International Telecommunication Union Telecommunication Standardization Sector

Digital Agriculture: A Standards Snapshot ITU/FAO Focus Group on Al and IoT for Digital Agriculture









Digital Agriculture: A Standards Snapshot

ITU/FAO Focus Group on AI and IoT for Digital Agriculture







Acknowledgements

This Report has been developed based on the outcomes of the ITU/FAO Focus Group on Artificial Intelligence (AI) and Internet of Things (IoT) for Digital Agriculture (FG-AI4A) with inputs from Dr Sebastian Bosse (FG-AI4A Co-Chair), Dr Ramy Fathy (FG-AI4A Co-Chair), the Focus Group Management team and Dr Zhongxin Chen (FAO).

Please contact Mythili Menon (ITU) in case you have questions related to FG-AI4A.

Additional information and material related to this Report are available at: <u>https://www.itu.int/en/ITU-T/focusgroups/ai4a/Pages/default.aspx</u>.

Legal notice

Third-party sources are quoted as appropriate. The International Telecommunication Union (ITU) is not responsible for the content found in external sources including external websites referenced in this publication.

Disclaimer

The views expressed in this publication are those of the authors and do not necessarily reflect the views of ITU. Any references made to specific countries, companies, products, initiatives or guidelines do not in any way imply that they are endorsed or recommended by ITU, the authors, in preference to others of similar nature that are not mentioned. Requests to reproduce extracts of this publication may be submitted to jur@itu.int. This document is intended for informational purposes only. Information provided is correct as of August 2024.

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of ITU concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

The mention of specific companies or certain manufacturer products does not imply that they are endorsed or recommended by ITU in preference to others of a similar nature that are not mentioned.

All reasonable precautions have been taken by ITU to verify the information contained in this publication. However, the published material is being distributed without warranty of any kind, either expressed or implied. The responsibility for the interpretation and use of the material lies with the reader.

The opinions, findings and conclusions expressed in this publication do not necessarily reflect the views of ITU or its membership.

ISBN

978-92-61-40141-2

© ITU FAO 2025. All rights reserved.

Table of contents

Foreword	- ITUviii		
Foreword	- FAOix		
Abbreviati	ons and Acronymsx		
Executive	Summaryxi		
Cultivating	Change: Towards Standards for Digital Agriculture1		
ITU/FAO F	ocus Group on AI and IoT for Digital Agriculture3		
Aland	d IoT Playbook for Digital Agriculture: Structure of FG-AI4A		
Demystifying Terminology4			
Uncovering Gaps: Standards in Digital Agriculture			
Navig	ating Ethics in Digital Agriculture5		
FG-AI	4A: Meetings and Events in Focus		
FG-AI	4A: Technologies in Focus		
Conclusior	n		
Appendix			
1	List of FG-AI4A Meetings and Overview of Meeting Participation11		
2	Complete List of FG-AI4A Related Workshops and Webinars		
3	FG-AI4A Exhibition and Field Demonstration14		

List of figures and tables

Figures

Figure 1: Working Groups of FG-AI4A	3
Figure 2: Overview of the FG-AI4A Outputs	4
Figure 3: Summary of standards associated with various technologies and themes in digital agriculture	5
Figure 4: Mr Ramy Fathy (FG-Al4A Co-Chair) presenting at the Workshop in Seongnam August 2022)	6
Figure 5: Mr Seizo Onoe (TSB Director) delivering the Keynote Address during the ITU/FAO Workshop in New Delhi (March 2024)	7
Figure 6: Inauguration of FG-AI4A Exhibition by Seizo Onoe (TSB Director) Mr Ajay Kumar Sahu (Additional Secretary (T) & Member (Services), Department of Telecommunications (DoT)) and Mr SK Chaudhari, Deputy Director General (NRM), Indian Council of Agricultural Research (ICAR)) in New Delhi India (March 2024)	7
Figure 7: Tour of the FG-AI4A Exhibition in New Delhi, India (March 2024)	7
Figure 8: Mr Zhongxin Chen, Senior IT Officer, FAO being honored for his contributions to the Workshop and FG-AI4A Meeting in New Delhi, India	
(March 2024)	8
Figure 9: Tour of the living labs of the Indian Agricultural Research Institute in New Delhi, India (March 2024)	8
Figure 10: Mr Sebastian Bosse (FG-AI4A Co-Chair) at the FG-AI4A Workshop in Utrecht (June 2024)	8
Figure 11: Networking Coffee in Utrecht (June 2024)	8
Figure 12: Snapshot of technologies in Use-case Report	9
Figure 13: Overview of Meeting Participation	12
Figure 14: Tour of the FG-Al4A Exhibition in New Delhi, India (March 2024)	14
Figure 15: Living Lab Field demonstration in New Delhi, India (March 2024)	14

