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Harnessing Artificial intelligence for Agricultural Transformation

The World Bank Group envisions a world where data, innovation and AI are embedded in how we produce and consume food from farm to table.

A new report from the World Bank Group “Harnessing AI for Agricultural Transformation” shows how AI can help transform global agriculture—boosting productivity, resilience, and sustainability, especially for small-scale producers in low- and middle-income countries. The report’s 60 case studies demonstrate that AI can be adaptable across diverse contexts and that public-private partnerships can drive innovation. The report argues that responsible, inclusive deployment of AI can accelerate food systems transformation and drive economic growth, while ensuring that vulnerable groups are not left behind.

The Problems

- **Agriculture faces unprecedented challenges.** Climate shocks, rising input costs, fragile supply chains, and widening inequality threaten food production and distribution. Small-scale producers, who grow one-third of the world's food, are especially vulnerable.
- **Data gaps and digital divides limit innovation.** Most agricultural data and AI models are built for high-income regions, leaving local crops, soils, and practices underrepresented. Only 15% of rural Africa has internet access, and over 600 million people lack reliable electricity.
- **AI can reinforce inequalities if not deployed responsibly.** Without inclusive design, localized data, and strong governance, AI risks amplifying bias, undermining privacy, and excluding smallholders and marginalized groups.

The Opportunities

AI offers transformative potential for smallholder farmers

- AI has the potential to transform agricultural production for smallholder farmers in low and middle-income countries, feeding the world, boosting climate resilience, reducing the drudgery of farm work and more.
- AI can synthesize diverse data (satellite, sensor, text, images) to deliver predictive insights, optimize inputs, and personalize advice at scale.
- Generative AI and multimodal models enable new interfaces for non-literate and low-connectivity users.
- AI-powered tools are already doubling incomes, increasing yields, and reducing resource use in pilots across developing countries.

Investing in agricultural AI brings outsized returns.

- Early results show up to 38% yield increases and \$580/ha profit gains for smallholders using tailored AI advisories in Ethiopia.¹
- AI-driven genebank screening in the Philippines is unlocking \$30.8 billion in projected economic returns.²
- AI-powered soil carbon measurement in Kenya and Mexico has reduced costs by 90% and enabled new climate finance for farmers. (Source: Boomitra.)

Digital public infrastructure (DPI) is key to scaling impact.

- The ability to scale AI depends on foundational digital infrastructure such as Digital IDs, land registries, open data platforms and more that are publicly governed and accessible. Examples include: digital IDs, land registries etc.

¹ Liben, et al. (2023), <https://cgspace.cgiar.org/items/e5a0700f-588d-4b15-a1f3-f840549c82c7>

² The International Rice Research Institute (IRRI), supported by Google.org's AI for Social Good program, is pioneering an AI-driven revolution in genebank utilization to combat climate change and ensure food security.

- National and regional investments in DPI and AI-ready data ecosystems are critical for equitable access and sustainable growth.
- Only with the right investments in infrastructure, governance, and capacity, and a commitment to inclusion and ethics. Only then will small-scale producers (who produce a third of the world's food) benefit and stand to gain the most.

What to Do

Policymakers can adopt national AI strategies inclusive of agriculture, with clear implementation pathways and budgets.

- They can embed AI in AgriFood System Policy by linking it to resilience, climate adaptation, and nutrition security goals.
- They can foster Open and Interoperable Data Ecosystems by supporting Agricultural Data Exchange Nodes (ADENs) and FAIR data principles.

Development institutions can integrate DPI and AI Investments in agriculture projects, ensuring that identity, payments, and data infrastructures are AI-ready.

- They can support AI Readiness Assessments and policy diagnostics for LMIC governments, especially in fragile or climate-vulnerable regions.
- They can channel Research Funding to co-develop LMIC-relevant AI models with local institutions, focusing on crops, languages, and supply chains underrepresented in global models

Use Cases from this Report:

Global

- **Across 40+ countries, the Land Degradation Surveillance Framework³** from CIFOR-ICRAF leverages AI and remote sensing to monitor soil health and guide restoration, resulting in measurable yield increases and improved food security for local communities.

Regional

- ACRE Africa's AI-enabled weather-indexed insurance⁴ has **protected over 3.7 million farmers across Kenya, Rwanda, Tanzania, and Zambia**, with automated payouts covering up to 80% of input costs during droughts.
- Digital Green's AI-powered chatbot reached **250,000 farmers and extension workers in five countries within five months**, supporting 40 crops in six languages and successfully answering **75% of farmers' questions in real time**.⁵
- iSDA's Virtual Agronomist⁶, serving over 200,000 plots in seven African countries, has boosted yields by up to **1.9-fold and profits by up to 4.7 times** through personalized AI-driven advice.

³ Land Degradation Surveillance Framework, <https://ldsfr.thebrit.org/>

⁴ <https://panagrimedia.com/acre-africa-cultivating-resilience-through-agricultural-insurance/>

⁵ <https://digitalgreen.org/a-new-frontier-for-farmer-chat-enhanced-smallholder-farmer-support-with-openai-operator-research-preview/>

⁶ <https://www.isda-africa.com/posts/virtual-agronomist-one-year/>

Africa

- **In Ethiopia, the NextGen Agro-advisory Decision Support Tool⁷** tailored fertilizer and management advice to local conditions, raising wheat yields by up to 38% and profits by \$580/ha per season for 60,000 smallholders.
- **In Kenya, Boomitra's AI-powered soil carbon measurement platform reduced costs by 90%**, enabled carbon credit payments for 100,000 farmers on 5 million acres, and doubled maize yields for farmers like Rose Khatambi Meja, who says, "Since adopting improved agricultural practices, my harvest has gone from 8.9 to 18.9 kg bags of maize per acre in two harvest seasons". (Source: Boomitra)
- Kenya's M-Shwari⁸, using AI for alternative credit scoring, amassed over **10 million accounts (4.5 million active users) in two years—roughly 20% of Kenya's adult population**—demonstrating scalability and rapid uptake of AI-backed lending.

Asia

- **In the Philippines, the International Rice Research Institute** used AI-driven image analysis to screen 60,000 rice varieties for climate resilience in a single season—three times more than in the previous five decades. The approach is projected to complete full collection screening in two years at one-sixth the cost, with projected economic returns of **US\$30.79 billion over five years**. (Source: IRRI).
- **In India, the Saagu Baagu initiative⁹ scaled** AI-powered precision farming for chili farmers, increasing yields by 21%, doubling incomes, and reducing pesticide use by 9%—showing how digital innovation can drive inclusive growth and sustainability.

Moving Forward

AI is not a silver bullet, but with the right investments in infrastructure, governance, and capacity, it can help reshape agrifood systems for the better. Governments, development partners and the private sector must collaborate and invest to realize AI's potential for productivity, climate adaptation and equity because no one player within the value chain can do this alone.



⁷ <https://nextgenagrodata.com/>
CoW (2023), <http://ethioagridata.com/>

⁸ <https://www.safaricom.co.ke/media-center-landing/press-releases/cba-partners-with-safaricom-to-launch-m-shwari>
<https://www.cgap.org/blog/top-10-things-to-know-about-m-shwari>

⁹ WEF (2023), https://www3.weforum.org/docs/WEF_Scaling_Agritech_at_the_Last_Mile_2023.pdf