WEBINAR REPORT

DIGITALIZATION AND AI APPLICATIONS IN AGRICULTURE: DRIVING EFFICIENCY AND PRODUCTIVITY

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PREPARED BY: WORLD AGRICULTURE FORUM

Panellists

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3. Gladys Morales: Global head of innovation, IFAD
4. Khuloud Odeh: Global Director of Digital and Data CGIAR

Moderator

Dr Jacqueline Hughes, Secretary General World Agriculture Forum

Webinar Recording link: https://youtu.be/bA5SyF6GuiY?si=2My0Dv6wVBitn5PQ

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INTRODUCTION

The agricultural sector is undergoing a digital transformation, with AI and data-driven technologies playing a crucial role in optimizing food production, supply chains, and sustainability. However, adoption remains a challenge due to infrastructure gaps, investment barriers, and data standardization issues.

The webinar on "Digitalization and AI in Agriculture: Driving Efficiency and Productivity" brought together experts to discuss the transformative role of artificial intelligence and digital technologies in the agricultural sector. The discussion highlighted key opportunities, challenges, and strategic solutions necessary for the adoption of digital tools to improve agricultural efficiency, productivity, and sustainability.

Panellists stressed the need for enhanced digital infrastructure, public-private collaboration, financial inclusion, and responsible AI deployment. This report summarizes key insights from the session, outlining the major themes and expert recommendations for the future of agriculture.

WEBINAR OVERVIEW

SETTING THE CONTEXT

Hassan Halawy opened the webinar by emphasizing how AI and digitalization are reshaping agriculture. Technologies like mobile advisory services, remote sensing, and digital marketplaces have moved from concept to necessity, helping farmers boost yields, optimize resources, and connect to broader markets. AI-driven analytics are now predicting market trends and assessing soil health, creating efficiency and new revenue streams.

While adoption varies globally, North America leads with precision farming, Brazil and Argentina leverage remote sensing, and Europe integrates high-tech solutions with sustainability. Meanwhile, developing nations like India and Bangladesh are rapidly adopting mobile-based advisory services to tackle climate and resource challenges.

Despite progress, agriculture lags behind sectors like healthcare and fintech due to barriers such as low literacy, weak rural digital infrastructure, high costs, and the need for localized solutions. Failures like Mineral and Aerofarms highlight challenges in scalability and financial sustainability. Given agriculture's complexity and market volatility, investor confidence remains inconsistent.

To accelerate adoption, Halawy emphasized the need for stronger digital infrastructure, tailored solutions, collaborative ecosystems, and capacity building. He also highlighted the UAE's leadership in agricultural digitalization, including its collaboration with the Gates Foundation to develop an agriculture-specific large language model for AI-driven insights.

In closing, he underscored that digital tools and data-driven insights are key to enhancing productivity, ensuring food security, and building a more resilient global food system.

Bridging the Digital Gap for Smallholder Farmers

Gladys Morales highlighted that while digitalization and AI are transforming agriculture, the key challenge is making these technologies affordable and accessible for smallholder farmers. She highlighted IFAD's efforts to develop farmer-centric digital solutions, such as Agro Web3—a universal protocol designed to enhance financial inclusion through digital wallets and blockchain technology.

Developed with the Inter-American Development Bank, Agro Web3 leverages AI, satellite imagery, and blockchain to help farmers secure financing, verify sustainability compliance, and streamline supply chains. IFAD is also investing in AI-driven tools, including:

- Predictive analytics for weather and soil
- Automated advisory services
- AI-powered supply chain management

These technologies enhance market access, reduce reliance on intermediaries, and lower costs. Morales emphasized the need for collaboration with governments to integrate digital infrastructure, ensuring smallholder farmers can access markets, secure funding, and adapt to climate challenges.

Overcoming Barriers to Technology Adoption

Marieke de Ruyter de Wildt emphasized that the biggest challenge in agrifood is not climate change but the slow adoption of technology. While AI, blockchain, and quantum computing hold great potential, their implementation remains fragmented. She noted that blockchain's value is often misunderstood, overshadowed by media coverage of trends like Elon Musk's Dogecoin, has fuelled scepticism and slowed trust in digital solutions.

