CFS COMMITTEE ON WORLD FOOD SECURITY

HLPE High Level Panel of Experts

PROCEEDINGS

HLPE-FSN note on Harnessing Artificial Intelligence, digitalization and data governance for food security and nutrition

COLLECTION OF CONTRIBUTIONS RECEIVED

22 June 2026

Background

The Committee on World Food Security (CFS) is organizing a High-Level Forum (HLF) on "Harnessing Artificial Intelligence, digitalization and data governance for food security and nutrition", focusing on enhancing equity and inclusiveness in food systems.

The Multiyear Program of Work of CFS (MYPoW) notes that "innovations such as artificial intelligence (AI), digital platforms and big data analytics have the potential to enhance productivity, improve early warning systems, support climate adaptation and strengthen value chains. At the same time, these technologies also bring new challenges, including concerns around data privacy, equity, algorithmic bias, digital exclusion and lack of governance mechanisms".

The purpose of this background note from the CFS High Level Panel of Experts on Food Security and Nutrition (HLPE-FSN) is to inform the event and provide the basis of discussions during the forum. This draft note is published for e-consultation. With this e-consultation, the HLPE-FSN Steering Committee is seeking your feedback.

Contributions

The online consultation was launched on 29 May 2026 and closed on 15 June 2026.

The HLPE-FSN Secretariat has received **48 insightful and sharp contributions** from experts and practitioners of diverse public and private organizations working in different fields of expertise, academia, civil society, and other institutions from 17 countries, namely Argentina, Brazil, Canada, Costa Rica, Germany, India, Iran (Islamic Republic of), Jordan, Mexico, Nepal, Spain, Tajikistan, Tunisia, The Netherlands, United Kingdom of Great Britain and Northern Ireland, United Republic of Tanzania and United States of America.

The results of this consultation will be used by the HLPE-FSN to elaborate the report. More information about the CFS request and the e-consultation is available here. More information on the HLPE-FSN publication process is available here.

Total Contributions: 48
Countries: 17
Contributions on behalf of a team/organization: 32

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Contributions are presented in chronological order, reflecting the sequence in which they were submitted. In the index, personal contributions are listed by name and surname, while contributions made on behalf of an organization or institution are listed by the name of the organization and the country.

Guiding questions

1. Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?
2. Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.
3. Are the issues identified fully capturing the links with FSN outcomes?
4. Is there any aspect of direct or indirect FSN outcome that should be further elaborated?
5. Is there any example or case study that would deserves to be mentioned?
6. In particular, do you have examples of effective policies to improve FSN outcomes of the use of Artificial Intelligence, digitalization and data governance in food systems?
7. Is there any missing reference to key literature and data?

Contributions

1. Benjamin Kwasi Addom

Surname	Addom
First name	Benjamin Kwasi
Are you contributing in a personal capacity or on behalf of an organization or team?	Personal capacity
Current position	Adviser, Digital Agriculture and Fisheries Trade Policy
Current institution/organization	Commonwealth Secretariat
Affiliation	International/Inter-Governmental Organization
Country	United Kingdom of Great Britain and Northern Ireland
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	Yes, most of the issues are very important including the emphasis on data.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	Yes. The issues relating to data for food, agriculture and nutrition need to be more elaborated in the context of national sovereignty. The Commonwealth National Agricultural Data Infrastructure (NAgDI) framework should be considered in supporting countries to prepare for AI adoption and use.
Are the issues identified fully capturing the links with FSN outcomes?	Yes
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	Emphasis on national data systems just the recent approach through food systems. Data management in our countries need to take a system approach to ensure the existing databases are interconnected and interdependent for term data systems.
Is there any example or case study that would deserves to be mentioned?	Yes. The Commonwealth National Agricultural Data Infrastructure (NAgDI) framework - https://thecommonwealth.org/national-agricultural-data-infrastructure

In particular, do you have examples of effective policies to improve FSN outcomes of the use of Artificial Intelligence, digitalization and data governance in food systems?	Yes. The Commonwealth National Agricultural Data Infrastructure (NAgDI) framework argues that for AI to benefit the sector, countries need a holistic framework for managing their data. Technologies and systems, policies and principles, governance and administration, marketing and business must be addressed together for countries to better harness the benefits of AI and digitalization.
Is there any missing reference to key literature and data?	Yes - 1. Commonwealth Secretariat (2025). National Agricultural Data Infrastructure: A Policy Guide. Coordinated by Addom, B.K. and Krishan, J.B. https://thecommonwealth.org/publications/national-agricultural-data-infrastructure-policy-guide 2 . Commonwealth Secretariat (2024). National Agricultural Data Infrastructure: Bangladesh. Coordinated by Addom, B.K. and Krishan, J.B. A Policy Brief. https://thecommonwealth.org/publications/national-agricultural-data-infrastructure-bangladesh 3. Commonwealth Secretariat (2024). National Agricultural Data Infrastructure: Caribbean. Coordinated by Addom, B.K. and Krishan, J.B. A Policy Brief. https://thecommonwealth.org/publications/national-agricultural-data-infrastructure-caribbean 4. Commonwealth Secretariat (2024). National Agricultural Data Infrastructure: Ghana. Coordinated by Addom, B.K. and Krishan, J.B. A Policy Brief. https://thecommonwealth.org/publications/national-agricultural-data-infrastructure-ghana 5. Commonwealth Secretariat (2024). National Agricultural Data Infrastructure: Malawi. Coordinated by Addom, B.K. and Krishan, J.B. A Policy Brief. https://thecommonwealth.org/publications/national-agriculture-data-infrastructure-malawi
Please insert below any additional comment.	I will be delighted to explain the framework in detail and how it can enable better use of AI by countries.

2. Pa Vikas

Surname	Vikas
First name	PA
Are you contributing in a personal capacity or on behalf of an organization or team?	Personal capacity
Current position	Senior Scientist
Current institution/organization	ICAR–Central Marine Fisheries Research Institute (CMFRI)
Affiliation	Government and other public institution
Country	India
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	The draft would benefit from explicitly including aquatic food systems — fisheries, aquaculture, and blue food value chains — as a distinct category within its analysis of AI risks and opportunities. The current framing, focused predominantly on terrestrial agriculture, does not fully reflect the global reality of food security.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	The draft gives insufficient attention to fisheries and aquaculture, despite their critical role in global food security and nutrition. AI applications relevant to these systems — including water quality monitoring, harmful algal bloom detection, feeding management, disease and parasite identification, biofouling detection, predator surveillance, and climate risk advisories — are largely absent from the draft. These are not speculative; peer-reviewed literature already documents functional AI tools in aquaculture systems (O'Donncha et al., 2021; Fini et al., 2025). Aquatic foods support the livelihoods of an estimated 600 million people globally and provide the primary protein source for over one billion people in Asia and Africa (FAO, 2024). Excluding aquatic food systems from this framework risks marginalizing a sector central to food security in the world's most vulnerable regions.
Are the issues identified fully capturing the links with FSN outcomes?	Partially, but not fully. The draft links AI adequately to food availability and productivity but the connections to nutrition outcomes, dietary quality, and agency — particularly for smallholder farmers and marginalized communities — remain weak. In fisheries and aquaculture specifically, the link between AI-assisted farm management and FSN outcomes is entirely absent, despite the sector's direct contribution to food and nutrition security of millions of vulnerable households. A more explicit mapping of AI applications to FSN outcome dimensions — availability, access,

	utilization, stability, and agency — would strengthen the draft considerably.
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	Yes. AI tools that reduce fish mortality, improve production stability, and provide early warning of environmental risks in aquaculture systems have direct and measurable FSN outcomes that are not elaborated in the draft.
Is there any example or case study that would deserves to be mentioned?	Yes. AI-assisted aquaculture monitoring systems in salmon farming in Norway and Chile — integrating machine learning for fish behavior, feeding, and water quality management — are already documented examples of specific-purpose AI delivering measurable production outcomes (O'Donncha et al., 2021; Fini et al., 2025). Similar low-cost systems are being explored for tropical cage culture systems in Asia, directly relevant to FSN in developing countries.
Please insert below any additional comment.	Scope of Artificial Intelligence Applications in Aquaculture Systems Aquaculture systems, spanning traditional pond culture, brackish water farming, and intensive cage culture, present wide-ranging opportunities for AI-assisted management across the entire production cycle. Feed is the single largest input cost in aquaculture, accounting for more than half of total production expenditure in most systems. Current feeding practices rely on visual observation of fish behavior and floating feed consumption, which works reasonably well for finfish but remains imprecise for shrimp culture, where check trays are still used to estimate feed uptake — an approach that is essentially a rudimentary form of decision-making. Next-generation AI systems capable of continuously observing fish swimming behavior, movement patterns, and feeding responses could transform this entirely. If such systems can interpret behavioral signals in real time, they can guide decisions on feed quantity, feeding frequency, feeding time, feeding location, and even feed particle size and color — parameters that collectively determine feed conversion efficiency and production economics. Water quality monitoring in most aquaculture systems currently ends with manual measurements recorded in registers, with limited operational value unless linked directly to fish growth and health outcomes. Real-time water quality auditing integrated with machine learning models — tracking dissolved oxygen, pH, ammonia, temperature, and salinity continuously — would

	convert routine data collection into actionable farm management intelligence. Stocking density decisions are presently based more on approximation than on evidence. A system that continuously collects and interprets production data — integrating species-specific physiology, seasonal environmental variability, pond or cage carrying capacity, and historical performance — could generate location-specific, season-specific stocking recommendations for ponds, tanks, and cages, transforming a rule-of-thumb practice into a data-driven decision. Harvest timing is currently farmer-driven but would benefit enormously from AI integration. A system that simultaneously considers fish growth trajectories, shrimp moulting phases, prevailing market prices, weather forecasts, and logistical factors could optimize harvest decisions in ways no individual farmer can replicate, reducing losses and improving returns. Open-water cage farms are especially exposed to external environmental threats — rainfall events, harmful algal blooms, anoxic conditions, and organic loading — that can cause rapid and catastrophic losses. Real-time data collection from environmental sensors, integrated with predictive models and automated alarm systems, could provide cage farmers with the lead time needed to take protective action before conditions become critical. AI systems combining meteorological forecasts, ocean data, and farm-level sensors can warn farmers of approaching storms, floods, cold snaps, and marine heatwaves, enabling timely interventions to reduce mortality and infrastructure damage. Remote sensing combined with machine learning can detect early-stage harmful algal bloom formation in coastal and open-water zones, alerting farmers and extension agencies before blooms reach damaging concentrations. Similarly, AI systems integrating hydrodynamic models, water quality forecasts, and climate data can advise on optimal timing and locations for cage relocation during monsoon seasons, cyclone threats, or prolonged hypoxic events — a capability with direct relevance to tropical mariculture systems. In cage culture, biofouling — the accumulation of organisms on net surfaces — progressively restricts water exchange, induces localized hypoxia, and reduces fish growth and survival. Computer vision systems using

	underwater cameras can detect and quantify fouling in real time, with AI models predicting fouling progression based on environmental conditions and t

3. Mbulu Education Network MBUENET, United Republic of Tanzania

Surname	Axwessoo
First name	Siayi
Are you contributing in a personal capacity or on behalf of an organization or team?	On behalf of a team/organization
Current position	CEO SoTB Secretary of The Board of Directors MBUENET
Current institution/organization	Mbulu Education Network MBUENET
Affiliation	Civil society/NGO
Country	United Republic of Tanzania
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	The Indigenous peoples' interests are skipped in AI as they have been LB Left Behind opposite of LNOB Leave No One Behind. As the Indigenous communities have their natural ways of food security and nutrition, in which case this is not the right way.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	Expansion of the AI for all
Are the issues identified fully capturing the links with FSN outcomes?	Not all
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	Keep the above into action AI to Indigenous communities.
Is there any example or case study that would deserves to be mentioned?	Scholarly articles are many and confusing.
In particular, do you have examples of effective policies to improve FSN outcomes of the use of Artificial Intelligence, digitalization and data governance in food systems?	As mentioned above
Is there any missing reference to key literature and data?	Deep readings may be compulsory

4. Bashir Barau

Surname	Barau
First name	Bashir
Are you contributing in a personal capacity or on behalf of an organization or team?	Personal capacity
Current position	Deputy Provost
Current institution/organization	Federal college of Agricultural Produce Technology Kano
Affiliation	Academia
Country	Nigeria
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	Yes, to some extent because data governance provides areas that are vulnerable and areas prone to food insecurity whereas artificial intelligence predict food drivers and stakeholders contribution for or against food sovereignty of a country.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	They HLP have done justice to the program
Are the issues identified fully capturing the links with FSN outcomes?	The most relative issues are the inclusion of food drivers actions and relevance
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	The issue that needs elaboration is synergy with and within food system transformation.
Is there any example or case study that would deserves to be mentioned?	There are many case studies, but I believe should be delegently discussed during the HLP

5. Margaret Koyenikan

Surname	Koyenikan
First name	Margaret
Are you contributing in a personal capacity or on behalf of an organization or team?	Personal capacity
Current position	Professor
Current institution/organization	University of Benin, Nigeria
Affiliation	Academia
Country	Nigeria

Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	Yes
Are the issues identified fully capturing the links with FSN outcomes?	Yes
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	Information dissertation to the vulnerable groups
Please insert below any additional comment.	The need to emphasize ethical use of AI to advance research and practice

6. Andre Francisco Pilon

Surname	Pilon
First name	Andre Francisco
Are you contributing in a personal capacity or on behalf of an organization or team?	Personal capacity
Current position	Assoc. Prof.
Current institution/organization	University of São Paulo International Academy of Sciences, Health and Ecology
Affiliation	Academia
Country	Brazil
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	To some extent, in some degree. Please see: Artificial Intelligence vs. Agroecology? The report Remote Control and Peasant Intelligence – On Automating Decisions, Suppressing Knowledges and Transforming Ways of Knowing, published by FIAN International, Friends of the Earth Europe and Coventry University's Centre for Agroecology, Water and Resilience, examines the implications of digital technologies taking hold in European agriculture: https://www.fian.org/files/is/htdocs/wp11102127_GNIAANVR7U/www/files/ENG_REMOTE%20CONTROL%26PEASANT%20INTELLIGENCE_Optimizer_compressed%20(1).pdf
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	Challenges are conceptual, more civic and political than technical: institutional capacity, judicial neutrality, informational transparency, social spaces for civic engagement are the main factors to deal with the dynamics that create and sustain lock-ins and barriers to change, including the power and

	threatening behavior of dominant political and economic actors, the deterioration of collective responsibility and welfare functions of the state. Transparency refers to the openness and clarity with which governments, organizations, and institutions operate, allowing stakeholders to understand decisions, policies, and actions. This concept is essential in fostering accountability, reducing corruption, and enhancing public trust by making information accessible and understandable. High levels of transparency often correlate with the legitimacy of political processes, electoral integrity, and effective governance on both national and international levels. Instead of addressing the consequences (the "bubbles in the boiling pot"), communication, advocacy, public policies, research and teaching programs should take in account the general phenomenon in view of the transformation of the dominant paradigms of development, growth, wealth, power and freedom embedded at political, economic, educational and cultural levels, in order to promote the aesthetic, ethical, spiritual, cultural and environmental meaning of life. All dimensions of being in the world (intimate, interactive, social and biophysical), should be combined as donors and recipients, as they elicit, maintain or transform the events. Ref.: PILON, A. F. (2025). The Bubbles or the Boiling Water? Ways to regenerate the Earth and Humanity, Katoikos: https://katoikos.world/analysis/the-bubbles-or-the-boiling-water-ways-to-regenerate-the-earth-and-humanity.html
Are the issues identified fully capturing the links with FSN outcomes?	To some extent, to some degree.
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	For a breakthrough in addressing the root causes of today's challenges, an ecosystem science-policy interface approach should: 1) define the problems in the core of the "boiling pot", instead of reducing them to the bubbles on the surface (fragmented issues, reduced academic formats, segmented policies, effects); 2) consider all dimensions of being in the world (intimate, interactive, social and biophysical), assessing their deficits and assets, as they combine to elicit, maintain or transform the events; 3) promote the singularity of (identity, proper characteristics) and the reciprocity (mutual support) of all dimensions, in view of their complementarity and dynamic equilibrium; 4) be committed to a critical analysis of present paradigms of growth, power, wealth, work and freedom

	embedded into the political, technological, economic, educational and cultural institutions; 5) in the socio-cultural learning niches, heuristic-hermeneutic processes should generate awareness, interpretation and understanding beyond established stereotypes, from a thematic ("what" is at stake), an epistemic ("how" to understand and define the events) and a strategic (who, when, where) viewpoint. Earth's and humanity's regeneration, as faces of the same coin, should be addressed simultaneously, for their mutual support. Ref.: PILON, A. F. (2024). The Bubbles or the Boiling Water? A Course on Environmental Capacity Building [ppt presentation] Research gate: https://www.researchgate.net/publication/381996602_The_Bubbles_or_the_Boiling_Water_A_Course_on_Environmental_Capacity_Building
Is there any example or case study that would deserves to be mentioned?	Sanne Van Der Hout, The Homeotechnological Turn: Sloterdijk's Response to the Ecological Crisis, Environmental Values 23 (4):423-442 (2014)
Is there any missing reference to key literature and data?	Barros, M. F., Pavanini, M., Lemmens, P. Peter: Sloterdijk's Philosophy of Technology: From Anthropogenesis to the Anthropocene, Technophany Vol.1 No.2.
Please insert below any additional comment.	Judging by the number of articles in my feed telling me that "it's time to reflect!" (leaders need pragmatic frameworks, not another policy doc), based on your efforts and the texts I have read, I thought you would be interested in my latest publications about the environment and the state of the world, which focus on capacity building and a regenerative approach beyond doing no harm. Please see them below, Public Profile and Selected Publications: https://www.unccd.int/science/former-spi-members/andre-francisco-pilon Pilon, A. F. (2021) The Political, Economic, Cultural, Social and Moral Grounds of Governance. Researchgate, DOI: 10.13140/RG.2.2.21732.09606 https://www.researchgate.net/publication/353830426_The_Political_Economic_Cultural_Social_and_Moral_Grounds_of_Governance PILON, A. F. (2025). The Bubbles or the Boiling Water? Ways to regenerate the Earth and Humanity, Katoikos: https://katoikos.world/analysis/the-bubbles-or-the-boiling-water-ways-to-regenerate-the-earth-and-humanity.html

	PILON, A. F. (2024). "The Party of the Dead": a Tale that Repeats Itself, MPRA Munich Personal RePEc Archive: https://mpra.ub.uni-muenchen.de/121869/1/MPRA_paper_121869.pdf PILON, A. F. (2021) Pandora's Box A Metaphor for today's World? Researchgate: https://www.researchgate.net/publication/355684440_Pandora's_Box_A_Metaphor_for_today's_World PILON, A. F. (2024). The Bubbles or the Boiling Water? A Course on Environmental Capacity Building [ppt presentation] Research gate: https://www.researchgate.net/publication/381996602_The_Bubbles_or_the_Boiling_Water_A_Course_on_Environmental_Capacity_Building PILON, A. F. (2025). The Bubbles or the Boiling Water? A Regenerative Approach beyond Doing no Harm, Researchgate: https://www.researchgate.net/publication/397085750_The_Bubbles_or_the_Boiling_Water_A_Regenerative_Approach_beyond_Doing_no_Harm

7. Gram Disha Trust, India

Surname	Gupta
First name	Ashish
Are you contributing in a personal capacity or on behalf of an organization or team?	On behalf of a team/organization
Current position	Founding Trustee
Current institution/organization	Gram Disha Trust
Affiliation	Civil society/NGO
Country	India
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	Partly. For all digitalization (including AI) - actual methodology preceded Technology. Whereas current thrust is to fit the former into the latter - in a prescriptive Top-Down Manner. Details follow in the answer to Point 10

Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	While the HLPE note correctly identifies the broad potential and risks of AI and digitalization, its orientation currently misses the most critical structural issue, the inequitable distribution of "Systemic Risk". The note must shift its focus from evaluating what cloud-based AI can do, to evaluating the mathematical and economic burden these technologies impose on smallholders. 1. The Institutionalization of Sovereign Co-Design Justification - The current digital agriculture ecosystem largely treats smallholders as passive end-users rather than active architects of their own resilience. Technology is frequently designed for them based on institutional assumptions (e.g., assuming continuous 4G connectivity or chemical input usage) rather than with them based on physical realities. The HLPE must mandate a "Sovereign Co-Design Protocol," requiring technologists to ground-truth their architectures alongside Farmer Organizations before any global platform endorsement. Relevant Literature - FAO (2020), Enabling Sustainable Food Systems: Innovators' Handbook. (Specifically referencing the frameworks required to shift structural dynamics and empower primary producers in systemic design). 2. The Cognitive and Economic Tax of Generalized AI - The current trajectory of digitalization disproportionately favors top-down, extractive models (like farmer-facing LLM chatbots). These systems assume a baseline of rural connectivity and digital literacy that does not exist in LMICs, imposing severe "Cognitive Tax" on the vulnerable populations the CFS aims to protect. The HLPE must add a specific focus on Frugal Edge Architecture, Small Language Models (SLMs) that operate offline and process data locally via simple IoT, acting as an "Invisible Orchestrator" rather than a passive advisory tool. 3. The Assessment Gateway (The Agritech Maxim & Stakeholder Integrity Factor) - The note lacks a definitive, non-partisan benchmark to filter harmful or extractive tech. The HLPE should consider formally incorporating two structural maxims into global policy guidance - * The Gram Disha Trust (GDT) Agritech Maxim - “If the technology decreases the operational (input) cost and complexity of the smallholder – consider it – else send it back to the drawing board”? * The Stakeholder Integrity Factor (SIF) - Digitalization policy must mandate shared risk. Technology providers and

	institutional backers cannot push unproven, cloud-based tools onto rural communities while bearing zero financial consequence for crop failure. Without these structural gateways, digitalization will accelerate digital exclusion and algorithmic bias, turning farmers into uncompensated data providers for global platforms rather than beneficiaries of technology.
Are the issues identified fully capturing the links with FSN outcomes?	No, the issues identified do not fully capture the direct, structural links between digitalization and FSN outcomes at the grassroots level. The current framing largely assumes that increased digital data or AI advisory automatically equates to improved food security. However, for smallholders in Low- and Middle-Income Countries (LMICs), FSN outcomes are strictly governed by two physical realities - their economic net margin and their resilience to systemic climate shocks. The framework must explicitly map digitalization to FSN outcomes through the following missing links - Net Margin Protection for Primary Producers and Consumers, Climate Resilience Benchmarking. 1. The FSN and Net Margin Link (The Agritech Maxim) FSN is fundamentally an economic outcome for the smallholder. If a digital solution mandates the purchase of an advanced smartphone, requires recurring data subscriptions, or demands high digital literacy, it directly extracts capital and time from the farming family. This worsens FSN. The framework must establish that digitalization only supports FSN if it passes the Agritech Maxim - it must mathematically decrease the operational input cost and complexity for the producer. 2. The FSN and Climate Resilience Link (Frugal Edge AI) FSN outcomes are physically destroyed during localized climate shocks. The note fails to link how current, cloud-dependent AI (like conversational chatbots) is functionally useless during these crises. For example, during a flash flood that destroys traditional riparian irrigation and triggers pest infestations, passive advisory does not save the crop. To secure FSN outcomes, policy must link AI to proactive, physical mitigation. This requires Frugal Edge AI—offline Small Language Models (SLMs) and local IoT acting as an "Invisible Orchestrator" to trigger early-warning mitigation alerts (via vernacular voice and visual cues) before the crop is lost. Alternately if the disaster is unavoidable, the AI should actually be

	able to provide localised mitigation outcomes, such suitable alternate crops and Price discovery of the salvaged crop. The Digitalization should also be able to provide traceability of Food source to the end consumer. 3. The FSN and Market Valuation Link (MoolyaSHIKHAR) Food security is deeply linked to how agroecological labor is valued in the market. The current note misses the link between data governance and sovereign pricing. When smallholders transition to Natural Farming and revive traditional crops, their data is often extracted by platforms without reciprocal economic benefit. To link data governance to positive FSN outcomes, policy must mandate True Price and Cost Accounting frameworks, such as MoolyaSHIKHAR. By utilizing open-source Digital Public Goods (DPGs), FPCs can leverage their own hyper-local agroecological data for "Pinnacle Price" discovery, transforming them from structural price takers to sovereign price makers, directly securing their livelihoods and FSN.
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	Yes, two critical aspects of FSN outcomes—one direct and one indirect—require significant elaboration to prevent digitalization from inadvertently harming smallholder communities in LMICs. 1. Direct FSN Outcome - Algorithmic Bias Toward Volume vs. Nutritional Density Current digital and AI frameworks predominantly train models to optimize volumetric crop yield, which inherently biases the technology toward high-chemical, resource-intensive farming systems. This directly threatens the nutritional diversity and ecological resilience of local food systems. For example, during the Gram Disha Trust trials in the Himalayas, standard AI models were maladaptive to the agroecological revival of indigenous, climate-hardy paddy varieties. The framework must elaborate on how algorithmic bias directly degrades localized nutritional outcomes, and it must mandate that agricultural AI be retrained on agroecological and Natural Farming metrics to support true FSN. 2. Indirect FSN Outcome - The "Cognitive Tax" as an Economic Drain An indirect FSN outcome that goes largely unmeasured is the economic and cognitive burden imposed by extractive digital tools. FSN at the household level is strictly governed by the net margin of the farmer. If a technology forces a farmer to absorb the costs of deprecated APIs,

	requires expensive hardware upgrades, or demands recurring data subscriptions, it extracts capital directly from the household's food and livelihood budget. To protect this indirect FSN outcome, the HLPE must elaborate on the necessity of policy firewalls like the Protective Maxims and the Stakeholder Integrity Factors. Technology providers must share the systemic risk, and no digital intervention should be recommended unless it is mathematically proven to decrease operational input costs and complexity for the producer. 3. Indirect FSN Outcome - Data Sovereignty and Market Valuation FSN is inextricably linked to market valuation and capital architecture. When smallholders transition to sustainable practices, their localized agronomic data is frequently extracted without economic reciprocity. The framework must elaborate on how data governance directly impacts economic FSN. By utilizing advanced True Price and Cost Accounting systems, deployed via open-source Digital Public Goods, Farmer Collectives can leverage their own hyper-local agroecological data for "True/Pinnacle Price" discovery. This structural shift transforms them from marginalized price-takers to sovereign price-makers, thereby securing the financial autonomy required for sustained, long-term food security.
Is there any example or case study that would deserves to be mentioned?	Yes. Based on the experience of developing Technologies for smallholders in the Himalayas. Here is are two cases which are suitable to mention - Gram Disha Trust. (2024–2026). VARTA-AI and VARTA-IoT: Frugal Edge Architecture for Smallholder Agroecology. Systems design frameworks for localized, offline Small Language Models (SLMs) and IoT integration in low-connectivity environments. https://gramdisha.org/slm-iot-integration-for-natural-farming/ and https://gramdisha.org/iot-agritech-smallholders/ Gram Disha Trust (2026, January 8). MoolyaSHIKHAR / True (or Pinnacle) Price Discovery for Smallholders – Empirical Impact case study. Gram Disha Trust. https://gramdisha.org/moolyashikhar-impact-case/
In particular, do you have examples of effective policies to improve FSN outcomes of the use of Artificial Intelligence, digitalization and data governance in food systems?	Yes. The state Government of Himachal Pradesh (India) enabled the Sustainable Food Systems Platform for Natural Farming (SuSPNF) in the year 2020, which itself was built upon the Natural Farming Prosperous Farmer (PK3Y Program) in 2017. For the last 9 years this program has yielded to such an extent that the State

	government has created mechanisms for Public Procurement based on Agroecological Transformation. It also has a strong Digitalisation component involving certified evaluation and market linkage called CETARA-NF. This innovation has also led to the National Government adapting this framework in the PGS-NATURAL national certification program. Since all these are enabled through digitalisation and yield themselves to AI based on Digital Public Goods frameworks. There are effective policies at sovereign scale in place to refer now.
Is there any missing reference to key literature and data?	Vashishat, Rohit & Sharma, Subhash & Chandel, Rajeshwar & Dev, Inder & Chauhan, Gaurav & ., Divyanshu & Gupta, Ashish & Gupta, Manoj & Laishram, Chinglembi. (2024). Sustainable agriculture made easy: CETARA-NF's self-certification. Journal of Agriculture and Food Research. 18. 101404. 10.1016/j.jafr.2024.101404. Dev I, Chandel RS, Vashishat RK, Rawat A, Gupta A and Verma S. 2026. Agroecology and Blended Finance - Fostering Resilience and Innovation in Natural Farming FPCs. Policy Paper No. 01/2026. Dr Yashwant Singh Parmar University of Horticulture and Forestry, Nauni-Solan and Gram Disha Trust, India; 48 pages. https://uhf.ac.in/pdf/digitization/Policy%20Paper.pdf Chandel, R.S., Gupta, A., Dev, I., Gupta, M., & Vashishat, R.K. (2026). Policy Framework for Certified Evaluation for Sustainable Agriculture. Novel Methodological Framework for Evolving National Standards from the Grassroots Upwards (Policy Paper No. 02/2026). Dr YS Parmar University of Horticulture and Forestry; 56 pages. https://uhf.ac.in/pdf/digitization/IInd%20Policy%20Paper.pdf R. Agarwal, I. Bhardwaj, A. K. Sharma, A. Sanghi and G. Agarwal, “Innovations in Agri-Tech: A Review of Artificial Intelligence Applications and Challenges in Modern Agriculture,” 2024 Second International Conference on Advanced Computing & Communication Technologies (ICACCTech), Sonipat, India, 2024, pp. 599-604, doi: 10.1109/ICACCTech65084.2024.00101. Rajak P, et. al. Internet of Things and smart sensors in agriculture: Scopes and challenges, Journal of Agriculture and Food Research, 2023, https://doi.org/10.1016/j.jafr.2023.100776 . Madrewar, Shivam & Khadkikar, Nimisha &

	Suryawanshi, Om & Mulani, Jasmin & Sagar, Ajay. (2024). Digital Agriculture: Impact of IoT and AI on Indian Agribusiness. International Journal of Applied Economics Accounting and Management (IJAEAM). 2. 327-350. 10.59890/ijaeam.v2i4.2346.
Please insert below any additional comment.	There are few primary literature cases which present a counter view to the normative discourse by Corporates which are taken into consideration. Whereas there are a very few non-partisan cases which are bereft of corporate funding access and yet are trying to determine the grassroot impacts on Smallholders especially in LMICs. Therefore such primary cases should be taken into cognition in equal measure as journal published literature.

8. Antonio Onorati

Surname	Onorati
First name	Antonio
Are you contributing in a personal capacity or on behalf of an organization or team?	Personal capacity
Current position	Peasant
Current institution/organization	ASSOCIAZIONE RURALE ITALIANA
Affiliation	Civil society/NGO
Country	Italy
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	Our response is grounded in the perspective of small-scale food producers, peasants and rural communities — actors who are the primary subjects of food insecurity yet are systematically underrepresented in both the training data of AI systems and the governance processes that shape their deployment. We submit this contribution alongside an analytical note on the CFS Concept Note (Bur/2026/04/08/04), which provides the detailed argumentation underpinning the positions expressed here. Our responses to the HLPE-FSN consultation questions should be read as complementary to that analysis.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	10.1 The AI–Seeds–Patents Nexus The HLPE-FSN note acknowledges that AI is being used to improve crop and livestock selection and genomic prediction (§2.1.1), and notes that 'the biological innovation sector' may require 'regulatory adaptation'. This formulation is deliberately opaque and fails to capture a structural dynamic that is central to the future of food systems: the intersection of AI, big genomic data, and intellectual property rights over plant genetic resources. AI-enabled genomic sequencing and digital

	sequence information (DSI) are accelerating the pace at which commercial breeders can identify, characterize and patent commercially valuable traits. The same analytical capacity that CIMMYT and CGIAR use for public breeding programmes is being deployed by Bayer-BASF-Corteva-ChemChina (the 'Big Four' after recent consolidations) to build proprietary genomic databases. These databases — combining field-collected phenotypic data with AI-processed genomic predictions — are generating patent portfolios that progressively narrow the space of genetic resources available to farmers, public breeders and future innovation in the commons. The link to FSN outcomes is direct and structural: farmers' access to seeds — guaranteed under Article9 of ITPGRFA and Article 28 of the UN Declaration on the Rights of Peasants (UNDROP, 2018) — is being progressively restricted by intellectual property regimes that AI is now accelerating. The ongoing debates in the Nagoya Protocol and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) over Digital Sequence Information (DSI) access and benefit sharing are a direct reflection of this dynamic. The HLPE-FSN note is silent on this nexus. New Genomic Techniques (NGTs) — which regulatory bodies in several jurisdictions are currently considering classifying outside existing GMO frameworks — further extend this dynamic: AI-generated sequence predictions enable targeted edits that are increasingly difficult to distinguish from conventional variation, making patent enforcement simultaneously easier and more sweeping. Key references: UNDROP Art. 19, 28 (UN, 2018); CBD–Nagoya Protocol on DSI (2022 COP15 decision 15/9); ITPGRFA Article 12.3(d); Kloppenburg (2010) 'Seed Sovereignty: The Promise of Open Source Biology'; Winge et al. (2022) on genomic data and benefit-sharing, https://www.fao.org/plant-treaty/areas-of-work/farmers-rights/overview/en 10.2 Agricultural Data as a Financial Asset: The Data–Land Financialisation Nexus The HLPE-FSN note acknowledges in a single sentence that 'growing collection of agricultural and environmental data can lead to new digital and financial products that can reshape how land, ecosystems and agricultural practices are governed' (§3.3). This observation deserves far greater prominence, as the phenomenon it describes is already operational, not merely

	prospective. Agricultural data is rapidly becoming a financial asset that is structurally integrated into land markets, insurance pricing, credit scoring and speculative capital flows. The mechanism operates as follows: digital platform operators aggregate field-level data across millions of hectares, creating proprietary productivity intelligence that is then monetized through multiple channels — input cross-selling, direct sale to third parties, insurance underwriting, and — critically — farmland valuation. The Bayer Climate FieldView platform entered into an agreement in 2020 with Tillable, a company operating as an intermediary for farmland leasing. Farm-level productivity data was used to reassess land values and renegotiate lease agreements upward, with tenant farmers bearing the cost of data they themselves had generated. This dynamic — data generated by farmers weaponized against farmers' land tenure — illustrates with precision the mechanism that the HLPE-FSN note leaves unnamed. More broadly, the architecture of major agricultural digital platforms (Climate FieldView/Bayer,
Are the issues identified fully capturing the links with FSN outcomes?	The HLPE-FSN note's framework of FSN outcomes — availability, stability, accessibility, utilization and agency — provides a useful analytical structure. However, the links between the issues identified and these FSN dimensions are not systematically elaborated, and several important connections are absent. 11.1 Agency: The Most Important and Least Developed Dimension The note rightly identifies agency as 'most under threat' (Executive Summary). This is the FSN dimension with the most direct connection to the political economy of AI: who controls the systems that govern food, who can participate in decisions about them, and who can contest or appeal algorithmic determinations. However, the note's treatment of agency remains primarily focused on technical dimensions (explainability, auditability, contestability of algorithmic outputs). The political economy dimension — how corporate control of digital infrastructure structurally reduces the agency of smallholders, public institutions and food-insecure populations — is acknowledged but not developed as a systemic risk to FSN outcomes. Agency, in food systems, encompasses the right to define one's own food and agriculture system (food sovereignty), the right to participate in

	governance decisions about technologies that affect livelihoods, and the right to refuse technologies that are incompatible with one's farming system or cultural values. None of these dimensions are systematically captured in the note's discussion of agency. 11.2 Stability: Conflict Blindness in Early Warning Systems The note provides an important and well-documented analysis of how AI-enabled early warning systems are structurally blind to conflict-driven food crises (§2.2). The Tigray example is well-chosen and well-documented. This is perhaps the most powerful FSN-outcome-specific critique in the note, and it deserves to be foregrounded rather than buried in a technical subsection. A related stability issue that is not developed: price-prediction tools and commodity market analytics, when controlled by private firms with market positions in the same commodities they model, create structural conflicts of interest that can amplify price volatility rather than dampen it. The note acknowledges that 'pricing information gives power over other actors including farmers' (§2.3.1) but does not connect this to stability outcomes. 11.3 Accessibility: The Gender and Generational Dimensions The note documents the gender digital divide (§3.3) and notes that women are severely underrepresented in training data for generalist AI systems. The FSN outcome link is correctly identified: women's nutritional knowledge and decision-making authority over food purchases are among the strongest determinants of child nutrition outcomes. A dimension that is less developed is the generational one. Young farmers and rural youth face a specific configuration of risks: digital tools designed for existing industrial farming systems make entry into agriculture more capital-intensive, while the erosion of traditional knowledge and intergenerational transmission through digital substitution undermines long-term system resilience. 11.4 Utilisation/Nutrition: The Agroecological Quality Gap The note's treatment of nutrition focuses primarily on AI-enabled precision nutrition tools and SMS-based behaviour change interventions. An FSN dimension that is not captured: the relationship between AI-optimised agricultural systems and the nutritional quality of the food they produce. AI tools optimised for yield maximisation, standardisation and supply-chain efficiency tend to favour monocultural and input-intensive systems