Tables

Table 1: List of FG-AI4A Meetings	1	1
Table 2: List of FG-AI4A related events	1.	3



Foreword - ITU



Technological progress is the driving force for better health, longer life expectancies, and Earth's ability to sustain its growing population. With 9.7 billion people expected to share our planet by 2050, new technologies must continue helping farmers to produce more with less.

Innovations in areas like artificial intelligence (AI), the Internet of Things (IoT), drones, and robotics hold great promise to improve the precision and sustainability of farming techniques. Farmers can now make decisions at the level of a single square metre or individual plant or animal, creating key improvements to agricultural sustainability.

With the aim of creating global access to these "digital agriculture" innovations, ITU and FAO have laid groundwork for new international standards with our <u>Focus Group on AI and IoT for</u> Digital Agriculture.

This publication highlights the motivations for the group's work and provides context for its outcomes.

Open to all interested experts, the focus group concluded its work in June 2024 with the delivery of a standardization roadmap, terminology, analyses of agri-tech use cases, and guidance on ethics as well as data collection and modelling.

Our <u>standards roadmap</u> sets the course for future work and our <u>glossary</u> provides an essential foundation for continued research and standardization.

The latest agri-tech innovations are detailed by our <u>report</u> on tech use cases for optimizing farming practices, crop management, and resource use and sustainability, as well as our <u>report</u> on sensors, drones, and other smart tech to gather data for real-time analysis by AI algorithms. We have also outlined ethical, legal, and regulatory considerations for data privacy, transparency, and fairness in agricultural AI systems with our <u>report</u> predicated on the European Union's AI Act, the Rome Call for AI Ethics, and the UN Resolution on AI.

I thank and applaud the dedicated experts from around the world that contributed to our focus group for bringing life to these outcomes.

Recognizing the many challenges still to be overcome, ITU and FAO continue working together to build bridges between different areas of expertise and stimulate the collaboration required for digital agriculture to achieve global impact.

I welcome you to join us.

Seizo Once

Seizo Onoe Director, Telecommunication Standardization Bureau (TSB) International Telecommunication Union (ITU)



Foreword - FAO



The Food and Agriculture Organization of the United Nations (FAO) is committed to addressing the global challenges in agrifood systems, including food security, sustainable agriculture, and rural development. In collaboration with the International Telecommunication Union (ITU), the ITU/FAO Focus Group on AI and IoT for Digital Agriculture (FG-AI4A) was established to explore the potential of harnessing the power of emerging digital technologies and AI to transform agricultural practices and improve food systems worldwide.

The integration of Artificial Intelligence (AI) and the Internet of Things (IoT) in agriculture offers unprecedented opportunities

to enhance productivity, efficiency, and sustainability. By leveraging these technologies, we can develop innovative solutions to address the pressing issues of hunger, malnutrition, and environmental degradation. This report highlights the collaborative efforts of the ITU/FAO Focus Group on AI and IoT for Digital Agriculture (FG-AI4A), which has been instrumental in laying the groundwork for technical standardization and promoting the ethical use of technology in agriculture.

The FAO's extensive experience in digitalization and transformation of agrifood systems, combined with ITU's expertise in digital technologies and standardization, has created a unique synergy that ensures the development of practical and globally applicable standards. These standards will be designed to promote innovation, enhance data quality and integration, and ensure the ethical deployment of AI and IoT in agriculture.

As we move forward, the FAO remains dedicated to fostering collaboration among stakeholders, including policymakers, technology developers, and agricultural experts, to maximize the benefits of digital agriculture. By addressing the complexities and challenges inherent in this rapidly evolving field, we aim to create a more sustainable, productive, and resilient agricultural industry capable of addressing global challenges such as food security, resource management, and climate change.

