study authored by over 400 scientists and development experts from more than 80 countries.

> **GE crops, the IAASTD found, primarily serve to boost multinational corporations' profits rather than to benefit poor and small-scale farmers around the world** (IAASTD 2008)

- Declaration, Nyéléni. (2015). Declaration of the international forum for agroecology. Sélingué: International Forum for Agroecology. Retrieved from http://www. foodsovereignty. org/forum-agroecology-nyeleni-2015.

> p. 2 - "Agroecology drastically reduces our use of externally-purchased inputs that must be bought from industry. There is no use of agrotoxics, artificial hormones, GMOs or other dangerous new technologies in agroecology."

> p. 5 – "IX. Denounce and fight corporate and institutional capture of agroecology
> 1. Fight corporate and institutional attempts to grab agroecology as a means to promote GMOs and other false solutions and dangerous new technologies."

International Movement Declarations

- The 1996 La Via Campesina declaration on food sovereignty (reviewed in Patel 2009)
- The 2007 Nyéléni Declaration

- LVC (La Vía Campesina). 2015. Peasant agroecology for food sovereignty and mother earth, experiences of La Vía campesina. Notebook No. 7. Zimbabwe: LVC.

> "Ours is the 'model of life', of the countryside with peasants, of rural communities with families, of territories with trees and forests, mountains, lakes, rivers and coastlines, and is in firm opposition to the 'model of death' of agribusiness, of farming without peasants or families, of industrial monocultures, of rural areas without trees, of green deserts and land poisoned by chemical pesticides **and genetically modified organisms**. We are actively challenging capital and agribusiness, disputing land and territory with them" (LVC 2015).

While LVC does not speak for the totality of farmers, as the world's largest organization of peasants, pastoralists, fisherfolk, and indigenous agriculturalists (comprising an estimated 200 million people), its views are also not inconsequential. At the very least, HLPE should note that that movements to expand and scale up agroecology and food sovereignty are understood by many to be in direct contradiction to GM approaches. As described by Giraldo and Rosset (2018):

> "new technological packages based on elements of agroecology are part of a generalized move to 'greenwash' agribusiness following the trail blazed by climate-smart agriculture, sustainable intensification, organic agriculture based on commercial inputs, drought-resistant GMOs and precision agriculture (Holt-Giménez and Altieri 2013; Loos et al. 2014; Pimbert 2015)".

A sample of seer-review studies of antagonisms between GMO pathways and agroecology pathways to sustainable development and food security & nutrition.

- Holt-Giménez, E. and Altieri, M. A. 2013. Agroecology, food sovereignty, and the new green revolution. *Agroecology and sustainable Food systems*, *37*(1), 90-102.

- Jacobsen, S.-E., Sørensen, M., Pedersen, S.M., Weiner, J., 2013. Feeding the world: genetically modified crops versus agricultural biodiversity. *Agronomy for Sustainable Development* 33, 651–662. doi:10.1007/s13593-013-0138-9

- Moseley, W. G. 2017. A Risky Solution for the Wrong Problem: Why GMOs won't Feed the Hungry of the World. Geographical Review, 107(4), 578-583.

- Pellegrini, Pablo. 2009. Knowledge, identity and ideology in stances on GMOs: The case of the Movimento Sem Terra in Brazil. *Science & Technology Studies*.

- Vanloqueren, G. and Baret, P. V. 2009. How agricultural research systems shape a technological regime that develops genetic engineering but locks out agroecological innovations. Research policy, 38(6), 971-983.

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Table 1. (*Continued*).

Issue	Dominant model	Food sovereignty
Farming technology	Industrial, monoculture, Green Revolution, chemical-intensive; uses GMOs	Agroecology, sustainable farming methods, no GMOs
Farmers	Anachronism; the inefficient will disappear	Guardians of culture and crop germplasm; stewards of productive resources; repositories of knowledge; internal market and building block of broad-based, inclusive economic development
Urban consumers	Workers to be paid as little as possible	Need living wages
Genetically Modified Organisms (GMOs)	The wave of the future	Bad for health and the environment; an unnecessary technology
Another world (alternatives)	Not possible/not of interest	Possible and amply demonstrated

Gene editing and other new genetic engineering technologies

The HLPE report would be strengthened by recognition and brief discussion of the new generation of genomic editing, RNAi, and synthetic biological techniques in genetic engineering (Doudna, J. A., and E. Charpentier. 2014. “The New Frontier of Genome Engineering with CRISPR-Cas9.” *Science* 346 (6213). It would be further strengthened with a discussion of gene drive, which has many far-reaching implications, including for agriculture (eg., Esvelt, Kevin M, Andrea L Smidler, Flaminia Catteruccia, and George M Church. 2014. “Concerning RNA-Guided Gene Drives for the Alteration of Wild Populations.” *ELife* 3 (July). doi:10.7554/eLife.03401.)

Regulatory oversight and policy have also galvanized interest from research and governance communities. Whether or not gene editing will be regulated ‘as GMO’ is carving lines between US and European agencies, as well as between different scientific disciplines, consumer advocacy, peasant/farmer movement, and civil society groups.

To the extent that gene editing is rapidly becoming the new normal in genetic modification of plants, animals, microbes, yeast, and fungi, it seems wise to recognize the emergent field. Doing so within the context of prior evidence-based assessments of GM efficacy in enhancing FSN would help situate the technology in context.