	whose nutritional profile (micronutrient density, dietary diversity) is typically inferior to agroecological systems. The SDG 2.1/2.2 targets require attention not only to food availability but to nutritional quality — a dimension that is structurally disadvantaged by the agricultural models that current AI tools are designed to opt
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	12.1 Long-Term Structural Effects on Food System Resilience The note focuses primarily on near-term, measurable FSN outcomes (yield, price, early warning lead time). The long-term structural effects of widespread AI adoption on food system resilience are not addressed. Specifically: the erosion of local seed systems, traditional agricultural knowledge and adaptive management practices through standardization and algorithmic replacement constitutes a long-term FSN risk that does not appear in yield or dietary diversity statistics until a shock exposes the brittleness of the system. The loss of crop diversity associated with genomic AI-driven crop selection is a case in point: AI-optimized varieties may outperform traditional varieties on measurable short-term indicators while reducing the genetic diversity that constitutes the system's adaptive capacity in the face of climate change and emerging pathogens. 12.2 Indirect Effects Through Land and Livelihood Displacement The data-land financialization dynamic described in Q10.2 has indirect FSN effects that operate through displacement rather than direct production impacts. As agricultural data enables farmland association, tenant farmers and smallholders face increased land access costs, reduced tenure security, and pressure to adopt technology-intensive production models to meet data-driven lease terms. These indirect pathways from data governance failures to FSN outcomes are not captured by the note's analytical framework. 12.3 The Nutrition–Biodiversity Link Dietary diversity — a key determinant of nutritional outcomes, particularly for micronutrient adequacy — is directly linked to agricultural biodiversity. AI tools optimized for supply-chain standardization and industrial food system efficiency tend to reduce both farm-level and market-level dietary diversity. The note's treatment of nutrition does not address this structural link between the dominant design of AI tools and the systematic

	narrowing of dietary diversity in both production and consumption environments.
Is there any example or case study that would deserves to be mentioned?	13.1 Bayer Climate FieldView / Tillable: Data Weaponised Against Farmers' Land Tenure As detailed in Q10.2, the 2020 agreement between Bayer's Climate FieldView platform and Tillable (a farmland leasing intermediary) illustrates the mechanism through which farm-level productivity data — generated by farmers using digital tools — can be weaponized to raise their own land costs. This case is well-documented and provides a concrete, named example of the data-land financialization nexus that the note alludes to but does not illustrate. 13.2 FEWS NET and the Tigray Famine: Conflict Blindness in AI Early Warning The note correctly cites the failure of Horn of Africa ML models to predict the Tigray famine (§2.2), triggered by the November 2020 conflict outbreak despite conflict data signals appearing three months prior. This is one of the most important documented failures of AI-enabled early warning in a FSN context and deserves greater prominence. The structural lesson — that models trained on climate signals are blind to the now-dominant driver of acute food insecurity — has direct policy implications for investment priorities. 13.3 Plantix: Commercial Interest Capture of Agricultural AI Advisory The note references the Plantix case (§3.3): an agricultural advisory application that originally claimed to aim at reducing pesticide usage but subsequently pivoted to becoming a pesticide vendor, raising conflict of interest concerns. This example deserves fuller elaboration as a systemic risk pattern: AI advisory tools funded by venture capital face structural pressure to monetise their user base through product sales, creating a systematic misalignment between user interest (neutral advice) and platform interest (product recommendation). 13.4 John Deere Right-to-Repair Conflict: Data Sovereignty in Farm Equipment The note mentions vendor lock-in and restrictions on software modification (§3.3). The John Deere right-to-repair conflict — in which farmers were legally prevented from accessing diagnostic software on tractors they owned, with the data generated by those tractors retained by the manufacturer — provides the most widely documented case of how intellectual property frameworks intersect with agricultural data

	sovereignty. This case has already resulted in regulatory action (FTC attention in the US, EU right-to-repair legislation) and provides a concrete policy anchor. 13.5 Brazil's Open Agricultural Data Framework: A Positive Policy Model The note's positive reference to Brazil's open government data strategy (§4) should be expanded to include the specific agricultural dimension: CONAB's open data on food prices, EMBRAPA's open research data commitments, and the interaction of these with Brazil's LGPD privacy framework. This represents the most advanced national-level implementation of the open data governance principles the note endorses. 13.6 India AgriStack: Digital Public Infrastructure with Governance Risks The note mentions India's Digital Agriculture Mission and AgriStack (§2.5) without engaging with the significant civil society concerns raised about its design. AgriStack proposes a unified farmer database linked to land records, Aadhaar identity, and agricultural service delivery. Concerns raised by the Alliance for Sustainable & Holistic Agriculture (ASHA) and others include: data sharing agreements with private companies (including Microsoft) without adequate consent frameworks; risks of exclusion for marginal and tenant farmers not represented in land records; and the potential use of unified databases for surveillance and targeting. This case illustrates that digital public infrastructure for agriculture is not inherently positive and requires robust rights-based governance.
In particular, do you have examples of effective policies to improve FSN outcomes of the use of Artificial Intelligence, digitalization and data governance in food systems?	14.1 UNDROP and UNDRIP as Normative Floor for Data Governance The most fundamental policy gap in the current governance landscape is the absence of binding human rights frameworks as the normative floor for agricultural data governance. The UN Declaration on the Rights of Peasants (UNDROP, 2018) — particularly Articles 19 (right to seeds), 21 (right to information and data), and 24 (right to adequate food) — provides directly applicable rights that should be integrated into any CFS recommendation on AI governance. Similarly, the UN Declaration on the Rights of Indigenous Peoples (UNDRIP, 2007) — particularly Articles 31 (right to maintain and control cultural heritage, traditional knowledge and intellectual property) and 32 (right to determine priorities for development) — applies directly to the collection and use of Indigenous agricultural

knowledge in AI training datasets. Neither declaration is referenced in the HLPE-FSN note. The CFS, as a body mandated to address food security in a human rights-consistent manner, should explicitly anchor its guidance on AI governance in these instruments. 14.2 Canadian Indigenous Data Governance: OCAP® Principles The note's positive reference to Canada's OCAP® principles (Ownership, Control, Access, Possession) and the First Nations Information Governance Centre (§4) represents a best-practice model for community-level data sovereignty. The key policy lesson — that collective governance structures, not individual consent mechanisms, are the appropriate unit of analysis for community data rights — is directly applicable to smallholder farming communities and should be extended beyond Indigenous contexts to all food-insecure communities whose data is being collected at scale. 14.3 African Union Data Policy Framework The AU Data Policy Framework (2022) and the Digital Transformation Strategy for Africa 2020–2030 provide a regional-level governance model that centres equitable access and benefit sharing. The explicit commitment to keeping commercial rights to African citizens' data 'in Africa' addresses the digital colonialism dynamic identified by UNDP. CFS should refer to this framework as a model for South-South data governance cooperation in FSN contexts. 14.4 EU Approaches: AI Act, Data Act, Right-to-Repair Three recent EU regulatory instruments are directly relevant to FSN-AI governance: the EU AI Act (2024), which establishes risk-based classification and mandatory transparency requirements for high-risk AI applications; the EU Data Act (2023), which includes provisions on agricultural machine data and the right of farmers to access and port data generated by connected equipment; and the EU Right to Repair Directive (2024), which addresses vendor lock-in through restrictions on maintenance and software access. While these are regional instruments, their extraterritorial effects (applicable to any system operating in the EU market) and their normative frameworks are relevant for CFS guidance. 14.5 Malawi and Tanzania: Farmer-Controlled Digital Extension Digital green’s approach in South and Southeast Asia, and analogous programmes in East Africa, provide documented examples of digital extension services governed by farmer organizations

	rather than platform companies. In these models, video content is created by farmers for farmers, extension advice is filtered through local agricultural knowledge networks, and data generated by the service is retained by the hosting organization rather than the platform provider. Impact assessments show comparable or superior knowledge adoption rates compared to commercial advisory apps, with substantially better alignment with local agroecological contexts.
Is there any missing reference to key literature and data?	The following references are directly relevant to the issues raised in this response and, in our assessment, should be incorporated into the HLPE-FSN note: Normative frameworks UN Declaration on the Rights of Peasants (UNDROP, 2018) — Articles 19, 21, 24; UN Declaration on the Rights of Indigenous Peoples (UNDRIP, 2007) — Articles 31, 32; Draft UN Treaty on Business and Human Rights (UNBTI, 2024 working draft) Seeds–AI–patents nexus Kloppenburg (2010) 'Seed Sovereignty'; Winge et al. (2022) on genomic data and DSI benefit-sharing; ITPGRFA Ad Hoc Technical Expert Group on DSI (2024); CBD COP15 Decision 15/9 Data–land financialization Duncan et al. (2021) 'Towards a political economy of digital agriculture', J. Rural Studies; Fairbairn (2020) 'Money Farming: Financialization and the Challenge of Integrating Agriculture'; Clapp & Isakson (2018) 'Speculative Harvests'; Rotz et al. (2019) 'The politics of left-behind places and left-out people in the emerging digital agricultural economy', NJAS Food sovereignty & agroecology IPES-Food (2022) 'Technology for Peasants or Peasant Technology?'; HLPE (2019) 'Agroecological and other innovative approaches for sustainable agriculture and food systems'; La Via Campesina (2023) Declaration on Agroecology and Technology Corporate power in food AI ETC Group (2021) 'Blocking the Chain'; Howard (2021) 'Concentration and Power in the Food System'; Miller (2024) on Plantix pivot — reference cited in the note but not fully developed Labour impacts ILO (2023) 'Digital labour platforms and the future of agricultural work'; Hendrickson et al. (2021); FAO (2022) 'E-agriculture in action: robots for agriculture' Right to repair / vendor lock-in FTC (2021) 'Nixing the Fix: An FTC Report to Congress on Repair Restrictions'; EU Directive 2024/1799 on the Right to Repair; GRAIN (2019) 'Farming data: the big businesses surveillance

	of agriculture' AgriStack civil society critique Alliance for Sustainable & Holistic Agriculture (ASHA) (2022) 'Open letter on AgriStack'; IT for Change (2022) 'Toward a Rights-Respecting Digital Agriculture' Long-term resilience Benton et al. (2021) 'Food system impacts on biodiversity loss'; FAO (2019) 'The State of the World's Biodiversity for Food and Agriculture' We note that the cover photograph is credited to 'Microsoft 365 Stock Image'. While this may be an administrative matter, it is symbolically significant for a document advising on the governance of technology corporations in food systems. We would recommend using imagery sourced from organizations working directly with smallholder farmers and rural communities.
Please insert below any additional comment.	16.1 On the Note's Narrative Framing The note's structure — beginning with opportunities before addressing risks, framing risks as 'challenges to be managed', and concluding with governance recommendations premised on adoption — reflects an institutional stance that presupposes technology adoption and then asks how to govern it. An alternative framing — one that begins with problem identification and then asks whether and which technologies are appropriate responses — would be more aligned with the 'discipline of use' the note itself advocates in its Way Forward section. The note's repeated formulation 'when properly managed, developed and governed' exemplifies this framing: it presupposes that the problem is governance, not the technology itself. In contexts where structural conditions (4Cs) are absent, where regulatory capacity is low, and where corporate interests dominate the development agenda, this formulation can function as an unconditional endorsement rather than a conditional one. 16.2 On the Proposed CFS Action Areas The three proposed CFS action areas (§4.1) — sharing experiences, updating the 2021 Data Recommendations, and coordinating with AI governance bodies — are useful but insufficient. In our assessment, the Forum should also consider: • Producing binding CFS guidance on agricultural data governance that explicitly anchors data rights in UNDROP and UNDRIP; • Mandating a dedicated HLPE study on the AI–seeds–patents nexus and its implications for farmers' rights

	under ITPGRFA; • Including a monitoring paragraph in any CFS output that assigns clear responsibilities for tracking outcomes, with civil society participation in monitoring; • Coordinating with the UN Open-Ended Working Group on Transnational Corporations and Human Rights to align CFS guidance with UNBTI developments. 16.3 On the Governance Process Itself The Forum's panel structure allocates 90 minutes to governance (Panel 3) — the most substantive policy space — and embeds civil society perspectives within multi-stakeholder panels rather than in dedicated consultative slots. ARI that the CFS ensure civil society and farmer organizations have dedicated speaking time in the closing session, where priorities for future CFS workstreams will be determined. The Forum's outputs should reflect a genuine multi-actor process, not engineered inclusivity.

9. Charles Jambe

Surname	Jumbe
First name	Charles
Are you contributing in a personal capacity or on behalf of an organization or team?	Personal capacity
Current position	Retired Professor
Current institution/organization	Centre for Independent Evaluations
Affiliation	Private sector
Country	Malawi
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	Yes, it is. but not properly handled in this document.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	The document lacks the link between AI and Food Systems and how countries have embraced AI to promote food systems
Are the issues identified fully capturing the links with FSN outcomes?	The issues identified are not properly linked to FSN. By the way FNS is just a small part of a food system which encompasses the entire value chain plus the wider

	social, economic, environmental, and policy context that influences how food is produced, distributed, consumed, and disposed of.
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	Strengthening point 11 about in the document would be very helpful.
Is there any example or case study that would deserves to be mentioned?	Yes, UNDP supported PISCA on how to facilitate weather information to farmers in view of weather predictions and how PISCA has helped to enhance food security by influencing crop choices and timing of planting and the outcome (production and productivity). The discussion would have been how can AI be integrated into PISCA.
In particular, do you have examples of effective policies to improve FSN outcomes of the use of Artificial Intelligence, digitalization and data governance in food systems?	There cases where real-time price information is shared to farmers. Even in agricultural extension there are systems to get advisory via ICT. The question is how AI can improve the system
Is there any missing reference to key literature and data?	I have not checked.
Please insert below any additional comment.	There are a number of challenges with the draft document. Overall, the document is not well organized. For example (a) The introduction is weak with no clear aim or purpose and its scope. (b) There is no detailed description of the methodology used (and limitations as well) e.g., what data was used. (c) the discussions in various sections have no direct connection to Food System or FSN (d) it been written as an essay with little critical or comparative analysis across regions (e.g., SSA, EU or Sahel, e.g., on what works and what does not and why (e) it does not provide practical suggestions or recommendations or strategies on how to harness AI in the food systems. I have made my detailed comments on the online on the document. I want to sincerely apologize beforehand if any of my comments are outside the scope of the analysis in the document.

10. Daniel Sanchez-Guillen

Surname	Sánchez-Guillén
First name	Daniel
Are you contributing in a personal capacity or on behalf of an organization or team?	Personal capacity
Current position	Researcher
Current institution/organization	el colegio de la frontera sur

Affiliation	Academia
Country	Mexico
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	No, it lacks the role of AI on pollination, precision agriculture does not encompass this issue. Moreover, the role of local knowledge by indigenous people and its integration with AI technologies should be addressed.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	Pollination, insect conservation, and sustainability is achieved only if resources necessary for agriculture are also protected
Please insert below any additional comment.	I believe AI technologies are a core issue in our modern culture, and now it pervades most of our everyday activities. This initiative acknowledges that. I hope you receive lots of feedback that will help improve this document.

11. Rotterdam Convention Secretariat, Food and Agriculture Organization of the United Nations, Plant Division (FAO-NSPRD)

Surname	Lo Bianco
First name	Andrea
Are you contributing in a personal capacity or on behalf of an organization or team?	On behalf of a team/organization
Current position	Program and Operations Specialist
Current institution/organization	FAO-NSPRD (Rotterdam Convention Secretariat)
Affiliation	UN
Country	Italy
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	In my opinion yes indeed. I am not an AI expert but for sure the paper is well written and captures very important issues related to AI affecting FSN. A fundamental issue is that AI/digitalization do not operate in a vacuum; their FSN impact depends on infrastructure and capacity: Adoption requires the "4Cs": Connectivity, Compute, Context, Competency. Many LMICs lack baseline conditions (energy, internet, skills, institutions), creating a global digital divide between LMICs and developed countries and within countries, gaps persist (rural–urban, gender, income, literacy) which of course limit the benefit of AI and digitalization. On this basis, benefits of AI (i,e, productivity, early warning, etc.) tend to be

	concentrated in better-resourced contexts and marginalized groups risk, unfortunately, further exclusion from digital services and decision-making systems. Furthermore, AI systems depend on data, hence areas with scarce data ("data deserts") often coincide with food-insecure regions (e.g. Sahel, Horn of Africa). Models tend to perform poorly in such contexts, reinforcing under-representation whereas in data-rich regions there are better predictions, services, and efficiency. On this basis digitalization risks worsening existing FSN inequalities unless data collection and representation are improved.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	I do not think so.
Are the issues identified fully capturing the links with FSN outcomes?	Yes, I think so.
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	According to World Peace Foundation, in modern conflicts, digital food security infrastructure (such as supply chain and distribution networks) can become targets for cyberattacks and network shutdowns, threatening famine prevention. The report briefly refers to the general risks of digital critical infrastructure and cyberattacks, but I think that this chapter of great interest nowadays could be further expanded.

12. Universidad Politécnica de Madrid, Spain

Surname	Manab
First name	Meem Arafat
Are you contributing in a personal capacity or on behalf of an organization or team?	On behalf of a team/organization
Current position	Early Stage Researcher
Current institution/organization	Universidad Politécnica de Madrid
Affiliation	Academia
Country	Spain
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and	The issues identified are largely accurate and the note's insistence on evidence over vendor claims is very valuable, true, true. However, the framing consistently mistakes a technical implementation gap for a governance gap. Data sovereignty, fair benefit-

nutrition (FSN), globally and in specific contexts?	sharing, and "contestability" are not primarily waiting for better policy language, I believe they are waiting for technical infrastructure that can operationalize that language. The note at its core reads as a well-intentioned charter, yes, it will be cited and applauded, and then it will produce little to no change, because the people who could implement it cannot extract actionable technical specifications from it (the world needs more actionable points), and the people who wrote it may not have engaged, I am very very afraid, with what those specifications would look like.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	I see you have used the word "dataspaces" but you do not engage with what building one will actually require, like, you know, machine-readable policy representations, ontological frameworks for rights and obligations, interoperability standards, and provenance mechanisms for data and model lineage. There could be very real things that could be done related to food crisis, food shortage, food quality, etc., because generic one-size-fits-all solutions are not good for domain-specific problems. A lot of work on autonomous vehicle, because big companies want money. Where is the work on food? The existing European data space framework, they have these laws, Data Act, Data Governance Act, European Health Data Space regulation, each of these have measurable gaps between their stated governance principles and what is technically implemented (or even implementable) today. Without bridging that gap, recommendations to "implement dataspaces" remain aspirational, but then they don't take off. The data spaces in Europe have been lagging forever. What is needed, I have reasons to believe, is sustained investment in policy-aware informatics, infrastructure, and research, not more policy coordination. Especially fields like this, we could save life, if technology was adapted to your needs specifically.
Are the issues identified fully capturing the links with FSN outcomes?	The note's fsn outcome metrics (hdds, fies, hfias) are appropriate, beautiful, beautiful. But sorry if I sound repetitive, their usefulness depends on data pipelines that do not exist in most high-need contexts. Measuring the fsn impact of digital tools requires same data infrastructure that those tools are supposed to build, a circularity the note does not acknowledge.

Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	Labor conditions under which AI training data is produced deserve attention. Small populations whose agricultural data is extracted for model training are often also the source of low-paid data annotation labor, creating a double extraction relation with direct implication for rural livelihood and food security that this note does not address.
In particular, do you have examples of effective policies to improve FSN outcomes of the use of Artificial Intelligence, digitalization and data governance in food systems?	Work on extracting machine-readable ODRL policies from business process models (https://bpmn.linkeddata.es/) and on building open linked data portals for benchmarking AI agents in health data spaces (https://mcp.linkeddata.es/) will show you that technical path from policy aspiration to implementation can exist and is very easy. Both cases show that the bottleneck is not technical incapability. It is this absence of institutional structures that bring legal informatics researchers, domain practitioners, and policymakers into sustained collaboration. Rather than these one-off consultations.
Is there any missing reference to key literature and data?	The European Health Data Space can provide a concrete and instructive test case for food data governance, I think. It is a well-resourced, politically supported framework with a significant gap between its stated data sovereignty principles and its current technical implementation. If you want to close that that gap, it is not better regulation but better translation infrastructure that will help. Interoperable data portals etc.. The same logic applies to FSN dataspaces, like in contexts where smallholder data is collected by private platforms under these terms that neither farmers nor regulators can technically audit or contest.

13. Embassy of the Hashemite Kingdom of Jordan

Surname	Khreesha
First name	Ibtihal
Are you contributing in a personal capacity or on behalf of an organization or team?	On behalf of a team/organization
Current position	Deputy Representative to UN Agencies
Current institution/organization	Jordan Embassy
Affiliation	Government and other public institution
Country	Jordan
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data	Jordan welcomes the comprehensive scope of the draft note. The issues identified by the HLPE-FSN are highly relevant and capture many of the key

governance affecting food security and nutrition (FSN), globally and in specific contexts?	opportunities and challenges associated with AI, digitalization and data governance, including digital divides, data governance, accountability, algorithmic bias, infrastructure, and institutional capacities. Jordan particularly appreciates the attention given to equity, governance and the enabling conditions required for responsible AI adoption. These issues are essential to ensuring that technological innovation contributes positively to food security and nutrition outcomes.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	Jordan recommends further consideration of the following issues: • Equity and justice in access to AI technologies and their benefits. There is a risk that existing inequalities between and within countries may widen if access to data, computing infrastructure, digital skills and AI tools remains concentrated among a limited number of actors. • Context-specific and locally relevant AI solutions. AI systems should be adapted to local realities, languages, cultures, environmental conditions and food systems rather than relying on one-size-fits-all approaches. • Institutional readiness. The effectiveness of AI depends not only on technology but also on the existence of institutions capable of translating digital evidence into policies, planning and implementation. • The role of social and institutional intelligence. AI should complement, rather than replace, local knowledge, community experience, participatory governance and human judgement.
Are the issues identified fully capturing the links with FSN outcomes?	The draft captures many important links between AI and FSN outcomes, particularly regarding productivity, resilience, risk management, value chains and access to information. However, additional attention could be given to the role of AI in strengthening food security governance, including evidence-based policymaking, coordination among institutions, monitoring systems, early warning mechanisms and crisis preparedness.
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	Jordan suggests further elaboration on: • The contribution of AI to food security monitoring and early warning systems. • The role of AI in improving policy coordination and decision-making. • The use of AI to support resource allocation during food security crises. • The implications of AI for social inclusion, participation and equitable access to food systems opportunities.

Is there any example or case study that would deserves to be mentioned?	Jordan has established the Higher Council for Food Security and the National Food Security Observatory. The Observatory supports data collection, monitoring, analysis and early warning, while the Higher Council strengthens policy coordination and evidence-based decision-making. This experience highlights the importance of linking data systems, governance structures and policy processes. AI and digital technologies have significant potential to strengthen these functions through forecasting, risk assessment and decision-support tools.
In particular, do you have examples of effective policies to improve FSN outcomes of the use of Artificial Intelligence, digitalization and data governance in food systems?	Jordan's experience demonstrates the importance of combining digital tools with institutional mechanisms. Effective outcomes are achieved when data collection, analysis, governance and decision-making are integrated within a coherent food security governance framework. Investments in digital systems should therefore be accompanied by capacity building, governance arrangements, data protection measures and mechanisms that facilitate the translation of information into policy action.
Is there any missing reference to key literature and data?	Jordan recommends considering additional evidence and literature on: • AI applications in food security monitoring and early warning systems. • Digital solutions in water-scarce agricultural environments. • Governance models for national food security observatories. • AI applications supporting food security decision-making in countries affected by climate stress, environmental degradation and displacement pressures.
Please insert below any additional comment.	Jordan believes that the success of AI should ultimately be assessed by its contribution to improved food security and nutrition outcomes, strengthened resilience, reduced inequalities and enhanced inclusion. Technology should be viewed as an enabling tool rather than an objective in itself. Future efforts should prioritize equity, local relevance, institutional strengthening and human-centered approaches to ensure that AI contributes meaningfully to the realization of the right to food and sustainable food systems.

14. Gerard Sylvester

Surname	Sylvester
First name	Gerard

Are you contributing in a personal capacity or on behalf of an organization or team?	Personal capacity
Current position	Investment Officer (Digital Agriculture)
Current institution/organization	FAO
Affiliation	UN
Country	Italy
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	Yes
Are the issues identified fully capturing the links with FSN outcomes?	Almost
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	Not at this moment
Is there any example or case study that would deserves to be mentioned?	AI-supported agriculture extension chatbot in Lesotho built completely on open stack
In particular, do you have examples of effective policies to improve FSN outcomes of the use of Artificial Intelligence, digitalization and data governance in food systems?	Better data analytics, interpretation and identifying patterns

15. Krishijournal, Nepal

Surname	Magar
First name	Dhanbahadur
Are you contributing in a personal capacity or on behalf of an organization or team?	On behalf of a team/organization
Current position	Agriculture journalist
Current institution/organization	Krishijournal
Affiliation	Civil society/NGO
Country	Nepal
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	Yes sure
Are there any other key issues that should be added and elaborated? If yes, please	Yes, there are so many issues.

provide a justification of why they are important, together with relevant literature and data.	
Are the issues identified fully capturing the links with FSN outcomes?	Yes sure
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	It's necessary for all
Is there any example or case study that would deserves to be mentioned?	Example of accessible of information and communications
In particular, do you have examples of effective policies to improve FSN outcomes of the use of Artificial Intelligence, digitalization and data governance in food systems?	Still is elaborating phase in agriculture.
Is there any missing reference to key literature and data?	It may be missed in operating systems
Please insert below any additional comment.	Agriculture issues are vast area so need to cautiously.

16. Food and Agriculture Organization of the United Nations (FAO)

Surname	Bravi
First name	Carlo
Are you contributing in a personal capacity or on behalf of an organization or team?	On behalf of a team/organization
Current position	Senior Economist
Current institution/organization	Food and Agriculture Organization of the United Nations (FAO)
Affiliation	UN
Country	Italy
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	Yes, the issues identified are the most important ones. The note could however better emphasize that data deserts and conflict-driven crises coincide precisely in the most food-insecure regions, making even well-designed AI tools structurally inadequate without prior investment in basic data infrastructure.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	One underaddressed issue is the role of farmer and community organizations as collective data governance actors. In smallholder-dominated food systems, individual data rights are unenforceable in practice; only organized producer groups can negotiate meaningful data sovereignty with private platforms. Literature on collective action in agricultural value chains (Markelova et al., 2009; Ton et al., 2018) supports this.

Are the issues identified fully capturing the links with FSN outcomes?	YES
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	Yes. When AI mediates access to subsidies or food assistance, algorithmic errors directly translate into denied entitlements and worsened food security outcomes for the most vulnerable. This concrete FSN impact — measurable through FIES or dietary diversity scores — is acknowledged but not sufficiently documented in the note.
Is there any example or case study that would deserves to be mentioned?	Yes. India's AgriStack is a relevant case: farmer representatives raised concerns that centralizing farmer data in private hands without consultation risks excluding smallholders from subsidy programs they depend on. It illustrates concretely how data governance failures translate into denied entitlements — a direct FSN outcome — and is already cited in the note but deserves stronger framing in this regard.
In particular, do you have examples of effective policies to improve FSN outcomes of the use of Artificial Intelligence, digitalization and data governance in food systems?	Yes. Kenya's KIAMIS (already cited) links farmer registries, subsidy management and agro-meteorological data into a single public digital infrastructure, currently reaching a large number of farmers. Brazil's open agricultural data policy through EMBRAPA and CONAB offers another model of publicly governed data serving FSN objectives. Both illustrate that effective policies combine public ownership of infrastructure with clear data governance mandates.

17. Racines de la Terre et Justice Sociale, Coordination nationale des mouvements sociaux et environnementaux, Tunisie

Surname	Hammami
First name	Karima
Are you contributing in a personal capacity or on behalf of an organization or team?	On behalf of a team/organization
Current position	Member of Racines de la Terre et Justice Sociale and Environmental Health & Water Specialist
Current institution/organization	Racines de la Terre et Justice Sociale/ Coordination nationale des mouvements sociaux et environnementaux de Tunisie
Affiliation	Civil society/NGO
Country	Tunisia
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data	The draft note addresses many of the key opportunities and challenges associated with Artificial Intelligence, digitalization and data governance for

governance affecting food security and nutrition (FSN), globally and in specific contexts?	food security and nutrition. It appropriately highlights issues related to productivity, climate adaptation, digital inclusion, data governance and equity. However, greater attention should be given to the role of environmental and public health surveillance systems as sources of strategic data supporting food security and nutrition outcomes.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	The note should explicitly address wastewater-based epidemiology, environmental surveillance and antimicrobial resistance monitoring. Wastewater systems provide valuable information on waterborne pathogens, environmental contamination and public health risks that may directly or indirectly affect food security and nutrition. Artificial intelligence can support the analysis of complex environmental datasets and strengthen early warning systems. The note should also place greater emphasis on data sovereignty and public governance of environmental, agricultural and health data, particularly in developing countries.
Are the issues identified fully capturing the links with FSN outcomes?	Not entirely. The note could better capture the links between environmental health, water quality, wastewater management and food security outcomes. Food security depends not only on agricultural production but also on safe water resources, environmental quality and effective disease surveillance systems.
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	The impacts of waterborne diseases, antimicrobial resistance, environmental pollution and wastewater reuse on food security and nutrition deserve further consideration. These issues can affect food safety, human health, agricultural productivity and ecosystem resilience.
Is there any example or case study that would deserves to be mentioned?	The Tunisian experience is also exploring innovative approaches such as the ongoing INTERACT project, which is in its early implementation phase. This initiative aims to integrate wastewater monitoring, pathogen surveillance, and advanced data analysis to strengthen public health preparedness and environmental governance. It also explores the potential use of artificial intelligence to support the processing of large environmental datasets and to contribute to the development of future early warning systems. Although still in progress, it illustrates a promising direction for combining environmental surveillance and digital tools in public health.

In particular, do you have examples of effective policies to improve FSN outcomes of the use of Artificial Intelligence, digitalization and data governance in food systems?	Effective policies should promote open and transparent public data systems, strengthen national capacities for data analysis, ensure equitable access to digital technologies and support public-sector leadership in the governance of environmental, agricultural and health data. AI applications should complement scientific expertise and public decision-making rather than replace them.
Is there any missing reference to key literature and data?	The note could benefit from additional references on wastewater-based epidemiology, antimicrobial resistance surveillance, environmental health monitoring and AI-supported early warning systems. Literature from WHO, FAO, UNEP and recent research on wastewater surveillance should be considered.
Please insert below any additional comment.	Artificial Intelligence offers significant opportunities for strengthening food security and nutrition. However, its benefits will depend on equitable access, robust public governance, transparency, scientific validation and the inclusion of developing countries in data generation and technological innovation. Environmental and public health data should be recognized as strategic assets for sustainable food systems.

18. Alliance pour la Souveraineté Alimentaire (MENA), Tunisia

Surname	Mahmoud
First name	Souad
Are you contributing in a personal capacity or on behalf of an organization or team?	On behalf of a team/organization
Current position	Coordinatrice
Current institution/organization	Alliance pour la Souveraineté Alimentaire -MENA
Affiliation	Civil society/NGO
Country	Tunisia
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	La note identifie plusieurs enjeux cruciaux avec rigueur, notamment la distinction entre IA spécifique et IA généraliste, les risques de concentration du pouvoir numérique, les préconditions infrastructurelles, et les asymétries de gouvernance des données. Ces contributions sont réelles et utiles pour le débat politique multilatéral. Cependant, le cadre analytique sous-jacent présente une limite structurelle importante : les enjeux sont systématiquement formulés comme des dysfonctionnements techniques ou des déficits de gouvernance corrigibles par la régulation et les

	bonnes pratiques, plutôt que comme des expressions de contradictions structurelles dans les rapports de pouvoir économique. Plus précisément : Ø Sur la concentration du capital numérique : La note traite correctement la concentration des infrastructures IA entre quelques firmes privées comme un risque majeur. Mais elle la présente comme une anomalie de marché plutôt que comme la tendance structurelle du capital à la monopolisation, particulièrement prononcée dans les industries à coûts fixes élevés et effets de réseau puissants. Cette distinction n'est pas sémantique : elle détermine la nature des réponses politiques appropriées. Si la concentration est une anomalie, la régulation suffit. Si elle est une tendance structurelle, des alternatives de propriété infrastructures publiques, coopératives numériques paysannes, plateformes sous contrôle démocratique sont nécessaires. Ø Sur les inégalités Nord-Sud : Le recours au cadre des « 4C » de la Banque mondiale pour analyser le « fossé numérique » dépolitise ce qui est le produit d'une histoire de domination économique internationale. Le retard numérique des pays à faibles revenus n'est pas un état originel : c'est le résultat d'une division internationale du travail historiquement construite qui a empêché le développement de capacités technologiques nationales autonomes. Analyser cet enjeu sans cette perspective historique conduit à des recommandations insuffisantes. Ø Sur l'impact environnemental : La note chiffre correctement la compétition pour les ressources (eau, énergie, capitaux) entre l'IA généraliste et les objectifs de sécurité alimentaire. Mais elle ne relie pas cet enjeu à la logique d'accumulation qui oriente les investissements vers les secteurs à haute rentabilité privée plutôt que vers les besoins sociaux fondamentaux. Sans cette analyse, les recommandations restent dans le registre des incitations volontaires, insuffisantes face à des mécanismes structurels puissants.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	Oui. Trois enjeux majeurs sont absents ou insuffisamment développés : Enjeu 1 : L'impact sur le travail agricole et les conditions d'emploi C'est la lacune analytique la plus grave de la note. En 44 pages sur la transformation numérique des systèmes alimentaires, aucune section n'est consacrée aux effets sur l'emploi agricole, les conditions de travail et

	les rapports salariaux dans les filières agroalimentaires. Pourquoi c'est important : L'agriculture mondiale emploie plus d'un milliard de personnes, représentant la principale source de revenus pour une large part des populations des pays à faibles et moyens revenus. Toute transformation technologique majeure de ce secteur a des implications directes sur ces travailleurs qui déterminent, au moins autant que la productivité technique, les résultats en matière de sécurité alimentaire et de nutrition. Les dimensions à intégrer incluent : ü Le déplacement de main-d'œuvre : La réduction de 46 à 75% de l'utilisation des pesticides par les drones agricoles, citée dans la note comme succès environnemental (Li et al., 2025 ; Nguyen et al., 2025a), signifie simultanément la réduction du travail de pulvérisation manuelle constituant une source de revenus pour des millions de travailleurs agricoles journaliers dans les pays du Sud. Aucun mécanisme de transition n'est discuté. ü La surveillance algorithmique des travailleurs : Dans les grandes exploitations industrielles, les centres de conditionnement et la logistique alimentaire, des systèmes de surveillance numérique en temps réel capteurs biométriques, suivi GPS, notation algorithmique de la performance sont déployés pour intensifier le travail et identifier les travailleurs les moins productifs. Ces outils créent de nouvelles formes de domination au travail difficilement contestables car présentées comme objectives. ü L'exclusion des syndicats des processus de décision : La note mentionne à plusieurs reprises la nécessité d'inclure les « organisations paysannes », mais ne fait aucune mention des syndicats de travailleurs agricoles et agroalimentaires, qui représentent les intérêts des salariés du secteur population distincte des agriculteurs indépendants. Littérature pertinente : ILO (2023), The future of work in agriculture ; FAO (2023), The status of women in agrifood systems (déjà cité dans la note mais sous-exploité sur la dimension travail) ; Woodcock & Graham (2019), The Gig Economy ; Berg et al. (2018), Digital labour platforms and the future of work, ILO. Enjeu 2 : L'extractivisme des données agricoles comme forme de travail non rémunéré La note traite la question des données principalement sous l'angle de la gouvernance et de la souveraineté. Elle n'aborde pas la dimension de la

	valeur économique produite par les utilisateurs et non rémunérée. Pourquoi c'est important : Chaque fois qu'un agriculteur utilise une application de détection de maladies, répond à une enquête numérique, ou enregistre ses pratiques sur un système de traçabilité, il produit de la valeur immédiatement captée par l'opérateur de la plateforme sans contrepartie. À l'échelle mondiale, cette extraction de valeur non rémunérée représente des montants considérables : les grandes firmes d'IA agricole valorisent leurs plateformes en dizaines de milliards de dollars sur la base de stocks de données produites pour l'essentiel par des agriculteurs non compensés. Une dimension particulièrement grave est l'appropriation des savoirs traditionnels des communautés paysannes et indigènes. Ces communautés ont développé sur des siècles des connaissances approfondies sur les variétés végétales locales, les pratiques agroécologiques et les techniques de gestion des ressources naturelles. Ces savoirs sont aujourd'hui systématiquement documentés et intégrés dans des bases d'entraînement par des acteurs externes, sans mécanismes adéquats de consentement éclairé ni de partage des bénéfices, reproduisant à l'ère numérique les dynamiques de biopiraterie documentées dans le doma
Are the issues identified fully capturing the links with FSN outcomes?	Partiellement. Les liens avec la disponibilité alimentaire (productivité) et la stabilité (systèmes d'alerte précoce) sont bien documentés. Les lacunes sont les suivantes : ü Sur l'accessibilité : La note reconnaît que les effets sur l'accessibilité sont « très spécifiques au contexte » mais n'analyse pas suffisamment les mécanismes par lesquels la numérisation peut réduire l'accessibilité : hausse des coûts de production pour les agriculteurs dépendants de plateformes propriétaires devenues indispensables, éviction des petits acteurs des marchés numérisés par des opérateurs mieux équipés, augmentation des prix alimentaires liée à la financiarisation des filières optimisées par algorithmes. ü Sur l'utilisation/nutrition : La note signale que les effets sur la nutrition sont peu documentés. Elle pourrait néanmoins identifier plus clairement le risque d'aggravation des inégalités nutritionnelles : les outils de nutrition de précision (ZOE, Viome, NutriGen, cités dans la note) sont développés exclusivement pour des clients aisés en