We hope this report serves as a valuable resource for all stakeholders and contributes to the ongoing efforts to achieve United Nations Sustainable Development Goal 2: Zero Hunger.

Dejan Jakovljevic CIO and Director, Digital FAO and Agro-informatics Division Food and Agriculture Organization (FAO)



Abbreviations and Acronyms

AI	Artificial Intelligence
CRNS	Cosmic-Ray Neutron Sensing
DARE	Department of Agricultural Research and Education
DLT	Digital Ledger Technologies
DoT	Department of Telecommunications
FAO	Food and Agriculture Organization of the United Nations
FG	Focus Group
FG-AI4A	Focus Group on AI and IoT for Digital Agriculture
ICAR	Indian Council of Agricultural Research
IoT	Internet of Things
ISO	International Organization for Standardization
ITU	International Telecommunication Union
RRA	National Radio Research Agency
SDGs	Sustainable Development Goals
SDO	Standards Development Organizations
TEC	Telecommunication Engineering Centre
TG	Topic Group
UAV	Unmanned Aerial Vehicle
WG	Working Group
WMO	World Meteorological Organization

х

Executive Summary

The Digital Agriculture: A Standards Snapshot details the progress and milestones of the ITU/ FAO Focus Group on AI and IoT for Digital Agriculture (FG-AI4A), which was established in October 2021. The FG-AI4A was created as an open platform for discussing the integration of AI and IoT technologies in agriculture with the aim of laying the groundwork for technical standardization. FG-AI4A's key achievements include developing a comprehensive glossary of digital agriculture terminology, mapping the current landscape of standardization, formulating best practices and guidelines, and data modelling framework for digital agriculture.

FG-AI4A's work focussed on the ethical considerations surrounding AI and IoT in agriculture, with a particular emphasis on data privacy, and transparency. This was explored in the context of the European Union's AI Act, the <u>Rome Call for AI Ethics</u> and the United Nations Resolution on AI to encourage responsible innovation and ethical AI deployment in agricultural.

The Focus Group has organized several meetings, webinars and workshops, engaging over 300 experts across diverse fields.

The efforts of FG-AI4A mark a pivotal advancement in the standardization of AI and digital technologies in agriculture. By addressing standardization gaps, promoting for the ethical use of technology, and prioritizing data quality and integration, the group is charting a course for the future of digital agriculture. These efforts are geared towards enhancing agricultural production practices, overall productivity and efficiency while ensuring sustainability and resilience.

The collaboration between the ITU and FAO in standards-making brings together a blend of expertise that enhances the quality and relevance of outputs of FG-AI4A. ITU's institutional knowledge in standardization, telecommunications and digital technologies, coupled with FAO's extensive experience in digitalization and transformation of agri-food systems, creates a unique synergy that would make it possible to address both technical and sector-specific needs.

This partnership has ensured that the standards developed would not only be technologically sound but also practical and globally applicable, while leveraging the global influence of these organizations in achieving widespread adoption and implementation of these standards for digital agriculture. These standards are also envisioned to promote innovation, and contribute to global food security in line with Sustainable Development Goal 2.

Cultivating Change: Towards Standards for Digital Agriculture

The agricultural sector faces a series of multi-faceted challenges, encompassing environmental, economic, social, dimensions. Although there has been a global increase in overall food production, undernourishment affects between 713 and 757 million people (8.9 and 9.4 percent of the global population respectively) people faced hunger in 2023.¹ Furthermore, around 14 percent of the world's food (valued at \$400 billion annually) continues to be wasted.

Therefore, ensuring access to sufficient, safe, and nutritious food for all, while reducing food wastage remain major challenges, especially in view of a growing global population.

Emerging technologies are increasingly being used in agriculture, including smart greenhouses, livestock monitoring systems, agricultural robots, and precision farming. The automation of tasks to related to planting, sowing, tilling, feeding, and harvesting often rely on technologies like Artificial Intelligence (AI) and Internet of Things (IoT).