She pointed out that large corporations and governments operate within outdated systems that limit accurate insights, hinder food system analysis, and delay responses to disruptions. To drive meaningful digital transformation, she stressed the need for reliable, validated data and a shift toward public, open-source infrastructure. Instead of rebuilding systems from scratch, she advocated for connecting and strengthening existing digital infrastructures worldwide.

Standardized and aligned technology adoption is critical for overcoming the current challenges in agricultural digitalization."- Marieke de Ruyter de Wildt

Building a Responsible and Inclusive Digital Agriculture Ecosystem

Khuloud Odeh highlighted how digitalization creates jobs, especially for youth and women, fostering equitable growth across the agricultural value chain. She noted that while AI applications—such as machine learning for soil conservation and water management—generate excitement, challenges remain, particularly in training reliable AI models due to data quality issues. To enhance AI's effectiveness in agriculture, Odeh emphasized the need for standardized agricultural data, interoperability between digital platforms, and open-access AI models for farmers.

Responsible AI and blockchain scaling must prioritize inclusivity, local agricultural needs, and governance frameworks. This requires frameworks that incorporate local languages to ensure AI tools can be used across diverse regions, align with regional agricultural practices to maintain relevance, and establish policies that promote responsible AI use. Odeh highlighted the UAE as a strong example of a government investing in AI-driven agriculture. However, for AI to succeed globally, she stressed the need for clear policies to ensure equitable digital access, greater collaboration between governments and the private sector, and a responsible approach to AI integration in agriculture.

> *Responsible digital transformation can only be achieved through inclusive policies, strategic investments, and robust international cooperation". -Khuloud Odeh*

Short to medium term opportunities to make technology become more inclusive

Khuloud Odeh In response to the question of how technology can become more inclusive in the short to medium term, emphasized the need to strengthen governance frameworks and invest in digital public infrastructure. She highlighted that existing legal and regulatory structures, developed by organizations like the FAO and the World Bank, must evolve to accommodate AI and data governance in agriculture. Without robust legal structures and clear policies, AI adoption risks deepening existing inequalities rather than bridging them. She highlighted the need for digital literacy programs to empower farmers, institutions, and policymakers.

Collaboration between tech companies and the agricultural sector is crucial. Partnerships should focus on aligning AI models with sector-specific needs. AI models like Falcon AI hold promise, but they must be adapted to farmers' needs to maximize impact. Lastly, targeted investments in digital infrastructure, especially in the Global South, are critical to closing the digital divide and ensuring technology benefits all farmers.

Lastly, targeted investments in digital infrastructure, especially in the Global South, are critical to closing the digital divide and ensuring technology benefits all farmers. Khuloud underscored the necessity of policies that not only facilitate AI integration but also ensure inclusive growth. These considerations extend beyond technical concerns, representing foundational steps toward unlocking the full potential of AI and digital transformation in agriculture.

How to build strong partnerships

Marieke de Ruyter de Wildt emphasized that while collaboration is widely encouraged, existing business models and institutional frameworks often hinder meaningful cooperation. Global organizations like the UN, FAO, and World Bank initiate valuable projects, but the private sector struggles with implementation due to a disconnect between governments, researchers, and businesses.

A key challenge is the mismatch in pace—governments and research institutions operate on long timelines, while private enterprises and tech firms move rapidly. This misalignment creates friction, slowing the adoption of digital solutions in agriculture. She pointed to the Netherlands as an example where years of discussions on alignment have resulted in more friction than collaboration.

To overcome these challenges, Marieke advocated for simplifying approaches and focusing on immediate, tangible actions rather than aiming for massive transformations overnight. Instead of waiting for perfect conditions, stakeholders should take small but impactful steps toward better collaboration, ensuring real progress in agricultural innovation.

Why Is Investment in Agricultural Technology Lagging?

Hassan Halawy explained that scalability in agriculture is far more complex than in other industries due to the diversity of crops, regional challenges, and language barriers. The lack of a universal solution has slowed progress, with most digital tools being developed in labs without direct input from farmers. This disconnect limits their real-world impact and adoption.