	Amérique du Nord et en Europe, tandis que les populations souffrant de malnutrition et de carences micro nutritionnelles dans les pays à faibles revenus bénéficient au mieux d'interventions SMS basiques aux impacts biologiques non démontrés (Barnett et al., 2025 ; Cunningham et al., 2024, déjà cités). ü Sur l'agentivité : C'est la dimension FSN la mieux traitée dans la note, qui identifie correctement les risques de biais algorithmique, d'exclusion et de réduction de l'autonomie décisionnelle. Elle devrait cependant établir un lien plus explicite entre la réduction de l'agentivité et la sécurité alimentaire à long terme : des systèmes alimentaires résilients requièrent des acteurs capables de s'adapter, d'innover et de décider capacités que l'automatisation et la dépendance technologique peuvent éroder. ü Sur la dimension de genre : La note mentionne que les femmes sont sous-représentées dans les données d'entraînement de l'IA généraliste (Norori et al., 2021) et que les systèmes numériques peuvent amplifier les inégalités de genre en matière d'accès aux services (Scott et al., 2021). Elle devrait développer plus explicitement le lien entre ces biais technologiques et les résultats nutritionnels des ménages, les femmes étant les principales décisionnaires en matière d'alimentation familiale dans la majorité des contextes (FAO, 2023).
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	Oui. Trois aspects méritent un développement approfondi : 1. Le lien entre déplacement technologique, revenus ruraux et sécurité alimentaire : La note traite séparément la productivité agricole et l'accès économique à l'alimentation. Elle devrait analyser plus explicitement la chaîne causale : automatisation → déplacement de travailleurs ruraux → réduction des revenus → réduction de l'accessibilité alimentaire. Dans les économies où l'emploi agricole est la principale source de revenus pour les ménages pauvres, les gains de productivité obtenus par automatisation peuvent coexister avec une dégradation de la sécurité alimentaire si les revenus du travail diminuent plus vite que les prix alimentaires ne baissent. 2. Le lien entre concentration des données et volatilité des prix alimentaires : La note traite la prédiction des prix des matières premières comme un outil d'aide à la décision pour les agriculteurs et les gestionnaires de politiques. Elle devrait également analyser le risque inverse : la concentration de capacités prédictives

	sophistiquées entre les mains de quelques opérateurs financiers peut amplifier la spéculation sur les marchés agricoles et contribuer à la volatilité des prix, aggravant l'insécurité alimentaire des populations les plus vulnérables. Les crises des prix alimentaires de 2007-2008 et 2010-2011, citées dans la note, ont été en partie alimentées par des comportements spéculatifs algorithmiques sur les marchés à terme agricoles. 3. Le lien entre souveraineté des données et souveraineté alimentaire : La note traite la souveraineté des données comme un enjeu de gouvernance technique. Elle devrait la relier explicitement au concept de souveraineté alimentaire le droit des peuples à définir leurs propres systèmes alimentaires promu par les mouvements paysans mondiaux et reconnu par plusieurs instruments internationaux. Un pays qui ne contrôle pas ses données agricoles stratégiques ne contrôle pas pleinement ses choix de politique alimentaire : les décisions sur quelles cultures promouvoir, quels marchés développer, quels risques gérer sont progressivement déléguées à des systèmes algorithmiques contrôlés par des acteurs extérieurs dont les intérêts ne coïncident pas nécessairement avec ceux des populations concernées.
Is there any example or case study that would deserves to be mentioned?	Oui. Les exemples suivants illustrent les enjeux manquants identifiés ci-dessus : Exemples et études de cas de la région MENA La région MENA présente des caractéristiques particulièrement pertinentes pour illustrer les enjeux identifiés dans ces commentaires : forte dépendance alimentaire aux importations, stress hydrique extrême, inégalités profondes entre économies pétrolières et pays à faibles revenus, présence simultanée de conflits armés majeurs (Yémen, Syrie, Soudan, Gaza) qui constituent précisément les angles morts des systèmes d'alerte précoce basés sur l'IA documentés dans la note. Sur les angles morts des systèmes d'alerte précoce IA dans les contextes de conflit La note signale que les modèles ML d'alerte précoce restent « structurellement aveugles aux crises les plus susceptibles d'atteindre les phases IPC 4-5 » car pilotés par des données agros climatiques et non par des données de conflit. La région MENA en fournit les illustrations les plus dramatiques : § Le cas du Yémen : Le Yémen représente l'une des pires crises alimentaires mondiales depuis 2015, avec plus de 17

	millions de personnes en insécurité alimentaire sévère selon le PAM. Cette crise est quasi-exclusivement pilotée par le conflit armé, les destructions d'infrastructures agricoles et hydrauliques, et le blocus des ports facteurs structurellement absents ou marginaux dans les modèles ML d'alerte précoce actuels. Le système FEWS NET, pourtant le plus sophistiqué disponible, a régulièrement sous-estimé la vitesse de dégradation de la situation alimentaire au Yémen précisément parce que ses modèles privilégient les signaux agro climatiques sur les signaux de conflit (Machefer et al., 2025, déjà cité dans la note). Ce cas devrait figurer explicitement comme illustration de la limite structurelle des outils IA dans les contextes où le conflit est le déterminant principal de l'insécurité alimentaire. § Le cas de Gaza : La destruction délibérée des infrastructures agricoles, des systèmes d'irrigation, des marchés alimentaires et des chaînes d'approvisionnement à Gaza depuis octobre 2023 constitue un cas extrême où aucun outil numérique ou IA ne peut compenser l'effondrement physique et institutionnel des systèmes alimentaires. Ce cas illustre de manière radicale la limite fondamentale soulignée dans la note : « les technologies amplifient les capacités humaines et institutionnelles existantes là où ces capacités sont absentes, aucun outil numérique ne peut les substituer ». Il illustre également les risques liés à la centralisation des données sensibles sur les populations dans des systèmes numériques vulnérables aux cyberattaques et aux destructions physiques d'infrastructure. § Le cas de la Syrie : La reconstruction des systèmes agricoles syriens post-conflit fait face à un défi de données particulièrement aigu : une décennie de guerre a détruit non seulement les infrastructures physiques mais aussi les systèmes d'information agricole, créant un « désert de données » au sens le plus littéral. Les tentatives de reconstruction numérique des registres fonciers et agricoles syriens par des organisations internationales illustrent à la fois le potentiel des outils numériques pour la reconstruction institutionnelle et les risques politiques liés au contrôle de ces données dans un contexte de gouvernance fragmentée. Sur le stress hydrique et la compétition pour les ressources entre IA et agriculture La note souligne que les centres de données consomment d'importantes quantités d'eau

	pour leur refroidissement, créant un conflit direct avec les besoins agricoles dans les zones de stress hydrique. La région MENA est la région du monde la plus touchée par ce conflit potentiel : § Le cas des Émirats Arabes Unis et de l'Arabie Saoudite : Ces pays investissent massivement dans des infrastructures IA et des centres de données de grande taille (Microsoft, Google et Amazon ont tous annoncé des investissements majeurs dans des centres de données en Arabie Saoudite et aux E
In particular, do you have examples of effective policies to improve FSN outcomes of the use of Artificial Intelligence, digitalization and data governance in food systems?	Les exemples suivants, partiellement absents de la note, méritent d'être mentionnés : Politiques de souveraineté des données agricoles La stratégie nationale de données agricoles du Maroc (Plan Maroc Digital 2030- volet agricole) : Dans le cadre de la stratégie Génération Green 2020-2030, le Maroc a engagé un processus de construction d'une infrastructure nationale de données agricoles sous contrôle du ministère de l'Agriculture, incluant un registre numérique des exploitations agricoles et un système d'information géographique des terres agricoles. Ce modèle, encore en développement, présente l'intérêt de maintenir la propriété des données agricoles stratégiques dans le domaine public national, en contraste avec des modèles où ces données sont confiées à des opérateurs privés. Ses limites notamment en matière d'inclusion des petits agriculteurs et des femmes rurales méritent également d'être documentées. La politique tunisienne d'agriculture intelligente face au stress hydrique : La Tunisie a développé des systèmes de gestion numérique de l'irrigation dans le cadre de sa réponse au stress hydrique chronique, notamment dans les périmètres irrigués du nord du pays. Ces systèmes, déployés sous contrôle des Groupements de Développement Agricole (GDA) structures collectives de gestion de l'eau constituent un exemple intéressant de gouvernance collective des données d'irrigation, même si leur couverture reste limitée. Ce modèle de gouvernance coopérative des données est directement pertinent pour les recommandations de la note sur les alternatives à la propriété privée des données. Politiques d'adaptation au changement climatique via le numérique Le système d'alerte précoce aux criquets pèlerins (SWARMS/FAO) dans la région MENA : La FAO opère depuis plusieurs décennies un système de surveillance et d'alerte

	précoce contre les invasions de criquets pèlerins couvrant l'Afrique du Nord, la Corne d'Afrique et la péninsule arabique. Ce système a progressivement intégré des outils numériques avancés imagerie satellitaire, modèles météorologiques, capteurs IoT au sol, applications mobiles pour les agents de terrain tout en maintenant une gouvernance intergouvernementale sous contrôle de la FAO. Il constitue l'un des exemples les plus documentés de déploiement réussi d'outils numériques spécifiques pour la sécurité alimentaire dans la région MENA, avec des impacts mesurables sur la réduction des pertes agricoles lors des invasions de 2019-2021. Ce cas illustre précisément la recommandation centrale de la note : privilégier des outils spécifiques à finalité claire, gouvernés par des institutions publiques, évalués sur des résultats concrets. Le Programme régional de gestion durable des terres (LADA/FAO-MENA) : Ce programme utilise des outils de télédétection et d'analyse de données géospatiales pour évaluer la dégradation des terres agricoles dans la région MENA et orienter les politiques de conservation. Il illustre l'usage productif des outils numériques spécifiques dans un cadre de gouvernance publique internationale, avec des données maintenues dans le domaine public et accessibles aux gouvernements membres.
Is there any missing reference to key literature and data?	Les références suivantes sont absentes de la note et soutiennent les enjeux identifiés dans ces commentaires : Sur le travail et la numérisation agricole : § ILO. (2023). The Future of Work in Agriculture: Challenges and Opportunities in the Digital Age. Geneva: International Labour Organization. § Berg, J., Furrer, M., Harmon, E., Rani, U., & Silberman, M.S. (2018). Digital Labour Platforms and the Future of Work: Towards Decent Work in the Online World. Geneva: ILO. § Woodcock, J., & Graham, M. (2019). The Gig Economy: A Critical Introduction. Cambridge: Polity Press. Sur l'extractivisme des données et la valeur du travail numérique : § Couldry, N., & Mejias, U.A. (2019). The Costs of Connection: How Data Is Colonizing Human Life and Appropriating It for Capitalism. Stanford: Stanford University Press. § Zuboff, S. (2019). The Age of Surveillance Capitalism. New York : PublicAffairs. (Particulièrement les chapitres sur l'extraction comportementale dans les contextes agricoles) §

	Pistor, K. (2019). The Code of Capital: How the Law Creates Wealth and Inequality. Princeton: Princeton University Press. Sur la souveraineté alimentaire et les droits des paysans : § La Via Campesina. (2021). Peasants' Rights and the Digital Revolution: Challenges and Perspectives. Jakarta: La Via Campesina. § Nations Unies. (2018). Déclaration des Nations Unies sur les droits des paysans et des autres personnes travaillant dans les zones rurales (UNDROP, A/RES/73/165). New York : ONU. (Instrument international directement pertinent, absent de la note) Sur la biopiraterie et les savoirs traditionnels à l'ère numérique : § Secretariat of the Convention on Biological Diversity. (2011). Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization. Montreal: CBD. § Oldham, P., Hall, S., & Forero, O. (2013). Biological Diversity in the Patent System. PLOS ONE, 8(11). Sur les inégalités structurelles et la numérisation du développement : § Toyama, K. (2015). Geek Heresy: Rescuing Social Change from the Cult of Technology. New York : PublicAffairs. (Le même auteur est cité dans la note pour son article de 2011 mais son ouvrage développe l'argument de manière bien plus complète) § Heeks, R. (2022). Digital Inequalities in the Global South. Cambridge: MIT Press.
Please insert below any additional comment.	Sur le positionnement politique de la note : La note conclut sa section « Voie à suivre » en affirmant que « l'IA responsable dans les systèmes alimentaires n'est pas seulement une question de garde-fous techniques, mais de conception institutionnelle ». Cette formulation est juste mais insuffisante. Une conception institutionnelle véritablement orientée vers la sécurité alimentaire et la nutrition comme droits fondamentaux doit aller au-delà de l'inclusion, de la transparence et de la contestabilité pour aborder les rapports de propriété sur les outils et les données qui structurent ces institutions. La note évite soigneusement de formuler des positions sur les questions de propriété publique versus privée, collective versus individuelle au nom d'une neutralité multilatérale compréhensible dans un document destiné à un organe aussi large que le CFS. Mais cette neutralité a un coût : elle conduit à des recommandations qui peuvent être adoptées par des gouvernements de orientations très différentes sans

	remettre en cause les dynamiques structurelles qui produisent l'insécurité alimentaire. Sur le processus de consultation lui-même : Le CFS devrait s'assurer que ce processus de consultation atteint effectivement les organisations représentant les travailleurs agricoles salariés, les communautés rurales des zones les plus touchées par l'insécurité alimentaire, et les mouvements paysans du Sud global et pas seulement les gouvernements, les institutions de recherche et les organisations de la société civile déjà bien intégrées dans les processus onusiens. Les voix les plus directement concernées par les impacts de la numérisation agricole sont souvent les moins présentes dans les consultations formelles. Sur la temporalité des recommandations : La note propose des actions au CFS adaptées au rythme institutionnel onusien suivi scientifique régulier, révision des recommandations de 2023, coordination avec d'autres organes. Face à la vitesse de déploiement des technologies IA dans les systèmes alimentaires, ce rythme risque d'être structurellement en retard. Le CFS devrait envisager des mécanismes d'alerte rapide politique distincts des mécanismes d'alerte précoce alimentaire permettant d'identifier et de signaler rapidement les déploiements technologiques qui menacent les droits des acteurs les plus vulnérables des systèmes alimentaires, sans attendre les cycles normaux de révision des recommandations.

19. Barbara Frattaruolo

Surname	Frattaruolo
First name	Barbara
Are you contributing in a personal capacity or on behalf of an organization or team?	Personal capacity
Current position	IPC Global Lead for Analyses
Current institution/organization	IPC
Affiliation	Partnership
Country	Italy

20. Ministério da Pesca e Aquicultura (MPA), Brazil

Surname	Souza Soares
First name	Fábio Hudson
Are you contributing in a personal capacity or on behalf of an organization or team?	On behalf of a team/organization
Current position	Coordenador Técnico
Current institution/organization	Ministério da Pesca e Aquicultura - MPA
Affiliation	Government and other public institution
Country	Brazil
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	Acreditamos que a "camuflagem" de dados imprecisos ou incertos, que acompanhados de uma boa argumentação, algo relativamente fácil para as IAs, pode trazer ideias ou soluções equivocadas. A segurança na utilização e revisão das informações fornecidas devem seguir critérios rígidos a depender do assunto em tratamento.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	Acesso a dados científicos, sobretudo ciência de base, com informações básicas, mas que servem como base de dados robusta e confiável.
Are the issues identified fully capturing the links with FSN outcomes?	o relatório reconhece que a IA pode ampliar desigualdades, mas ainda não explora plenamente como ela pode redefinir quem controla os sistemas alimentares globais.
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	O relatório discute bastante como a IA melhora a eficiência dos sistemas alimentares, mas ainda detalha pouco como ela pode transformar estruturalmente a própria natureza desses sistemas, inclusive suas relações de poder, dependência e resiliência de longo prazo.
Is there any example or case study that would deserves to be mentioned?	Acredito que em casos que muitas vezes possam envolver a opinião pessoal do gestor, como no caso de se concordar ou não com uma definição sobre determinada espécie, há divergências de ideologias e muitas vezes a IA não consegue distinguir nos comandos, podendo ser imparcial.

In particular, do you have examples of effective policies to improve FSN outcomes of the use of Artificial Intelligence, digitalization and data governance in food systems?	"Sistemas digitais e ferramentas de IA voltados à Segurança Alimentar e Nutricional não devem se limitar à otimização produtiva, mas também incorporar a manutenção da integridade ecológica e da resiliência socioecológica dos sistemas alimentares. Nesse contexto, políticas de prevenção e monitoramento de espécies invasoras representam um exemplo estratégico de integração entre governança de dados, inteligência ambiental e segurança alimentar de longo prazo."
Is there any missing reference to key literature and data?	Desconheço.
Please insert below any additional comment.	No contexto do Ministério da Pesca e Aquicultura (MPA), o debate sobre Inteligência Artificial, digitalização e governança de dados aplicado à Segurança Alimentar e Nutricional (SAN) é especialmente relevante, pois essas ferramentas podem fortalecer o monitoramento ambiental, a rastreabilidade, a gestão pesqueira e aquícola, a previsão de riscos e a conservação dos recursos aquáticos. Contudo, os benefícios dessas tecnologias dependem de governança pública robusta, inclusão digital, soberania de dados e integração entre produção e conservação ambiental. Nesse sentido, políticas voltadas ao monitoramento de espécies exóticas invasoras, como a tilápia-do-nilo (Oreochromis niloticus), representam um exemplo importante de como IA e sistemas digitais podem contribuir não apenas para ganhos produtivos, mas também para a manutenção da integridade ecológica, da biodiversidade aquática e da resiliência dos sistemas alimentares. Assim, a digitalização no âmbito do MPA não deve se limitar à eficiência produtiva, mas também incorporar estratégias de prevenção ecológica, fortalecimento de espécies nativas e proteção da soberania alimentar e ambiental brasileira.

21. Joao Gabriel Rodrigues Telles Almeida

Surname	Rodrigues Telles Almeida
First name	Joao Gabriel
Are you contributing in a personal capacity or on behalf of an organization or team?	Personal capacity
Current position	Postdoctorate
Current institution/organization	El Colegio de la Frontera Sur

Affiliation	Academia
Country	Mexico
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	Yes. The issues identified by the HLPE-FSN are highly relevant and capture many of the most important risks and opportunities related to AI, digitalization and data governance in food security and nutrition. The note is particularly strong in distinguishing specific-purpose AI from generalist AI, warning against "silver bullet" narratives, and emphasizing the importance of context, institutional capacity, accountability, contestability, data sovereignty and final FSN outcomes rather than mere adoption metrics. My suggestion is not to replace this orientation, but to deepen one dimension that is already implicit in the note: the question of epistemic authority. In FSN systems, AI does not only process information or optimize services. It can also influence which forms of knowledge are treated as valid, which categories are used to describe problems, and which recommendations become institutionally authoritative. This is especially important in Indigenous, peasant and smallholder contexts, where FSN depends not only on formal datasets but also on local ecological knowledge, oral memory, farmer experimentation, community norms, seasonal observation and territorial decision-making. Therefore, equity and inclusiveness should not be limited to access to digital tools or protection from data misuse. They should also include the capacity of communities, producers and local institutions to evaluate, correct and govern the knowledge that AI systems use and produce.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	Yes. One issue that should be further elaborated is how to operationalize context, data sovereignty and contestability through locally grounded AI infrastructures. In particular, the note could give more attention to retrieval-augmented generation systems, or similar knowledge-grounded architectures, based on locally validated corpora and existing recommendation protocols. This matters because food systems are highly context-dependent. Recommendations about crops, soils, pests, climate adaptation, fire, nutrition, water, agroforestry, storage or value chains cannot be safely generalized without considering local ecological conditions, cultural practices, productive histories and institutional capacities. A generic AI output may be

	linguistically coherent and technically plausible, but still inadequate for a specific territory. RAG systems could help address this problem by grounding AI-generated responses in curated knowledge bases before producing recommendations. In FSN, these knowledge bases could include agroecological manuals, local agricultural calendars, public extension protocols, climate-risk bulletins, community food practices, nutrition guidelines, farmer experimentation records, public policy documents and Indigenous or peasant knowledge validated through appropriate governance mechanisms. The literature on large language models shows that AI systems reproduce inequalities embedded in their training data, including linguistic, cultural, social and geographic asymmetries (Bender et al. 2021; Weidinger et al. 2022; Kerche et al. 2026). Research on retrieval-augmented generation, ontology-grounded retrieval and domain adaptation suggests that grounding model outputs in specialized external knowledge bases can improve contextual performance (Lee et al. 2025; Sharma et al. 2025; Xu et al. 2025). However, for FSN the challenge is not only technical performance. The corpora themselves must be legitimate, locally relevant, accountable, regularly updated and governed with clear rules on consent, ownership, access, validation and benefit-sharing. Empirical evidence from intercultural AI use supports this point. In a workshop with 76 Tseltal students in Chiapas, generative AI outputs became more adequate when participants introduced territorial references, cultural procedures, linguistic judgment and collective correction. When such grounding was absent, outputs tended to reproduce generic templates or inaccurate representations (Almeida, 2026). Although this is not a direct FSN case, it is relevant for understanding how AI behaves in culturally and linguistically situated contexts. The same problem may affect agricultural, nutritional and climate-adaptation recommendations if they are not grounded in local knowledge and validated by local actors.
Are the issues identified fully capturing the links with FSN outcomes?	Partially. The note already makes an important contribution by distinguishing between availability, accessibility, nutrition, stability and agency, and by insisting that digital tools should be evaluated against final FSN outcomes rather than usage metrics. This is a

	strong starting point. However, the links between AI governance and FSN outcomes could be made more explicit through the concept of knowledge-mediated outcomes. AI and data governance affect FSN not only by improving productivity, early warning or value-chain coordination. They also affect how problems are framed, how risks are interpreted, which recommendations are prioritized, and how communities act upon information. For example, a digital advisory system may improve access to information, but if its recommendations are not locally validated, it may lead to inappropriate decisions regarding crop choice, pest management, water use, diets, land use or climate adaptation. In this case, the problem is not only technical inaccuracy. It is the displacement of situated judgment by externally generated recommendations. The note could therefore strengthen the connection between AI governance and FSN outcomes by emphasizing three additional links: first, whether AI systems reinforce or weaken local decision-making capacity; second, whether they support or marginalize existing advisory and knowledge systems; and third, whether their outputs can be contested and corrected by the people affected by them.
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	Yes. The note should further elaborate indirect FSN outcomes related to knowledge dependency, institutional dependency and the displacement of local advisory capacities. Direct outcomes are easier to identify: AI can support crop monitoring, pest detection, climate alerts, food distribution, nutritional guidance, market information and value-chain coordination. But indirect outcomes may be equally important. If AI systems become the main source of technical authority without local validation, communities and public institutions may become dependent on external platforms, proprietary datasets or non-transparent recommendation systems. This could affect FSN in several ways. It may reduce farmer experimentation, weaken public extension systems, marginalize Indigenous and peasant knowledge, promote standardized solutions that do not fit local ecological conditions, or concentrate control over agricultural and nutritional knowledge in private infrastructures. For this reason, indirect outcomes should include changes in local knowledge systems, advisory practices, institutional autonomy, community

	agency and the capacity to maintain context-specific forms of food production, care and ecological management. These outcomes are harder to measure than yield or service uptake, but they are central to long-term FSN resilience.
Is there any example or case study that would deserves to be mentioned?	Yes. A relevant indirect case study is the intercultural use of generative AI with Tseltal students at the Universidad Intercultural de Chiapas in Oxchuc, Mexico (Almeida, 2026). Although the case is not directly about food security or nutrition, it is relevant for AI governance in culturally and linguistically diverse territories. The study showed that AI outputs became more adequate when users actively introduced local references, linguistic judgment, cultural procedures and collective evaluation. It also showed that, when interacting in Tseltal, the system tended to shift toward translation and produced grammatical or structural inconsistencies. This reveals a broader issue for FSN: AI systems may appear useful while still lacking operational depth in minoritized languages and locally specific knowledge systems. This case could help the HLPE-FSN discussion because similar dynamics may occur in agricultural, nutritional or climate-adaptation advice. If AI systems are not grounded in local knowledge and validated by local actors, they may reproduce generic assumptions while appearing technically authoritative. The case also shows that human agency, collective correction and local interpretive authority are not secondary safeguards; they are conditions for meaningful and responsible AI use in intercultural settings.
In particular, do you have examples of effective policies to improve FSN outcomes of the use of Artificial Intelligence, digitalization and data governance in food systems?	I would not present the following as fully evaluated effective policies, since the evidence base on AI and final FSN outcomes is still limited. Rather, I suggest them as promising policy directions aligned with the concerns already identified in the note. First, public investment should prioritize locally grounded AI systems for agricultural extension, nutrition, agroecology and climate adaptation, especially systems based on validated local and regional corpora. This could include RAG systems connected to existing protocols, manuals and public-interest knowledge bases rather than relying only on general-purpose AI tools. Second, AI advisory systems used in public food, agriculture or nutrition programs should be required to ground their outputs in existing recommendation protocols, such as agroecological

	manuals, public health guidelines, extension service materials, climate bulletins and community-validated practices. Third, participatory validation mechanisms should be established before AI-generated recommendations are used in decision-making. These mechanisms should include local producers, Indigenous authorities, nutrition experts, extension workers, community organizations and public institutions. Fourth, data governance frameworks should recognize community knowledge not merely as raw data, but as knowledge embedded in collective authority, language, territory and memory. This requires rules on consent, access, ownership, updating, benefit-sharing and the right to contest outputs. Fifth, public procurement rules for AI in FSN should require transparency, explainability, local validation, interoperability, auditability and the possibility of contesting AI recommendations. Sixth, open-source and public-interest AI infrastructures should be supported where possible, especially when they reduce dependency on proprietary platforms and allow local institutions to audit, adapt and update systems. These policy directions would help ensure that AI supports FSN outcomes without replacing local judgment, weakening public institutions or deepening dependency on private infrastructures.
Is there any missing reference to key literature and data?	The note could benefit from additional references in four areas. First, critical AI literature on bias, training data and representational inequality, including Bender et al. (2021), Weidinger et al. (2022) and Kerche et al. (2026). These works help explain why AI systems may reproduce linguistic, cultural, social and geographic inequalities. Second, literature on retrieval-augmented generation, ontology-grounded retrieval, domain adaptation and knowledge-grounded AI systems, including Lee et al. (2025), Sharma et al. (2025) and Xu et al. (2025). This literature is relevant for operationalizing the note's concern with context, data sovereignty and technical implementation. Third, empirical studies on intercultural AI use, Indigenous languages and local validation processes, such as Almeida (2026). This type of work shows how AI outputs are negotiated, corrected and reoriented through situated human judgment. Fourth, data on linguistic inequality, digital corpora availability and local-language support in AI systems. This is important because the quality of AI outputs depends heavily on

	the availability of digitized corpora, conversational datasets, language resources, connectivity, institutional capacity and local data governance. Without this data, AI inclusion may be discussed too generally. The note already makes important references to digital divides, data deserts and contextual data. The additional literature would help deepen the cultural, linguistic and epistemic dimensions of these same problems.
Please insert below any additional comment.	The note provides a strong and cautious basis for discussion. I especially value its emphasis on problem framing before tool selection, the distinction between specific-purpose and generalist AI, the concern with final FSN outcomes, and the warning that digital tools amplify existing institutional and social capacities rather than replacing them. My main suggestion is to further operationalize the note's concerns with context, agency, sovereignty and contestability through the idea of epistemic sovereignty. In FSN, this means that communities, producers and local institutions should be able to define how knowledge about their food systems is produced, validated, interpreted and used. For this reason, the most promising direction is not generic AI assistance, but locally grounded AI systems built from validated protocols, community knowledge, public-interest datasets and transparent mechanisms of review. RAG systems and related architectures may be useful in this regard, but only if they are developed with strong governance around consent, ownership, validation, updating and accountability. The risk is that AI systems may produce fluent and persuasive recommendations that appear technically reliable while remaining disconnected from local realities. The opportunity is that, when properly governed, AI can help organize existing knowledge, improve access to recommendations, support local institutions and strengthen decision-making. Therefore, equity and inclusiveness in AI for FSN require more than connectivity, data access or digital literacy. They require the capacity to negotiate technological mediation without ceding authority over local knowledge systems. In practical terms, this

	means building AI systems with locally governed knowledge bases, participatory validation protocols and clear mechanisms for contesting, correcting and refusing inadequate recommendations.

22. Alireza Karbasi

Surname	Karbasi
First name	Alireza
Are you contributing in a personal capacity or on behalf of an organization or team?	Personal capacity
Current position	professor
Current institution/organization	Ferdowsi University of Mashhad
Affiliation	Academia
Country	Iran (Islamic Republic of)
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	partly to some extent to some degree
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	institutional capacity is important
Are the issues identified fully capturing the links with FSN outcomes?	A coceptual framwork is good for between all of the topics
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	local food systems can be mentioned
Is there any example or case study that would deserves to be mentioned?	There are many studies in developing and developed countries
In particular, do you have examples of effective policies to improve FSN outcomes of the use of Artificial Intelligence, digitalization and data governance in food systems?	According to the research in diffrent part of the world it can be found
Is there any missing reference to key literature and data?	Deep reading is needed
Please insert below any additional comment.	It is needed divided two part examples consist of .developing and developed countries.

23. State Institution "Republican Center of Nutrition", Tajikistan

Surname	Нушервони
First name	Билол
Are you contributing in a personal capacity or on behalf of an organization or team?	On behalf of a team/organization
Current position	Заместитель директора - Director
Current institution/organization	Государственное учреждение Республиканский центр питания – State Institution "Republican Center of Nutrition"
Affiliation	Government and other public institution
Country	Tajikistan

Surname	Haqnazarov
First name	Inomjon
Are you contributing in a personal capacity or on behalf of an organization or team?	On behalf of a team/organization
Current position	Director
Current institution/organization	Republican Nutrition Center
Affiliation	Government and other public institution
Country	Tajikistan

24. Representación Permanente de la República Argentina ante FAO, FIDA y PMA

Surname	República Argentina
First name	República Argentina
Are you contributing in a personal capacity or on behalf of an organization or team?	On behalf of a team/organization
Current position	Representación Permanente de la República Argentina ante FAO, FIDA y PMA
Current institution/organization	Representación Permanente de la República Argentina ante FAO, FIDA y PMA
Affiliation	Government and other public institution
Country	Argentina
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	En términos generales, los temas identificados resultan pertinentes y reflejan adecuadamente los principales desafíos asociados a la adopción de la inteligencia artificial, la digitalización y la gobernanza de datos en los sistemas alimentarios. Particularmente relevantes son las cuestiones vinculadas al acceso a la tecnología, la disponibilidad y calidad de los datos, la capacidad institucional para su utilización y los riesgos asociados a la concentración de información y

	capacidades tecnológicas. Estos factores condicionan directamente la posibilidad de aprovechar las herramientas digitales para mejorar la productividad agropecuaria, fortalecer la resiliencia climática y contribuir a la seguridad alimentaria. No obstante, para que estas herramientas puedan desplegar todo su potencial, resulta necesario considerar algunos desafíos estructurales previos que afectan especialmente a los territorios rurales. Entre ellos se destacan las limitaciones en materia de conectividad, la insuficiente capacitación y alfabetización digital de productores y trabajadores rurales, la escasez de técnicos especializados para implementar y gestionar estas tecnologías, y la necesidad de generar evidencia concreta sobre los beneficios económicos y productivos derivados de su adopción. Superar estas barreras constituye una condición indispensable para promover una transformación digital que permita ampliar el acceso a las innovaciones tecnológicas y maximizar su contribución a la producción agropecuaria y a la seguridad alimentaria.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	Sería conveniente incorporar con mayor énfasis el papel de la digitalización y la inteligencia artificial en la gestión eficiente de los recursos hídricos y en la expansión sostenible de la producción bajo riego. Las tecnologías basadas en sensores, monitoreo remoto, análisis predictivo y automatización están demostrando una creciente capacidad para optimizar el uso del agua, incrementar la productividad y mejorar la adaptación al impacto provocado por los eventos climáticos extremos Asimismo, debería destacarse la necesidad de promover infraestructuras de datos agropecuarios interoperables que faciliten la generación de soluciones tecnológicas adaptadas a las realidades productivas locales. Resulta necesario prestar especial atención al desarrollo de capacidades humanas para interpretar, gestionar y transformar los datos en decisiones agronómicas efectivas. Si bien la incorporación de tecnologías digitales en el sector agropecuario ha avanzado significativamente en numerosos países, la brecha existente entre la generación de datos y su utilización práctica para la toma de decisiones comienza a constituir una limitante para una adopción más amplia y eficiente. En este sentido, la formación de recursos humanos especializados, la capacitación de productores y técnicos, y el fortalecimiento de los sistemas de

	extensión y transferencia de conocimiento son elementos fundamentales para garantizar que la transformación digital se traduzca en mejoras concretas de productividad, sostenibilidad y seguridad alimentaria. Sin capital humano capacitado, las inversiones en digitalización corren el riesgo de convertirse en un costo adicional en lugar de una herramienta efectiva para el desarrollo del sector.
Are the issues identified fully capturing the links with FSN outcomes?	Los temas abordados presentan una clara vinculación con los resultados de la seguridad alimentaria y la nutrición, especialmente en relación con la disponibilidad, estabilidad y acceso a los alimentos. Asimismo, las herramientas digitales, la inteligencia artificial y la gestión de datos tienen el potencial de contribuir significativamente al incremento sostenible de la producción agropecuaria, mejorar la eficiencia en el uso de recursos estratégicos como el agua y fortalecer la competitividad de los productores, aspectos fundamentales para garantizar la seguridad alimentaria en el largo plazo. No se debe dejar de analizar la relación entre estas tecnologías y los resultados en materia de seguridad alimentaria considerando las condiciones habilitantes necesarias para su adopción. En particular, deben tenerse en cuenta las limitaciones de conectividad en amplias zonas rurales, donde la infraestructura digital resulta insuficiente o, en algunos casos, inexistente. Esta situación condiciona el acceso efectivo de productores y comunidades rurales a las herramientas digitales y puede profundizar las brechas tecnológicas existentes. Por ello, además de promover la digitalización y el uso de la inteligencia artificial, resulta fundamental avanzar en políticas de conectividad rural e infraestructura digital que permitan una adopción más amplia y efectiva de estas tecnologías en los sistemas agroalimentarios.
Is there any example or case study that would deserves to be mentioned?	Entre los casos que merecen ser destacados se encuentran las aplicaciones de agricultura de precisión y gestión inteligente del riego mediante sensores de humedad, imágenes satelitales, monitoreo remoto y sistemas de apoyo a la toma de decisiones. Estas herramientas permiten optimizar el uso del agua y los insumos, reducir costos de producción, mejorar los rendimientos y fortalecer la adaptación de los sistemas productivos. Asimismo, los sistemas de monitoreo y alerta temprana basados en

	inteligencia artificial para la gestión de riesgos climáticos constituyen experiencias con impactos concretos sobre la productividad, la resiliencia y la sostenibilidad de los sistemas agropecuarios. Sin embargo, la replicabilidad y escalabilidad de estas experiencias dependen en gran medida de la disponibilidad de infraestructura digital adecuada. En algunas regiones, la calidad de la conectividad en las áreas rurales continúa representando una limitante significativa para la adopción de tecnologías digitales avanzadas. Mientras que los centros urbanos presentan niveles relativamente altos de acceso a internet, amplias regiones rurales enfrentan déficits estructurales de conectividad, con una brecha digital que restringe el acceso a herramientas basadas en datos e inteligencia artificial. Por ello, además de promover casos exitosos de innovación tecnológica, resulta fundamental impulsar políticas orientadas a fortalecer la infraestructura de telecomunicaciones y ampliar el acceso a banda ancha en las zonas rurales, condición indispensable para una transformación digital efectiva del sector agropecuario.
In particular, do you have examples of effective policies to improve FSN outcomes of the use of Artificial Intelligence, digitalization and data governance in food systems?	Una política eficaz para mejorar los resultados de la seguridad alimentaria y la nutrición mediante la digitalización, la inteligencia artificial y la gobernanza de datos consiste en promover ecosistemas públicos de información agropecuaria que integren datos climáticos, productivos, hídricos y territoriales bajo criterios de interoperabilidad, acceso y reutilización. En este sentido, resulta especialmente relevante el principio de que los datos generados mediante iniciativas financiadas con fondos públicos sean accesibles y cumplan con los principios FAIR (Localizables, Accesibles, Interoperables y Reutilizables), favoreciendo la generación de conocimiento, la transparencia y una mejor toma de decisiones. En Argentina existen experiencias que ilustran los beneficios de este enfoque. Un caso destacado es el relevamiento de la capacidad instalada de la industria molinera de trigo, donde la integración de información operativa aportada por los propios actores del sector permitió construir un diagnóstico integral de la actividad. Esta herramienta proporciona información estratégica para el diseño de políticas públicas más precisas, mejora la planificación sectorial y fortalece la capacidad de análisis y monitoreo de la cadena agroindustrial. Asimismo, la

	modernización y unificación de registros agropecuarios constituye otro ejemplo de política pública efectiva. La implementación del Sistema de Información Simplificado Agrícola (SISA) para el sector de granos y la reciente creación del Sistema de Información de Operaciones de Carnes y Lácteos (SIOCAL) representan avances significativos en materia de interoperabilidad y gobernanza de datos. Estos sistemas han permitido simplificar procesos administrativos, reducir cargas burocráticas, centralizar la información en plataformas digitales únicas y mejorar la calidad, trazabilidad y disponibilidad de los datos para la gestión pública y privada. Además, en el marco de su estrategia de modernización, el Instituto Nacional de Semillas (INASE) implementó una serie de herramientas digitales dentro de su Sistema de Gestión y Portal de Servicios orientadas a optimizar la fiscalización y agilizar los trámites del sector semillero. Entre las principales innovaciones se destacan la digitalización de lotes mediante polígonos georreferenciados asistidos por inteligencia artificial para la estimación productiva, la incorporación de inspecciones digitales en tiempo real, y la desburocratización de procesos clave como la autorización digital del obtentor, la inscripción de material precomercial y la solicitud anticipada de rótulos. Estas medidas promueven un esquema de autogestión y despapelización que no solo incrementa la transparencia y la trazabilidad de la cadena, sino que también elimina demoras administrativas para los operadores. Complementariamente, resulta fundamental fortalecer la conectividad rural, la alfabetización digital de productores y técnicos, y el desarrollo de plataformas de soporte a la toma de decisiones. Estas acciones permiten ampliar el acceso a las tecnologías digitales, reducir brechas territoriales y generar las condiciones necesarias para una adopción más efectiva de herramientas basadas en datos e inteligencia artificial, contribuyendo al aumento sostenible de la producción agropecuaria y al fortalecimiento de la seguridad alimentaria.

