# Report of CGIAR's Digital Transformation Accelerator side event– AI-powered innovation: Acceleration research for agri-food system transformation

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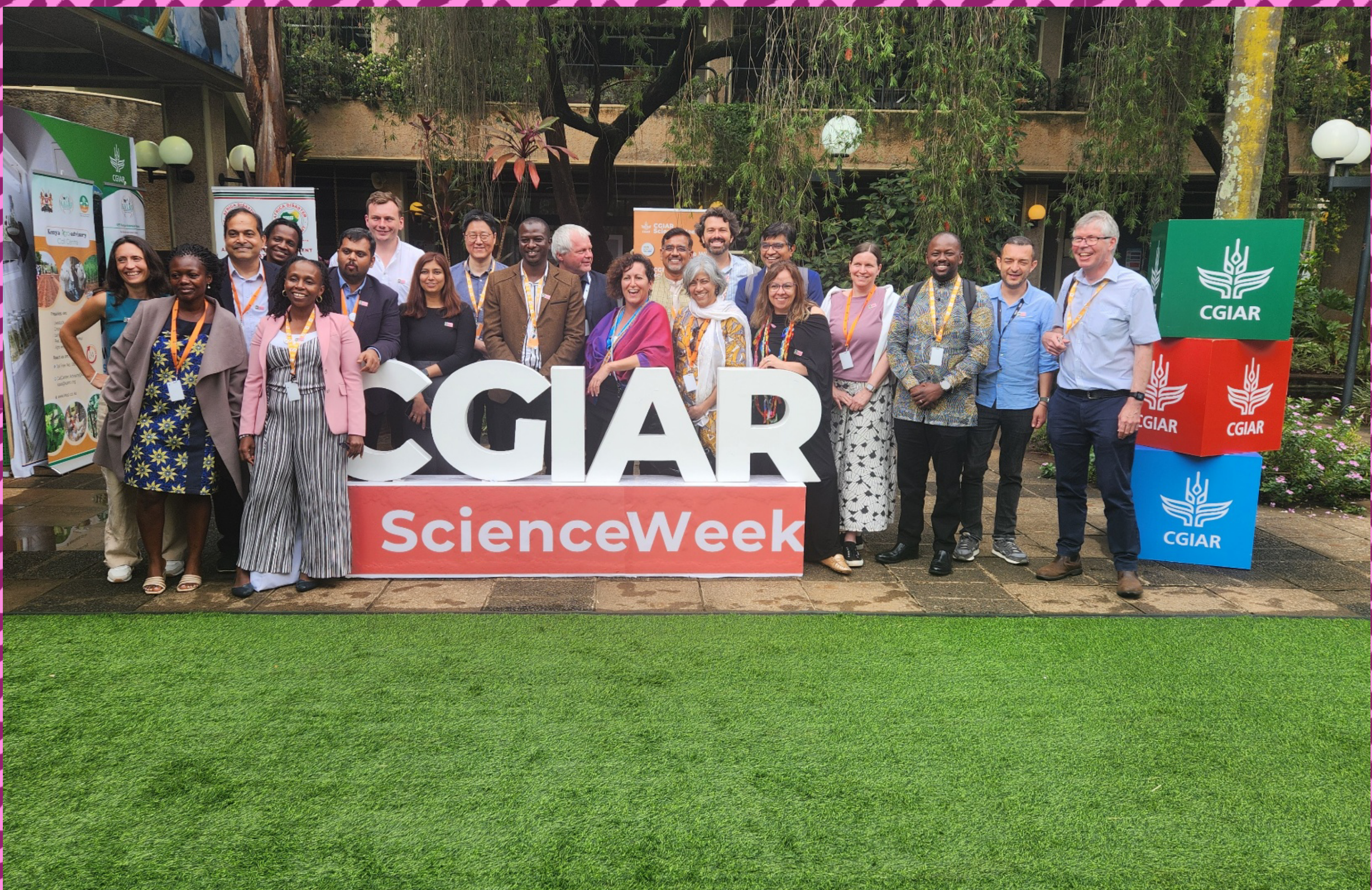
CGIAR Science Week 2025, Nairobi, Kenya



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# Copyright information, citation, disclaimers and acknowledgements

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CGIAR is the world's largest, publicly funded agrifood research partnership. Our ambition is a food and nutrition-secure future that leaves no one behind. We operate through 15 Research Centers and with 10,000 staff in more than 100 countries. Our impact is made possible by collaboration with over 4,000 partners.