Another issue is the overwhelming influx of data from multiple sources on large farms. Without a standardized framework for collecting, classifying, and interpreting agricultural data, farmers struggle to extract actionable insights. Unlike the medical industry, which attracts substantial investment, agriculture remains undervalued despite global concerns about food security. The weak financial performance of major agricultural companies further discourages investment.

However, he reaffirmed that as the sector refines data management and aligns technology with farmers' real needs, investment and traction will follow.

Key Short and Medium-Term Opportunities in adopting Agricultural Technologies

Gladys Morales highlighted the need for greater standardization and interoperability to accelerate progress in agricultural technology. She pointed to Agro Web3's recent qualification under ISO standards for blockchain-powered digital wallets as a significant step toward streamlining digital agricultural systems. Partnerships with organizations like CGIAR, IFAD, FAO, and the private sector are already advancing digital solutions. For example, a project Indenti in maxico designed to enhance digital solutions for trade in cereals and other agricultural commodities. Another example is My Farms Trees (a CGIAR initiative) – A digital platform that supports farmers engaged in forestry and agroecology by providing incentives and payments for sustainable practices. This initiative collaborates with major digital players such as Safaricom and M-Pesa in Africa.
She emphasized that effective partnerships must begin at the design stage, ensuring interoperability between platforms, standardized data for seamless communication, and solutions that deliver real benefits to farmers. Morales also stressed the importance of digital public infrastructure in improving market access, regulatory compliance, and affordability of agricultural technology.
Addressing investment challenges, she called for incentives to attract private sector funding and suggested leveraging institutions like IFAD and the World Bank to de-risk investments. She concluded that digital transformation must remain farmer-centric, prioritizing AI-powered advisory services in local languages, voice-based communication for those with literacy barriers, and offline solutions to serve areas with limited internet access.

Improving the rate of Technology Adoption in Agriculture

Marieke de Ruyter de Wildt stressed that the challenge isn't the lack of digital tools but the difficulty in selecting and using them. Farmers across regions struggle with the overwhelming number of options, making education and simplification key to increasing adoption. She called for collaboration among stakeholders to make technology more intuitive and accessible, predicting that agriculture could become one of the most digitized industries within few years.
Hassan Halawy added another crucial perspective: growing consumer demand for transparency in food production is pushing digital adoption forward. He identified three major consumer-driven trends shaping the industry:

- Traceability: Consumers want to know where their food comes from and how it is produced.
- Sustainability: There is a growing emphasis on reducing the environmental impact of food production.
- Fair Pricing: More consumers demand ethical supply chains that ensure farmers receive fair compensation.

He underscored that in the short term, digital tools improve distribution and efficiency; in the long term, they reduce food waste, optimize resources, and enhance productivity. He concluded that once traceability solutions are fully integrated, the global food system can be redesigned to be more transparent, efficient, and sustainable.

Gladys Morales further emphasized that effective technology adoption goes beyond user-friendly design—it requires deep community engagement and sustained local involvement. She outlined four key strategies that IFAD has identified as essential for scaling digital agriculture.

1. Engaging Farmers and Youth
    a. Local leaders and youth should be at the forefront of adoption efforts.
    b. Training young people as advisors builds trust and ensures long-term sustainability.
2. Addressing Behavioral Barriers
    a. Social dynamics influence technology adoption as much as technical factors.
    b. Youth involvement encourages acceptance and helps curb rural migration.
3. Investing in Digital Public Infrastructure
    a. Government support is essential for scaling successful pilot projects beyond small initiatives.
    b. The "MUSOs for Development" alliance is working on financing solutions to bridge this gap.
4. Farmer Training and Digital Literacy
    a. Education must be prioritized, especially for women and youth.
    b. Policy reforms are needed to remove regulatory barriers, such as preventing women from owning land despite working on it for decades.
    c. Ensuring financial access and full inclusion will drive sustainable adoption.

By focusing on community leadership, behavioural change, infrastructure investment, and farmer education, IFAD aims to ensure that digital agriculture solutions are scalable, sustainable, and inclusive.

Khuloud Odeh emphasized that AI itself can play a critical role in driving its own adoption. she highlighted the idea of "AI for AI", explaining that AI can help overcome traditional barriers to digital transformation in agriculture.