25. Federal Ministry of Agriculture, Food and Regional Affairs, Germany

Surname	Chatelain
First name	Carla
Are you contributing in a personal capacity or on behalf of an organization or team?	On behalf of a team/organization
Current position	Employee
Current institution/organization	Germany government represented by the Federal Ministry of Agriculture, Food and Regional Affairs.
Affiliation	Government and other public institution
Country	Germany
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	The BMZ funded project Capacity for Nutrition - National Information Platform for Nutrition (C4N-NIPN), that is implemented by GIZ, carried out research with Johns Hopkins Bloomberg School of Public Health in 2024, related to AI and nutrition. The risks that are mentioned in the HLPE-FSN draft document are included in the outcome of the above-mentioned research. We can share a presentation of the research. Importance was given to the following points: o Data privacy: research needs to respect individual and community rights, and maintain privacy o Security: growth in the adoption of AI analytical techniques will increase the number of data transactions and potential breaches to health data privacy o There are existing capabilities to re-identify anonymized data, using a few parameters within the data; this needs to be regulated o Bias: algorithms are only as good as the data on which they are trained, and any bias in that data can lead to biased outcomes that could exacerbate existing health disparities o Discrimination: algorithms can perpetuate patterns of marginalization and inequality and increase harm for already vulnerable populations o Inequity: substantial resources are necessary to compile and store the large amounts of data being used; in resource-poor settings, this may be cost-prohibitive, and internet access required may be unavailable o Validity: some existing predictive models have not been appropriately validated, and as updates occur, predictive performance of models need to be continually revalidated
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are	- The note could further elaborate on the implications for food security and nutrition (FSN) of the use of AI, digitalization and data governance. The analysis on

important, together with relevant literature and data.	pages 23,24 rightly highlights that unequal digital access and representation in data can result in unequal service delivery and the underrepresentation of women in training data. This should be reflected more systematically in the recommendations. Relevant safeguards include sex-disaggregated and context-sensitive data, participatory design, accessible offline alternatives and effective redress mechanism. - While the HLPE document mentions the risk for a "digital-colonialism dynamic", it doesn't further elaborate on some major problematics related to this. Please consider that modern artificial intelligence might perpetuate historical patterns of domination, resource extraction, and inequality and further elaborate on this.
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	- The indirect FSN outcomes of digital exclusion should be further elaborated. When public services such as banking, agricultural advice, insurance, subsidies and nutrition information are accessed via digital systems, women with limited access to mobile phones, connectivity, digital IDs, bank accounts or digital literacy skills may encounter additional obstacles. This can indirectly impact their access to food, income, public support, and nutrition-related decision-making. The example of women's limited mobile phone access in rural India, which was mentioned earlier in the text, illustrates this risk well.
Is there any example or case study that would deserves to be mentioned?	- Use of AI by LAO NIPN (NIPN: National Information Platforms for Nutrition https://nipn.lsb.gov.la/). The NIPN AI system has been trained to process large volumes of information and to translate complex analyses into clear insights, automatically flagging data gaps and inconsistencies. The platform also enables users to query the system in plain language, receiving concise and relevant summaries or recommendations in return. This feature significantly improves the accessibility of data and promotes its use among non-technical stakeholders. - In parallel, the Lao NIPN team, in collaboration with Alive & Thrive (A&T), is piloting the use of AI tools for monitoring the violation of breastmilk substitute advertising and promotion on social media. This innovative approach represents an important step towards strengthening the enforcement of national nutrition regulations and demonstrates how AI can support real-time monitoring and accountability mechanisms in the nutrition sector. See: Virtual

	Violations Detector. A&T presented their tool to K4N in July , during which they identified one of the risks with AI being used in LMIC on nutrition data as being a "Novelty effects of AI innovations: it raises unrealistic/impractical expectations", pointing out the need to raise awareness and manage expectations on what AI can and cannot achieve.
Please insert below any additional comment.	- The analysis on pages 23,24 is particularly valuable and should be reflected more explicit in the way forward. Rather than merely being mentioned as a group affected by digital divides and data gaps, women should be included in equality-sensitive safeguards as part of responsible AI and data governance for FSN. This includes representative data, non-discriminatory access to digital public infrastructure, human oversight and appeal and contestability mechanism. Without such safeguards AI and digital tools risk exacerbating existing disparities in access to agricultural advice, public support, credit, insurance and nutritional information. - We welcome the inclusion of the topic of "waste prevention." - Regarding financing, here is a general note: The paper makes it clear that additional ODA funds are needed/required for this initiative; see page 19, last paragraph: "On the other hand, investment in digital infrastructure and data collection must not compete with existing official development aid (ODA) budgets but needs to be added to them." This does not seem realistic—globally—in times of shrinking fiscal space and tighter donor funds.

26. Ministerio de Agricultura y Ganadería, Costa Rica

Surname	Azofeifa
First name	Roberto
Are you contributing in a personal capacity or on behalf of an organization or team?	On behalf of a team/organization
Current position	Jefe de la Unidad de Acromática
Current institution/organization	Ministerio de Agricultura y Ganadería
Affiliation	Government and other public institution
Country	Costa Rica
Are the issues identified by the HLPE-FSN the most important issues related to	Si. Aunque en materia de costos y beneficios el documento es escaso.

Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	Es importante ahondar en lo relativo a costo de las inversiones y sus beneficios a nivel de productor (finca) como del país. También es importante abordar las ventajas para el sector consumidor.
Are the issues identified fully capturing the links with FSN outcomes?	Será el avance en los temas de la digitalización en la agricultura, que el enfoque de Seguridad Alimentaria y Nutricional se podrá ir fortaleciendo desde la perspectiva de la digitalización en la agricultura.
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	Cómo lograr que los beneficios de la digitalización en los sistemas alimentarios alcancen a las familias consumidoras de menos recursos.
In particular, do you have examples of effective policies to improve FSN outcomes of the use of Artificial Intelligence, digitalization and data governance in food systems?	Las experiencias piloto en Costa Rica han mostrado resultados muy positivos en cuanto a reducción del uso de agroquímicos, reducción de la contaminación por nitratos y nitritos, aumento en la producción en cebolla y papa, aumento de los ingresos de pequeños y medianos productores. Los resultados no se han publicado oficialmente. El análisis y reflexión sobre los impactos aún no se ha realizado.
Is there any missing reference to key literature and data?	La OCDE ha escrito sobre el tema; el año anterior hizo una encuesta sobre digitalización en los países miembros. También el IICA ha publicado. En el documento no se han incluido citas sobre estudios de OCDE o de IICA. Vale la pena chequear.
Please insert below any additional comment.	La digitalización en la agricultura, tanto desde la perspectiva de la producción, como de la comercialización y el consumo, está facilitando cambios sumamente interesantes a favor de la eficiencia en la producción, el uso de los recursos naturales, la reducción del consumo de agua e insumos agropecuarios, el manejo de los animales domésticos, el monitoreo de la biodiversidad y recursos naturales, la comunicación entre los diversos actores de las cadenas agroalimentarias, el acceso a mercados por parte del sector productivo (en particular pequeños y medianos). Sin embargo, para que los beneficios sean socializados sin dejar a nadie atrás, los desafíos para los gobiernos se ven aumentados al tener que capacitar los equipos de investigación y extensión, como también, a aumentar sus inversiones en los modelos demostrativos que

	provean las evidencias sobre los beneficios para productores y consumidores. For more information, see Annex A.

27. National Fund for Education Development, Brazil

Surname	Bandoni
First name	Daniel
Are you contributing in a personal capacity or on behalf of an organization or team?	On behalf of a team/organization
Current position	Coordinator of Food and Nutritional Security for the National School Feeding Program
Current institution/organization	Brazil national fund for education development
Affiliation	Government and other public institution
Country	Brazil
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	Yes, The HLPE-FSN identifies most of the key opportunities and risks associated with Artificial Intelligence (AI), digitalization and data governance in food systems. From the standpoint of public food and nutrition policies, especially in low- and middle-income countries, it is imperative to focus more on the role of AI and digitalization in enhancing public programs that directly impact food security and nutrition outcomes. These include school feeding, social protection, public food procurement, nutrition surveillance, and food-based social assistance programs.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	Public sector data governance for food and nutrition programmes; Participatory and inclusive digital governance; Digital public infrastructure for AI
Are the issues identified fully capturing the links with FSN outcomes?	The document elucidates significant connections between AI applications and the dimensions of food availability, stability, and access. However, the association with nutritional outcomes could be further strengthened. Nutrition outcomes depend not only on food production and supply chains but also on food environments, consumer behaviour, nutrition education, social protection, public procurement, health systems, and regulatory measures. These dimensions received comparatively less attention throughout the document.
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	A more comprehensive analysis is required to evaluate the role of AI and digitalization in public food and

	nutrition programmes. School feeding programmes constitute one of the most extensive public food systems worldwide, serving hundreds of millions of children daily. Digital technologies and AI have the potential to enhance various aspects of these programmes, including menu planning, procurement management, programme implementation monitoring, food quality control, nutrition education, and impact assessment.
In particular, do you have examples of effective policies to improve FSN outcomes of the use of Artificial Intelligence, digitalization and data governance in food systems?	Brazil's National School Feeding Programme (PNAE), which integrates digital monitoring systems with public procurement policies that support family farming and healthy diets.

28. Dirección General de Planeación y Desarrollo en Salud (DGPLADES), Secretaría de Salud, México

Surname	Herrera
First name	Miguel Angel
Are you contributing in a personal capacity or on behalf of an organization or team?	On behalf of a team/organization
Current position	Director de Medicina Tradicional y Desarrollo Intercultural
Current institution/organization	Dirección General de Planeación y Desarrollo en Salud (DGPLADES), Secretaría de Salud, México
Affiliation	Government and other public institution
Country	Mexico
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	En el documento donde se analizan los sistemas alimentarios indígenas, se da cuenta de una serie de situaciones relacionadas con la cultura y los procesos de desculturación, que tienen que ver con elementos ideológicos y que son muy importantes y que difícilmente pueden seabordados y comprendidos por la IA. También el establecimiento de relaciones estructurales de desigualdad y discriminación a nivel social y cultural, presentes en los programas gubernamentales de salud y desarrollo que se aplican con los pueblos indígenas.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	Las Dietas Tradicionales Regionales. El Informe EAT–Lancet 2025 propone 8 soluciones para enfrentar la situación de alimentación en el mundo. La 2ª señala: “Proteger y promover dietas tradicionales regionales. Con frecuencia representan una profunda conexión con el entorno local, la diversidad biológica, las prácticas agrícolas, las creencias culturales y las

	adaptaciones a largo plazo de los recursos disponibles". Este es uno de los elementos centrales en el modelo de la dieta de la milpa. https://drive.google.com/file/d/1Fgv52f9TS0Tug_MyIrYgImyEF460UQR9/view . Este modelo de alimentación llamado: "La Dieta de la Milpa. Corazón de la Cocina Mexicana. Alimentación Regional Saludable, Culturalmente Pertinente", señala elementos clave para fortalecer la salud humana y ambiental, considerando los elementos, biológico, cultural e intercultural, que se aplican de manera diferenciada en cada contexto regional, lo cual lo hace muy difícil para ser comprendido por la IA. Dicho documento se encuentra en la siguiente liga: https://drive.google.com/file/d/1RsnBfWwqRXxY4hHyjBR-JjWpTtTAbZ10/view
Are the issues identified fully capturing the links with FSN outcomes?	Posiblemente no
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	Posiblemente no sean completos
Is there any example or case study that would deserves to be mentioned?	En este momento todavía no
In particular, do you have examples of effective policies to improve FSN outcomes of the use of Artificial Intelligence, digitalization and data governance in food systems?	Ninguno
Is there any missing reference to key literature and data?	No conocemos bibliografía para llenar los huecos identificados por nosotros

29. Hamid Reza Mojtabavi

Surname	Mojtabavi
First name	Hamid Reza
Are you contributing in a personal capacity or on behalf of an organization or team?	Personal capacity
Current position	Secretary-General of Sustainable Aquatic Development Institute (SADI)
Current institution/organization	Sustainable Aquatic Development Institute (SADI)
Affiliation	Private sector
Country	Iran (Islamic Republic of)
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and	Yes. The issues identified by the HLPE-FSN are highly relevant and among the most important issues related to AI, digitalization and data governance affecting food security and nutrition. The note is particularly strong in recognizing that AI is not merely a technical

nutrition (FSN), globally and in specific contexts?	matter, but is closely linked to governance, data sovereignty, equity, public interest, platform power, digital exclusion and the risk of digital dependency. However, I believe that the issues could be further strengthened by giving more explicit attention to learning, collective action, adaptive capacity and institutional transformation. Food system challenges are not solved only by better data, better models or better regulation. They also depend on the capacity of actors to learn together, cooperate, adapt to uncertainty and build institutions capable of responding to complex and changing conditions. Therefore, while the report correctly identifies many of the key issues, it could more fully capture the importance of institutional learning, collaborative governance, boundary organizations, structural power in value chains, and the governance of objectives, standards and narratives in food systems.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	Yes. I believe several additional issues deserve explicit attention because they are likely to determine whether AI and digitalization contribute to inclusive and resilient food systems or reinforce existing inequalities and dependencies. First, institutional learning and adaptive capacity should be recognized as central dimensions of food system transformation. The challenge is often not a lack of data, but the ability of individuals, organizations and institutions to convert data into knowledge, learning and adaptive action. Literature on adaptive governance and resilience has consistently shown that learning capacity is a critical determinant of long-term sustainability (Folke et al., 2005; Berkes, 2009). Second, collective action and collaborative governance should receive greater attention. Many food system challenges cannot be solved by governments, markets or technology providers acting independently. Producer organizations, cooperatives, multi-stakeholder platforms and other forms of collective organization often determine whether digital innovations produce inclusive outcomes or increase existing asymmetries. Third, boundary organizations and intermediary institutions deserve explicit recognition. Think tanks, innovation brokers, extension systems, knowledge networks and facilitation organizations play an essential role in translating knowledge into action, connecting science with policy and practice, and supporting cooperation

	among stakeholders. Fourth, epistemic dependency and cognitive sovereignty should be considered alongside data sovereignty. Even when countries retain ownership of data and infrastructure, dependence may emerge if analytical frameworks, interpretations and recommendations increasingly originate from a small number of external AI systems. This issue has significant implications for policy autonomy and long-term development. Fifth, structural power beyond data ownership requires further examination. Power in food systems is exercised not only through control of data and digital infrastructure but also through control of standards, certification systems, protocols, indicators and market access mechanisms. AI may reinforce these forms of structural power unless appropriate governance mechanisms are established. Finally, greater attention should be paid to exit strategies, technological diversity and resilience. Digital sovereignty requires not only the ability to adopt technologies but also the ability to leave them, switch providers and avoid long-term lock-in. Diversity of technologies, institutions and governance arrangements should be viewed as a resilience asset rather than an inefficiency. Relevant literature includes adaptive governance and resilience research (Folke et al., 2005; Ostrom, 2009; Berkes, 2009), institutional learning literature (Argyris & Schön, 1978), collective action and commons governance (Ostrom, 1990), and recent work on digital sovereignty, platform power and data governance (UNDP, 2025; World Bank, 2025b). These perspectives would complement and strengthen the report's existing analysis.
Are the issues identified fully capturing the links with FSN outcomes?	They capture many important links with FSN outcomes, but not fully. The report appropriately discusses how AI and digital tools may affect productivity, early warning, climate adaptation, supply-chain transparency, food safety, nutrition advice and public policy delivery. These are all important direct or indirect pathways to FSN outcomes. However, I believe the report could more clearly distinguish between technical outputs and real FSN outcomes. For example, increased data availability, more users, better predictive accuracy or wider platform adoption should not automatically be treated as improvements in FSN. The key questions

	should remain: Are more people food secure? Is access to safe and nutritious food improved? Are vulnerable groups better protected? Are small-scale producers more resilient? Are food systems more adaptive and equitable? The report could also elaborate more on indirect pathways. AI may influence FSN not only through production and logistics, but also through changes in market power, standards, certification, consumer behaviour, data ownership, and institutional capacity. These indirect effects may ultimately be as important as direct productivity gains. Therefore, I suggest that the report more explicitly frame FSN outcomes in terms of availability, access, utilization, stability, equity, resilience and agency. This would help prevent digital performance indicators from being confused with real food security and nutrition outcomes.
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	Yes. I believe the report could further elaborate several indirect FSN outcomes that may become increasingly important as AI and digitalization reshape food systems. First, greater attention should be paid to resilience and adaptive capacity as FSN outcomes in their own right. In an era of climate uncertainty, geopolitical disruptions, market volatility and environmental stress, the ability of food systems to adapt and continue functioning may be as important as productivity gains. Second, the report could more explicitly address institutional capacity and learning as indirect determinants of FSN. Food security depends not only on technology but also on the ability of institutions to learn, coordinate, respond to crises and improve over time. Digital technologies may strengthen or weaken these capacities depending on how they are governed. Third, social capital, trust and cooperation deserve greater attention. Effective food systems depend on relationships among producers, consumers, governments, researchers and market actors. AI-enabled systems may support collaboration, but they may also increase fragmentation, dependency or exclusion if poorly designed. Fourth, the report could further examine the impact of AI on agency. Food security is not only about food availability and access; it is also about the ability of individuals and communities to influence decisions affecting their food systems. Digital systems can either empower stakeholders or concentrate decision-making power in the hands of a few actors. Finally,

	greater attention could be given to long-term food system sovereignty, including control over data, knowledge, standards and strategic decision-making processes. These factors may significantly influence future FSN outcomes even when short-term production indicators appear positive. For these reasons, I suggest broadening the discussion of FSN outcomes beyond productivity and efficiency to include resilience, adaptive capacity, learning, trust, agency and food system sovereignty.
Is there any example or case study that would deserves to be mentioned?	Yes. While the report includes several useful examples, I believe it would benefit from incorporating additional case studies that illustrate not only technological success but also the institutional and governance conditions that enable positive FSN outcomes. One particularly valuable example is the experience of Andhra Pradesh, India, where digital technologies have been combined with farmer organizations, extension systems, public institutions and collective action mechanisms. The success of many aquaculture and agricultural initiatives in the region cannot be explained by technology alone; it is the interaction between technology, institutions and stakeholder coordination that has generated results. A second important category of examples concerns shared-access and cooperative digital models, such as machinery-sharing platforms ("Uber for tractors"), collective market information systems and producer-owned data platforms. These examples demonstrate how digital technologies can strengthen inclusion rather than merely improve efficiency. The report could also benefit from including examples from small-scale fisheries and aquaculture, where AI and digital tools are increasingly being used for: Traceability; Disease monitoring; Water quality management; Market information; Early warning systems. These sectors are highly relevant for food security and nutrition in many developing countries but remain underrepresented in global digitalization discussions. Finally, examples of public digital infrastructure and data governance frameworks that seek to balance innovation with sovereignty, accountability and public interest would be particularly valuable. Such cases help illustrate that successful digital transformation depends not only on technology adoption but also on governance arrangements, institutional capacity and stakeholder

	participation. The strongest case studies are often those that demonstrate how technology, collective action, learning and governance interact to improve FSN outcomes, rather than those that focus exclusively on technological performance.
In particular, do you have examples of effective policies to improve FSN outcomes of the use of Artificial Intelligence, digitalization and data governance in food systems?	14. Do you have comments on the proposed way forward and considerations for CFS? Yes. I strongly support the report's emphasis on data governance, public digital infrastructure, interoperability, transparency and the need to address platform concentration and digital dependency. These are essential foundations for ensuring that AI serves the public interest in food systems. However, I believe the proposed way forward could be strengthened by placing greater emphasis on learning, adaptation and institutional development. Sustainable transformation of food systems cannot be achieved through technology deployment and regulation alone. It also requires building the capacity of individuals, organizations and institutions to learn, cooperate and adapt over time. The report could further encourage CFS to promote: Institutional learning systems; Collaborative governance mechanisms; Multi-stakeholder dialogue platforms; Boundary organizations that connect science, policy and practice; Mechanisms for collective experimentation and adaptive management. In addition, the report rightly highlights data sovereignty, but future work could also consider knowledge sovereignty and cognitive sovereignty. Countries and communities should not only retain control over data but also maintain the capacity to interpret information, generate knowledge and make decisions independently. I also encourage greater attention to the governance of standards, indicators and certification systems. As AI becomes increasingly integrated into food systems, influence over what is measured, reported and rewarded may become a significant source of power. Ensuring transparency, accountability and broad participation in these processes will be critical. Finally, I suggest that CFS consider establishing a recurring platform for monitoring the real-world impacts of AI on food security and nutrition, distinguishing between technological promises and demonstrated outcomes. Such a platform could help build a stronger evidence base and support adaptive policymaking in a rapidly

	changing technological environment. Overall, the proposed way forward is highly valuable, but it could be further strengthened by complementing technology governance with a stronger focus on learning systems, collective action, adaptive governance and long-term institutional resilience.
Is there any missing reference to key literature and data?	I suggest prioritizing policy recommendations that go beyond technology adoption and focus on governance, public interest, institutional capacity and resilience. First, data governance and data sovereignty should be a top priority. Food system data should not become an extractive resource controlled by a small number of private actors. Clear rules are needed on data ownership, access, use, benefit-sharing, privacy, portability and accountability. Second, CFS should prioritize public digital infrastructure for food systems. Digital transformation should not depend exclusively on proprietary platforms. Open, interoperable and publicly accountable digital infrastructures are essential to avoid dependency, exclusion and vendor lock-in. Third, policies should support collective action and producer participation. Small-scale farmers, fishers, aquaculture producers and food workers should not only be data providers or technology users. They should participate in the design, governance and benefit-sharing of digital systems. Fourth, CFS should encourage institutional learning and adaptive governance. Digital technologies should be embedded in systems that allow continuous monitoring, feedback, experimentation and correction. This is especially important under climate, market and geopolitical uncertainty. Fifth, anti-monopoly and competition policies should be strengthened to prevent excessive concentration of data, platforms, cloud infrastructure and AI models in the hands of a few global firms. Finally, policy recommendations should ensure that AI and digitalization are assessed against real FSN outcomes, not only technical indicators. The key test should be whether these technologies improve food security, nutrition, equity, resilience, agency and sustainability.
Please insert below any additional comment.	Thank you for the opportunity to comment on this important and timely report. Overall, I consider this background note to be one of the most balanced and constructive contributions

	currently available on the relationship between artificial intelligence, digitalization, data governance and food systems. Its emphasis on public interest, data sovereignty, platform power, accountability and digital dependency is particularly valuable. My main observation is that future discussions could benefit from complementing the current governance framework with a stronger focus on learning, collective action, institutional development and adaptive capacity. In complex food systems, technology alone is rarely the determining factor. Long-term success depends on the ability of societies, organizations and communities to learn, cooperate, innovate and adapt under conditions of uncertainty. In this regard, I believe future work could explore the development of a broader framework that integrates: Learning systems; Collaborative and adaptive governance; Boundary organizations; Collective action mechanisms; Institutional resilience; Strategic asset protection; Cognitive and knowledge sovereignty. Such a framework could complement existing discussions on AI, data governance and digital infrastructure while providing a more comprehensive perspective on long-term food system transformation. I would be pleased to provide additional clarification, examples or supporting material regarding any of the comments presented above if this would be useful. I would also welcome the opportunity to contribute to future discussions, consultations or working groups exploring complementary frameworks for governing AI, digitalization and data in ways that strengthen food security, nutrition, resilience and inclusive development.

30. Nadir Nasir Yusuf

Surname	Yusuf
First name	Nadir Nasir
Are you contributing in a personal capacity or on behalf of an organization or team?	Personal capacity
Current position	Quality Assure
Current institution/organization	Candico
Affiliation	Private sector
Country	Ethiopia
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	Yess
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	Yess, It should handled wisely
Are the issues identified fully capturing the links with FSN outcomes?	Of course
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	More Future Promise
Is there any example or case study that would deserves to be mentioned?	More Study on AI Data feeding and Black box Outcomes
In particular, do you have examples of effective policies to improve FSN outcomes of the use of Artificial Intelligence, digitalization and data governance in food systems?	Not yet

31. National Institute of Agriculture Technology, Argentina

Surname	TALLARICO
First name	Gabriela
Are you contributing in a personal capacity or on behalf of an organization or team?	On behalf of a team/organization
Current position	Coordinator of the National AgTech Program
Current institution/organization	INTA - National Institute of Agricultural Technology of Argentina
Affiliation	Government and other public institution
Country	Argentina

Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	We consider the issues and challenges identified by the HLPE-FSN to be the most important at the global scale and closely aligned with the realities observed in the specific context of Argentina. The document does not rely on a techno-solutionist narrative; rather, it grounds the analysis not only in the technology itself, but also in the structural conditions that determine who benefits from it. Some aspects that are not reflected in sufficient depth include country-scale references, regional heterogeneity, and marked intraregional inequalities, which tend to understate the institutional constraints faced by intermediary extension and research organizations; the private capture of data at the holding, farm, or plot level; the agronomic biases built into the models (territorial, crop-specific, and those affecting alternative production scales, among others); and the shortage of "hybrid talent" as an immediate operational constraint. Another complementary analytical dimension that could be incorporated is the need for any AI strategy for food security and nutrition (FSN) to explicitly include the strengthening of evaluation and auditing capacities within national public institutions—not only among producers—as a non-negotiable precondition for sovereign technological adoption oriented toward the public good.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	The HLPE-FSN document is structured around a cross-country analytical logic with a comparative focus, contrasting high-income and low-income countries, and leaves aside an approach that would adequately capture the complexity of dual agrifood systems such as Argentina's, where an extensive Pampas-based sector—among the most technologically advanced in the world—coexists with family and peasant agriculture characterized by poor connectivity, low mechanization, and high food vulnerability. Therefore, countries with similar profiles require their own analytical categories to assess internal heterogeneity and to examine the advanced capacities of some sectors alongside the structural vulnerabilities of others, where the main risk lies not in the absence of technology, but in its unequal distribution and its capture by interests that do not align with FSN objectives. Accordingly, these tools tend to be deployed where data, infrastructure, and absorptive capacity already exist, thereby deepening the gap rather than reducing it. This is compounded

	by the absence of a consolidated public agricultural data infrastructure in FAIR formats, which turns dependence on private data—captured by machinery suppliers, input providers, and carbon platforms—into a structural constraint for any sovereign AI strategy oriented toward the public good. This same duality is reflected in the availability of training data, which are concentrated mainly in intensive systems and tend to reproduce and normalize that paradigm. Bibliography: Connectivity as a condition for the digital transition of family farming in Argentina. Current gaps, public policies, and perspectives https://repositorio.inta.gob.ar/handle/20.500.12123/24832 / Challenges of Argentine agriculture: https://repositorio.inta.gob.ar/xmlui/handle/20.500.12123/2149
Are the issues identified fully capturing the links with FSN outcomes?	The causal relationship between AI and its short-term impacts—such as productivity, early warning, and market access, among others—is represented in the document, showing that direct linkage. By contrast, the causal chains associated with medium- or long-term impacts are somewhat underrepresented. Some of the linkages that would merit further elaboration are those connecting data governance, the concentration of technological power, environmental sustainability in relation to technological use, and the various algorithmic biases (territorial, productive, gender-related, affecting peasant communities, etc.) that could affect FSN. It would be necessary to analyse these multicausal dynamics and conditioning factors so that their operational usefulness for the design of impact assessment policies is not constrained. Such an analysis would also make it possible to identify intervention points, monitoring indicators, the different links in the chain, and the institutional mediations required.
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	In addition to the dimensions addressed in the previous question, it would be useful to include an analytical section on issues such as decision delegation, in order to assess the risk of transferring critical decisions to opaque algorithmic systems, which could weaken accountability and localized food governance capacity. The impact of market bias should also be considered, insofar as “precision nutrition” solutions are often designed for affluent populations, leaving a knowledge gap as to how these tools may serve contexts of greatest need in low- and

	middle-income countries. It would also be pertinent to assess the environmental footprint and the massive water and energy consumption of AI data centres, which compete directly with agriculture and rural communities for these resources, especially in regions affected by water stress.
Is there any example or case study that would deserves to be mentioned?	In Argentina, although there are various implementation initiatives and market cases with developments currently under way, the documentation on their impacts and direct benefits has not yet been assessed in sufficient depth to justify citing supporting sources or referring to them specifically.
In particular, do you have examples of effective policies to improve FSN outcomes of the use of Artificial Intelligence, digitalization and data governance in food systems?	Argentina has legal frameworks for data protection and open data within public institutions, which provide a basic institutional foundation and whose articulation should be further strengthened in order to build an agricultural data governance architecture oriented toward the public good and to establish a coherent policy framework that creates opportunities for the food system.

32. Agricultural Research, Education and Extension Organization (AREEO), Iran (Islamic Republic of)

Surname	Sadooghi
First name	Leila
Are you contributing in a personal capacity or on behalf of an organization or team?	On behalf of a team/organization
Current position	PhD students
Current institution/organization	Agricultural Research, Education and Extension Organization (AREEO), Tehran, Iran
Affiliation	Government and other public institution
Country	Iran (Islamic Republic of)
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	Overall, the issues identified by the HLPE-FSN are among the most important factors affecting global food security and nutrition. The draft appropriately highlights key areas such as productivity improvement, early warning systems, climate change adaptation, value-chain efficiency, algorithmic bias, digital exclusion, and the need for transparent and accountable governance. As such, it provides a comprehensive and coherent framework for discussion across a wide range of contexts. However, the relative importance of these issues varies considerably depending on local circumstances. In low-resource settings, challenges such as inadequate

	infrastructure, limited digital literacy, restricted access to locally relevant data, and weak institutional capacity often constitute more significant barriers than the technologies themselves. These constraints can substantially limit the effective adoption and use of digital technologies and AI-driven solutions.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	Yes, several additional issues deserve greater attention. The growing use of AI and machine learning in food commodity markets may contribute to price volatility, with potential consequences for food-importing countries. The social impacts of agricultural automation should also be considered, particularly in contexts where large numbers of people depend on seasonal farm work for their livelihoods. In addition, the increasing reliance on data-driven optimization may reduce crop diversity and weaken the resilience of food systems over time. The report could further address the risks associated with dependence on digital platforms during emergencies, highlighting the need for reliable backup mechanisms. Finally, strengthening local capacities, skills, and governance frameworks is essential to ensure the long-term sustainability of digital agriculture initiatives.

33. Department of Economy, Planning and Development (DEPDev), Philippines

Surname	Pereira
First name	Michael Angelo
Are you contributing in a personal capacity or on behalf of an organization or team?	On behalf of a team/organization
Current position	Senior Economic Development Specialist
Current institution/organization	Department of Economy, Planning, and Development (DEPDev)
Affiliation	Government and other public institution
Country	Philippines
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	The note successfully identifies many of the most critical issues surrounding artificial intelligence (AI), digitalization, and data governance in food systems, particularly the opportunities for improving productivity, supply chain efficiency, climate resilience, and food system governance, as well as the risks related to data governance. This framing is consistent with existing literature which recognizes that AI and digital tools can support precision agriculture, climate risk management, and food

	safety, while also raising concerns on related to digital divides, algorithmic bias, data ownership, and unequal distribution of benefits, among others (World Bank, 2025a; FAO, 2021; Mehrabi et al., 2021). Further, the emphasis on equity and inclusiveness (seen on page 5 of the draft note) is particularly critical given that food insecurity remains disproportionately concentrated among vulnerable populations, including fisherfolk, farmers, women, indigenous peoples, and rural communities, among others. From the perspective of developing countries such as the Philippines, however, the discussion could further emphasize the role of AI and digital technologies as enablers of structural transformation rather than merely just a productivity-enhancing tools. Food security challenges are increasingly linked not only to production constraints but also to climate vulnerability, fragmented value chains, logistics inefficiencies, disaster risks, and market access barriers (Anshida et al., 2026; Nelson et al., 2015). In this context, AI has the potential to support integrated food systems transformation through improved forecasting, adaptive planning, resource optimization, and evidence-based policymaking. The note may also benefit from discussing and highlighting the uneven distribution of AI readiness across countries. Many developing countries face foundational constraints related to digital infrastructure, connectivity, data availability, financing, and human capital, among others. The World Bank's framework on AI foundations emphasizes the importance of connectivity, compute, context, and competency as prerequisites for meaningful AI adoption, adaptation, and innovation (World Bank, 2025b). Similarly, global research on data-driven agriculture shows that unequal access to digital infrastructure and uneven representation in datasets can reinforce exclusion, particularly for smallholders and rural communities that are underrepresented in digital systems (Mehrabi et al., 2021). Consequently, discussions on AI governance should recognize that the primary challenge for many countries is not only regulating AI systems but ensuring equitable access to foundational digital infrastructure and building local capacities, emphasizing the provision of

	interventions and incentives to strengthen buy-in of the stakeholders, to participate in the emerging digital economy.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	While the draft note provides a comprehensive assessment of the opportunities and risks associated with AI, digitalization, and data governance in food systems, three additional pointers warrant further attention given their growing relevance to food security and nutrition. First, climate adaptation and disaster resilience should be given standalone consideration. Climate change is increasingly recognized as one of the most significant threats to global food security, affecting agricultural productivity, livelihoods, and nutrition outcomes (IPCC, 2023; FAO, 2023). AI-enabled climate forecasting, crop monitoring, and early warning systems have demonstrated considerable potential in strengthening resilience to climate-related shocks through improved risk anticipation, disaster preparedness, and adaptive decision-making (World Bank, 2025a; DOST-ASTI, n.d.). This is particularly relevant for countries such as the Philippines, which consistently rank among the most climate-vulnerable countries globally and experience recurrent typhoons, floods, droughts, and other extreme weather events that disrupt food production and distribution systems. Second, the note should further elaborate on the role of digital public infrastructure (DPI) as an enabling foundation for inclusive and accountable food systems governance. Increasing evidence suggests that interoperable digital identity systems, farmer registries, geospatial information platforms, digital payment systems, and public data exchanges can significantly improve the delivery of agricultural support services, social protection programs, food subsidy mechanisms, disaster assistance, and nutrition interventions (United Nations, 2024; World Bank, 2025b). Further, the note should more explicitly recognize the importance of indigenous knowledge systems, traditional agricultural knowledge, and local innovation. Existing literature highlights that successful agricultural innovation often emerges from the combination of scientific knowledge and locally adapted practices developed through generations of experimentation and environmental stewardship (FAO, 2021; IPBES, 2022). AI systems

	should therefore be designed to complement rather than replace local knowledge systems.
Are the issues identified fully capturing the links with FSN outcomes?	The note generally captures the relationship between AI, digitalization, food security, and nutrition outcomes. It recognizes that these technologies may influence food production, supply chain efficiency, and food safety, among others. However, the discussion may be further strengthened by explicitly linking AI and digital interventions to the four widely recognized dimensions of food security: availability, access, utilization, and stability (FAO, 2021). This would help clarify the specific pathways through which AI and digital technologies affect food security and nutrition outcomes. From a Philippine policy perspective, this framing is consistent with the Philippine Development Plan (PDP) 2023–2028, specifically Chapters 3 and 5, which emphasizes agricultural modernization, food security, poverty reduction, resilience-building, and inclusive growth as core development priorities. This approach also aligns with the National Innovation Agenda and Strategy Document (NIASD) 2023-2032, which recognizes innovation and emerging technologies as instruments for strengthening productivity, resilience, and sustainable development. Applying to this systems perspective would allow the HLPE-FSN note to evaluate AI not merely as a tool, but by its measurable contribution to the food security and nutrition outcomes and public value.
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	The note may further elaborate on indirect food security and nutrition outcomes related to governance, institutional capacity, and inclusion. Food security is not determined only by production levels, but also by the ability of institutions to anticipate risks, coordinate responses, and protect vulnerable groups. AI-supported decision systems can assist governments in monitoring food prices, identifying climate risks, assessing crop losses, targeting assistance, and improving the timing and location of public interventions. However, these systems must be designed with transparency, accountability, and human oversight to avoid reinforcing exclusion or shifting responsibility away from public institutions (Heeks, 2002; UNDP, 2025). Another outcome that warrants further discussion is anticipatory governance. In climate-vulnerable

	countries such as the Philippines, food security is frequently affected by typhoons, floods, droughts, and other shocks. AI-enabled weather analytics, geospatial intelligence, and early warning systems can support anticipatory action by allowing governments to identify risks before they become crises. Lastly, the note may also give greater attention to nutrition-sensitive food systems. AI applications are often discussed in terms of agricultural productivity, but food security and nutrition outcomes also depend on dietary diversity, affordability, consumer behavior, food safety, and the broader food environment. AI and data analytics may support monitoring of food environments, early detection of nutrition risks, and more targeted public health interventions. However, safeguards are needed to prevent misinformation, commercial manipulation, and inequitable access to nutrition-related digital services (FAO, 2021; WHO, 2025).
Is there any example or case study that would deserves to be mentioned?	Several Philippine examples may be useful for the HLPE-FSN note, particularly because they illustrate how AI-related and data-driven tools can support food security in a climate-vulnerable developing country context. First, the Philippine Rice Information System (PRiSM) is a relevant case of operational digital agriculture. PRiSM is Southeast Asia's first rice monitoring system using satellite imagery and information and communications technology to generate data on rice area, yield, and risks from flood and drought. It supports the Department of Agriculture (DA) in strategic planning, decision-making, project implementation, and disaster preparedness. This case is particularly relevant because rice remains central to Philippine food security and agricultural policy, thus PRiSM demonstrates how remote sensing, geospatial data, mobile field monitoring, and crop modeling can provide timely and policy-relevant information for production planning and disaster response (PhilRice, n.d.; Balié, et al., 2020). Second, the National Color-Coded Agricultural Guide Map (NCCAG) provides another useful example. It is a database of map overlays showing the natural suitability of economically important crops, integrating data on soil properties, elevation, rainfall, temperature, water availability, socio-economic conditions, and projected climate-induced multi-hazards. This

	demonstrates how data-driven decision support can guide crop planning, land use decisions, climate adaptation, and agricultural investment (DA, n.d.). Lastly, various Philippine investments in geospatial, climate, and disaster risk information systems through agencies such as the DOST-PAGASA, DOST-PHIVOLCS, PhilSA, NAMRIA, and the DA may be considered relevant examples of public-sector data infrastructure that can support AI-enabled food security applications. These examples show that effective AI adoption in food systems often begins not with frontier AI, but with reliable public data, geospatial infrastructure, climate information and institutional coordination.
In particular, do you have examples of effective policies to improve FSN outcomes of the use of Artificial Intelligence, digitalization and data governance in food systems?	The Philippine policy experience illustrates that effective AI and digital governance for food systems should be anchored in whole-of-government planning, innovation policy, digital public infrastructure, and responsible data governance. This can be seen in the PDP 2023–2028, specifically Chapters 3 and 5, where it identifies the modernization of agriculture and agribusiness as a key strategy to raise productivity, move Philippine products up the value chain, promote diversification, and ensure food security. This provides an important policy basis for using AI and digital technologies to improve productivity, resilience, logistics, and evidence-based decision-making in the food system. The NIASD also supports this direction by promoting innovation-led development, stronger research and development, industry-academe-government collaboration, technology diffusion, and regulatory improvements. In the context of food security and nutrition, this implies that AI should be deployed not only as a technology solution but as part of a broader innovation ecosystem that includes research institutions, farmers' organizations, cooperatives, local government units, startups, and the private sector. Further, the National Artificial Intelligence Strategy for the Philippines (NAIS-PH) also provides a relevant framework for the overall direction on AI development and deployment. It emphasizes responsible AI, data governance, infrastructure, and talent development, among others, which can ultimately guide AI application in various sectors, including that of agriculture, food logistics, and nutrition. A proposed AI Governance Framework has

	been developed by the DEPDev and presented to the National Innovation Council (NIC) chaired by the President of the Philippines, the approval of the same subject to changes to be effected and reflected based on the feedback of the NIC.
Is there any missing reference to key literature and data?	We recommend including references as cited from our answers to the previous questions, as this will help bolster the credibility of the note.
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34. Mukteswar Prasad Mothadaka