In order for these technologies to work in a complementary manner for a growing number of agrifood-ecosystems, interoperability driven by standardization is essential, allowing for seamless integration and enhancing agricultural production processes. Standardization within this domain would also help in facilitating scalability, enabling solutions to be adapted across different regions and types of farming, thereby accelerating the adoption of emerging technologies. Additionally, it would help maintain data security and privacy, fostering trust among users.

Standardization in digital agriculture promotes innovation and collaboration, providing a solid foundation for sustainable and profitable farming practices.

The International Telecommunication Union (ITU), the United Nations specialized agency for digital technologies has been at the forefront of technical standardization related to emerging technologies including AI across various verticals.² Furthermore, the Food and Agriculture Organization of the United Nations (FAO) in its role as the specialized agency of the United Nations for leading international efforts to defeat global hunger, helps countries to eliminate hunger, food insecurity and malnutrition.

Combining their expertise and to prevent duplication of efforts, ITU together with FAO created the Focus Group on Artificial Intelligence (AI) and Internet of Things (IoT) for Digital Agriculture (FG-AI4A) in October 2021, to lay the foundation for standardization and explore future prospects in the context of digital agriculture.

This Report will trace the journey of this Focus Group highlighting its key achievements, outcomes and meetings held.

¹ The State of Food Security and Nutrition in the World 2024.

² ITU serves as an international standards developing organization (SDO).

Accordingly, this report will:

- Underscore the foundational technologies utilized in digital agriculture play which can transform traditional agricultural practices into more efficient and data-driven processes.
- Highlight the importance of standardization for digital agriculture.
- Provide an overview of the key gaps in digital agriculture standardization.
- Emphasize on the importance of presenting a common understanding of agricultural terminology among stakeholders to ensure clarity in research and development.
- Draw attention to the relevance of ethical use of emerging technologies for agricultural purposes.
- Present the outputs developed by FG-AI4A and highlight the developments during landmark meetings.



ITU/FAO Focus Group on AI and IoT for Digital Agriculture

The <u>ITU/FAO Focus Group on AI and IoT for Digital Agriculture (FG-AI4A)</u> explored how emerging technologies could be leveraged for data collection and management, refine modeling techniques with the increasing amount of agricultural and geospatial data, and facilitate efficient communication for actions aimed at optimizing agricultural production practices.

The Focus Group also examined essential concepts and mapped the current standardization landscape for agriculture to underscore the existing gaps that need to be filled.

AI and IoT Playbook for Digital Agriculture: Structure of FG-AI4A

FG-AI4A organized its activities through six different Working Groups (WG) as shown in Figure 1. The Focus Group was chaired by Mr Ramy Ahmed Fathy (Egyptian National Telecom. Regulatory Authority (NTRA)) and Mr Sebastian Bosse (Fraunhofer HHI, Germany).



Figure 1: Working Groups of FG-AI4A

To effectively examine the diverse applications of emerging technologies in agriculture, Topic Groups (TGs) were formed to contribute insights to the efforts of the Working Groups. Figure 2 illustrates the outputs of the Focus Group on AI for Agriculture (FG-AI4A) and their interlinkages.

Figure 2: Overview of the FG-AI4A Outputs



Demystifying Terminology

Digital agriculture includes in its ambit a variety of specialized terms, concepts and technologies that may not be familiar to all participants in the standards-making process, including policymakers, private sector entities, academic experts, and others. A clear understanding of digital agriculture related terminologies is crucial for developing standards and guidelines, especially given the diverse range of stakeholders involved.

During the research for the development of this Glossary, the <u>FAO Terminology Portal</u> and <u>ITU-R/ITU-T Terms and Definitions database</u>. It has been observed that while looking at the intersection between agriculture and technology, there exists a notable interchangeability of terminology. Terms including "digital agriculture," "smart agriculture," and "smart farming" are frequently used synonymously. For the purpose of the Glossary, definitions related to these terms were included from various sources to ensure that all aspects related to them are adequately reflected.

Overall, the <u>Glossary</u> created by the Focus Group offers precise definitions, facilitating a shared understanding of digital agriculture related terms, providing a foundation for further research and supporting standardization in this field through interdisciplinary collaboration.