Levels of hunger and malnutrition are at record highs. Without urgent action, many more lives and livelihoods will be lost. Many of the 500 million small-scale producers who provide a third of the world's food on 83% of the world's farms are affected. With science, we can co-design the innovations they need to produce more and better food with fewer resources, adapt to the changing environment, and protect natural resources.

# Executive summary

CGIAR's Digital Transformation Accelerator Side Event: Digital innovations for advancing agri-food systems research, held during Science Week 2025 showcased how artificial Intelligence (AI) is reshaping agri-food systems research, innovation, and advisory services, particularly in the Global South. Attended by over 250 participants both in person and online, the four-hour session highlighted frontier AI applications while addressing critical institutional, ethical, and localization challenges in scaling digital innovation.

Keynote addresses by Aisha Walcott-Bryant, head of Google Research Africa presented real-world applications of AI for climate resilience, including flood forecasting, field boundary detection, and hyper-local weather prediction. These solutions underscored the transition from experimentation to wide-scale operational deployment.

Thematic sessions demonstrated AI's versatility across the following agricultural domains:

- Generative AI for advisory services: The International Maize and Wheat Improvement Center (CIMMYT) and partners showcased how AI tools are being localized to provide multilingual, personalized, and voice-enabled farming advice. Innovative uses of large language models (LLMs), Interactive Voice Response (IVR) systems, and WhatsApp-based tools emphasized accessibility for low-literacy and digitally marginalized users.
- Earth observation and AI for climate adaptation: The University of Galway introduced tracking adaptation progress in agriculture and food security (TAPAS), a platform leveraging satellite data and machine learning to monitor adaptation outcomes, assess investment impacts, and guide climate resilience strategies.
- AI in genebank management: The International Rice Research Institute (IRRI) presented transformative use cases of AI in managing rice genetic resources, from automating seed phenotyping to enhancing genetic diversity analysis through image-based classification models and natural language interfaces.
- Artemis: AI-powered phenotyping: The Tanzania-based Artemis project was launched as a scalable, AI-enabled platform using smartphone-based digital phenotyping. The project combines frugal innovation, interdisciplinary collaboration, and speech recognition to empower breeding programs and integrate farmer voices into research workflows.
- The Agricultural Information Exchange Platform (AIEP): A multi-organization initiative piloted AI-powered advisory tools tailored for smallholder farmers in Kenya and India. Co-designed with end users, the platform supports voice, SMS, and chatbot interfaces to deliver timely, localized, and gender-sensitive agricultural information.

Throughout the event, discussions emphasized the shift from proof-of-concept pilots to institutional readiness and sustainable models for AI adoption. Key takeaways included the need for interdisciplinary partnerships, participatory design, open-source data infrastructure, and responsible governance to ensure that AI contributes to equitable and impactful transformation of agri-food systems.

The event concluded with calls for broader collaboration across public, private, and research sectors to co-develop AI solutions that are inclusive, context-aware, and scalable.

## Background

Artificial intelligence (AI) is rapidly emerging as a transformative force in agri-food systems, offering unprecedented opportunities to accelerate research, enhance decision-making, and drive innovation across the agricultural value chain. As global challenges such as climate change, resource scarcity, and food insecurity intensify, the strategic application of AI is increasingly seen as essential to achieving sustainable, resilient, and inclusive food systems—particularly in resource-constrained environments.

The side event “AI-powered innovation: Acceleration research for agri-food system transformation,” held on 10 April 2025, at the United Nations Office in Nairobi, was convened to explore the role of AI in addressing these pressing challenges. Bringing together researchers, innovators, and practitioners, the four-hour session served as a platform to assess the current state of AI integration in agri-food research and to spotlight promising applications and initiatives underway across the CGIAR system and its partners.

The event was structured around a keynote session and a series of thematic discussions. These included the deployment of generative AI to enhance advisory services for smallholder farmers, AI-powered earth observation tools for climate adaptation and natural resource management, and the use of AI in digital phenotyping and genebank utilization to accelerate breeding programs. Special attention was given to participatory and inclusive design approaches, such as the Agriculture Information Exchange Platform (AIEP), which demonstrated how AI can be tailored to support farmers with low digital literacy through gender-sensitive, multilingual, and multi-channel advisory systems.