Surname	Mothadaka
First name	Mukteswar Prasad
Are you contributing in a personal capacity or on behalf of an organization or team?	Personal capacity
Current position	Principal Scientist (Retired) & Emeritus Scientist
Current institution/organization	Retired from Inidian Council of Agricultural Research,Delhi, India
Affiliation	Retired Principal Scientist & Emeritus Scientist
Country	India
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	Yes
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	With regard to aquaculture Salmon was given as example. When we concentrate on single species there are chances of loss of biodiversity. AI-driven optimization often prioritizes high-yield salmon farming, and machine-driven patterns fail to account for holistic, indigenous understandings of nature especially of economically underdeveloped nations. This can lead to decreased genetic diversity Global

	aquaculture production reached a record 130.9 million tonnes in volume, with a total value of approximately USD 312.8 billion accounting for 59% of the total global fisheries and aquaculture production, of total 223.2 million tonnes, aquaculture has surpassed capture fisheries in aquatic animal production. This shift is crucial for food and nutritional security of the world (SOFIA,2024). Farmed salmon is a highly lucrative and rapidly expanding segment of the global seafood industry. In volume, farmed salmonids account for more than 2.8 million metric tons annually-about $20 billion in global value. Contribution of salmon amounts 2.14% n volume 6.4 % in value Together with other species, salmon drives the broader importance of the value and importance of seafood sector Asia currently accounts for approximately 58.6% of the total world population, hosting nearly 4.86 billion people out of a global population of roughly 8.3 billion. Asia also dominates the aquaculture sector, generating roughly 70% of aquatic animal production and 97% of global algae production. In Asia, about 22.4% of the population experiences moderate or severe food insecurity, compared to the global average of 26.6%. While Asia performs slightly better than the global average, it still houses nearly half of all undernourished people worldwide due to its massive population size. South Asia harbours 40% of hunger population contributing to 80% of Asia's hunger mouths. From this point of view concerted efforts are in need to mitigate hunger and problems of overall wellbeing of the population.
Are the issues identified fully capturing the links with FSN outcomes?	Not all issues are identified. Few Examples such as quantum coupled AI for aquaculture and food security are provided here under. Quantum-Powered AI for aquaculture a. Hyper-Precise Water Management: Quantum processors can quickly evaluate vast amounts of real-time sensor data, predicting environmental shifts (such as temperature, pH, dissolved oxygen, and toxic algal blooms) far more accurately than classical AI. b. Optimized Feeding & Growth: Quantum algorithms can process countless variables (fish biomass, appetite, and weather) to calculate the exact feeding times and quantities, directly cutting input waste by up to 30%. c. Supply Chain Logistics: For large-scale or multi-site operations, quantum AI solves combinatorial optimization problems in seconds. This drastically

	streamlines the processing, harvesting, and transporting of perishable yields. d. Secure Data Infrastructure: Using Quantum Key Distribution (QKD) allows farms to safely encrypt and transmit highly sensitive production, yield, and pathogen data across long distances, ensuring proprietary methods are secure from cyber threats. Existing Employments a) Automated & AI-Driven Production: Companies operating advanced, closed-loop facilities use AI-driven software to manage every internal function, including feeding, water quality, and stock size monitoring. b) Supply Chain Optimization: Swarm Engineering employs quantum-driven AI to unravel the enormous intricacies of workforce and logistics optimization for agricultural and aquaculture supply chains. Need for Quantum Computing for Food Security As far as SDG are concerned only ~18% of the targets on track, the remaining are regressive or too slow. One very important positive development is that nearly 68% of the global population have access to the internet which is advantageous to benefit fruits of digitization that includes of agriculture. To accelerate research exponentially and for augmenting intricate agricultural systems the important solution is Quantum computing. In strategizing resilient crops, fertilizers that are sustainable, and for elevation of world supply chains to alleviate food losses and wastes Quantum computing is essential. Following three important areas in agriculture systems that can be transformed through quantum technology. • Crop Genetics & Breeding: In comparison with conventional computers quantum algorithms can mimic plant genetic codes and molecular constructions far faster, facilitating researchers circumvent protracted crossbreeding cycles, directly identifying characters for drought and disease resistance, and high nutritional value for production of new varieties of crops. • Fertilizer Production: It is a well-known fact that ammonia synthesis is energy intensive process, however, this can be improved employing using quantum chemistry to develop more effective, sustainable methods. • Logistics & Supply Chain Optimization: The advantage with Quantum AI algorithms is the ability to process numerous variables viz., weather patterns, fuel expenses, and supply systems concurrently • For instance, Syngenta is vigorously working with Quantum Basel to identify the

	ways and means how these technologies ever increasing global food demand sustainably. Similarly, the Open Quantum Institute energetically title holding the employment of these advances in computations to meet UN Sustainable Development Goals at the earliest possible period.
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	There need to be semantics to demarcate Food Losses and Food Wastage. These terms are intermingled often lead to confusion for the reasons that food losses occur due to different causes.
Is there any example or case study that would deserves to be mentioned?	India being most populous nation in the world as a case study few facts provided hereunder. India loses approximately 22% of its food grain output annually, equating to roughly 74 million tonnes. These massive post-harvest losses-costing the economy billions of dollars (USD) are predominantly determined by insufficient scientific storage, lack of adequate transportation infrastructure, and pest infestation. A perusal at the data highlights the scale and scope of these losses: Key Statistics & Economic Impact • Losses in volume: Nearly 74 million tonnes of food are lost each year, which accounts for roughly 10% of total food grain and horticulture production. • Losses in value: Estimates indicate that agricultural and food produce losses cost India nearly ₹1.55 trillion annually. • Grain-Specific Losses: Cereals alone account for a massive ₹260 billion in economic losses, while pulses and oilseeds face losses around ₹180 billion Source of the Losses • Poor Storage & Handling: About 6.58% of grains are completely lost due to inadequate storage. Insects, rodents, and birds account for the bulk of this, while moisture issues lead to mold and mycotoxin contamination. • Perishables Spoilage: While food grains represent a significant portion, losses are even higher in perishable commodities like fruits and vegetables due to missing cold chain networks that amount to as high as 22%. • Supply Chain Gaps: Significant quantities are lost during threshing, drying, cleaning, and marketing. Measures of Mitigation To mitigate these losses federal and agricultural bodies are supporting targeted solutions. They include; 1. Replacement of conventional storage facilities with weather resilient silos and ready to deploy storage facilities. 2. Prevention of pests, insects and moisture damage with metallic silos and Super Grain Bags 3. Consolidating PPPs through PEG (Private

	Entrepreneurs Guarantee) Scheme to swift enhancement in regional warehousing capacity.
In particular, do you have examples of effective policies to improve FSN outcomes of the use of Artificial Intelligence, digitalization and data governance in food systems?	One of the important developments across the world isthat 68% ofthe world population haveaccess to the internet. It can increase in the coming years. It hastremendous potential in employing AI, digitalization anddata governance in food systems. This needto behasten with use ofquantum analyses so as to reach foodsecurity goals in unit time and space.
Is there any missing reference to key literature and data?	Christian Molinari, 2025 related Acquaculture monitoring (e.g. salmon farming in Chile and Norway
Please insert below any additional comment.	Any measures alleviating food losses or food wastes can contribute to global food security. In this regard, a target can be fixed to decrease percent reduction in losses and wastes in a unit time for example by 2050 a 5% reduction can be proposed in a unit space (a region or nation) as it is very difficult to reach a state of zero waste or losses of food especially in agrarian and developing and under developed nations

35. IT for Change, India

Surname	Muhammed Ashraf
First name	Merrin
Are you contributing in a personal capacity or on behalf of an organization or team?	On behalf of a team/organization
Current position	Senior Associate - Research and Policy Engagement
Current institution/organization	IT for Change
Affiliation	Civil society/NGO
Country	India
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	There are two areas where the note can deepen its analysis of the "Challenges and Limitations to Align Digital Innovations with the Public Good in Food Systems". Issue 1. Domestic innovation capabilities – Another "precondition for each country to leverage AI for the public good in food systems." World Bank's 4 Cs framework needs to be situated within a framework of value creation and value distribution. Even with the 4 Cs, it is likely that value generated from digitalisation and data-enabled intelligence flows out of the country into the coffers of dominant corporations, reinforcing neocolonial tendencies of the current AI paradigm We need an overarching systemic capability framework within which the 4Cs should be interpreted. Systemic capability refers to the capacity of individuals and societies to secure

	livelihoods, adapt to economic shifts, and improve wellbeing. It goes beyond skills and employment to provide the bridging capital for social transformation through appropriate policies and infrastructures. A local knowledge economy depends on systemic capability pathways for domestic value creation. This requires contextually grounded AI innovation strategies that reduce dependence on foreign AI services. The "context" dimension in the World Bank framework makes a case for "localising AI" through representative data and solutions to local problems. But we must ask whether 'context' also includes concrete benefits from AI and the net value added to local economies and societies. What productivity gains, improvements in wellbeing, support for small producers and businesses, and multiplier effects does AI generate? 'Context' should also recognise the non-commercial and non-commodified value of food systems and their data embedded in local knowledge systems. Systemic capability implies self-determination while allowing for interdependence in data and AI value chains. Global and regional policies are needed to enable countries in the South to use digitalisation and data-based intelligence to protect knowledge sovereignty and advance locally owned innovation. Issue 2. Sector-specific challenges in the governance of FSN data Stewardship of mixed datasets: FSN datasets often combine anonymised and aggregate personal data (such as farmer profiles, landholding records, and farm household data) with non-personal data of non-human origin (such as geospatial data, crop patterns, and soil information). Experience with agricultural data exchanges across countries has revealed challenges in stewarding such mixed datasets and instituting effective public licensing conditions for re-use. The paper should discuss these issues. The need to challenge data enclosures: By framing "data deserts" as a key issue, the paper points to the scarcity of appropriate datasets for AI innovation. However, while many countries lack FSN datasets in the public domain, transnational digital and agricultural corporations hold valuable datasets in proprietary enclosures under trade secret protection (e.g. Google and Bayer). Such enclosures inhibit democratic innovation. ETC Group's recent case study report shows how corporate monopolies in digital agriculture deepen

	dependency, erode autonomy, and transform farming into a data-extractive sector, raising fundamental questions of justice, rights, and sovereignty. This must be flagged in the paper. A country may not yet possess adequate data and AI infrastructure. In the interim, addressing food security and nutrition challenges may require rights to access geospatial and other datasets held behind private fences through measures such as compulsory public licensing. The role of IP in building agricultural data monopolies also warrants discussion. The Note should underline the need for public and social licensing approaches that recognise community claims in FSN data, alongside regulatory space for mandatory data-sharing obligations on transnational corporations holding publicly important FSN datasets.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	In addition to the issues identified in the Note, we recommend the inclusion of following key issues - Risk of Biopiracy: Tangible risk of biopiracy with the advent of digital sequence information and the still nascent governance framework around it. This weakens protection for the traditional knowledge and non-personal data of Indigenous Peoples, peasants, women, and workers, and the access and benefit-sharing regime under the Convention on Biological Diversity. Refer to Jim Thomas' case study on the generative biology stack and its data justice and ESCR implications for more information on this issue. Assetisation and financialisation: Agricultural data is commodified and transformed into financial products such as carbon credits, ESG derivatives, and risk profiling without farmers consent or control. Value is captured upstream by corporations, while producers remain data suppliers without benefits. Data extraction becomes the new route for value extraction from the natural resources commons. The risks of privatisation of Digital Public Infrastructures (DPIs): Many examples of DPI models in agriculture prioritise efficiency and scale over equity, reinforcing power imbalance, and lacking transparency and accountability. As Research ICT Africa notes, the growing role of private actors in building and operating DPI raises the concern that the capture of public value by private infrastructure operators could replicate the asymmetries of data extractivism that DPI was designed to correct. The questions of who controls DPI data, for whose benefit, and under what

	accountability frameworks, are AI governance questions as much as infrastructure questions. Further, these DPI models also tend to sidestep the question of preserving agricultural data as a societal commons and of how free-riding may be prevented.This is evident from FAO's DPG and DPI to India's AgriStack.
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	It may be worthwhile to highlight the risks posed by dominant data and AI innovation in terms of the violation of specific Economic, Social and Cultural Rights (ESCR). For instance, The connection between food security and livelihood security for small producers (right to livelihoods in Articles 6-7 of ICECSR): Automation, algorithmic management, and surveillance can displace agricultural workers, undermine traditional farming expertise, and reshape labor around precarious digital regimes, eroding dignified forms of rural employment. There are inadequate safeguards against the restructuring of agricultural labour markets. Protection of Knowledge Systems and Cultural Practices: Data-driven agricultural models often prioritise standardised, quantifiable approaches to farming, marginalising Indigenous knowledge, local farming traditions, and culturally embedded relationships with land and ecosystems. As the CFS recommendations (2023) on food security and data governance acknowledge: "Indigenous Peoples, peasants and other small-scale food producers have a variety of methods to generate, collect, store, and use data that are often not considered in standard data collection systems and in FSN decision-making. It is important to recognise the significance of these data for FSN and FSN decision-making at local and national level, and to support the effective, inclusive and meaningful participation of those who generate and manage these data, information, and knowledge, while respecting their human rights and protecting their traditional knowledge, innovations and practices". Equitable Access to and Governance of AI Innovation in Agriculture: While farmers generate valuable data that underpins AI and digital innovation in agriculture, they are often excluded from decision-making processes and the benefits derived from these technologies. This raises concerns about equitable access to scientific and technological advances (Art 15.1b, ICESCR). Loss of the commons: It is important

	to draw attention to how land record digitisation undercuts customary rights, particularly usufruct rights of women farmers, indigenous people, and small cultivators who lack formal land titles.
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	Case study of Kerala Food Platform: The Kerala Food Platform (KFP) is a government-owned digital platform ecosystem currently being developed by the Kerala Development and Strategic Innovation Council (K-DISC), operating under the aegis of the Department of Planning and Economic Affairs (Innovation and Development), the Government of Kerala, India. The Kerala Food Platform is an institutional-level intervention in order to develop a multi-stakeholder, cooperative-led platform where all stakeholders in the agricultural value chain—farmers, producers, consumers, and business providers of value-add services—are on-boarded onto one digital ecosystem, where data-driven insights and innovation is leveraged to support a state-wide cooperative agricultural network to promote inclusive & sustainable agri-value chains and food systems. IT for Change's Submission to the FAO Global Forum on Food Security and Nutrition.pdf
In particular, do you have examples of effective policies to improve FSN outcomes of the use of Artificial Intelligence, digitalization and data governance in food systems?	National governance approaches: Public accountability and public value maximisation safeguards for DPIs in agriculture and FSN domains: In Digital Public Infrastructure initiatives such as agricultural data exchanges and agricultural open data commons, it is important to have robust guidelines governing data sharing, data access, use, and re-use for protection of small producers' rights and preventing the capture of the social resource of the agriculture data commons. Specific safeguards such as purpose and use limitation for data processing, penalties in the case of data breaches, public and social licensing of downstream AgTech innovation, proactive disclosure and public consultations prior to the approval of any data and AI innovation on top of the data commons may all become important. Stewardship models that deepen and promote a collective and commons-based data governance regime need to be encouraged for socialising data value through appropriate legal-policy measures. Access-and-use conditionalities through appropriate licensing and fair use frameworks are vital to prevent market capture of the data innovation

	dividend. (IT for Change, 2025) International policy measures A binding global framework on data and AI governance grounded in the precautionary approach. Ex ante environmental and social impact assessments attentive to sector-specific and contextual risks of human rights violations as well as collective and social harms, must be recognised as a baseline norm. Such assessments, as the experience of the ecological justice movement demonstrates, must not be seen as expert-led exercises. On the contrary, they need to be grounded in societal rights to demand accountability for tech innovation trajectories. A leaf can be taken out of the Aarhus Convention - which recognises that the right to access information and participate in decision making on environmental matters belongs to all members of a society, and locus standi does not rest only with affected communities. Intersections with prior international agreements governing information and data resources in the agricultural and FSN domain. FSN data and AI governance debates need to be attentive to debates on access and benefit sharing in Digital Sequence Information, in the Convention on Biological Diversity and Nagoya Protocol. As civil society has often flagged, the definition of "genetic resources" must include Digital Sequence Information. Further, accessing DSI for commercial purposes must trigger the same access and benefit sharing obligations as physical access. International public financing for critical data and AI infrastructure. As the Global Digital Justice Forum has observed in 2025, “Bridging the digital infrastructure divide [in cloud computing capacities] is an urgent priority. It needs real alternatives to failed market mechanisms. In this context, public financing at the international level in shared cloud and data infrastructure for AI innovation becomes critical. This can take the form of the "CERN for AI” proposal envisioned in UNCTAD’s Technology and Innovation Report of 2025. Digital trade regime that does not incurse on regulatory space to ensure food sovereignty. As trade justice advocates have long argued, trade agreement provisions can violate food sovereignty of global South countries through provisions impeding public stockholding etc. In the data and AI age, this threat has assumed a new form. Many agreements contain digital trade chapters or provisions that force countries to deregulate digital

	agricultural services markets or open up public agriculture data sets to foreign players indiscriminately. In the age of data and AI, there can be no food sovereignty without data sovereignty.
Please insert below any additional comment.	Sharing references used in our submission. - Q9, reference to ETC's case study Commons to Code_How Platforms Rewire Agriculture and Reshape Power_3.pdf - Q 10 , (i) reference to Jim Thomas' case study AI's Large Looting Models_The Emerging Generative Biology Stack as the Next Frontier of Biopiracy.pdf (ii) Reference to Research ICT Africa's research – https://researchictafrica.net/2025/08/29/rethinking-data-governance-for-truly-public-dpi/ (iii) Reference to evidence on FAO's DPI and DPG – Seeing Everything from Nowhere_A Human Rights Assessment of the United Nations Food and Agriculture Organization's Data Governance_2.pdf (iv) Reference to India's AgriStack Recovering_the_'public'_in_India's_Digital_Public_Infrastructure.pdf - Q 12; (i) reference to displacement of agricultural workers A/80/213: Corporate power and human rights in food systems - Report of the Special Rapporteur on the right to food, Michael Fakhri | OHCHR (ii) Reference to loss of the commons World Bank Document - Q. 14 - reference to IT for Change's research on stewardship models Recovering_the_'public'_in_India's_Digital_Public_Infrastructure.pdf

36. Blockchain and Climate Institute (BCI), United Kingdom of Great Britain and Northern Ireland

Surname	Cheung
First name	Adrian

Are you contributing in a personal capacity or on behalf of an organization or team?	On behalf of a team/organization
Current position	Executive Assistant to the Chief of Staff
Current institution/organization	Blockchain and Climate Institute (BCI)
Affiliation	Civil society/NGO
Country	United Kingdom of Great Britain and Northern Ireland
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	The Blockchain & Climate Institute welcomes the HLPE-FSN draft note and broadly supports its evidence-based and governance-oriented approach. We commend the text for separating documented evidence from vendor-driven hype, for explicitly prioritising specific-purpose over generalist artificial intelligence, and for highlighting data sovereignty and algorithmic contestability as central governance concerns. Whilst the issues identified by the HLPE-FSN are specific to the AI, Digitalisation & Data Governance and produce strong insights into how this could impact food security, the note would benefit from a stronger awareness of its possible interaction with other systems. In particular, the draft note does not underscore the importance or the linkages between AI, Digitalisation & Data Governance with systems such as trade systems, which could interact in ways that produce unexpected effects. To minimise uncertainty, the note should unpack the linkages between AI, Digitalisation, Data Governance, and trade systems, and identify areas for further improvement in food security. In regard to trade systems, the HLPE-FSN note could further consider how AI is increasingly used to predict food production, trade flows, and market conditions. The increasing utilisation of AI for these forecasts has a real and measurable influence on export restrictions and contributes to fluctuating food prices. For this reason, the increasing use of AI in forecasting has a disproportionately higher impact on food-importing countries, which may be highly vulnerable to sudden price increases and disruptions in global supply chains. The note could also examine how cross-border data flows and digital trade rules affect countries' access to agricultural data and their ability to make independent food security decisions (FAO, The state of Agricultural Commodity Markets 2022 2022) In addition, whilst the note briefly addresses the 'digital divide', the note would be strengthened by further discussion of this. This is

	succinctly illustrated in Microsoft's AI diffusion report 2025, which clearly indicates the division in the global North & South in terms of AI use (Microsoft, Global AI Adoption in 2025: A Widening Digital Divide 2026). The report identified a growing 10%+ gap of AI user share between those of Global North and Global South nations. The UN Centre for Trade & Development supports this, arguing that the AI divide in between those of developed nations and developing nations. It identifies that most supercomputers and AI companies are concentrated in the global North, rather than the South. In essence, most of the computational power, AI innovation and semiconductor production happens in the Global North, this has strong implications for global power asymmetries and limits the benefits delivered by AI, digitalisation & data governance to the global south (UNCTAD, 2025 Technology & Innovation Report, 2025). Given that many Lower Income Countries (LICs) lack the necessary cloud infrastructure for AI deployment, the preconditions for AI-enabled food security are simply absent. It is estimated that 70% of LICs continue to use analogue technology in industrial processes and reduced educational opportunities in STEM subjects which would help bridge this digital divide (Adhikari & Tesfachew, How to Propel Digital Transformation in the Least Developed Countries 2024). According to the International Telecommunications Union, only 34% to 38% are connected to the Internet in Least Developed Countries & 53% have a mobile phone in LDCs compared to 82% in developed nations, (ITU, Measuring digital development: Facts and figures 2025 2025). Furthermore, the inaccessibility to AI, digital devices or the internet in LDCs is further exacerbated by rural-urban divides by 30% to 40% points, whereas the urban-rural divide in developed nations is much a narrower, approximately 10%.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	Yes. The HLPE-FSN note could benefit from addressing relevant AI standards produced by the International Telecommunications Union (ITU) & the International Organisation for Standardisation (ISO). These include, to name a few: 1. ISO/IEC TS 42112:2026 – Guidance on Machine Learning: provides strong recommendations on evaluating Machine Learning (ML) models, focusing on their effectiveness, efficiency, and considering how best

	to increase the effectiveness and accessibility of AI infrastructure, at scale (ISO, ISO/IEC TS 42112:2026 2026). 2. ISO/IEC 42001:2023 – Artificial Intelligence Management Systems (AIMS): the first certifiable AI management system standard. It provides governance requirements for organizations deploying AI, including risk management, accountability, transparency, safeguarding and continuous monitoring. This is particularly relevant for public-sector food security systems and AI-enabled agricultural services, because it delineates how AI should align with organisational objectives, how data would be safely stored & used, and in what methods AI would be used to support organisational objectives (ISO, ISO/IEC 42001:2023 2023). 3. ISO/IEC 23894:2023 – Guidance on AI Risk Management: provides methodologies for identifying, assessing, and mitigating AI risks, including bias, 'AI hallucinations' reliability & safety. This directly aligns with the HLPE-FSN's discussion of operational and social risks, to provide robust & practical suggestions to increase the accountability of AI use and to reduce exclusion produced by AI (ISO, ISO/IEC 23894:2023 2023). Collectively, these standards above would inform and guide the process of bridging the digital divide and the responsible, accountable & effective implementation and adoption of AI in LICs. It would be helpful to further consider the demographics that are most likely & least likely to AI, digitalisation & data governance. This has been briefly discussed in the note, regarding the gender divide. However, there are a broader spectrum of factors that contribute to farmers' adoption of AI. According to an academic review of factors that led to farmers' adoption of digital agricultural tools to enhance agricultural productivity, young male farmers who are highly educated are most likely to adopt these technologies (Manzoor et al., Digital Agriculture technology adoption in low and middle-income countries—a review of contemporary literature 2025). Unsurprisingly, the likelihood of stronger profits from AI is a key factor leading to AI adoption. Therefore, the note should discuss policies that facilitate the commercial use & accessibility of AI, to increase the likelihood of profitability from AI. These could include government subsidies, training,

	education & ease of use, which have all been demonstrated to contribute to AI adoption. The HLPE-FSN note could be strengthened by considering demographic differences between developed countries and LICs. For example, farmers in many LICs are significantly younger than their counterparts in higher-income countries (et al., Rural Development Report, 2019), and younger populations are generally more receptive to digital technologies. This suggests that pathways to AI adoption may vary across contexts, and that a single, universal approach may not adequately reflect local demographic realities.
Are the issues identified fully capturing the links with FSN outcomes?	There are high upfront costs that act as a key barrier to AI adoption — this means that only those who can afford it can adopt AI. This leaves those without the means, i.e. smallholder farmers and their cooperatives, at risk of being structurally excluded from AI tools even when public digital infrastructure and AI are available (Olusola Omotayo & Babatunde Omotoso, AI offers promise for agriculture, but smallholder farmers risk being left behind 2026). Such an impact would further socio-economic divides and power asymmetries between smallholder farmers and larger companies. Furthermore, it may be prudent to consider how AI, digitalisation & data governance would be able to estimate and deliver FSN outcomes in conflict-stricken areas. As political instability and conflicts around the world erupt between Ukraine & Russia, Iran & the USA, and in Israel & Palestine/ Lebanon. The HLPE-FSN makes a brief mention of this and notes that existing AI models failed to predict the conflict in Tigray despite data indicating a potential conflict. As a result of the conflict, it catalysed the food insecurity issues in Tigray, culminating in a famine that endangered civilian populations. This illustrates the importance of addressing how AI models, digitalisation & data governance should be responsibly and ethically leveraged in conflict contexts to mitigate food insecurity. This could involve considering how AI, digitalisation & data governance systems could be integrated into existing early warning systems such as the FAO's GIEWS or the WFP's HungerMap LIVE to effectively respond to food insecurity in conflict zones with humanitarian aid (Curtis et al., AI and Global Food Security 2026).

	In another case study in Ukraine, it examined how AI was able to deliver factual nutritionally informed advice to conflict contexts. It identified the strengths of AI; in that it increased the accessibility of nutritional guidelines to vulnerable populations and substituted human nutritionists where they were unavailable. However, it also concluded the risk and presence of AI hallucinations remained, and that stronger safeguards, mitigation of data bias, and human oversight was necessary to make it a reliable supplementary tool, rather than an autonomous decision-maker, to national food security strategies (Iellamo et al., Can ethical artificial intelligence aid child feeding during conflict? A review of the experience and lessons learned from FHI 360's in Ukraine 2026). For instance, AI models should account for survivorship bias, wherein data fails to measure for internally displaced people, refugees, or those dead. Moreover, whilst AI can assist humanitarian organisations in identifying civilian needs and facilitate effective aid relief, it also involves the management of highly sensitive data. Robust cybersecurity measures & data governance frameworks need to be considered to effectuate ethical and secure AI use in conflict contexts, where political, terrorist, and criminal interests are strong, and have powerful incentives to acquire highly sensitive information.
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	The HLPE-FSN note would improve its relevance by considering how digitalisation & data governance impacts the affordability of food, with relevance to FSN indicator number 4. In developed nations, food companies and supermarkets are already using data governance & digitalisation to 'optimise' their pricing strategy. This has led to dynamic prices and, at times, increasing prices of food. The use of AI & data by the food industry, such as in supermarkets can also be leveraged to predict consumer behaviour (Stylianou & Pantelidou, A machine learning approach to consumer behavior 2025), allowing supermarkets and retailers an opportunity to manipulate consumer behaviour in favour of the food industry's interests. Therefore, it would be helpful for the HLPE-FSN note to consider how AI, digitalisation & data governance could be leveraged in a way that fairly protects consumers, and ensures nutritious & organic food remains affordable to the

	majority of the population, as the note briefly discusses. Another FSN outcome the note would benefit from further elaboration is FSN indicator number 20. FSN indicator 20 identifies the proportion of the population that has access to potable & clean water. Given the importance of water in almost all aspects of human physiology, health and daily life, ranging from drinking, cleaning, cooking, agriculture and hygiene (UN, Guidance note on Food Security and Nutrition 2025) the HLPE-FSN note should address outcome number 20 in further detail. For instance, the deployment of AI models to predict flood risk, or to help optimise water consumption in agriculture, could deliver positive impacts on the availability of clean water. The note should also consider how AI can supplement the water industry & wastewater industries to efficiently and effectively distribute clean water and manage wastewater. For example, outdated public infrastructure is often a cause of loss of clean water. The appropriate utilisation of Internet of Things sensors would help to identify leaks in infrastructure, causing leaks and reducing the loss of clean water (Guezouli et al., IOT and AI for real-time water monitoring and leak detection 2024).
Is there any example or case study that would deserves to be mentioned?	As mentioned above, potable water is essential to human health and living, and deserves greater attention in this note, and commercial tools that utilise AI to increase the availability of potable water have demonstrated to be successful. Across African nations and Southeast Asia, tools that leverage AI & IoT sensors to identify the nearest sources of potable water have helped to increase the accessibility of potable water (Paul & Michael, Role of monitoring tools in project performance evaluation 2024). In addition, the addition of IoT sensors have enabled it to measure & provide valuable real-time information regarding water potability, availability and accessibility. This eases administrative strain and increases efficiency, especially in areas where skilled personnel trained in assessing water potability are lacking. Similar tools have also seen success in developed nations like Sweden. In Sweden, the SIWA Leak Finder is one of many examples of AI tools helping to fulfil the FSN outcomes, where it was able to identify leakages in Sweden's public water infrastructure and instruct

	personnel to fix the infrastructure to prevent further leaks (Welin, A case for AI: Water pipeline leaks 2024). This effectively minimises loss of potable water and increases the efficiency of water distribution and its affordability.
In particular, do you have examples of effective policies to improve FSN outcomes of the use of Artificial Intelligence, digitalization and data governance in food systems?	Yes. The European Union's Common Agricultural Policy (CAP) increasingly integrates digital agriculture tools, satellite monitoring, precision farming technologies and data-driven environmental reporting. Through initiatives such as the European Digital Strategy and Common European Agricultural Data Space, the EU has sought to improve agricultural productivity, sustainability, traceability and evidence-based policymaking while promoting interoperability and farmer participation (EU, Common Agricultural Policy 2023-2027 2022). This is accompanied by the EU AI Act which provides a governance framework by introducing risk-based regulation for AI systems. This approach is particularly relevant to food systems where AI may influence agricultural decision-making, food safety monitoring, subsidy allocation or public-sector services. The Act demonstrates how innovation can be balanced with transparency, accountability and human oversight. A further policy lesson is the incorporation of internationally recognized standards into AI governance. Standards developed by the ISO, European Committee for Standardization (CEN) and ITU provide practical mechanisms for trustworthy AI deployment. As aforementioned, ISO/IEC 42001 (AI Management Systems) supports organisational accountability, alignment with organisational goals, and data governance frameworks that encourage responsible AI use.
Is there any missing reference to key literature and data?	• The World Bank Digital Progress and Trends Report 2025, which found that less than 5% of populations in low-income countries possess basic digital skills, compared to 66% in high-income countries — directly relevant to any AI-for-FSN intervention design. This disparity in education and in digital literacy could lead to a rapid adoption of AI in developed countries, whilst developing countries struggle to. Hence, it would not be surprising to assume that AI would accelerate, rather than bridge, international inequalities and reinforce socioeconomic disparity between developed nations and developing nations. The World Bank Digital

	Progress & Trends report suggests stronger investment into the 4C's (Connectivity, Compute, Context, Competency) to narrow the digital divide and establish the potential for a successful AI transformation (Liu & Qiang, Digital Progress and Trends Report 2025 strengthening AI foundations 2025). The HLPE-FSN note would benefit from addressing concerns identified in the World Bank Digital Progress and Trends Report, as well as adopting some of the practical advice outlined in it. • The Microsoft Global AI Diffusion Report 2025, which documents how global AI adoption is shaped as much by access and availability as by model quality, and that open-source systems can propagate widely with limited oversight (Microsoft, Global AI Adoption in 2025: A Widening Digital Divide 2026). • The Food Data Trust: A Framework for Information Sharing report explores how improved data sharing across the UK food supply chain can enhance food safety, efficiency, and innovation. It argues that as digital technologies—such as artificial intelligence, the Internet of Things, and automation—transform food production (Pearson et al., Food Data Trust: A framework for information sharing 2021). However, the report identifies significant barriers to data sharing. These include legal constraints (such as competition law), technological fragmentation, and cultural issues, particularly a lack of trust between organisations. To overcome this challenge, the report advocates a decentralised, "zero trust" architecture, built on three pillars: governance, technology, standards, and business models. Governance defines the legal rules, responsibilities, and accountability mechanisms needed to ensure fairness and transparency. Technology and standards focus on interoperability, including APIs and shared data standards aligned with FAIR principles (findable, accessible, interoperable, reusable). Business models provide incentives and operational structures that encourage participation while delivering tangible value to stakeholders. Finally, as the Blockchain & Climate Institute, we have several propositions for how blockchain / distributed ledger technologies (DLT) could be further discussed in the HLPE-FSN note. These address core governance challenges in food systems; 1. Blockchain / distributed ledger technologies

	(DLTs) can complement AI and data governance frameworks by enabling secure and transparent, management of agricultural data. This supports stronger data sovereignty for all, and is an accessible and inclusive way for smallholder farmers to be involved in the AI transformation through decentralised control mechanisms. 2. Blockchain / DLT can also enhance food supply chain traceability by providing immutable records of production, processing, distribution, and sales. This thereby increases consumer trust, reduces fraud, and facilitates consumer access to markets for nutritious & sustainable produce. 3. Blockchain / DLT can provide cryptographically verifiable and auditable data inputs for agricultural metrics, carbon markets, and sustainability reporting before the data is digested by AI analytics, whilst also supporting secure data sharing architectures consistent with the zero-trust principles established in the Food Data Trust report.
Please insert below any additional comment.	Unfortunately, our response to question 1 exceeded the character limit. Please don't hesitate to reach out to adrian.cheung@blockchainclimate.org for our full response to question 1 of the consultation questions for the HLPE-FSN note, thank you.