Uncovering Gaps: Standards in Digital Agriculture

As digital agriculture could facilitate the adoption of a wide range of technologies–including AI, IoT, digital twin, unmanned aerial vehicles, digital ledger technologies (DLT) and robotics, there is a pressing need for standardized guidelines to ensure interoperability, data compatibility, and security across different systems.

Without these standards, the lack of coherence can lead to fragmented solutions, where technology types could fail to communicate or integrate efficiently, undermining the overall effectiveness of digital tools in improving agricultural productivity and sustainability.

The FG-Al4A created a <u>Standards Roadmap</u> that consolidates existing international standards, highlighting the technologies and agricultural themes covered within these standards (See Figure 3).



Figure 3: Summary of standards associated with various technologies and themes in digital agriculture

Standards addressing the ethical use of AI and IoT technologies, data privacy, and environmental sustainability are essential to ensure that technological advancements contribute positively to the agricultural sector. To align with Sustainable Development Goal 2, it's essential to combine these technologies with traditional agricultural practices, boost climate adaptability and resilience, and ensure that farmers worldwide have access to them. These efforts are vital for securing food security, promoting sustainability, and building resilience to climate change.

During the course of developing this Roadmap, it was noted that the majority of existing standards (42%) focus on farming systems, while other areas, such as disease and pest detection, are not addressed by current standards. As per this standardization landscape, digital twin and DLT are not also extensively leveraged for agriculture.

The FG-AI4A Standards Roadmap paves the way forward to identify these gaps in terms of standardization that need to be filled through the activities of the Focus Group.

Navigating Ethics in Digital Agriculture

As digital technologies can significantly impact agricultural practices by increasing efficiency and productivity, ethical considerations ensure that these advancements do not compromise the welfare of farmers, consumers, and others within the food supply and production chain. By fostering trust and accountability, ethical practices not only enhance the acceptance and integration of these technologies into agricultural systems but also promote social and environmental sustainability, ensuring that the advancements contribute positively to food security and agricultural resilience.

FG-AI4A developed a <u>Report</u> focussing on the ethical, legal, and regulatory considerations for data privacy, transparency, and fairness in AI systems for agriculture. This Report analyzes the <u>European Union AI Act</u>, <u>Rome Call for AI Ethics</u> and other EU regulations related to data protection, intellectual property rights, and liability along with the principles of territorial application, and risk-based categorization of AI systems in the agricultural sector such that equitable distribution of benefits is ensured for all stakeholders.

The Report also highlighted the importance of the <u>United Nations Resolution on Al</u> to foster the ethical deployment of Al in agriculture, and the importance of adhering to Al-based standards to foster trust, promote responsible innovation, thereby ensuring ethical and effective use of Al in agriculture to improve productivity.

Further research would also need to be conducted on the ethical use of these technologies in the context of livestock management. It is essential to establish guidelines for the ethical application of technologies in livestock management to ensure the humane treatment of animals and animal health.

FG-AI4A: Meetings and Events in Focus

Between March 2022 to June 2024, FG-AI4A conducted ten meetings including seven online meetings and three on-site meetings. <u>Seven Webinars</u> were organized with various partners including FAO, the World Meteorological Organization (WMO), UN-Water and other SDOs like the International Organization for Standardization (ISO). Additionally, three Workshops were collocated with on-site FG-AI4A meetings within the same period. (See Appendix)

Figure 4: Mr Ramy Fathy (FG-AI4A Co-Chair) presenting at the Workshop in Seongnam August 2022)



More than 300 distinguished experts from various disciplines collaboratively engaged in the development of the FG-AI4A Outputs, bringing a wealth of knowledge and expertise to the forefront of agricultural innovation for standardization.

The third meeting of FG-AI4A was organized as an on-site meeting in Seongnam, Republic of Korea, preceded by the <u>ITU/FAO Workshop on "Digital Agriculture at Scale: Sustainable Food</u> <u>Systems with IoT and AI</u>", from 24-25 Au gust 2022. This meeting and Workshop were hosted by National Radio Research Agency (RRA), Ministry of Science and ICT, Republic of Korea.