One major advantage of AI is making technology more accessible. Generative AI enables verbal interactions, removing literacy barriers and allowing farmers to engage with digital tools more easily. AI also enhances data readiness by cleaning, classifying, and analyzing agricultural information, helping scientists, policymakers, and researchers make better decisions.

Beyond farming, AI is transforming research institutions like CGIAR and FAO by optimizing workflows, improving decision-making, and enhancing collaboration. It is also reshaping scientific research, with AI assisting in predictive analytics, simulations, and advanced modelling. By integrating AI into research teams, scientific breakthroughs can happen faster, leading to rapid innovation in agriculture.

Odeh challenged conventional approaches to digital transformation, stating that true adoption happens naturally when a solution effectively addresses a problem and is intuitive to use. If users resist, it often means the problem wasn't fully understood or the technology isn't user-friendly.

Finally, she compared the adoption of digital solutions in agriculture to the startup ecosystem, where successful innovations attract investment by solving real-world problems. She argued that new agricultural technologies will secure funding if they address a clear need, have a defined market, provide tangible value, and demonstrate revenue potential. When these factors align, scalable and sustainable solutions will thrive.

Final Reflections: Risks and opportunities and vision for the future

Hassan Halawy acknowledged agriculture as a high-risk industry, emphasizing that technology is not a replacement for farmers but a tool to support them. In the short term, AI will enhance decision-making, leading to improved productivity, sustainability, and optimized farm operations.

However, he highlighted key risks, including cybersecurity threats, as increasing connectivity through sensors and digital tools makes farms vulnerable to cyberattacks. Additionally, some farmers remain hesitant to adopt new technologies due to their complexity.

Despite these challenges, Halawy emphasized that food doesn't grow in supermarkets—it depends on farmers who have always adapted. While technology is the future, it must be implemented thoughtfully to ensure lasting benefits.

> *"In the short term, AI will serve as a tool to enhance decision-making, leading to improved productivity, greater sustainability, and optimized farm operations."-Hassan Halawy*

Khuloud Odeh reinforced the transformative potential of technology while cautioning that every tool can be used for good or harm. She illustrated this with a simple analogy—a knife can be used for cooking or as a weapon. Likewise, AI's impact depends on how it is applied. To ensure it serves agriculture effectively, she emphasized the need to keep human needs and values at the center of its development and use.

> *"AI should enhance farmers' knowledge rather than replace it, and scientific validation must ensure the reliability of AI models."- Khuloud Odeh*

Gladys Morales rejected the idea of choosing between human-centered and digital-first approaches, instead asking, "How do we adapt to AI quickly and ethically?" She identified two major risks: digital exclusion, where inaccessible or costly technology could widen inequalities, and data privacy & cybersecurity, which must be prioritized through proactive measures like Web3 and blockchain rather than addressed after breaches occur.
Morales also warned of market manipulation and over-reliance on big tech. If a few corporations dominate AI-driven marketplaces, they could control prices and limit farmers' autonomy. She emphasized the need for transparency, standardization, and interoperability to lower costs and ensure fair benefits for all stakeholders.
Closing with an optimistic yet pragmatic view, she stated: "When I see a challenge, I see an opportunity. By working together, we can fill the gaps and ensure technology serves all farmers—not just a few."

Agriculture Technologies must be inclusive, ethical, and secure, ensuring that farmers' data and identities remain protected". - Gladys Morales

Marieke de Ruyter de Wildt emphasized that data quality is the foundation of everything discussed. Without reliable data, security measures lose effectiveness, and AI becomes untrustworthy. To ensure AI and digital agriculture succeed, she stressed the need for publicly validated data, with agencies certifying its accuracy to drive adoption.
She also highlighted the urgency of the moment, warning that the next one to two years will be critical. To scale digital solutions effectively, mixed funding models will be essential. Despite these challenges, she expressed confidence that the industry has the tools, creativity, and expertise needed to succeed.

"Technology is only as strong as the data behind it. If we get data quality right, we can drive real transformation in agriculture."- Marieke de Ruyter de Wildt

Closing Remarks

The moderator, **Dr. Jacqueline Hughes**, summarized the key takeaways from the panel, emphasizing the importance of inclusive technology that ensures equitable access for all. She highlighted the need for open digital infrastructure to support scalability and stressed the significance of establishing regulatory frameworks and governance to mitigate risks. Dr. Hughes also pointed out that business models and human behaviour play a crucial role in the adoption of new technologies. Lastly, she underscored the importance of keeping AI as a tool with humans remaining at the centre of decision-making and control.