37. Global Diary Platform, United States of America

Surname	Bradley
First name	Beth
Are you contributing in a personal capacity or on behalf of an organization or team?	On behalf of a team/organization
Current position	Chief Science Officer
Current institution/organization	Global Dairy Platform
Affiliation	Private sector
Country	United States of America
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	The HLPE-FSN note identifies many of the key issues related to artificial intelligence (AI), digitalization, and data governance affecting food security and nutrition (FSN), including equity, data governance, digital inclusion, accountability, transparency, and the need for evidence-based assessment of digital technologies. Global Dairy Platform (GDP) appreciates the emphasis on distinguishing demonstrated impacts from future promises and the recognition that technology alone cannot address

	structural barriers to food security and nutrition. The report would benefit from greater recognition of the role of responsible private-sector innovation and investment in developing and scaling digital solutions across food systems. Many of the technologies discussed, including precision agriculture tools, animal health monitoring systems, food safety applications, traceability systems, and digital advisory services, have been developed through collaboration among private companies, producers, researchers, governments, and civil society organizations. The report would also benefit from additional consideration of livestock systems and the role of digital technologies in supporting sustainable production of nutrient-dense foods, animal health and welfare, climate resilience, and food-system efficiency.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	The report would benefit from additional consideration of: 1) Interoperability and data-sharing frameworks. Effective food-system innovation increasingly depends on trusted mechanisms that enable data sharing across value chains while protecting privacy, confidentiality, and producer rights. 2) Livestock and dairy applications of AI and digital technologies. Existing applications include animal health monitoring, disease detection, reproductive management, feed efficiency optimization, animal welfare assessment, methane measurement and mitigation, and supply-chain traceability. 3) Public-private collaboration as a driver of innovation. Many successful digital solutions emerge through partnerships among governments, producers, researchers, technology providers, and food-system actors. 4) Voluntary standards and pre-competitive collaboration. Common methodologies, interoperability standards, and shared measurement frameworks can improve trust, transparency, and scalability. 5) Inclusion. In principle, AI can help producers through better weather information, advisory services, pest detection, logistics, and market intelligence. The World Bank argues that data-driven digital agriculture can improve efficiency and equity and can connect smallholders to markets, but it also warns that some farmers still lack internet access or the skills required to use digital tools effectively. These issues are likely to affect not only farmers, but

	also small processors across value chains with weak capital, weak digital infrastructure and limited access to technical support. Affordability, training, and public outreach services are key elements for improving the future functioning of AI. 6) Inequality across countries. Developed versus developing. According to UNCTAD, few countries and a small number of large platforms dominate AI publications, patents, data flows, and digital revenues, leaving many developing countries in the role of passive users or data providers. It also mentions that existing divisions in geography, gender, income, and age are being reproduced in the AI economy. Therefore, these inequalities can appear along the entire value chain, from access to advisory services and on-farm technologies to processing, logistics, traceability, and retailing. 7) Regulation. The issue here is whether AI serves the public interest, can protect users, and regulates the use of generated data. UNCTAD argues that AI is advancing faster than governance frameworks. The World Bank similarly identifies data governance, limited competition, privacy risks, and exclusion as major concerns in digital agriculture. The main questions that arise are: who owns and controls the data generated (farms, processors, traders, and consumers) and who is mainly benefiting from this data? These issues are important because improvements in food security, nutrition, sustainability, and resilience increasingly depend on coordinated data ecosystems rather than isolated technologies.
Are the issues identified fully capturing the links with FSN outcomes?	The report captures many important links between digital technologies and FSN outcomes. Some pathways could be strengthened: greater attention could be given to the contribution of digital technologies to improving productivity, efficiency, resilience, food safety, animal health, and the affordability and accessibility of nutritious foods. These pathways are particularly important in livestock and dairy systems, which contribute significantly to food security, nutrition, livelihoods, and rural development globally. A stronger discussion of how digital technologies support both sustainability and productivity would provide a more complete picture of their contribution to FSN outcomes.

Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	The report could further elaborate on the role of digital technologies in: 1) Animal health and welfare monitoring 2) Food safety and traceability systems 3) Climate adaptation and resilience 4) Reduction of food loss and waste 5) Supply-chain optimization 6) Measurement and management of environmental impacts 7) Producer decision-making and risk management. These applications can have significant indirect effects on food availability, affordability, quality, safety, and sustainability.
Is there any example or case study that would deserves to be mentioned?	Additional examples from livestock and dairy systems would strengthen the report, including: 1) Precision livestock farming technologies that monitor animal health, welfare, and productivity using sensors, computer vision, and machine learning. 2) Digital tools that support early disease detection and biosecurity management. 3) Methane measurement and monitoring systems that help producers assess and reduce greenhouse gas emissions. 4) AI-enabled feed management systems that improve feed efficiency and reduce resource use. 5) Traceability and food safety systems that strengthen consumer confidence and improve supply-chain transparency. These examples demonstrate how digital technologies can simultaneously support productivity, sustainability, resilience, and nutrition outcomes.
In particular, do you have examples of effective policies to improve FSN outcomes of the use of Artificial Intelligence, digitalization and data governance in food systems?	Policies that have been demonstrated effective generally share several characteristics: 1) Support for interoperable digital infrastructure 2) Investment in connectivity, digital literacy, and capacity building 3) Risk-based and technology-neutral governance frameworks 4) Public-private partnerships that facilitate innovation while protecting public interests 5) Data governance frameworks that balance privacy, producer rights, transparency, and responsible data sharing 6) Support for open standards and interoperability 7) Policies that promote equitable access to digital technologies and services across regions, genders, age groups, and scales of production Rather than focusing on specific technologies, successful policies tend to create enabling environments that allow locally appropriate solutions to emerge and scale.
Is there any missing reference to key literature and data?	The report would benefit from additional literature and case studies covering: Precision livestock farming; Dairy and livestock sustainability

	measurement systems; Animal health and welfare monitoring technologies; Food safety and traceability systems; Public-private innovation partnerships; Data interoperability and trusted data-sharing frameworks; Governance, accountability, and equitable distribution of benefits arising from AI-enabled systems; The implications of AI for inequalities within and between countries, including disparities in access to data, infrastructure, skills, and digital markets Relevant references include: FAO. Digital Agriculture Transformation Strategy (2022–2030); World Bank. Digital Agriculture Action Plan (2024–2030); UNCTAD. Technology and Innovation Report 2025: Inclusive Artificial Intelligence for Development; OECD Digital Government Index and Open, Useful and Re-usable Data Index. 2025 Results and Key Findings; Berckmans (2017) Animal Frontiers, Volume 7, Issue 1, Pages 6-11; Tullo et al. (2019) Science of the Total Environment, Volume 650, Part 2, Pages 2751-2760. The inclusion of more livestock- and dairy-focused evidence, alongside literature addressing digital inclusion, governance, and inequality, would help ensure that the report reflects the diversity of food systems and digital applications relevant to FSN outcomes.
Please insert below any additional comment.	Global Dairy Platform welcomes the HLPE-FSN effort to examine the opportunities and challenges associated with AI, digitalization, and data governance in food systems. As the report evolves, we encourage a balanced assessment that recognizes both the legitimate risks and the demonstrated benefits of digital technologies. We also encourage greater recognition of the important role that responsible private-sector innovation, public-private collaboration, interoperability, and trusted data-sharing frameworks play in advancing food security, nutrition, sustainability, and resilience. Digital technologies are not a substitute for strong institutions, sound governance, or human capacity. Realizing benefits will require attention to digital inclusion, capacity building, equitable access, and governance frameworks that ensure AI and data systems serve the public interest while enabling

	innovation. When implemented responsibly, and in partnership with food-system stakeholders, they can make meaningful contributions to more productive, resilient, sustainable, and inclusive food systems.

38. Van Vollenhoven Institute for Law, Governance and Society, Leiden Law School, The Netherlands

Surname	Canfield
First name	Matthew
Are you contributing in a personal capacity or on behalf of an organization or team?	On behalf of a team/organization
Current position	Data Governance for Equitable and Sustainable Food Systems (DigiFood) Project
Current institution/organization	Van Vollenhoven Institute for Law, Governance and Society, Leiden Law School
Affiliation	Academia
Country	Netherlands (Kingdom of the)
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	1) Assessing rather than 'harnessing': The document is titled 'Harnessing Artificial Intelligence', reflecting the framing adopted by the CFS. However, as the report rightly notes, generalist AI comes with significant ecological and social risks. The title 'Harnessing AI' therefore does not accurately reflect the report's findings, which emphasize the importance of thoroughly assessing these technologies, not merely 'harnessing' them. In fact, the current title reflects what researchers of AI have identified as a problematic discourse of 'AI hype' which over overstates the potential and downplays the risks of such technologies. Before a workstream is established to address these issues in the CFS, it is essential to revise this framing. 2) Disaggregate data and technologies: The report underlines the need for more nuanced terminology when discussing AI and related digital technologies. Currently, generalist AI based on Large Language Models (LLMs) has emerged as the dominant form of AI within both industry and research. The report identifies a clear distinction between these high-intensity forms of AI and small-scale AI that requires less data and computational power. Thus, specifying what kind of AI, algorithmic tools and forms of machine learning we are talking about is paramount, as each technology entails distinct sets of benefits

	and risks. Discussing 'AI' in general blurs these distinctions in ways that may provide a false narrative and reinforce the interests of the few companies that control the most powerful LLMs. Each technology must be clearly analyzed and assessed on its own terms. However, the disaggregation should not stop at AI technologies. AI technologies are embedded in a larger digital transformation of food systems, which includes digital tools that may not fall within the report's definition of AI. Digital technologies range from high-tech farm information management systems and platforms tailored to the needs and interests of industrial farmers to small-scale applications and platforms providing information about local markets or weather forecasts. Here, too, disambiguation and differentiation are important to avoid misguided assumptions and generalizations. Reducing the discussion to AI may provide a distorted image of the current state of knowledge and discussions surrounding the digitization of food systems. Relatedly, there is no 'one-size-fits-all' approach to agricultural data. For instance, farmer and land data pose very different risks and challenges than weather or market data. The latter may be better suited for 'open' data policies, while the former require a higher level of protection. Analyzing data governance and developing governance frameworks should be data-specific, with stronger protections for those forms of data that are extracted from farmers, their land, and collective resources. 3) 'Data deserts': The concept of 'data deserts' referenced by the report reproduces a set of problematic assumptions that support datafication without adequately analyzing existing knowledge resources. The HLPE Report on Data Collection for Food Security and Nutrition made clear that there is often lots of data that remains inaccessible or poorly leveraged. Indeed, farmers are already heavily surveilled by many different actors including researchers, governments and the private sector. The language of 'data gaps' and 'deserts' works to support the expansion of datafication in ways that tend to generate mistrust and data extraction. It mirrors similar language on 'food deserts' that has been extensively critiqued by scholars for failing to

	deal with the structural problems that have produced food insecurity.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	4) Human rights and data governance: Currently, there is little discussion of either specific human rights or human rights-based approaches to digital agriculture in general. This is a critical omission, since different human rights instruments formulate normative protections and guarantees that can and should guide any intervention in this area. Human rights-based approaches to data should be based on, among others: • The progressive realization of the right to adequate food in the context of national food security; • The UN Declaration on the Rights of Peasants and Other People Working in Rural Areas (UNDROP); • The UN Declaration on the Rights of Indigenous Peoples (UNDRIP). The right to food provides an important framework for identifying relevant rights-holders, as well as a set of principles for policy development rooted in the PANTHER framework (Participation, Accountability, Non-Discrimination, Transparency, Human Dignity, Empowerment, and Rule of Law). These principles offer the baseline for the development of both data governance, AI governance, and other forms of digital governance. For example, while the report rightly recognizes the role of participation, it neither specifies what kinds of participatory mechanisms should be developed nor for what kinds of data and technologies. Participation in digital and AI governance is critical, but it can quickly become meaningless and performative if decoupled from concrete rights and entitlements as significant research on multi-stakeholderism has demonstrated. Furthermore, UNDROP and UNDRIP both provide important normative guidance for rural peoples that are often made vulnerable by digital technologies and digital inequalities. Articles 19(2) and 26 of UNDROP also expressly protect the rights of peasants and other people working in rural areas 'to maintain, express, control, protect and develop their traditional and local knowledge, such as ways of life, methods of production or technology, or customs and tradition.' This suggests that data governance must work proactively to support the protection of local and traditional knowledge and technologies. Finally, a human rights approach must be gender-sensitive and alert to the ways that intersectional

	gendered and racialized harms can be exacerbated through digital technologies and AI. 5) Privacy and the rights of individual data subjects: A human rights approach could bring into sharper relief the ways in which new AI and digital tools potentially infringe on existing laws and regulations regarding the right to privacy, purpose limitations, the right to be forgotten, etc. Data subjects' rights are increasingly well-recognized in data governance frameworks around the world and must guide the development and deployment of any digital tool for food security and nutrition. 6) Collective rights approaches: The impacts and benefits of digital technologies for food security and nutrition are often discussed from the perspective of the interests of individual farmers. However, across different contexts, the objects of datafication and digitization are understood to be collectively held, such knowledge about crop varieties or agroecological farming practices. The report should more clearly engage with collective concerns and approaches, such as agricultural data trusts and cooperatives and collective rights frameworks such as UNDROP or the African Charter on Human and Peoples' Rights. Importantly, these approaches are only in their early stages of development and take many forms. Some examples are platforms that are connecting farmers to markets, while others are more established commercial cooperatives that are increasingly extending control over data. Collective approaches require significantly more research to understand these various initiatives, including both the extent to which they are capable of exercising meaningful control over data and how they address power imbalances and hierarchies within their organizations.
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	Surveillance concerns: The report fails to identify surveillance concerns raised by digital agricultural technologies and the threats digital technologies can pose to the autonomy of farmers and small-scale food producers. It is well understood that the collection, aggregation and centralization of vast amounts of farmer and farm data via digital technologies can lead to enhanced surveillance by public and private actors. In agriculture, the use of remote sensing, for example, is being deployed to govern farmers and monitor compliance with state

	regulation in ways that can violate privacy, enable mission creep, and reduce farmers agency. In LMIC countries, the development of e-incentive or e-subsidy programs can also operate to nudge farmers into particular practices and input usage. While governments are responsible for ensuring food security, they must do so in ways that respect the rights of food producers. Digital public infrastructures (DPIs): DPIs are emerging as one of the primary approaches to governing the digital economy. The report rightly emphasizes that they offer an important opportunity to retain public and sovereign control over food security and nutrition data. With the lack of a universally accepted definition of DPI, however, there are concerns that the public interest dimension of DPIs could be subverted and sidelined. Current discussions tend to treat DPIs as a technical set of building blocks and prioritize the extraction and concentration of data over adequate governance. Several global actors are now developing 'DPIs as a Solution' that frame DPIs as a 'one-size-fits all' approach without proper consultation or participation of rights-holders. In these circumstances, national ownership and capacity to manage and leverage these infrastructures can be limited. The report rightly notes that states without the computational resources or expertise will likely rely on the private actors developing such approaches, which raise significant concerns about power imbalances, data sovereignty, and the threat of digital colonialism. Moreover, although DPIs can use open standards and may be open source, the circumstances surrounding their implementation are often untransparent. Memoranda of understanding between governments and private sector developers may not be made public, undermining the claims of 'openness' upon which DPIs are premised. A deeper discussion of the meaning and structure of DPIs is needed to ensure effective democratic control of these infrastructures.
Is there any missing reference to key literature and data?	The report elaborates a variety of social, economic and ecological risks posed by digital technologies, but the report fails to engage with the significant literature emerging from rural sociology and related empirical studies of technology adoption in agriculture and food systems. This includes research

	that identifies: • The inadequacy of existing contractual frameworks between food producers and technology producers. Current frameworks often use the language of data ownership without clear protections of data originators; (Ruder 2025) • The surveillance of farm and food-chain workers; (Klauser 2018) • Land dispossession resulting from digitalization; (Fraser 2019; Bludnik 2022) • The provision of inaccurate data that undermines claims to "precision"; (Visser, Sippel, and Thiemann 2021) • The deskilling of agricultural labor and the undermining of local and Indigenous knowledge; (Stone 2007; Glover and Sumberg 2025) • The rise of new forms of "rentiership" that create new forms of dependence through subscription-based services; (Hackfort, Marquis, and Bronson 2024) • The role of digital technologies in exacerbating debt-stress; (Donovan and Park 2022; Green 2024; Kolling, Donovan, and Fejerskov 2025) • The potential for digital technologies to enable biopiracy of national and community plant and livestock genetic resources. (Bond and Scott 2020) Bludnik, Izabela. 2022. "Digitalisation as a Driving Force for Land Grabbing in the Global South." Procedia Computer Science 207: 265–71. https://doi.org/10.1016/j.procs.2022.09.059 . Bond, Molly R., and Deborah Scott. 2020. "Digital Biopiracy and the (Dis)Assembling of the Nagoya Protocol." Geoforum 117: 24–32. https://doi.org/10.1016/j.geoforum.2020.09.001 . Donovan, Kevin P., and Emma Park. 2022. "Knowledge/Seizure: Debt and Data in Kenya's Zero Balance Economy." Antipode 54 (4): 1063–85. https://doi.org/10.1111/anti.12815 . Fraser, Alistair. 2019. "Land Grab/Data Grab: Precision Agriculture and Its New Horizons." The Journal of Peasant Studies 46 (5): 893–912. https://doi.org/10.1080/03066150.2017.1415887 . Glover, Dominic, and James Sumberg. 2025. "Skill and Deskilling in an Uncertain Agricultural World: Introduction to the Special Issue." Outlook on Agriculture 54 (2): 123–32. https://doi.org/10.1177/00307270251337112 . Green, W. Nathan. 2024. "Agrarian Financial Ecologies: Centring Land and Labour in Geographies of Debt." Transactions of the Institute of British Geographers 49 (3): e12664.

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Please insert below any additional comment.	We appreciate the HLPE-FSN's efforts to provide an action-oriented, impartial review of scientifically documented advances and risks in the use of data, digital tools, and AI for food security and nutrition to inform future policy discussions. While the report provides a balanced and fairly comprehensive picture of the state of knowledge, its discussion of the points highlighted above remains inchoate. In concluding, it is important to underline that any individual digital intervention or AI model does not operate in isolation but is shaped by the intersection of the structural conditions characterizing the existing global system of food and agriculture on the one hand and the global digital economy on the other. Both systems have historically shown to favor the interests of specific interest groups and display

	high concentrations of political and economic power. Against this backdrop, it is important to stress that technological solutionism must not overshadow a clear-eyed assessment of the diverse impacts of the rapid digital transformation of food security and nutrition.

39. International Land Coalition

Surname	Timponi Cambiaghi
First name	Cristina
Are you contributing in a personal capacity or on behalf of an organization or team?	On behalf of a team/organization
Current position	Global Policy and Advocacy Lead
Current institution/organization	Interna
Affiliation	Alliance of organisations from diverse constituencies
Country	Italy
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	The note identifies many of the key issues, including digital exclusion, algorithmic bias, unequal access to technology, data governance gaps, and concentration of power among large technology firms. However, the analysis could more explicitly address: 1. The unequal power relations between data producers and data users, including between communities, governments, private companies, and technology providers; 2.The risks of data extraction from rural communities without meaningful participation, ownership, or benefit-sharing; 3. The importance of citizen-generated and community-led monitoring, information and data systems as complementary sources of evidence for food systems governance. 4. The implications of digitization for tenure rights, especially where land, fisheries, forests, and natural resources are concerned.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	Data sovereignty and community data governance: The note discusses data governance but could further examine who owns, controls, accesses, and benefits from data. Smallholder farmers, Indigenous Peoples, pastoralists and local communities often generate data without retaining meaningful control over its use. AI systems increasingly rely on large datasets, yet the rights and interests of data contributors remain poorly protected. This is particularly important because data about land, water, forests, biodiversity and production systems

	can have direct implications for livelihoods, tenure security and food security. Community consent and participation: The note could give greater attention to participatory governance mechanisms, including: 1. Free, Prior and Informed Consent (FPIC); 2. Community data protocols; 3. Participatory mapping; 4. Community monitoring and information systems. These approaches can help ensure that digitalization strengthens rather than undermines rights and food security outcomes. Digitalization and tenure security: Digital land registries and cadastral systems are often presented as efficiency-enhancing innovations. However, in contexts where customary rights are not recognized or where tenure disputes exist, digitization can reinforce existing inequalities or facilitate dispossession. The governance conditions under which digital technologies are deployed are therefore as important as the technologies themselves.
Are the issues identified fully capturing the links with FSN outcomes?	Partially. The note strongly addresses availability, access, utilization and stability dimensions of food security. However, the relationship between AI, digitalization and agency could be further developed. Agency should not only be understood as protection from exclusion or discrimination. It should also include the ability of individuals and communities to: 1. Generate their own data. 2. Interpret and use information. 3. Influence decisions that affect their livelihoods. 4. Participate in governance processes. These capacities are essential determinants of food security and resilience.
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	Tenure security as an enabling condition for FSN: Secure rights to land, territories, fisheries and forests are fundamental determinants of food security, nutrition, investment, resilience and sustainable resource management. Digital technologies increasingly influence how these rights are documented, monitored and governed. The note could more explicitly recognize the interaction between data governance, tenure governance and FSN outcomes. Transparency and accountability: Food-related data—including information on land ownership, land use, concessions and natural resource governance—often remain inaccessible or opaque. Greater transparency can contribute to: 1. Reduced corruption; 2. Better resource governance;

	3. More accountable public institutions; 4. Stronger citizen participation. These indirect effects can significantly influence long-term food security outcomes.
Is there any example or case study that would deserves to be mentioned?	Community-led mapping and monitoring: Across the ILC network, communities have used participatory mapping and citizen-generated data to document land rights, monitor land governance and support advocacy efforts. The ILC publication "Wisdom of the Land: Combining Traditional Ecological Knowledge, Community Land Governance and Geospatial Data" provides a clear example of how communities are integrating traditional ecological knowledge with innovative, community-led governance and management practices. These initiatives demonstrate that data generation does not need to be centralized or externally driven to be effective. The ILC's People-Centred Data Initiative: ILC members collect and manage data based on community priorities and local realities and contribute with data through initiatives and platforms such as "LANDex", "Land Mark" and "ALLIED".. These processes connect local efforts to global monitoring processes and help fill information gaps while strengthening community agency and accountability. The experience shows that data systems can simultaneously improve evidence generation and empower rights holders. Indigenous and community mapping initiatives: Many Indigenous Peoples' organizations have successfully combined geospatial technologies with traditional knowledge systems to document territories and support resource governance. In the Philippines, ILC members PAFID are using 3D mapping to support ancestral domain claims, data which has also been recognized by the government for its contributions to monitoring biodiversity Target 3 in the KM-GBF. These experiences illustrate how digital tools can complement rather than replace local knowledge.

In particular, do you have examples of effective policies to improve FSN outcomes of the use of Artificial Intelligence, digitalization and data governance in food systems?	Several policy directions deserve attention: 1. Recognition of citizen-generated data: Governments can formally recognize community-generated and citizen-generated data as valid evidence for policy-making, as well as a means of inclusion and partnership in monitoring processes. This improves representation of marginalized populations that are often absent from or underrepresented in official statistics. 2. Participatory data governance frameworks: Policies that require participation of rights holders in the collection, management and use of data can improve legitimacy and accountability. 3. FPIC requirements for digital data systems: Digitalization initiatives affecting Indigenous Peoples and local communities should incorporate Free, Prior and Informed Consent principles, particularly when collecting or using territorial, land, or resource-related data. 4. Open and transparent land information systems: Policies promoting transparency in land ownership, land use and natural resource governance can strengthen accountability and support equitable food systems.
Please insert below any additional comment.	Data governance is not only about managing information; it is about governing power. AI and digital technologies will contribute to food security and nutrition only if the people most affected by food system decisions—including smallholder farmers, Indigenous Peoples, pastoralists, fishers, women and local communities—have meaningful control over how data are generated, interpreted, shared and used. The future of equitable food systems depends not only on access to technology, but also on democratic and rights-based governance of the data that underpin it. The nearly 300 members of the International Land Coalition (ILC) share one goal: bringing about people-centred land governance. This means putting those who live on and from the land at the centre of decision-making. Too often, they are excluded from decisions about their land by those in power. That is why ILC members across the globe are collecting and managing 'people-centred' or citizen-led data, according to their own priorities to shift power imbalances that have historically marginalised and excluded them. ILC members are showing the complex realities of land governance on the ground,

	providing information they need to advocate for their rights while holding governments accountable for the promises they make.

40. Amari

Surname	Ms.
First name	Amari
Are you contributing in a personal capacity or on behalf of an organization or team?	Personal capacity
Current position	Associate Analyst
Current institution/organization	Newlines Institute
Affiliation	Civil society/NGO
Country	United States of America
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	Mostly. The report successfully identifies many of the major opportunities and risks associated with AI, digitalization, and data governance in food systems, including precision agriculture, risk management, early warning systems, supply-chain transparency, food safety, digital exclusion, data governance, privacy concerns, algorithmic bias, vendor dependence, and environmental impacts. The distinction between specific-purpose AI and generalist AI is particularly useful because it highlights that not all AI systems carry the same costs, infrastructure requirements, governance risks, or demonstrated benefits. The report is also effective in distinguishing proven applications from speculative claims and appropriately cautions against "silver bullet" narratives surrounding AI adoption. This emphasis on evidence-based assessment is especially valuable given the rapid pace of technological development and the tendency to overstate the transformative potential of emerging technologies.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	One important issue that should be more explicitly incorporated is gender inclusion and gender-responsive AI governance. While the report references equity, inclusiveness, algorithmic bias, and digital exclusion, and acknowledges that technological systems can reproduce existing inequalities, it does not directly examine how gender shapes access to and outcomes from AI, digitalization, and data governance in food systems. Women play critical roles across agricultural

	production, food processing, informal food markets, household nutrition, and caregiving. However, women often have less access to land ownership, credit, agricultural extension services, digital technologies, mobile devices, internet connectivity, and formal financial systems. As a result, AI systems trained on existing agricultural, financial, or administrative datasets may unintentionally reinforce existing inequalities when women are underrepresented in the data used to build these systems. This issue is supported by a growing body of evidence. FAO's The Status of Women in Agrifood Systems (2023) documents persistent gender gaps in access to productive resources, agricultural services, and digital technologies. The GSMA Mobile Gender Gap Report (2024) found that women in low- and middle-income countries remain significantly less likely than men to own a smartphone or use mobile internet, limiting their ability to benefit from digital agricultural services. Similarly, research by CGIAR and IFPRI has shown that digital agriculture initiatives often reach male farmers more effectively than female farmers unless gender-responsive design measures are intentionally incorporated. The report would benefit from discussion of: Gender-responsive AI and data governance frameworks. Sex-disaggregated data collection and monitoring. Gender bias auditing of AI systems. Equitable access to digital infrastructure and digital literacy programs. Participation of women farmers, producers, and food-system workers in the design and deployment of digital technologies. The relationship between digital inclusion and women's access to agricultural information, climate adaptation resources, insurance products, credit, market information, and social protection programs. Relatedly, the report discusses algorithmic bias broadly but does not explore how AI systems may reproduce gender bias when datasets disproportionately reflect male landowners, formally registered farmers, or individuals with greater access to digital services. These biases can affect resource allocation, subsidy targeting, insurance eligibility, extension services, and emergency assistance programs. Literature from UN Women, UNESCO, and the OECD has highlighted how algorithmic systems can replicate existing social inequalities when underlying datasets are incomplete or

	unrepresentative. Another issue that could receive greater attention is the concentration of technological power among a small number of technology companies and cloud infrastructure providers. While vendor lock-in and data governance are discussed, the implications for digital sovereignty and unequal bargaining power between food-system actors and technology providers deserve further elaboration. Recent analyses by UNCTAD, the World Bank, and the OECD have documented increasing concentration in digital infrastructure, cloud computing, and data services. This concentration can limit competition, increase dependence on proprietary systems, and reduce the ability of governments and local institutions to control agricultural data and digital public infrastructure. Given the growing role of AI systems that rely on large-scale computing resources, this issue has important implications for equitable participation in digital food systems.
Are the issues identified fully capturing the links with FSN outcomes?	Partially, but additional detail would strengthen the analysis. The report effectively connects AI applications to agricultural productivity, climate adaptation, supply-chain efficiency, and food safety. However, stronger attention could be given to how these technologies influence the four dimensions of food security: Food availability Food access Food utilization and nutrition Food stability The report would benefit from a clearer discussion of who benefits from technological adoption and who may be excluded. Distributional impacts are particularly important because improvements in efficiency do not automatically translate into improvements in food security or nutrition outcomes. For example, digital technologies may increase productivity while simultaneously excluding smallholder farmers, women, Indigenous communities, or populations with limited digital access. Measuring impacts on yields, income, dietary diversity, resilience, food affordability, and nutritional outcomes would strengthen the FSN focus of the report.
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	Yes. The report could more explicitly address: Distributional impacts of AI adoption. Effects on rural livelihoods and labor markets. Women's economic participation and access to resources. Impacts on informal food systems. Nutritional equity across different population groups. The role of

	digital technologies in social protection and food assistance targeting. Additionally, the report could discuss whether AI-enabled decision-making systems improve resilience among vulnerable populations or primarily benefit already well-resourced producers and firms.
Is there any example or case study that would deserves to be mentioned?	The report includes several useful examples, including satellite crop monitoring, drought and flood forecasting systems, food safety applications, crop insurance tools, and digital agricultural advisory platforms. Additional examples could include: Rwanda's investments in digital transformation and smart agriculture initiatives, including the use of digital platforms, remote sensing, and data-driven agricultural services to support farmers and strengthen agricultural planning. Rwanda also provides an important example of how digitalization strategies can be integrated with broader national development goals while emphasizing inclusion and capacity building. Gender-responsive digital extension programs that specifically target women farmers. AI-assisted social protection systems that use safeguards to prevent exclusion errors. Digital farmer registries that collect sex-disaggregated data and monitor equitable access to services. Community-based digital advisory systems designed for low-connectivity environments. Women-centered agricultural mobile platforms that improve access to market and climate information. The Rwanda case is particularly relevant because it illustrates both the opportunities and challenges associated with scaling digital technologies in agriculture within a low- and middle-income country context. It also offers lessons on digital infrastructure development, public-sector leadership, and the importance of ensuring that women, smallholder farmers, and rural communities are not left behind in digital transformation efforts.

In particular, do you have examples of effective policies to improve FSN outcomes of the use of Artificial Intelligence, digitalization and data governance in food systems?	Effective policies should prioritize: Open and interoperable data systems. Transparent AI governance frameworks. Data privacy and ownership protections. Public digital infrastructure. Gender-responsive data collection. Independent algorithmic auditing. Capacity-building and digital literacy initiatives. Inclusion of smallholder farmers and marginalized groups in technology design and implementation. Particularly promising are policies that require sex-disaggregated data collection and equity impact assessments before the deployment of AI systems affecting agricultural services, food assistance, insurance, or credit allocation.
Is there any missing reference to key literature and data?	The report would benefit from additional literature on: Gender and digital divides in agriculture. Gender bias in AI systems. Women's access to digital agricultural services. Data justice and digital inclusion in food systems. Intersectional approaches to AI governance. Distributional impacts of agricultural digitalization. In particular, literature from FAO, IFAD, CGIAR, UN Women, and the International Telecommunications Union on gender gaps in digital access and agricultural services could strengthen the report's equity framework. Overall, the report provides a strong foundation for understanding the opportunities and risks associated with AI, digitalization, and data governance in food systems. However, a more explicit focus on gender inclusion, women's equity, and the distributional impacts of technological adoption would significantly strengthen its ability to assess how these technologies affect food security and nutrition outcomes across diverse populations.

41. Agriculture and Agri-Food, Canada

Surname	Pfeiffer
First name	Yael
Are you contributing in a personal capacity or on behalf of an organization or team?	On behalf of a team/organization
Current position	Senior Policy Analyst
Current institution/organization	Agriculture and Agri-Food Canada
Affiliation	Government and other public institution
Country	Canada
Are the issues identified by the HLPE-FSN the most important issues related to Artificial	As part of Agriculture and Agri-Food Canada, our focus is mostly on food production- land use, most

Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	productive farmland use, precision agriculture and livestock monitoring (health and disease prevention) would be of particular interest.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	It would be great if the impact and benefits to primary production (on-farm, greenhouse, controlled environment growing conditions) would be elaborated in more detail. Livestock health and food waste prevention(spoilage) can also be elaborated a bit more.
Are the issues identified fully capturing the links with FSN outcomes?	While the environmental use of AI is touched upon, the environmental benefits (variable-rate inputs, reduction of pesticide/fertilizer/water use) could be expanded.
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	The different environmental impacts of generalist and specific AI tools can be further expanded upon in 3.4 to demonstrate that tools designed for specific 'jobs' can have more environmental+economical benefits than costs. Is there any concrete data or calculations to support how much each tool can use? The sheer pace and pressure to adopt AI technologies and what education tools can be explored (to educate producers) can also be touched upon.
Please insert below any additional comment.	Data infrastructure and internet access in rural areas is particularly of interest in Canada as many farms don't have reliable internet access (considering the size of the country).

42. Global Alliance for the Future of Food

Surname	Alves Zanella
First name	Matheus
Are you contributing in a personal capacity or on behalf of an organization or team?	On behalf of a team/organization
Current position	Senior Advisor, Global Fora
Current institution/organization	Global Alliance for the Future of Food
Affiliation	Foundation
Country	Brazil
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	We have prepared a detailed contribution in line with other HLPE consultations, which can be accessed at this link: https://drive.google.com/file/d/1WJq0uF6JG-3dCri7RHGMdpzm9BFITGI5/view?usp=sharing . Feel free to get in touch and request by email in the case the link doesn't work.

Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	We have prepared a detailed contribution in line with other HLPE consultations, which can be accessed at this link: https://drive.google.com/file/d/1WJq0uF6JG-3dCri7RHGMdpzm9BFITGI5/view?usp=sharing . Feel free to get in touch and request by email in the case the link doesn't work.
Are the issues identified fully capturing the links with FSN outcomes?	We have prepared a detailed contribution in line with other HLPE consultations, which can be accessed at this link: https://drive.google.com/file/d/1WJq0uF6JG-3dCri7RHGMdpzm9BFITGI5/view?usp=sharing . Feel free to get in touch and request by email in the case the link doesn't work.
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	We have prepared a detailed contribution in line with other HLPE consultations, which can be accessed at this link: https://drive.google.com/file/d/1WJq0uF6JG-3dCri7RHGMdpzm9BFITGI5/view?usp=sharing . Feel free to get in touch and request by email in the case the link doesn't work.
Is there any example or case study that would deserves to be mentioned?	We have prepared a detailed contribution in line with other HLPE consultations, which can be accessed at this link: https://drive.google.com/file/d/1WJq0uF6JG-3dCri7RHGMdpzm9BFITGI5/view?usp=sharing . Feel free to get in touch and request by email in the case the link doesn't work.
In particular, do you have examples of effective policies to improve FSN outcomes of the use of Artificial Intelligence, digitalization and data governance in food systems?	We have prepared a detailed contribution in line with other HLPE consultations, which can be accessed at this link: https://drive.google.com/file/d/1WJq0uF6JG-3dCri7RHGMdpzm9BFITGI5/view?usp=sharing . Feel free to get in touch and request by email in the case the link doesn't work.
Is there any missing reference to key literature and data?	We have prepared a detailed contribution in line with other HLPE consultations, which can be accessed at this link: https://drive.google.com/file/d/1WJq0uF6JG-3dCri7RHGMdpzm9BFITGI5/view?usp=sharing . Feel free to get in touch and request by email in the case the link doesn't work.

Please insert below any additional comment.	We have prepared a detailed contribution in line with other HLPE consultations, which can be accessed at this link: https://drive.google.com/file/d/1WJq0uF6JG-3dCri7RHGMdpzm9BFITGI5/view?usp=sharing . Feel free to get in touch and request by email in the case the link doesn't work.

43. Sarah Louise Ruder

Surname	Ruder
First name	Sarah-Louise
Are you contributing in a personal capacity or on behalf of an organization or team?	Personal capacity
Current position	Research Associate and Adjunct Professor
Current institution/organization	University of the Fraser Valley and Simon Fraser University
Affiliation	Academia
Country	Canada
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	Overall, I found the draft excellent. I especially appreciate the distinctions and clarity in discussing small/special-purpose and generalist AI. The "Way Forward" section is well structured and likely to inform meaningful ongoing work for the HLF.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	Data governance - I appreciate that data governance is mentioned in the context of AI for FSN. That is essential and still often overlooked. However, you could consider how the ongoing challenges of data governance, policy, surveillance, etc. will translate to uses of AI in the food system. AI systems, of course, rely on data. You already address issues of digital/divide inclusion in the report. Another issue is the limitation of data related legislation to focus on personal information, leaving the terms of agricultural data governance often up to the powerful corporations that own the digital tools/infrastructure. This is a focus of my recent research in Canada: 3. Duncan, E. R.,* Ruder, S. L., KC, K. B., Wittman, H., and Fraser, E. (2026). The Political Economy of Agricultural Data Governance: Farmer Perspectives on Trust in Data Sharing. Journal of Rural Studies. https://doi.org/10.1016/j.jrurstud.2026.104076 ; 4. Ruder, S. L. (2025). “Terms and Conditions” of Surveillance Capitalism: Agricultural Data

	Governance in Canada. Journal of Peasant Studies, 54(4), 725-750. https://doi.org/10.1080/03066150.2024.2429480 ; 6. Ruder, S.L. and Wittman, H. (2025). Agricultural Data Governance from the Ground Up: Exploring Data Justice with Farmer and Agri-Food Movements. Big Data & Society, 12(1), 1–14. https://doi.org/10.1177/20539517251330182 .
Are the issues identified fully capturing the links with FSN outcomes?	I found the draft to be rather comprehensive given its scope.
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	The inclusion of the environmental and social impacts of data centres is great. This point could be elaborated upon re: placing data centres on Indigenous territories and/or agricultural lands; placing data centres on water-scarce areas competing with food-related water needs.
Please insert below any additional comment.	"Harnessing" is an interesting word for the title. There are multiple connotations to the word. My initial impression was that this could be "making the most of" AI in a positive/optimistic view. In reading the report, I was glad to see a critical and measured treatment of both the benefits and risks. Upon further reading, I thought about "harnessing" as "to put a harness on" or take back control. -- Just thought I would flag in case it would be useful to know.