The ninth meeting of FG-AI4A was held in New Delhi, India from 18-19 March 2024, together with the <u>ITU/FAO Workshop on "Cultivating Tomorrow: Advancing Digital Agriculture</u> through IoT and AI", hosted by Telecommunication Engineering Centre (TEC), Department of Telecommunications (DoT), Ministry of Communications, India and the Indian Council of Agricultural Research (ICAR), Department of Agricultural Research and Education (DARE), Ministry of Agriculture and Farmers' Welfare, India. The meeting and workshop were complemented by networking opportunities, featuring coffee breaks and lunches, allowing participants to connect with the speakers and other experts. A tour of the living labs of the Indian Agricultural Research

Institute showcasing vertical farming, along with the use of IoT and drones for agriculture and plant phenomics was also organized for the attendees.

Figure 5: Mr Seizo Onoe (TSB Director) delivering the Keynote Address during the ITU/FAO Workshop in New Delhi (March 2024)



Figure 6: Inauguration of FG-AI4A Exhibition by Seizo Onoe (TSB Director) Mr Ajay Kumar Sahu (Additional Secretary (T) & Member (Services), Department of Telecommunications (DoT)) and Mr SK Chaudhari, Deputy Director General (NRM), Indian Council of Agricultural Research (ICAR)) in New Delhi India (March 2024) Figure 7: Tour of the FG-AI4A Exhibition in New Delhi, India (March 2024)



Figure 8: Mr Zhongxin Chen, Senior IT Officer, FAO being honored for his contributions to the Workshop and FG-AI4A Meeting in New Delhi, India (March 2024)

Figure 9: Tour of the living labs of the Indian Agricultural Research Institute in New Delhi, India (March 2024)



The 10th meeting of FG-AI4A and the ITU/ FAO Workshop on "The Future of Digital Agriculture: Role of Artificial Intelligence were held in Utrecht, the Netherlands, hosted by AgriBITs, a VNU Europe summit. The meeting experience was further enhanced by networking sessions accompanied by coffee and a luncheon, providing participants with ample opportunities for engaging discussions.

(FG-AI4A Co-Chair) at the FG- (June 2024) AI4A Workshop in Utrecht (June 2024)

Figure 10: Mr Sebastian Bosse Figure 11: Networking Coffee in Utrecht





FG-AI4A: Technologies in Focus

The FG-AI4A explored the integration of a variety of technologies including AI and IoT technologies to optimize farming practices, enhance crop management, and improve resource utilization and sustainability. It analyzed several successful use cases for the formulation of best practices as contained in its <u>Use-case Report</u>. Key examples include the use of Cosmic-Ray Neutron Sensing (CRNS) for soil moisture monitoring, AI-powered pest and disease monitoring in viticulture and tea plantations, and autonomous irrigation systems and cultivation systems. The report also emphasizes best practices such as real-time monitoring, continuous data analysis, thorough field testing, and sustainability through optimized resource use.



Figure 12: Snapshot of technologies in Use-case Report

Recognizing the crucial role of data modeling in digital agriculture, FG-AI4A also produced a <u>Report</u> detailing the use of sensors, drones, and other smart farming equipment to gather real-time data, which is then analyzed with AI algorithms for precision agriculture. The Report highlights the significance of semantic data models for standardizing data representation and tackles challenges such as data quality, volume, integration, accessibility, privacy, and environmental variability. It also outlines the necessary steps for implementing AI-based modeling in agriculture.

Conclusion

FG-AI4A embodies a significant effort by the ITU and FAO to promote the integration of AI and digital technologies in agriculture, focusing on the development and adoption of standards. The key areas of work covered by this Focus Group include the development of guidelines, ethical considerations, and the role of data modeling in enhancing agricultural practices.

By addressing gaps in standardization, promoting the ethical use of technology, and emphasizing the importance of data quality and integration, FG-AI4A sets a trajectory for the future of digital agriculture. These efforts not only aim to improve productivity and efficiency in agriculture but also to ensure sustainability and resilience against climate challenges. As the sector continues to evolve, the guidelines developed by FG-AI4A will serve as a valuable foundation for stakeholders looking to implement and benefit from advanced digital technologies in agriculture.

As we look to the future, the reports, frameworks and guidelines provided by FG-AI4A offers these as comprehensive tools for stakeholders, including policymakers and industry experts. These are designed to maximize the benefits of digital agriculture while addressing the complexities and challenges inherent in this rapidly evolving field.