Overall, the event highlighted not only the technological advancements but also the institutional, ethical, and operational frameworks needed to scale AI solutions effectively. By examining both frontier innovations and grounded implementations, the discussions provided a comprehensive backdrop for understanding how AI can support the transformation of agri-food systems to be more adaptive, efficient, and equitable.

Over 200 in-person and 50 online participants attended the side event.

Participants keenly follow Aisha Walcott-Bryant, head of Google Research Africa delivering her keynote address. Photo credit: ILRI/Wandera Ojanji

## Opening remarks: Shalini Gakhar

Shalini Gakhar, data scientist, IRRI, opened and moderated the first session. She introduced the theme and set the tone for the side event titled "AI-powered innovation: Acceleration research for agri-food system transformation." Emphasizing the significance of AI in transforming agri-food systems, Gakhar highlighted the importance of this session as a foundational discussion for the broader Digital Transformation Accelerator Strategy.

To engage the audience, Gakhar invited participants to pause for 30 seconds to envision a future shaped by AI in agriculture. She described a vivid scenario: a dusty field where drones glide overhead, solar-powered sensors feed data to cloud-based AI systems, and farmers receive voice-based advisories in local languages—alerts that enable them to adapt in real time to changing climate conditions. This imaginative prompt underscored the session’s key message: these technologies are not speculative, they already exist. What is needed now is the political will, social readiness, and cultural integration to ensure their widespread and inclusive adoption.

Gakhar noted that the technologies required to bring this vision to life–drones, AI models, data platforms–are in place. However, the challenges ahead are no longer primarily technical but lie in how such technologies are deployed responsibly, equitably, and effectively across diverse agri-food systems.

She concluded her remarks by framing the session not simply as a panel discussion, but as a "pulse check from the future." The session would explore how CGIAR and partners can work collectively to integrate AI into agricultural research and advisory systems to support transformation at scale.

## Keynote addresses: Status of AI in agri-food system research and innovation

### Advancing impact driven moonshots for AI in agri-food system research

Aisha Walcott-Bryant, head of Google Research Africa, delivered the keynote address, offering a compelling overview of Google's work in applying AI to address global challenges, with particular relevance to agri-food systems in the Global South. She outlined the strategic focus of her team within Google Research, which targets high-impact, scalable AI solutions in areas such as climate resilience, disaster response, and food security. Their approach centers on identifying problems where Google's technical capabilities particularly in AI, computing power, and global infrastructure, can deliver measurable social benefit.

Aisha Walcott-Bryant, head of Google Research Africa delivering her keynote address. Photo credit: ILRI/Wandera Ojanji.

### Highlights of Google's impact-driven AI work:

- **Flood forecasting**: What began as a pilot in a small Indian village has now scaled to serve over 90 countries. Google's AI-driven flood forecasting provides early warnings that are disseminated through platforms like Google Search and Maps.
- **Wildfire detection**: Similar AI-based alert systems are used to delineate and monitor wildfire boundaries, providing life-saving information during emergencies.
- **Project Green Light**: A traffic signal optimization initiative designed to reduce $CO_2$ emissions by minimizing vehicle idle times in urban environments. This project exemplifies how AI can simultaneously address environmental and mobility challenges.
- **Project Sky**: Developed in collaboration with UN agencies, this project uses satellite imagery and AI to identify populations affected by natural disasters. It has significantly reduced disaster response times–from months to weeks–following events such as hurricanes and earthquakes.
- **Open Buildings and Field Boundaries:** Abigail Annkah, a colleague at Google Research Africa, would later elaborate on how this technology–originally developed for mapping buildings–has been adapted for identifying field boundaries, with direct applications in agricultural planning and monitoring.

- **Weather Nowcasting for Africa**: Recently launched, this system provides hyper-local weather forecasts (updated every 15 minutes) for up to 12 hours ahead. Available via Google Search across the continent, it fills a critical data gap for African users. Walcott-Bryant highlighted ongoing efforts to refine this tool in collaboration with partners, exploring use cases in agriculture, insurance, traffic, and more.
- **Drought forecasting**: A promising new frontier built upon the success of flood prediction, this AI-based system is designed to anticipate drought conditions using land surface models. Though still in early development, the technology is being readied for wider collaboration.
- **African Languages Initiative**: In partnership with local universities, Google Research Africa is working to collect and open-source linguistic data to support inclusive AI tools in diverse African languages.