44. Consea, Brazil

Surname	Pasquim
First name	Elaine
Are you contributing in a personal capacity or on behalf of an organization or team?	On behalf of a team/organization
Current position	General-coordinator
Current institution/organization	Consea
Affiliation	Multistakeholder Organization
Country	Brazil
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	To address the challenges of food and nutritional security, it is essential that the use of Artificial Intelligence goes beyond a focus restricted to increasing productivity. This focus is generally associated with large agricultural enterprises, such as large landholdings and monocultures, the use of genetically modified organisms and pesticides, as well as the food industry, especially multinational ultra-processed food companies, whose priority

	tends to be profit and not the fight against hunger. In addition, it is necessary to shift the focus of the analysis: the problem does not lie in the quantity of food produced, but in the profound social and economic inequality that limits access to food. In this sense, it becomes essential to guide the use of these technologies to effectively promote access to adequate food. Thus, the application of Artificial Intelligence, in conjunction with data digitization and governance processes, must be committed to combating poverty, expanding access to services and public policies, promoting the enforceability of the Human Right to Adequate Food, and strengthening social control. It is essential to consider, above all, historically excluded groups, ensuring that these technologies do not exacerbate existing inequalities, but contribute to their reduction. It is therefore proposed that the benefits of Artificial Intelligence be democratized, understood as a public good, in order to also reach small and medium-sized producers. Therefore, it is fundamental that there be investment in AI in which this public not only has access, but also appropriates its use and improves its development from a community and collaborative perspective, and not just controlled by a small group of companies. Thus, it is essential to provide training processes so that groups of family farmers have the possibility of moderating the content, classifying the data and reshaping artificial intelligence in the face of the demands produced by community, cultural and collective knowledge, using a logic of cooperative and democratic governance, working with public bodies and non-profit education, science and technology institutions, capable of reducing dependence on large multinational providers, allowing better local control of collected data, and environmentally responsible use of these technologies. In particular, the centrality of family farming stands out, as it is responsible in Brazil for a significant portion of the food consumed by the population, such as rice, beans, and vegetables. Another fundamental aspect concerns the need for the application of Artificial Intelligence to respect and value the traditional knowledge of indigenous peoples, quilombola communities, and other traditional communities. In this context, it is crucial to protect traditional agricultural systems and

	heirloom seeds, essential elements for the preservation of socio-biodiversity. Finally, in line with the motto of the global movement of people with disabilities — "Nothing about us without us" — it is essential to guarantee the active participation of different social actors in the formulation of public policies and in the regulation of Artificial Intelligence, digitization, and data governance in the field of food and nutritional security. In this process, the fundamental role of social movements and civil society stands out, whose qualified presence is essential in the spaces for debate and in the decision-making bodies related to these themes. It should also be emphasized that the use of artificial intelligence technologies cannot replace free and informed consent, nor exclude knowledge from communities, or harm the quality of social participation due to knowledge that is not accessible to communities.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	Beyond the concepts of bias and hallucination, it is important to recognize that other key issues occupy a central place in the debate on Artificial Intelligence, digitization, and data governance. In this context, the Brazilian Government has adopted, more broadly, a set of concepts that can enrich and deepen the ongoing discussion. One of these concepts is interoperability. Food and Nutritional Security policies are inherently intersectoral, with data distributed among various Ministerial Departments and state and municipal secretariats, such as Social Assistance, Education, Agrarian Development, Human Rights, Health, among others. In the Brazilian case, this is compounded by the challenge of coordination between the different federative entities (Union, states, and municipalities), which have heterogeneous institutional capacities. In this scenario, the adoption of interoperability becomes fundamental, as it presupposes communication and data sharing between different systems, contributing to the improvement of public service delivery and to the formulation and social control of evidence-based policies (https://www.gov.br/governodigital/pt-br/infraestrutura-nacional-de-dados/interoperabilidade). Added to this is the need for transparency in data disclosure. Another relevant concept is that of Sovereign Cloud. In the field of

	Food and Nutritional Security, food sovereignty is a fundamental principle; similarly, in the field of information, it is essential to consider data sovereignty. In this sense, the Government Cloud emerges as a strategic instrument to ensure the independence, security, and protection of public information, strengthening the State's autonomy in managing its data (https://www.gov.br/governodigital/pt-br/infraestrutura-nacional-de-dados/ambiente-tecnologico/nuvem/nuvem-de-governo/nuvem-de-governo and https://www.gov.br/gestao/pt-br/assuntos/noticias/2025/se/na-soberania-digital-brasil-consolida-a-nuvem-de-governo-como-passo-para-a-independencia-e-a-protecao-de-dados). Finally, the auditability of data and digital accessibility, which play essential roles in this debate, also stand out. Auditability makes it possible for data and decisions based on Artificial Intelligence to be verifiable, allowing for error correction, bias identification, and the strengthening of social control. In this sense, it is essential that the diverse audiences in the field of Food and Nutrition Security (FNS) can be adequately informed to actively participate in the processes, ensuring effective social control of data and decisions based on artificial intelligence in this field. Digital accessibility, on the other hand, refers to the democratization of access to technologies and information, including the risks in their use, taking into account the different physical-motor, perceptual, cultural, and social capacities of citizens, in order to promote inclusion and equity (https://www.gov.br/governodigital/pt-br/acessibilidade-e-usuario/acessibilidade-digital). It should be noted that access to technologies does not exempt governments from carrying out alternative and face-to-face processes for training, dissemination of knowledge, access to public policies, or conducting free, prior, and informed consultations.
Are the issues identified fully capturing the links with FSN outcomes?	The issue is covered in other topics.
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	It is essential that the debate on data in Food and Nutritional Security incorporates an intersectional perspective, a concept coined by Kimberlé Crenshaw, since different factors overlap, such as income, gender, race/ethnicity, disability, and

	territory. This overlap means that certain population groups are disproportionately affected by food insecurity. From this perspective, the use of data and algorithmic systems can both make invisible and give visibility to populations in situations of greater vulnerability. This largely depends on the possibility of adequately disaggregating the data and guiding its use towards the formulation of specific public policies to promote equity, aimed at the needs of these groups. In addition, it is important to highlight the importance of considering how the data and decisions produced contribute to democracy, to social and inclusive participation in public policy decision-making, to the reduction of food insecurity, and to the construction of fair, resilient, sustainable, and healthy food systems.
Is there any example or case study that would deserves to be mentioned?	IARAA (Artificial Intelligence for Agrarian Reform and Agroecology): Developed by the MST (Landless Workers' Movement), the World March of Women, and the Baobab Institute. It functions as a decentralized knowledge base, ensuring that technology serves peasant organizations and popular feminism. The platform focuses on technological sovereignty and tools committed to the people (link: https://www.instagram.com/reel/DYNsE6Vv33R/) EITA Cooperative (https://eita.coop.br/): a workers' cooperative that develops technologies in dialogue with popular social organizations and movements. They understand that software is an artifact built from choices, capable of being re/constructed and altered. To ensure that these choices are collective, training throughout each project is fundamental. The Cooperative Values Driven AI project by the UK-based Co-operative Councils Innovation Network brings together municipal councils, civil society groups, and technologists to develop ethical technologies for organizing shared political commitments and influencing public policy agendas and government procurement. Link: https://www.councils.coop/project/coop-values-driven-ai/ Open Courier is building a new kind of delivery and decentralized ecosystem of community-owned delivery platforms (https://opencourier.cs.princeton.edu /)

45. Ruobin Wu

Surname	Wu
First name	Ruobin
Are you contributing in a personal capacity or on behalf of an organization or team?	Personal capacity
Current position	Young professional officer (innovation and digital agriculture)
Current institution/organization	FAO
Affiliation	UN
Country	Samoa
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	Yes. However, in specific contexts like low-income countries and Small Island Developing States (SIDS), a stronger emphasis is needed on what the note currently treats as "qualifying factors": fundamental data and infrastructure gaps. In many data-poor food systems (so-called "data deserts"), the lack of reliable local data and digital capacity is not just a secondary risk but rather a first-order constraint on any benefits from AI. For example, many Pacific Island countries have such severe limitations in statistical data and information systems that global databases (e.g. FAOSTAT) must often rely on modelled estimates rather than national data. The note could make more explicit that without bridging these data and connectivity gaps, even the most promising digital tools cannot deliver FSN gains. Secondly, it may be valuable to further underline digital public goods and regional shared digital infrastructure as essential pathways for small countries to overcome capacity constraints. The note briefly mentions "data embassies" and regional cooperation in a footnote, but these ideas warrant greater prominence: for instance, regional digital public infrastructure (like shared farmer registries or climate data platforms) can provide technical capacity and economies of scale that individual small states cannot achieve alone.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	Two additional issues merit attention: AI and Indigenous & Traditional Knowledge: The intersection of AI systems with Indigenous and traditional knowledge in food systems is a significant concern, especially for regions like the Pacific. Agricultural, fisheries, and land management practices in many countries are deeply rooted in traditional knowledge and Indigenous cultural frameworks. This addition is in line with the

	principles of the UN Declaration on the Rights of Indigenous Peoples (e.g. Article 31 on Indigenous peoples' right to maintain and control their cultural knowledge). By highlighting this issue, the note would encourage governance frameworks ensuring that new digital tools augment and protect Indigenous and small-scale farmers' knowledge rather than overriding or misappropriating it. AI-Generated Misinformation in Food Systems: The note touches on the risks of AI "hallucinations" and biased algorithms, but it could more explicitly address AI-driven misinformation in the broader food system. Generative AI tools can produce large volumes of plausible-sounding but false or misleading content on topics like farming practices, food safety, and nutrition. In contexts where formal extension services or reliable information channels are limited, communities—including smallholders and consumers—may be especially vulnerable to such misinformation spread via social media or messaging platforms. This can have direct implications for FSN (e.g. influencing farmers' input choices or consumers' diet decisions based on false claims). Including this issue, supported by emerging studies on the need to counter false digital information around food and health, would underscore that responsible AI governance in food systems must consider the information ecosystem and not only technical interventions.
Are the issues identified fully capturing the links with FSN outcomes?	Yes. One possible enhancement would be to underscore the interplay between digital food environments and nutrition outcomes. The note does reference digital marketing and misinformation in food choices (2.4), but expanding on how online advertising and social media influence diets—particularly in rapid nutrition transitions—could strengthen the FSN linkage in the context of obesity and non-communicable diseases.
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	Yes. In addition to those already highlighted, a few specific FSN-related aspects could be elaborated: Fisheries & Maritime Food Systems: The note presently concentrates on terrestrial agriculture, but in many coastal and island contexts, small-scale fisheries play an equally critical role in food security and nutrition (fish is the primary protein source for many Pacific communities). The HLPE-FSN note could benefit from explicit treatment of AI and

	digital applications in small-scale fisheries, such as tools for community-based fish stock monitoring, early warning of maritime hazards, or market access for fishers. These hold distinct challenges (e.g., poor connectivity at sea, different data needs like oceanographic data) and opportunities for FSN that deserve mention alongside the focus on agriculture.
Is there any example or case study that would deserves to be mentioned?	Yes. A few concrete examples from different regions illustrate the diverse applications of digital and AI in food systems: Farmer Registry and Digital Extension in Fiji (VitiAgri): In 2023, Fiji's Ministry of Agriculture launched the VitiAgri Data Hub, a national farmer registry platform (developed with a local agritech company's support). VitiAgri provides agriculture officers with a single digital system and mobile app to register and profile the country's ~97,000 farmers, track farm production data, and record field visits in real time. This shared platform generates unique farmer IDs and centralizes information previously scattered across surveys and paper records, enabling more targeted extension support and informed policymaking. This case exemplifies how digital public infrastructure (farmer databases) can strengthen service delivery and inclusiveness in the agriculture sector of small countries. Climate Hazard Risk Dashboard in Tuvalu: In 2024, the Pacific Island nation of Tuvalu, with support from the Green Climate Fund, UNDP, and the Pacific Community (SPC), deployed a nationwide online Hazard and Risk Dashboard. This state-of-the-art digital platform allows users (from national planners to local communities) to visualize and model climate risks—such as sea-level rise and storm surge impacts—down to the level of individual villages and coastlines. The dashboard integrates decades of data on shoreline changes and elevation, enabling "what-if" scenario analysis and location-specific risk assessments even offline (with local servers placed in government offices). This case demonstrates how digital tools can empower vulnerable communities with actionable information for resilience and adaptation planning, crucial for long-term food security in climate-threatened SIDS. Inclusive E-commerce Platforms (Case of Pinduoduo, China): In the agri-food value chain, e-commerce innovations are transforming market access for small producers. For instance, Pinduoduo, launched in 2015, is a

	Chinese digital marketplace that pioneered group-discount "team purchases" for agricultural products, enabling smallholder farmers to sell directly to a user base of hundreds of millions. By aggregating consumer demand via social media integration, Pinduoduo has boosted rural farmers' incomes and cut out intermediaries, illustrating how digital platforms can drive inclusive market participation. (Notably, Pinduoduo's approach to connecting small farmers to consumers was recognized with a FAO Innovation Award in 2022, highlighting its relevance to global FSN objectives.) This case study underlines the potential of private-sector innovation in improving market linkages and livelihoods for small-scale producers through digital means.
In particular, do you have examples of effective policies to improve FSN outcomes of the use of Artificial Intelligence, digitalization and data governance in food systems?	Yes. Two policy initiatives from the Pacific region illustrate frameworks that foster positive FSN outcomes from digital transformation: Pacific Digital Economy Programme (PDEP): PDEP is a multi-country initiative (supported by partners including the Australian Government (DFAT), UNDP, UNCDF, and UNCTAD) aimed at closing the digital divide and building foundational digital capabilities across Pacific SIDS. Rather than funding any single "AI for agriculture" application, PDEP invests in connectivity, digital skills, e-government capacity, and policy – the underlying building blocks that make later adoption of AI and digital tools feasible. Lagatoi Declaration on Digital Transformation of the Pacific (2023): In August 2023, ICT Ministers from 13 Pacific Island Countries endorsed the Lagatoi Declaration, a collective commitment to accelerate equitable digital transformation. This high-level policy declaration, supported by regional bodies, addresses six priority areas: (1) digital public infrastructure and connectivity; (2) digital innovation and entrepreneurship; (3) cybersecurity and trust; (4) digital skills and literacy; (5) digital government and inclusion; and (6) regional cooperation on digital governance. By adopting joint standards and collaborating on shared digital services, Pacific SIDS aim to create an environment where AI, data sharing, and digital tools can be leveraged safely and cost-effectively to improve food systems, health, and resilience.
Is there any missing reference to key literature and data?	Rome Call for AI Ethics (2020); The State of Digital Transformation in Pacific Island Countries (2025);

	The State of Digital Agriculture in the Commonwealth (2021)
Please insert below any additional comment.	Prioritize Digital Public Goods: The note should explicitly encourage open-source, interoperable digital public goods as the backbone for digital innovation in food systems. Endorsing Digital Public Goods (DPGs) (open software, standards, and content) would promote affordable, context-adaptable solutions and help avoid dependency on proprietary platforms. Sequence Investments – Data & Infrastructure First: It is worth emphasizing as a policy principle that investment in foundational digital infrastructure and data systems must precede large-scale AI application programs in food systems. For example, establishing reliable farmer registries, market information systems, and agricultural statistics databases will create the data foundation needed for any effective AI-driven advisory or analytics tool. Safeguard Indigenous Knowledge & Data Sovereignty: The HLPE-FSN note should address the protection and promotion of Indigenous and traditional knowledge in digital agriculture. This could include recommending that CFS or member countries develop governance mechanisms to ensure Indigenous communities have control over whether and how their agricultural and ecological knowledge is digitized and used in AI systems, consistent with the principles of free, prior, and informed consent.

46. Food and Nutrition Division, Food and Agriculture Organization of the United Nations (FAO)

Surname	Aburto
First name	Nancy
Are you contributing in a personal capacity or on behalf of an organization or team?	On behalf of a team/organization
Current position	Deputy Director, Food and Nutrition Division
Current institution/organization	FAO
Affiliation	UN
Country	Italy

Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	Yes. We don't have more to add.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	1. AI application in food processing. Food processing has great impacts in dietary quality but there is no mentioning of it in the document. Various branches of AI (both specific-purpose and generalist) have transformed industrial level food processing processes, improving efficiency and nutritional value. A detailed technical review can be found at https://doi.org/10.1007/s12393-024-09395-1 . 2. The application of blockchain in supply chains has extended beyond tracing. Several solution providers develop one-stop platforms for businesses and farmers to help them perform transactions (via cryptocurrency where legal tender supply is inadequate), monitor inventory, and follow market trend. Notable cases include Agri-wallet ([1](https://www.agri-wallet.com/), [2](https://fairfood.org/resources/case-study-how-agri-wallet-drives-sustainable-food-production/)) and Sarafu ([1](https://sarafu.network/), [2](https://ibtekr.org/en/cases/rethinking-money-how-sarafu-is-guiding-kenyans-toward-a-new-financial-system/), [3](https://en.wikipedia.org/wiki/Sarafu-Credit?useskin=vector), [4](https://arxiv.org/abs/2512.04030)). Another case is Hello Tractor, an Uber-like tractor rental service provider operating in several African countries. The company is utilizing blockchain technology to bring together tractor owners and dealers, farmers and banks, establishing a digital ecosystem for transparent transactions ([1](https://hellotractor.com/), [2](https://africanharvesters.com/agtech-ibm-research-hello-tractor-partners-on-ai-and-blockchain/), [3](https://www.bu.edu/gdp/2022/08/04/the-uber-meets-salesforce-for-tractors-using-blockchain-technology-to-increase-access-to-machinery-for-farmers-in-africa/)).
Is there any example or case study that would deserves to be mentioned?	For dietary assessment: recent advances in utilizing deep learning, particularly convolutional neural

	networks (CNN), in dietary assessment greatly improves accuracy and efficiency in scenarios such as food image classification, portion size estimation, and nutrient content prediction. There have been many research papers (e.g. [1](https://www.sciencedirect.com/science/article/pii/S2666154325001048?via%3Dihub), [2](https://www.sciencedirect.com/science/article/pii/S0952197625007274?via%3Dihub), [3](https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0322695), [4](https://www.sciencedirect.com/science/article/pii/S088915752401144X?via%3Dihub), [5](https://www.nature.com/articles/s41598-025-32610-w)) but it's unclear how has the progress been taken up at the consumer end (e.g. dish identification apps).
Is there any missing reference to key literature and data?	There are two good reviews that are worth mentioning: https://doi.org/10.3389/fnut.2025.1636980 and https://doi.org/10.1007/s12393-024-09395-1
Please insert below any additional comment.	1. One risk or weakness of current mainstream LLMs could be added: data based on which the models are trained often lack Global South input, resulting in a poor fit with Global South situations. But this can be partly alleviated by the point below. 2. It is worth mentioning that some recent progresses in LLMs are favorable for Global South. The capacity of open-source models are improving rapidly, not far behind leading close-source models. These models allow fine-tuning and retraining, so they can be tweaked to be more suitable for country and local contexts. There are "slim" open-source models with fewer parameters that require relatively lower resources to train, which may be more suitable for Global South countries. On the user end, a mid- to long-term trend is on-device, off-line LLMs. They don't need network connection so this will help overcome infrastructural challenges. Although currently the performance of such models is not satisfactory and they need powerful hardware (e.g. latest flagship smartphones) to run, with the current speed of iteration it may happen in the not too-distant-future that everyone has a powerful locally-run LLM in their phone.

47. Civil Society and Indigenous Peoples' Mechanism (CSIPM)

Are you contributing in a personal capacity or on behalf of an organization or team?	On behalf of an organization
Current institution/organization	Civil Society and Indigenous Peoples' Mechanism (CSIPM)
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security and nutrition (FSN), globally and in specific contexts?	The note identifies very important issues related to artificial intelligence, digitalisation and data governance affecting food security and nutrition. The CSIPM appreciates how the note attempts to bring evidence to check unsubstantiated claims regarding the potential of AI and other digital technologies to address challenges to the realization of the human right to food and nutrition. Overall, the examples described in the note (chapter 2) show that evidence for benefits is still scarce and patchy, calling for a much more nuanced approach when discussing the benefits of AI and other digital technologies, as opposed to dominant techno-optimistic or techno-deterministic discourses. The note could make this finding more explicit and should avoid statements like "AI has considerable potential to improve the efficiency of food systems" (p. 20), which contradict the findings of the previous chapter. Moreover, these findings should lead the HLPE-FSN to call for the application of a precautionary approach to the use of AI and other digital technologies in the context of food systems. Although the note refers in several places to the political economy of digitalization and AI—in particular, to the fact that most digital and AI tools are developed by a small number of technology companies, which are concentrated in a few countries—the draft note does not fully address the implications this has for the risks and potential benefits of these technologies when it comes to addressing food security and nutrition challenges. For example, the extremely high resource needs and data extractivism are at the very foundation of many current digital and AI tools, rather than byproducts. In addition. the fact that a significant portion of digital technologies and infrastructure is developed, owned, and controlled by corporations is intrinsically linked to the fact that these technologies tend to consolidate and deepen existing inequalities within food systems and

	beyond (as recognized by the draft note). Similarly, the way in which many digital and AI systems are biased toward specific objectives and corporate actors is a direct consequence of the business model through which they are developed and deployed, and not merely a consequence of the bias in the data available or used. The CSIPM considers that acknowledging this reality is a precondition for any realistic discussion about the risks and potential benefits of AI and other digital technologies. The CSIPM recommends that the HLPE-FSN be more explicit about these in its note. Regarding data governance, FSN datasets often contain a mix of anonymized, aggregate personal data (such as farmer profiles, record of rights of landholdings, farm household data etc.) with non-personal data of non-human origin (e.g. geospatial data, crop patterns, climate and soil information etc.). The experience of agricultural data exchanges in multiple countries has revealed challenges for effective stewardship of such mixed datasets and of instituting effective public licensing conditionalities for re-use. The note needs to contain a discussion of these issues from experiences thus far.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	In addition to the issues identified in the draft note, the CSIPM recommends the inclusion of the following key issues 5. Risk of Biopiracy: Tangible risk of biopiracy with the advent of 'digital sequence information' (DSI) and the still nascent governance framework around it. This weakens protection for the traditional knowledge and non-personal data of Indigenous Peoples, peasants and other small-scale food producers, women, and workers, and the access and benefit-sharing regime under the Convention on Biological Diversity. Refer to Jim Thomas' case study on the generative biology stack and its data justice and ESCR implications for more information on this issue. 6. Assetisation and financialisation: Agricultural data is commodified and transformed into financial products such as

carbon credits, ESG derivatives, and risk profiling without farmers consent or control. Value is captured upstream by corporations, while producers remain data suppliers without benefits. Data extraction becomes the new route for value extraction from the natural resources commons. This dynamic is compounded by the integration of machinery platforms with insurance and financial service providers: farmer-generated machine data is used to price parametric insurance products, yield-linked credit, and commodity hedging instruments, while the farmers themselves bear the costs of data generation and have no legal entitlement to the derived financial value. The EU Data Act (2025) provides partial redress by granting farmers the right to access and transfer machine-generated data, but stops short of addressing the proprietary status of aggregated and derived datasets claimed by manufacturers.

7. The risks of privatisation of Digital Public Infrastructures (DPIs): Many examples of DPI models in agriculture prioritise efficiency and scale over equity, reinforcing power imbalance, and lacking transparency and accountability. As Research ICT Africa notes, the growing role of private actors in building and operating DPI raises the concern that the capture of public value by private infrastructure operators could replicate the asymmetries of data extractivism that DPI was designed to correct. The questions of who controls DPI data, for whose benefit, and under what accountability frameworks, are AI governance questions as much as infrastructure questions. Further, these DPI models also tend to sidestep the question of preserving agricultural data as a societal commons and of how free-riding may be prevented. This is evident from case studies of FAO's DPG and DPI and India's AgriStack.

8. Corporate integration across agricultural input chains: The draft note does not address the structural consolidation occurring across machinery, seeds, fertilisers, and insurance industries mediated by digital platforms. Major agricultural machinery manufacturers are building or co-investing in digital farm management platforms (e.g. John Deere Operations Center, CLAAS connect, CNH FieldOps) that integrate data flows across previously distinct sectors. This integration enables machinery corporations to serve as gatekeepers of the agri-food data value chain, conditioning access to insurance products, agronomic recommendations, and financial services on the use of proprietary platforms. The precautionary principle should be applied to this vertical and horizontal integration, and the note should call for antitrust and data governance frameworks that prevent platform lock-in and ensure farmers' freedom to choose service providers independently of their machinery brand.
9. Public capabilities: Public policies and infrastructures need to urgently be supported and strengthened. For AI and digitalization to benefit local contexts and FSN, national / local public-owned infrastructures and policies are essential. Public capabilities and funding to assess AI and digitalization impacts on the marginalization of women, of digital unliterate populations, and local and indigenous knowledge on deepening existing inequalities, on resilience / new dependencies creation, on food price volatility. Public capabilities are the conditions for adequate digitalization and AI tools, guaranteeing they will benefit FSN. (The World Bank 4C's framework does not provide sufficient conditions for implementing AI and other digital technologies. There is a need for an overarching systemic capability framework within which the 4Cs should be

interpreted. Systemic capability refers to the actual capacity for individuals in a society to secure a livelihood, adapt to economic shifts, and consistently improve their wellbeing. The system must be able to go beyond skills and employment, to be able to offer the bridging capital for social transformation through appropriate policies and infrastructures. Appropriate global and regional policies are necessary for countries in the South to find their strategic pathway to use digitalisation and data-based intelligence for protecting and promoting their knowledge sovereignty and adopting locally-owned innovation.

10. Governance: The note should emphasize more strongly that the governance of AI, digitalization and data must acknowledge and address power asymmetries between different actors and put in place specific safeguards for the rights of Indigenous Peoples as well as the rights of peasants and other people living in rural areas, the rights of women and the rights of other marginalized people and groups. The draft note identifies data as a strategic lever for governance of AI and other digital technologies, but fails to provide RtFN-based elements for such governance. In addition, while emphasizing the potential of open public data, the draft note fails to address the issue that corporate actors extract, store, process and use huge amounts of data extracted from different sources – including big amounts of public data – while using it exclusively and privatizing the benefits deriving from the use of such data. The note should also provide elements on how international institutions and UN agencies should address risks in their data governance frameworks. At the same time, the note should not give the impression that data is the only lever for governance in the context of digitalization and AI. Indeed, data is an important, but not sufficient area of intervention. Other key areas for

	regulation and governance are the control of digital infrastructure, intellectual property, and effective framework to address corporate concentration/oligopolies and ensure corporate accountability. This is especially relevant given the emerging integration of machinery corporations with seed, fertiliser, and insurance industries through proprietary data platforms, which creates new monopolistic structures requiring specific regulatory attention. For instance, intellectual property has played a big role in building agricultural data monopolies. The note should therefore underline the need to address the same through various public and social licensing approaches that recognises community claims in FSN data and the importance of regulatory space to institute mandatory data sharing obligations on transnational digital and agricultural corporations holding pivotal publicly important FSN datasets. This will be a useful addition to the existing draft.
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	The CSIPM suggests the HLPE-FSN to highlight the risks posed by dominant data and AI innovation in terms of the violation of the human right to food and nutrition and related Economic, Social and Cultural Rights (ESCR). For instance, (1) The connection between food security and livelihood security for small-scale food producers (right to livelihoods in Articles 6-7 of ICECSR): Automation, algorithmic management, and surveillance can displace agricultural workers, undermine traditional farming expertise, and reshape labor around precarious digital regimes, eroding dignified forms of rural employment. There are inadequate safeguards against the restructuring of agricultural labour markets. In addition, the integration of precision machinery with algorithmic input management (automated seed/fertiliser prescriptions, data-driven insurance requirements) further reduces small-scale producers' decision-making autonomy and creates new dependencies on corporate platforms for basic farming operations.

	(2) Protection of Knowledge Systems and Cultural Practices: Data-driven agricultural models often prioritise standardised, quantifiable approaches to farming, marginalising Indigenous knowledge, local farming traditions, and culturally embedded relationships with land and ecosystems. As the CFS recommendations (2023) on food security and data governance acknowledge: "Indigenous Peoples, peasants and other small-scale food producers have a variety of methods to generate, collect, store, and use data that are often not considered in standard data collection systems and in FSN decision-making. It is important to recognise the significance of these data for FSN and FSN decision-making at local and national level, and to support the effective, inclusive and meaningful participation of those who generate and manage these data, information, and knowledge, while respecting their human rights and protecting their traditional knowledge, innovations and practices". The note should provide elements on how the CFS can contribute to transforming this recognition into public policies at all levels, with an emphasis on the respect, protection and promotion of the distinct data, information and knowledge systems of rural communities and Indigenous Peoples. (3) Equitable Access to and Governance of AI Innovation in Agriculture: While small-scale food producers generate valuable data that underpins AI and digital innovation in agriculture, they are often excluded from decision-making processes and the benefits derived from these technologies. This raises concerns about equitable access to scientific and technological advances (Art 15.1b, ICESCR). (4) Loss of the commons: It is important to draw attention to how digitalization in the context of tenure of land, fisheries and forests undermines tenure rights, particularly customary and collective rights as well as usage rights and the rights of women, youth and Indigenous Peoples. (5) Impacts on agricultural and food workers: While the draft note focuses on productivity, distribution, and consumption, it fails to address the impacts of digital technologies on the more than one billion people employed in agriculture worldwide. Automation technologies, such as drones and

	robots, may increase efficiency but can also displace rural, agricultural and food workers, particularly in contexts where alternative employment is scarce. Indeed, automation often coincides with worsening labor conditions, including increased precarity for migrant workers, women, and other vulnerable groups. Therefore, impact assessments of digital agricultural technologies must include indicators on employment, wages, working conditions, and social protection. In addition, the growing use of algorithmic surveillance in farms, food processing facilities, and logistics, where digital monitoring systems can intensify work, risks undermining workers' rights, and weaken collective bargaining.

48. Food and Agriculture Organization of the United Nations (FAO)

General Feedback

The impact of Artificial Intelligence (AI), digitalization and data governance on food security and nutrition (FSN) depends not only on the technologies themselves, but also on digital inclusion, institutional arrangements, governance mechanisms, and the ability of rural actors to participate in value creation and decision-making.

Overall, the note identifies many of the key issues related to AI, digitalization and data governance that are relevant to FSN. However, it could be strengthened by framing digital transformation not only as a matter of innovation, productivity or efficiency, but also as a question of governance, equity, accountability, agency and power relations.

A cross-cutting message should be that digitalization does not automatically lead to inclusion. Benefits depend on the extent to which rural actors can meaningfully access, use and benefit from digital tools, while retaining effective offline alternatives where needed. This is consistent with FAO's work on rural digital inclusion (FAO, 2024).

Gender equality should also be elevated from a connectivity issue to a structural and cross-cutting concern. In contexts where women have less access to assets, extension services, connectivity, finance and decision-making power, AI and digital tools may amplify existing inequalities unless they are designed and governed in gender-responsive ways (FAO, 2023; UN Women, 2024; GSMA, 2025).

Are you contributing in a personal capacity or on behalf of an organization or team?	On behalf of Food and Agriculture Organization of the United Nations (FAO)
Are the issues identified by the HLPE-FSN the most important issues related to Artificial Intelligence, digitalization and data governance affecting food security	Overall, the note identifies many of the most important issues related to AI, digitalization and data governance affecting FSN. These include productivity enhancement, climate-risk management, food safety, nutrition advice,

and nutrition (FSN), globally and in specific contexts?	supply-chain transparency, digital exclusion, algorithmic bias, public digital infrastructure and data governance. One area that could be further strengthened is the analysis of the institutional and governance conditions through which AI and digitalization translate into FSN outcomes. Recent work on digital inclusion emphasizes that digital transformation does not automatically lead to inclusion, and that exclusion often results from the interaction between increasing digitalization, persistent digital divides and the absence of effective offline alternatives (FAO, 2024). Digital platforms should therefore be treated not only as technological tools, but also as governance arrangements that shape access to markets, finance, technologies and participation in decision-making processes. These institutional dimensions are highly relevant to FSN outcomes and could be more explicitly reflected in the note (UNIDROIT, FAO and IFAD, Draft CLSAE Guide, 2026). The note could also more clearly recognize that agency is one of the FSN dimensions most directly affected by AI and digitalization. Digital technologies can expand access to information, services and markets, but they can also reduce autonomy where systems are opaque, externally controlled, or designed without meaningful participation by farmers, workers, consumers and rural communities. Gender equality should be treated as a cross-cutting issue throughout the note. At present, gender appears mainly in relation to connectivity gaps. This could be expanded to cover access and meaningful use, data representation, algorithmic bias and design, and impacts on agency, labour and intra-household decision-making. Women remain less likely than men to use mobile internet in low- and middle-income countries, and digital gender gaps also translate into data gaps and algorithmic bias. As a result, advisory tools, credit- scoring systems and other AI applications may be calibrated to the realities of male, larger or more mechanized farms, unless deliberate corrective measures are taken. Finally, the impact of AI on the labour market/force in the agrifood sector could be better developed. Automation and digitalization may also reshape

	agricultural and food-system labour in gendered ways. Technologies that improve safety, reduce drudgery or facilitate access to information may benefit women and workers, but only if their needs are considered in design, financing and adoption processes.
Are there any other key issues that should be added and elaborated? If yes, please provide a justification of why they are important, together with relevant literature and data.	Three areas could be further elaborated. • Digital inclusion beyond access. The note appropriately recognizes digital divides. However, digital inclusion involves more than access to infrastructure and connectivity. Barriers also include affordability, skills, language, literacy, social norms, trust, identity documentation and the capacity to convert access into meaningful economic and social benefits. The note could therefore distinguish between access, meaningful use and equitable distribution of benefits (FAO, 2024). • Rural institutions and collective action. The role of cooperatives, producer organizations, community-based organizations, rural advisory systems and rural financial institutions deserves greater attention. Inclusive and accountable institutions can improve smallholders' access to markets, finance, technologies, information and public services, while also helping address asymmetries in bargaining power and information (IFAD, 2018; UNIDROIT, FAO and IFAD, Draft CLSAE Guide, 2026). • Data governance beyond privacy and ownership. Beyond privacy, ownership and sovereignty, the note could further explore interoperability, public-interest data sharing, farmer-centred and community-based data governance, accountability of digital platforms, concentration of data and digital market power, transparency in algorithmic decision-making, grievance mechanisms and safeguards against exclusion. These issues are increasingly important as data becomes a strategic asset in agrifood systems. • Furthermore, under the section 2.3 – Precision farming, the paper mentions that the limited adoption of precision farming technology is largely due to low digital literacy, lack of infrastructure and concerns about effectiveness in real-farming conditions. It could also be important to discuss the costs-benefits and economy of scale of such technologies. In high-

	income countries and large commercial farming systems, the costs of digital innovations can be better absorbed than in LMICs and smaller farming systems. In the section 4- Way forward, the need of accountability, interoperability, equity and transparency in establishing national, regional and/or global data governance framework or data spaces could be further developed.
Are the issues identified fully capturing the links with food security and nutrition (FSN) outcomes?	The note captures many important pathways linking AI and digitalization to FSN outcomes, particularly through productivity, climate resilience, food safety and nutrition information. However, the links with FSN outcomes could be made more explicit and systematic. AI and digitalization affect FSN not only through production, but also through access to finance, agricultural insurance, market participation, logistics, social protection, income stability, bargaining power, agency and resilience. The note could therefore structure the analysis more explicitly around the six dimensions of FSN: availability, access, utilization, stability, agency and sustainability. • Availability: AI and digitalization can support production through advisory services, pest and disease monitoring, climate-smart practices, improved input use and better information for decision-making. • Access: Digital finance, mobile payments, digital savings, insurance, market information, logistics platforms and social protection systems can improve access to food, income opportunities and services. • Utilization: Digital tools can support food safety, nutrition information, traceability and targeted advisory services. Gender-responsive and local-language tools may also help overcome literacy and mobility barriers. • Stability: Early warning systems, climate-risk monitoring, anticipatory action, agricultural insurance and digital public infrastructure can support resilience to shocks, but only if they reach those most exposed to risk. • The distributional dimension should be more prominent. Rural populations and marginalized groups may have the most to gain from digitalization, but they are also among those most at risk of being left behind

	due to digital divides, weak institutions and lack of effective alternatives (FAO, 2024). • Sustainability: Digital tools can support resource management and monitoring, but their environmental, social and institutional impacts should also be assessed. The distributional dimension should be more prominent. Rural populations and marginalized groups may have the most to gain from digitalization, but they are also among those most at risk of being left behind due to digital divides, weak institutions and lack of effective offline alternatives.
Is there any aspect of direct or indirect FSN outcome that should be further elaborated?	Several indirect FSN pathways deserve further elaboration. • Digital financial inclusion. Digital payments, mobile money, digital credit, digital savings and agricultural insurance can strengthen resilience, facilitate productive investment and improve market participation. At the same time, they raise risks related to opaque credit scoring, over-indebtedness, exclusion of offline populations, misuse of personal data and insufficient consumer protection. • Digital financial inclusion. Digital payments, mobile money, digital credit, savings products and agricultural insurance can strengthen resilience, support productive investment and improve market participation. However, they also raise risks related to opaque credit scoring, over-indebtedness, exclusion of offline populations, misuse of personal data and insufficient consumer protection (IFAD, 2015; CGAP, 2022). • Agency and participation. The note could further consider whether individuals and communities are able to participate in decisions affecting data collection, technology design and service delivery. Agency is increasingly recognized as an important dimension of FSN. • Gender-disaggregated effects. The same tool can affect different people in different ways. If digital advisory systems are layered onto extension systems that already underserve women, they may widen rather than close existing gaps. Conversely, well-designed voice-based, local-language and community-supported tools may expand women's access to information and services (FAO, 2019; World Bank Gender Innovation Lab).

