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CALL FOR SUBMISSIONS:

From Foresight to Field: Exploring regional and multistakeholder perspectives to implement a foresight on emerging technologies and innovations in agrifood systems

Harvesting change: Harnessing emerging technologies and innovations for agrifood system transformation

Global foresight synthesis report

In 2023, FAO published the report “Harvesting change: Harnessing emerging technologies and innovations for agrifood system transformation”. The report explores the critical role of technology and innovation in transforming agrifood systems to address future challenges in the attempt to shorten the time lag between research and investment innovation phases and the uptake of technology and innovation, thus creating preparedness an ensuring inclusive, resilient, and sustainable agrifood systems transformation.

Challenges and Opportunities
The agrifood sector faces a complex web of interconnected challenges, often referred to as a "polycrisis." These challenges include climate change, resource scarcity, and social inequalities. However, emerging technologies and innovations offer solutions to overcome these hurdles and create more resilient, sustainable, and inclusive agrifood systems.

1 The full list of challenges includes: (i) population and development dynamics, food and nutrition security, sustainable diets; (ii) climate changes and disaster risks; (ii) erosion of natural resource base, water scarcity, loss of biodiversity; (iv) food loss and waste; (v) energy demand in agrifood systems; (vi) inclusion of the most vulnerable; (vii) transboundary and emerging agrifood systems threats; (viii) national and international governance.
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Foresight Approach
This study utilizes a foresight approach, a method for navigating uncertain situations for longterm planning. It identifies 20 promising technologies and innovations with the potential to address multiple agrifood challenges. These are:

- Nature-based and ecosystem innovations
- Artificial general intelligence in agriculture
- Agricultural innovation policy labs
- Energy storage technologies
- Social impact bonds
- Real-time satellite imagery, positioning systems and autonomous GIS
- 6-10G connectivity in agrifood systems
- Environmental biotechnologies
- Synthetic biology
- Ensuring access to science-based information on sustainability matters
- Internet of food
- Frugal innovation
- Digital twins
- Quantum internet and computing applied to agrifood systems
- Aerial robotics and drones
- New methods for controlling gene expression
- Global logistics network
- Territorial or landscape value-chain and food-to-consumer economy policies
- Carbon credits in agriculture and aquaculture
- Nanomaterials for water technologies.

Foresighting the emergence of technologies and innovation in agrifood systems: A look at five global scenarios
The report explores five potential future scenarios for agrifood systems’ technologies and innovations in 2050 and beyond. These five global scenarios offer a glimpse into the potential futures of agrifood systems depending on the emergence of technologies and innovations and their enabling environment. By understanding these possibilities, stakeholders can make informed decisions about the development and use of technologies and innovations to create a more sustainable and equitable agrifood systems.

Scenario A: Struggling Between Technological Illusions and Sustainability
This scenario depicts a world where technological advancements occur, but fail to fully address sustainability concerns. Public policy engagement and effective monitoring systems are weak, hindering progress. Research focuses on farm productivity with limited attention to broader challenges. Wealthy farmers benefit most from new technologies, while smaller players struggle. There’s a sense of disillusionment as technology doesn’t deliver on its promises.

Scenario B: Mess and Muddle in Technologies and Innovations
Profitability for investors becomes the primary driver of innovation in this scenario. Technologies cater to high-value chains, leaving vulnerable farmers behind. Research agendas are disconnected from development needs. Banks offer easy access to financing for technologies that may not be sustainable in the long run. Large companies dominate, stifling innovation from smaller players. Regulation is weak, leading to ethical and societal concerns. Knowledge becomes intellectual property, limiting accessibility. This scenario fosters misinformation and a lock-in to technologies controlled by private interests.

Scenario C: Sustainable Prosperity of Technologies and Innovation
This optimistic scenario envisions a future where technology development prioritizes sustainability, inclusivity, and responsible innovation. Governance is participatory, with strong public-private-user partnerships. Research aligns with development challenges, supported by innovative funding mechanisms. All stakeholders collaborate in designing and implementing sustainable technologies. Monitoring systems ensure solutions address social, economic, and environmental aspects. Access to knowledge and innovation is open and inclusive, empowering actors with the necessary skills.

Scenario D: AI in Charge of Agrifood Systems and Beyond
This scenario explores a future dominated by artificial intelligence (AI) managing most aspects of agrifood systems. AI systems make key decisions on production models, resource allocation, and research priorities. While efficiency improves in areas like food waste and transportation, concerns arise regarding diversity, inclusion, and equity. AI models, potentially biased towards situations in developed countries, may not address the needs of remote areas or alternative farming models. Human
access to knowledge and decision-making is restricted, potentially leading to cyber threats and concerns about AI governance.