The continued collaboration and commitment of all stakeholders–including policymakers, technology developers, and agricultural experts are crucial for harnessing the full potential of digital agriculture through effective standardization. This collective effort will ensure the creation and implementation of robust, interoperable standards that facilitate seamless integration of digital technologies across the agricultural sector. Such standardization is key to enhancing data sharing, improving efficiency, and ensuring the reliability and security of digital tools. This approach will lead to a more sustainable, productive, and resilient agricultural industry, capable of addressing global challenges such as food security, resource management, and global hunger.

Appendix

1 List of FG-AI4A Meetings and Overview of Meeting Participation

Meeting Dates	Meeting No.	Location	Hosts	
30-31 March 2022	1 st Meeting of FG-AI4A	Virtual Meeting	N/A	
9-10 May 2022	2 nd Meeting of FG-AI4A	Virtual Meeting	N/A	
25-26 August 2022	3 rd Meeting of FG-AI4A	Seongnam, Korea (Rep. of)	National Radio Research Agency (RRA), Ministry of Science and ICT, Republic of Korea	
17-19 October 2022	4 th Meeting of FG-AI4A	Virtual Meeting	N/A	
20 January 2023	5 th Meeting of FG-AI4A	Virtual Meeting	N/A	
22-24 May 2023	6 th Meeting of FG-AI4A	Virtual Meeting	N/A	
14 August 2023	7 th Meeting of FG-AI4A	Virtual Meeting	N/A	
1 December 2023	8 th Meeting of FG-AI4A	Virtual Meeting	N/A	
19 March 2024	9 th Meeting of FG-Al4A	New Delhi, India	Telecommunication Engi- neering Centre (TEC), Department of Telecommu- nications (DoT), Ministry of Communications, India and Indian Council of Agricultural Research (ICAR), Department of Agricultural Research and Education (DARE), Ministry of Agriculture and Farmers' Welfare, India	
18 June 2024	10 th Meeting of FG-AI4A	Utrecht, The Netherlands	AgriBits - VNU Conference	

Table 1: List of FG-AI4A Meetings



Figure 13: Overview of Meeting Participation

2 Complete List of FG-AI4A Related Workshops and Webinars

Date	Title of Event	Location	Partners
14 February 2022	Towards Digital Agriculture: Expanding on the AI and IoT Paradigm	Online	FAO
29 March 2022	Accelerating agricultural digital transformation through AI and loT	Online	FAO, ISO
21 April 2022	Digital agricultural technolo- gies for Global Food Security	Online	N/A
28 April 2022	Weeding and harvesting robots for sustainable and affordable horticulture	Online	FAO
24 August 2022	Workshop on "Digital Agricul- ture at Scale: Sustainable Food Systems with IoT and AI"	Seongnam, Korea (Rep. of)	FAO [Collocated with the 3 rd Meeting of FG-AI4A)
17 February 2023	Digital Agriculture: Driving Digital Transformation for Food Security	Online	FAO and ISO
14 March 2023	Digital water in smart sustain- able cities	Online	WMO and UN-Wa- ter
18 March 2024	Workshop on "Cultivating Tomorrow: Advancing Digital Agriculture through IoT and AI"	New Delhi, India	FAO [Collocated with the 9 th Meeting of FG-AI4A
22 March 2024	Unleashing the Power of Digital Water Solutions: Exploring the flow of emerging technologies	Online	WMO and UN-Wa- ter
17 June 2024	Workshop on "The Future of Digital Agriculture: Role of Arti- ficial Intelligence"	Utrecht, The Neth- erlands	FAO [Collocated with the 10 th Meet- ing of FG-Al4A]

Table 2: List of FG-AI4A related events

3 FG-AI4A Exhibition and Field Demonstration

Figure 14: Tour of the FG-AI4A Exhibition in New Delhi, India (March 2024)



Figure 15: Living Lab Field demonstration in New Delhi, India (March 2024)





International Telecommunication Union Place des Nations CH-1211 Geneva 20 Switzerland



Published in Switzerland Geneva, 2025 Photo credit: ITU