	• Labour and intra-household effects. Automation and digitalization may reshape agricultural and food-system labour in gendered ways. Technologies that improve safety, reduce drudgery or facilitate access to information may benefit women and workers, but only if their needs are considered in design, financing and adoption processes.
Is there any example or case study that would deserves to be mentioned?	The list of examples does not include examples of early warning systems making use of AI for food security and disaster impact reduction. Perhaps, some related examples could be added. • FAO Data Lab in collaboration with the Office for Emergencies and Resilience (OER) developed LUMINA, a multi-scale relational geospatial database that integrates environmental, socioeconomic, and human security indicators with food security and nutrition survey data on child anthropometry and household-level characteristics to estimate the prevalence of acute child malnutrition in South Sudan. The approach supports earlier, more targeted, and more cost-effective action by providing decision-makers with localized, evidence-based insights. The interactive application is accessible online. • FAO Data Lab developed a country-level system piloted in two countries that combines satellite imagery, agricultural statistics, and AI-based modelling to estimate loss and damage in agriculture. The system translates earth observation and local data into subnational estimates of crop and economic losses caused by droughts, floods, and other climate-related shocks. It is a practical case study of how AI can strengthen food security and nutrition by generating timely, policy-relevant evidence for disaster response, resilience planning, and targeted support to vulnerable farming communities. Several other examples and case studies could help illustrate both the opportunities and governance challenges associated with AI, digitalization and data governance in agrifood systems.

	• FAO-EBRD Smart Milk Platform, Kazakhstan. The Smart Milk Platform demonstrates how digital platforms can improve traceability, information sharing, food safety compliance and value-chain coordination among dairy farmers, processors and service providers. It also illustrates the importance of governance arrangements for data sharing and platform management (FAO-EBRD Smart Milk portal; UNIDROIT, FAO and IFAD, Draft CLSAE Guide, 2026). • Digital Green and Farmer.Chat. Digital Green's video-enabled extension model and the AI-powered Farmer.Chat platform show how digital advisory services can improve farmers' access to knowledge, climate-smart practices and decision-support tools. They also show the value of combining digital tools with local facilitators and community engagement (Digital Green Farmer.Chat; FAO STI Portal). • Buy from Women platform, Rwanda. The Buy from Women initiative illustrates how digital technologies can support women farmers' access to markets, extension services, financial services and information, when combined with targeted and gender-responsive support (Buy from Women; AU Digital Agriculture Strategy). • China's rural e-commerce and digital agriculture ecosystem. China's rural e-commerce programmes, supported by digital marketplaces, logistics systems, digital payments and agricultural data platforms, illustrate how digitalization can connect smallholders to markets and support rural livelihoods. They also point to the importance of data governance, platform accountability and digital inclusion (FAO, 2024; UNDP China).
Do you have examples of effective policies to improve FSN outcomes of the use of Artificial Intelligence, digitalization and data governance in food systems?	On data governance and the issues of privately held data, perhaps the EU data act could be cited as an example. It enables public sector bodies to access and use data held by the private sector for specific public interest purposes (e.g. public health emergencies, emergencies resulting from natural disasters including those aggravated by climate change and environmental degradation, as well as human-induced major disasters, such as major cybersecurity incidents, the production of official

statistics, the mitigation of or recovery from a public emergency). See: https://eur-lex.europa.eu/eli/reg/2023/2854

Several policy experiences demonstrate how governance, regulation and public investment can enhance the contribution of AI, digitalization and data governance to FSN outcomes.

- Kenya's mobile money and digital finance ecosystem. Kenya's experience shows how enabling regulation, digital infrastructure and agent networks can expand access to payments, savings and financial services for rural populations. Studies have linked these developments to improved resilience, reduced vulnerability to shocks and greater inclusion of previously unbanked households, while recent reforms underline the importance of consumer protection and oversight of digital lending (IFAD, 2015; Mugume, 2021).
- Uganda's digital financial inclusion policies. Uganda provides a useful example of how mobile money regulation, digital identification systems, financial literacy and consumer protection measures can support financial inclusion. Effective outcomes depend not only on technology adoption, but also on regulation, consumer protection, financial literacy and cross-sectoral coordination (FSD Uganda, 2020).
- Rwanda's digital agriculture and women's inclusion initiatives. Rwanda's experience, including Buy from Women, illustrates how gender-responsive digitalization policies can improve participation in agricultural value chains when digital innovation is combined with targeted capacity development, access to services and inclusion measures (Buy from Women; AU Digital Agriculture Strategy).
- FAO's digital inclusion approach. FAO's work on digital inclusion in rural transformation suggests that successful policies go beyond expanding connectivity. Effective approaches combine investments in digital infrastructure with digital literacy, affordability measures, locally relevant services and continued offline alternatives (FAO, 2024).
- Legal and institutional frameworks for digital platforms and data use. Emerging work by FAO, IFAD and UNIDROIT suggests that legal and institutional

	frameworks governing digital platforms, data use and market participation are increasingly important. Such frameworks can help address power asymmetries, support trusted intermediaries, facilitate dispute resolution and promote equitable participation of smallholders, cooperatives and agri-MSMEs in digital ecosystems. Across these examples, effective policies are those that combine digital innovation with inclusion, safeguards and public-interest governance. Policies should address affordability, digital literacy, local-language services, gender-responsive design, accessibility, consumer protection, accountability of platforms, continued offline alternatives and participation of rural actors in decisions on data and technology design.
Is there any missing reference to key literature and data?	The note could consider the following references: • Dalberg. Study on Data Sovereignty: Understanding the Landscape, Challenges, and Opportunities. November 2022. https://dalberg.com/wp-content/uploads/2022/11/Study_Data_Sovereignty.pdf. • Luis Silva Da Silva, Hamed Sabzchi Dehkharghani, Brahima Diarra, et. al, 2026, AI-Augmented spatio-temporal modeling of acute malnutrition risks embedded in livelihoods systems: lessons from South Sudan. Paper to be presented at the Tenth International Conference on Agriculture Statistics in Krakow, 8-10 July 2026. • Parth Khare, et. Al, 2026. Advancing Subnational Agricultural Disaster Risk Assessment: Scalable Earth Observation Driven Framework for Vietnam. Paper to be presented at the Tenth International Conference on Agriculture Statistics in Krakow, 8-10 July 2026. • FAO. 2024. Towards Digital Inclusion in Rural Transformation. • FAO. 2023. The Status of Women in Agrifood Systems. Rome. • FAO. 2019. Building Connections: Digital Solutions for Rural Women.

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- UN Women. 2024. Artificial Intelligence and Gender Equality.
- CGAP. 2022. Consumer Protection in Digital Financial Services. Washington, DC.
- CGAP. 2024. Responsible Digital Finance Ecosystems. Washington, DC.
- African Union Commission. 2023. Digital Agriculture Strategy and Action Plan 2024-2033.
- World Bank. 2025. Digital Progress and Trends Report: Strengthening AI Foundations.
- World Bank Gender Innovation Lab. Ethiopia Gender Diagnostic.
- Mugume, A. 2021. Post-COVID-19 Recovery for African Economies: The Role of Digital Financial Inclusion. African Development Bank / African Economic Research Consortium.
- FSD Uganda. 2020. Strengthening Uganda's Consumer Protection Framework for Digital Financial Services.
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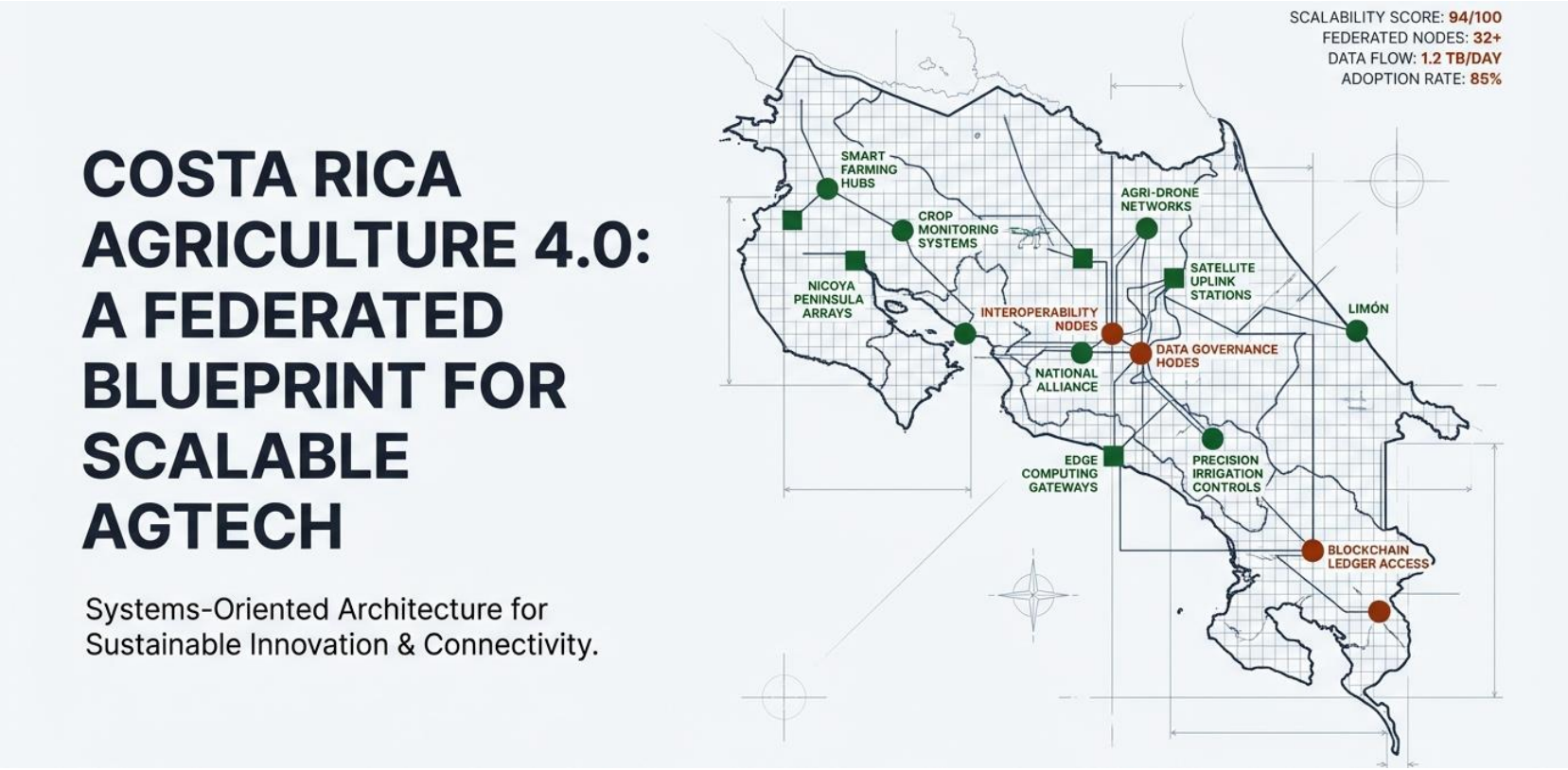
Annex A: Ministerio de Agricultura y Ganadería, Costa Rica

MINISTERIO DE AGRICULTURA Y GANADERÍA | GOBIERNO DE COSTA RICA

Unlocking frontier tech adoption for sustainable agriculture: Ministry of Agriculture and Livestock perspective



R. Azofeifa R.
Agromatics Unit, Agricultural Extension Programme
10–12/March/2026
San Jose, Costa Rica

Tierra Blanca, Cartago province

Tierra Blanca is located between 2100 and 2200 m.a.s.l. It is an agricultural community where farming is highly intensive, with a strong dependence on agrochemicals and practices that have led to soil degradation.

Its soil is of volcanic origin, acidic, with a pH between 4 and 5.5, which affects the efficiency of fertilizers.

Most producers are small and medium-sized; 80% rent their land, which is a barrier that limits investments in sustainability and soil conservation.

They produce 80% of the onions, 65% of the potatoes, and 55% of the carrots consumed nationally (statistics reported by the Tierra Blanca Agricultural Extension Agency, 2019).

There is a strong commercial pressure from agrochemical companies.

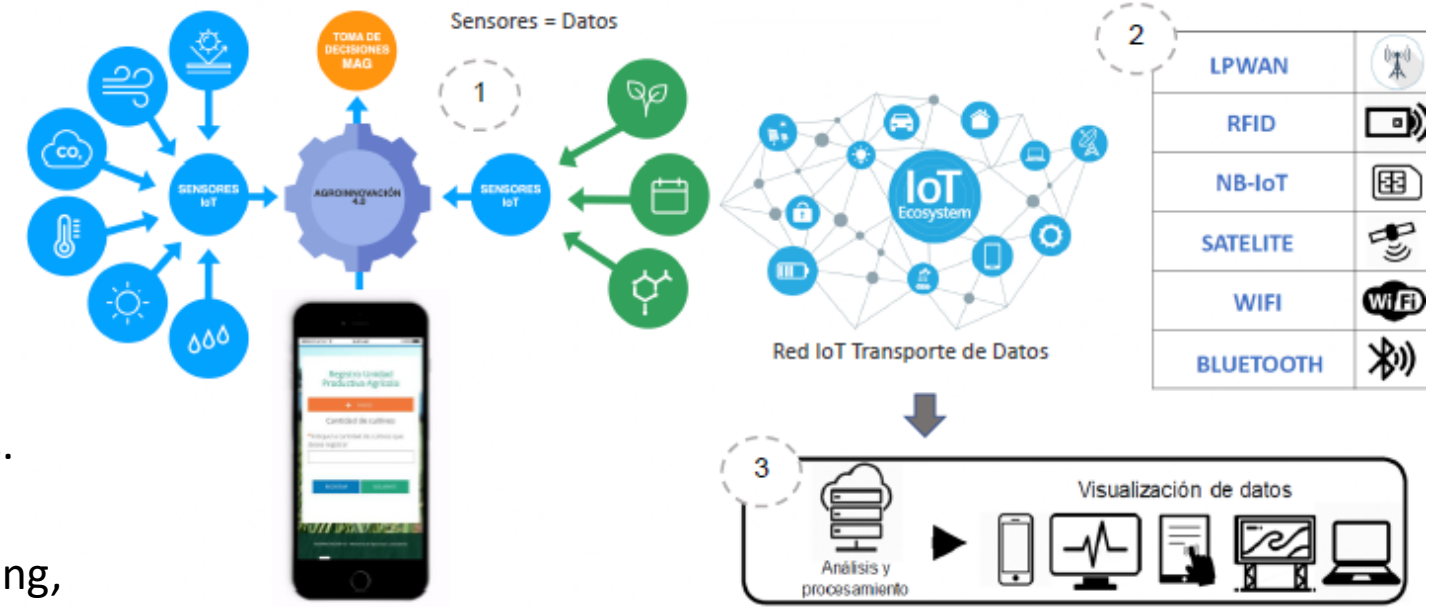
Agriculture 4.0 Innovation Ecosystem: pioneer experience

This pionner experience consisted in the development of an innovation ecosystem on Agriculture 4.0 in Costa Rica, aimed at strengthening precision agriculture, technological innovation, and sustainable production.

It is based on the generation, transmission, and processing of data from sensors installed in the field. The system utilizes:

- Soil, climate, and plant nutrition sensors
- IoT network for data transmisión
- Digital infrastructure for data storage and analysis.

Main objective: To improve agronomic decision-making, enphazacing irrigation, nutrient management, and climate monitoring.



System implementation

Station Types

Station A – Smart
- Intelligent Prediction
- Evapotranspiration (ETo) Calculation
- Nutritional Monitoring (NO3 and K+)
- Soil and Plant Sensors

Station B – Meteorological
- Monitoring of Climate Variables

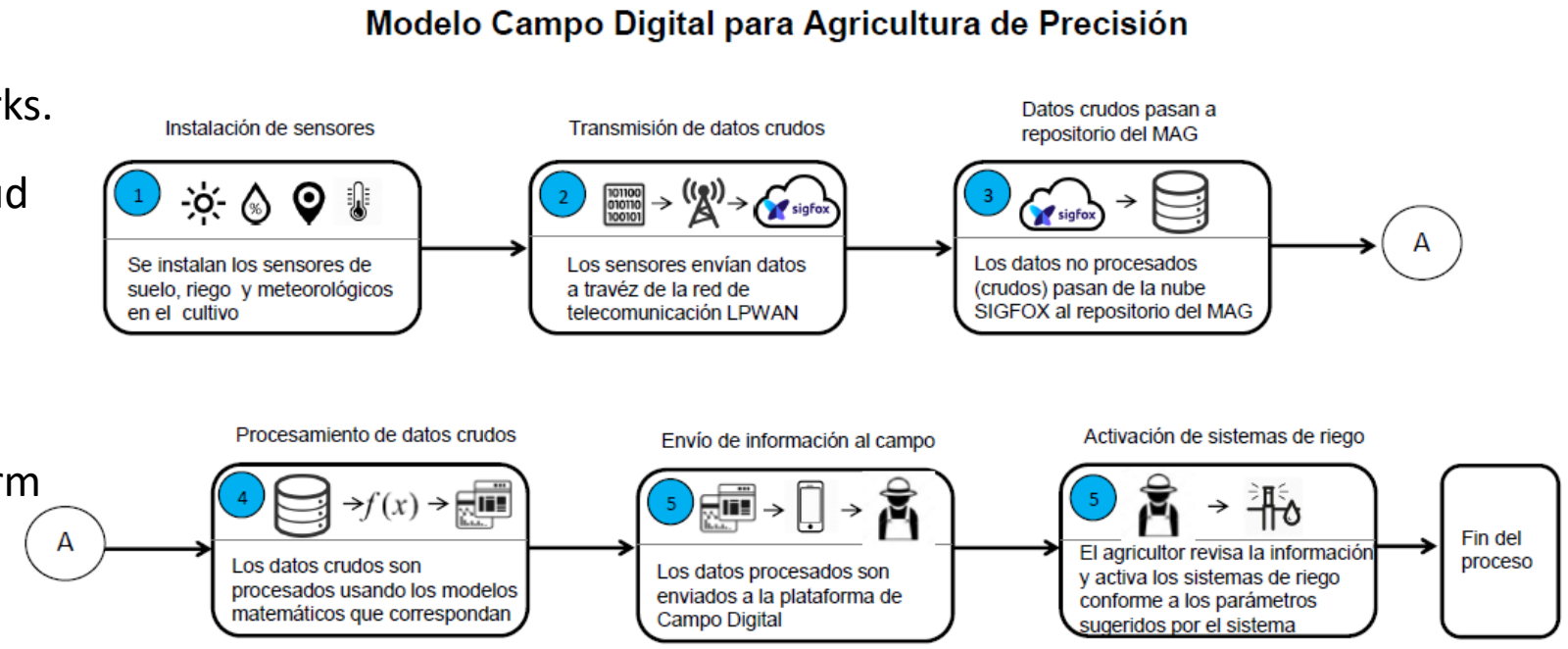
Station C – Water Management
- ETo for Water Resource Management

Station D – Controlled Environments
- Irrigation Management by Vapor Pressure Deficit (VPD).

Digital model functioning

Data Flow System

1. Installation of sensors in the crop (soil, climate, and irrigation).
2. The sensors send data via LPWAN networks.
3. The raw data is transmitted from the cloud to institutional repositories.
4. It is processed using precision agriculture mathematical models.
5. The information is sent to a digital platform (“Digital Field”).
6. Farmer receives recommendations and adjusts irrigation or agronomic management.



Expected Result

Data transformatiom into more precise, aplicable and efficient agronomic decisions.

Results and main challenges

Results

• Development of a technological ecosystem for digital agriculture.

• Generation of climate and agronomic data for precision agriculture.

• Analysis platform to support irrigation and crop nutrition management.

Maing challenges

• Resolving data access and connectivity licensing issues for farmers and technicians.

• Strengthening the practical use of information by producers.

• Ensuring institutional sustainability and maintenance of the technological infrastructure.

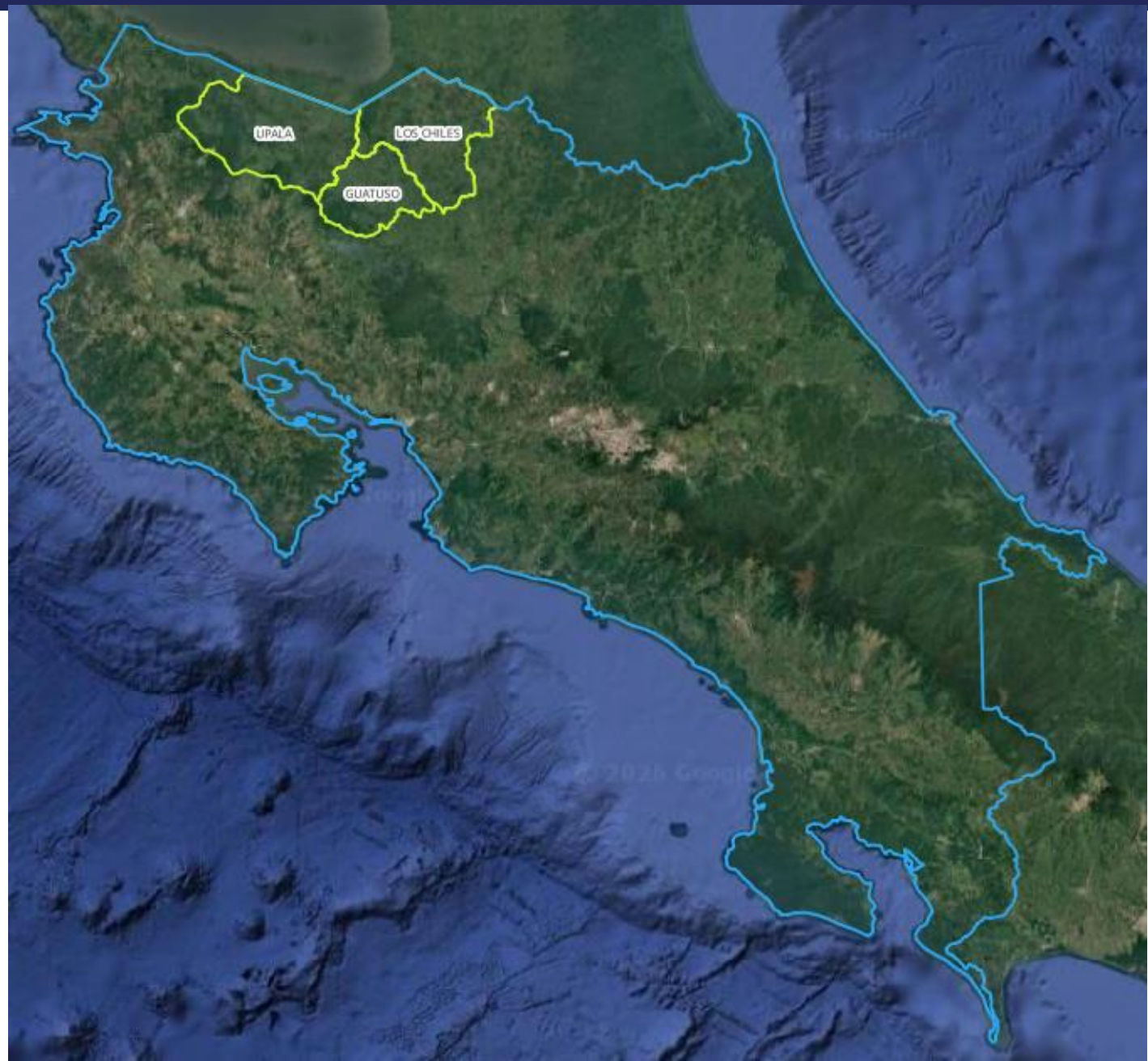
Advances and Initiatives in North Zone

The Northern Zone of Costa Rica is also a pioneer area in the advancement toward digital agriculture

- A first pilot project was carried out in the canton of Guatuso followed by an in course experience in the other two cantons which conform the so called North-North area (Guatuso, Los Chiles y Upala).

- The region is characterized by a strong agricultural tradition, with small-scale producers cultivating cacao, roots, and tubers; pineapple is one of the main economic drivers of the area.

- It has a productive potential supported by innovation initiatives, technical training, and inter-institutional collaboration aimed at strengthening producers' capacities and promoting sustainable value chains.



Advances and Initiatives in North Zone

Digital Agriculture in Guatuso: first experience

The project involved the implementation of a pilot system for digital agriculture and agroclimatic information in Guatuso, led by the FAO in collaboration with the Ministry of Agriculture and Livestock, the National Institute for Rural Development, and other local organizations.

Its main objective was to introduce digital technologies—such as weather stations, soil sensors, remote sensing, and drones—to improve production decision-making and strengthen the resilience of family farming systems.

Main results are savings in inputs, reduced production uncertainty, the practical incorporation of digital agriculture tools, the generation of key information on pasture health—essential for most participating families—and the strengthening of public-private partnerships that facilitated implementation.

Organización de las Naciones Unidas para la Alimentación y la Agricultura

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Advances and Initiatives in North Zone

Scaling up Agroinnovation 4.0 Program to the three cantons in the North-North Territory (Guatuso, Upala and Los Chiles) of Costa Rica

The project aims to transform the region's production system through digital agriculture, strengthening technical capacities, environmental sustainability, and creating new economic opportunities for rural producers.

1. Creation of a local knowledge network for digital agriculture: Integrating technical staff from the Ministry of Agriculture and Livestock (MAG), producers, and private sector stakeholders.

2. Strengthening technical assistance through a "Smart" network: Using digital technologies (sensors, agroclimatic data, remote sensing) to facilitate more accurate diagnoses and provide personalized recommendations to producers.

3. More profitable and technologically empowered producers: Through access to digital tools, production traceability, and knowledge adapted to their specific conditions.

4. Environmental improvements and soil regeneration: Through regenerative practices that improve fertility, reduce environmental impacts, and contribute to more sustainable production systems.

5. Access to new sources of financing and carbon markets based on verifiable and traceable metrics.

Agri-innovation 4.0:
Precision Agriculture and Technological Innovation

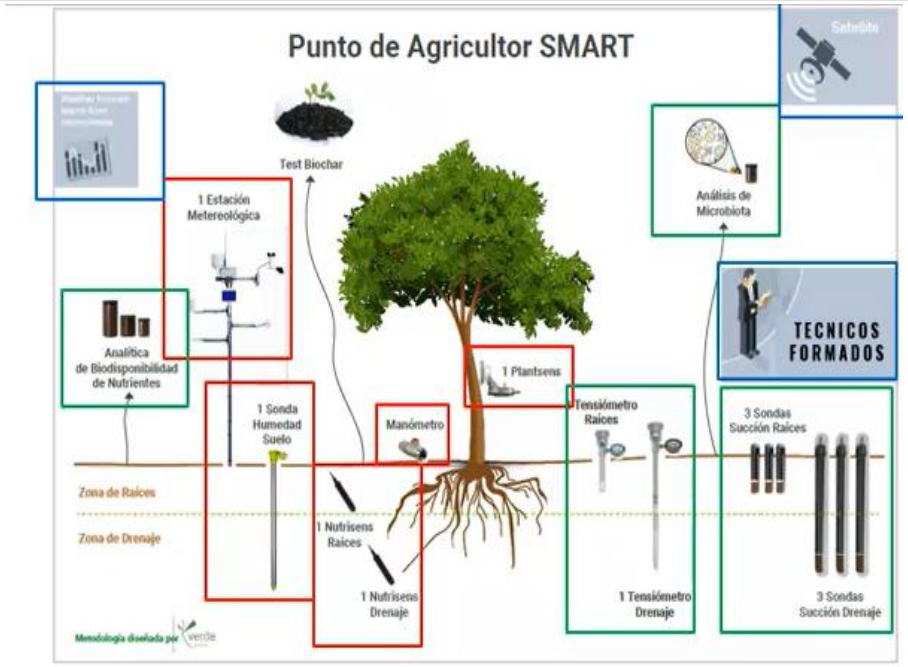
The project, entitled Agri-innovation 4.0: Promoting Precision Agriculture and Technological Innovation in Costa Rica, is currently underway.

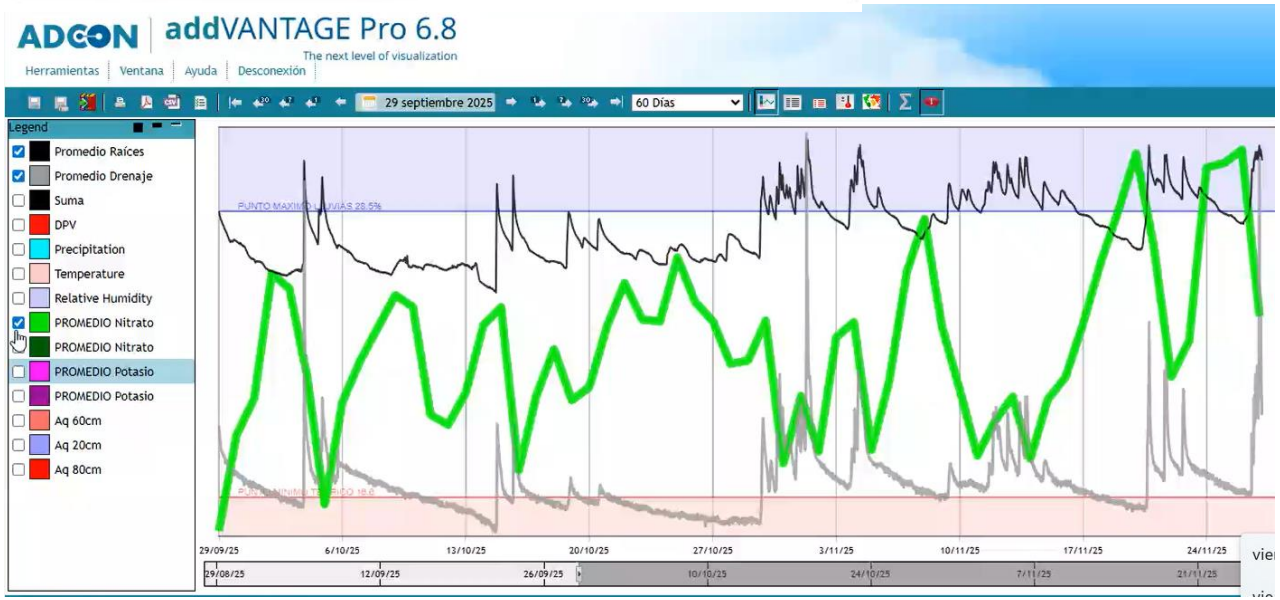
Its objective is to promote environmentally sustainable agri-food production using precision agriculture tools, information, research, and technology transfer.

It is being carried out with financial support from the Spanish Agency for International Development Cooperation (AECID).

It involves the use of digital agriculture tools to support informed decision-making for the efficient management of agriculture, both in perennial crops (coffee) and annual crops (vegetables and pineapple).

Agri-innovation 4.0:
Precision Agriculture and Technological Innovation





Outpus.

Precision Agriculture. Implementing advanced precision agriculture practices optimizes the use of water, soil, and agricultural inputs, increasing productivity and strengthening the sustainability of production systems.

Knowledge Transfer Training and technical assistance processes consolidate the capacities of producers and extension personnel, enhancing their skills through specialized support and international academic cooperation.

Technological Platform. The incorporation of agrometeorological stations, sensors, and remote sensing technologies—including drones—facilitates production management through precise data, specialized analysis, and regular agroclimatic reports.

Institutional Sustainability. The resources allocated to the maintenance, ongoing training, and operation of the system are ensured through its integration into the institutional budget and structure of the Ministry of Agriculture and Livestock.

Other advances and initiatives

Other relevant developments that promote the use of cutting-edge technologies include

Executive Decree 45310, which establishes the technical regulations for the ground application of agrochemicals, including the use of agricultural drones.

Strengthening the technical capacities of producers in drone operation.

This includes providing equipment as well as theoretical and practical training. This represent a significant investment from public funds.

Other advances and initiatives

In the field of research and technology transfer carried out by the National Institute of Agricultural Innovation and Technology Transfer (INTA):

Promotes digital agriculture through research and validation of technologies to improve agricultural productivity and sustainability.Integrates digital tools for production management, agroclimatic monitoring, and the efficient use of resources in different production systems.

Transfers digital knowledge and technologies to producers and technicians through training, field days, and knowledge management platforms.

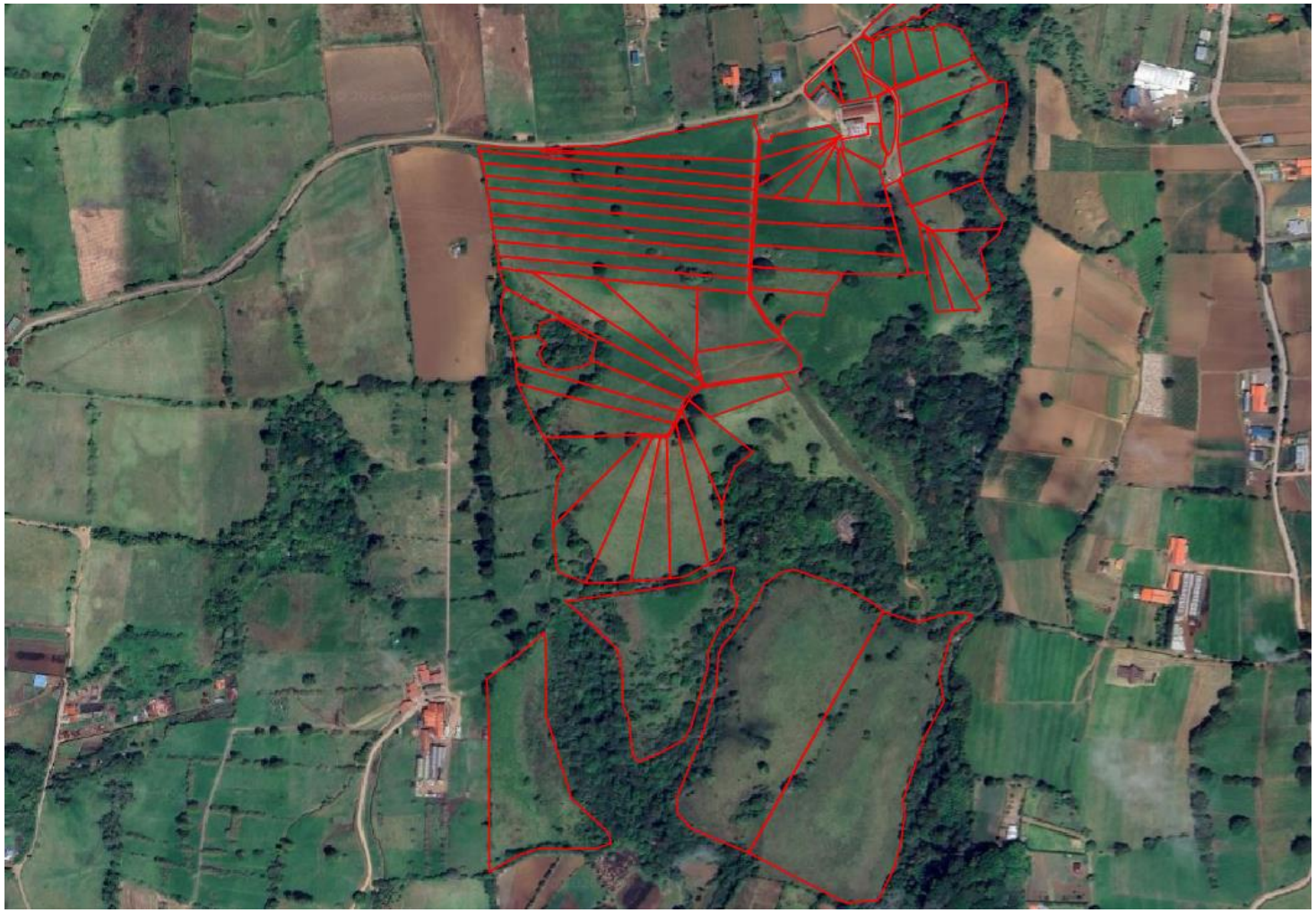
Participates in projects and partnerships that promote climate-smart agriculture, the use of sensors, and replicable models for the digitalization of Costa Rican agriculture.

Other advances and initiatives

Starting in 2025, the Agromatics Unit will promote public-private and public-public partnerships:

to combine resources and advance digitalization in sustainable agricultural production.

promote capacity building in the use of geographic information systems (GIS) as tools for land-use planning and other relevant applications for monitoring land cover on farms



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¡Thanks!