Recommendations and Action Priorities

1. **Invest in Rural Digital Infrastructure: E**xpanding digital infrastructure in rural areas is crucial for enhancing technological adoption in agriculture. Public-private partnerships should focus on improving connectivity and ensuring that digital tools are both affordable and relevant for smallholder farmers.
2. **Ensure High-Quality Data and Transparent Governance:** The effectiveness of AI-driven solutions depends on high-quality, verified data. Establishing clear regulatory frameworks for data governance can build trust, enhance transparency, and prevent misuse. Aligning practices with international standards will be essential for seamless integration.
3. **Expand Financial Access and Market Connectivity:** Digital platforms should support financial inclusion by offering tailored financial products and direct-to-market solutions. This approach can empower smallholder farmers, especially women and youth, to access markets and improve their income.
4. **Bridge the Digital Divide Inclusively:** Localizing digital tools and enhancing digital literacy are vital to ensuring underserved populations benefit. Simplifying technologies and providing training can help bridge the digital gap effectively, particularly for women and youth.
5. **Adopt Responsible AI Practices:** Scaling AI responsibly requires ethical frameworks that consider local contexts, data privacy, and fairness. Promoting open-source AI models and transparency in AI deployment can mitigate risks associated with misuse and bias.
6. **Leverage AI for Climate-Smart Agriculture:** AI has the potential to predict climate risks and optimize resource use, transforming agriculture into a more sustainable sector. Investing in AI-driven solutions for precision irrigation, pest management, and climate-resilient crops should be a priority.
7. **Promote Decentralized and Transparent Value Chains:** Technologies like blockchain can enhance transparency and fairness in agricultural value chains by enabling direct transactions between farmers and buyers, reducing intermediaries, and ensuring fair compensation.
8. **Mobilize Blended Finance and Impact Investments:** Combining grants, impact investments, and commercial funding can help scale digital innovations in agriculture. Incentivizing investors to support sustainable and inclusive solutions is essential for bridging funding gaps.
9. **Strengthen Policy and Regulatory Frameworks:** Governments need to adopt forward-looking policies that balance innovation with regulation. This includes standards for data sharing, AI ethics, and cybersecurity to create a secure and enabling environment for digital transformation.
10. **Prepare the Next-Gen Workforce:** Building a tech-savvy workforce by integrating digital skills into agricultural education is vital. Providing opportunities for youth and women to participate in emerging agricultural technologies can help drive innovation and inclusivity.

Future Outlook

The future of agriculture lies in a balanced, inclusive, and collaborative digital ecosystem. Rather than replacing human expertise, AI must be developed as a tool that supports farmer decision-making, enhances sustainability, and amplifies local knowledge.

Transparent and interoperable systems, open-source innovation, and decentralized governance will be key to ensuring that technology benefits all—especially smallholders, women, and youth—rather than concentrating power in the hands of a few. Collaboration across sectors and geographies will ensure that innovation is relevant, responsible, and resilient.

Strategic digital investments, inclusive policies, and a shift from pilot projects to scalable, community-driven solutions will define the next chapter in agri-food systems. If guided by equity, ethics, and environmental responsibility, digital agriculture can strengthen global food systems while safeguarding the planet for generations to come.

CONCLUSION

The webinar highlighted both the promise and the complexity of integrating digital technologies into agriculture. It became clear that while the tools exist, adoption depends on the right combination of investment, education, policy support, and inclusive design.

Panellists emphasized that successful transformation requires centering farmers—not replacing them—with technologies that are intuitive, affordable, and rooted in real-world needs. The digital future of agriculture will be shaped not only by innovation but by the values we embed within that innovation: fairness, transparency, and inclusivity.

Moving forward, the task is not only to scale technology, but to ensure it serves those who feed the world. Through shared responsibility and cross-sectoral partnerships, digital agriculture can deliver on its potential to drive productivity, resilience, and equity across global food systems.