**Scenario E: Technologies and Innovations – Our Best Last Chance**

This scenario depicts a world facing rapid climate change and societal disruptions. Non-state actors, including the private sector and civil society organizations, take charge in the absence of effective government policies. Research focuses on developing immediate solutions to critical challenges. Public and private funds support a multitude of potentially risky innovations, prioritized for speed over traditional research protocols. While access to knowledge and innovation is excellent, solutions may come at the expense of ethical considerations and long-term sustainability. However, with few alternatives, societal consensus prioritizes these technologies as humanity's last chance for survival.

**Key Findings**

- **Place, pace, and impact:** No single technology can address all challenges in all locations or at the same pace. A combination of solutions, tailored to specific locations (place) and development timelines (pace), is necessary. This includes traditional knowledge where appropriate.

- **Focus on impactful triffecta:** Technologies and innovations should be prioritized based on their potential impact on specific challenges, considering their suitability for a particular location (place) and timeframe (pace). We need the three Rs: Right impact, in the Right time, on the Right place to realize the innovation potential.

- **Policy, nature, and data:** Policy changes, nature-based solutions, and data-driven technologies are perceived as having the most significant impact and fastest adoption rates in many contexts.

- **Incremental vs. Disruptive:** While most advancements are expected to be refinements of existing technologies, disruptive innovations can have a rapid transformative effect. However, they may require longer time for the innovation to mature (be fully used) and raise more uncertainties.

- **New trends** are emerging in agrifood technologies and innovation as a blend of democratization (access to all), sustainability and efficiency.

- **Investment gap:** There's a potential imbalance between investment in emerging technologies and their perceived impact. Currently, some digital technologies (robots, drones) and bio-improvements are benefiting from increased investors’ interest, while innovations with higher perceived impact to address agrifood systems’ challenges receive less attention. There’s a critical need for greater focus on policy solutions, social and market innovations and geospatial technologies, and to address complex challenges.

- **Venture capital:** While venture capital plays a crucial role in funding innovations, a collaborative approach with public funding can ensure a focus on both immediate and future challenges and ensure balanced investments for impact.

**Recommendations**

The report concludes with recommendations for strategic planning, including:

- **Alignment:** Research and innovation agendas should be aligned with societal needs, considering the specific challenges and contexts (place) of different regions.
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- **Capacity development**: Strengthening technical and functional capacities of stakeholders is crucial to manage the increasing complexity of agrifood systems, taking into account the varying needs and development stages of different locations (place).

- **Democratization of technologies and innovations**: All stakeholders, including vulnerable groups, should have the opportunity to have a say in generating and use of technologies and innovations. This includes capacity development, education, and fostering inclusive governance structures.

- **Contextualization**: Technologies should be adapted to local contexts and challenges (place), moving beyond traditional technology transfer models. This requires considering the specific needs and development timelines (pace) of different regions.

- **Monitoring and evaluation**: Continuously monitoring and evaluating technologies and innovations allows for adjustments based on their performance, impact, and suitability for a particular location (place) and development stage (pace). Direct feedback mechanisms with the end-users have to be ensured.

- **Co-creation**: Collaborative innovation through co-creation is essential for scaling solutions and ensuring inclusivity across different locations (place).

- **Global South collaboration**: Enhanced international collaboration can facilitate the transfer of existing technologies and innovations to developing countries, considering their specific contexts (place) and development timelines (pace).

- **Conducive environment**: Innovative policy incentives, research programme adjustments, and efficient governance structures are needed to foster innovation and accelerate the development and scaling of solutions tailored to specific locations (place) and development contexts (pace).

**Conclusion**

By harnessing the potential of emerging technologies and innovations, with a focus on place, pace, and impact, we can transform agrifood systems to be more resilient, sustainable, and inclusive, ensuring a secure and healthy food future for all.

Emerging technologies and innovations may take various paths, requiring diverse stakeholder involvement and partnerships. Technology transfer remains an important innovation pathway for disruptive innovations, but co-innovation processes will be crucial for incremental advancements. These iterative, participatory approaches are best suited for tackling nature-based innovations, policy labs, and undefined challenges that require iterative learning and consensus building and hence, they deserve targeted policies and investments.