Walcott-Bryant emphasized that the core technologies already exist to support AI integration in agri-food systems, but the focus must now shift toward collaborative testing, data sharing, and localized implementation. She invited researchers, practitioners, and institutions to partner with Google Research Africa to ensure these innovations meet the contextual needs of the regions they aim to serve. She concluded by introducing her colleague Annkah, who would provide a deeper technical presentation on some of the research outputs mentioned, including Open Buildings and applications in agricultural land mapping.

## Scaling agri-spatial intelligence AI workflow: From Open Buildings to Agricultural Landscape Dataset

Abigail Annkah, research software engineer at Google AI, delivered a keynote presentation focused on scaling agro-spatial intelligence through AI. She began by addressing the pressing need for scalable, timely, and granular monitoring systems in agriculture, particularly in the face of climate change, population growth, and sustainability challenges. Current systems, often limited to district or national scales, are insufficient for the complexity of today's agricultural landscapes.

Anka introduced Google's Open Buildings dataset as a foundational success story that inspired a new project: developing an AI-driven Agricultural Landscape Dataset with a focus on field boundary detection. This work was initiated in response to a 2022 Google Sustainable Development Startups (SFDS) survey, which identified the lack of accessible, high-resolution field boundary data as a key barrier to scaling innovations that support smallholder farmers particularly in Africa.

Abigail Annkah, research software engineer at Google AI delivering her keynote address. Phot credit: ILRI/Wandera Ojanji.

### Project approach and methodology

The project was launched in two phases:

- **Pilot phase in Rwanda:**
  - Used high-resolution satellite imagery and trained AI segmentation models to detect field boundaries.
  - Engaged a few startup partners who provided feedback on the dataset's utility.
  - The minimum viable product (MVP) approach enabled iterative improvements and confirmed the model's value.
- **Scaling to multiple countries:**
  - The model was further trained on labeled data from Rwanda, India, Colombia, and the UK, using a multi-label training approach with separate model heads for each country and class type.
  - A self-supervised learning strategy (student-teacher model) was employed to generalize the AI to unlabeled data from additional regions.
  - This enabled effective prediction of field boundaries in countries where no training data were provided (e.g., Kenya).

The final outputs include AI models that predict field boundaries, tree crops, and tree areas, with an emphasis on applicability across diverse field structures (e.g., flatlands, marshlands, terraces).

### Technical innovations

- Adaptation of AI segmentation models from the Open Buildings dataset to agricultural use cases.
- Use of self-supervised learning to address the scarcity of labeled data.
- Multi-label training to accommodate regional and structural diversity in field types.

### Evaluation and learnings

Annkah emphasized the importance of extensive model evaluation and user feedback:

- Key challenges included under- and over-segmentation, missing class representations, and model bias.
- Iterative annotation and model refinement were crucial to achieving higher performance.
- The team categorized failure modes and communicated model limitations to users clearly.

### Use cases and availability

The data and tools are being made available through a Google-hosted API, initially launched for India and set to include datasets from Rwanda, Kenya, and other regions in Africa and Latin America. Startups that participated in the SFDS survey indicated that access to accurate field boundary data dramatically improved operational efficiency—reducing manual field mapping times and enabling better targeting for agricultural services.

### Conclusion

Annkah concluded by underscoring that AI, when combined with iterative product development and user engagement, can powerfully scale agri-food intelligence systems. The adaptation of existing AI tools—like those used in Google's Open Buildings project—to new domains such as agriculture demonstrates the transformative potential of collaborative, data-driven innovation.

## Generative AI for advisory services

This session explored how generative AI can be leveraged to enhance agricultural advisory services for small-scale producers in the Global South. With AI technologies becoming more advanced and accessible, the discussion focused on practical implementations, emerging frameworks, and strategic opportunities for deploying these tools in resource-limited farming contexts. Speakers presented pilot projects and case studies that highlighted both the potential and challenges of integrating generative AI into existing advisory systems. Key themes included improving accessibility, ensuring relevance to local contexts, and addressing ethical considerations to ensure equitable and responsible AI deployment.

### Hyper-localizing digital advisory services: AgroTutor and the role of AI

### Presenter: Andrea Gardeazábal Monsalve, monitoring, evaluation and learning manager, ICT for Agriculture, CIMMYT


Andrea Gardeazábal Monsalve. Photo: ILRI/Wandera Ojanji.

Monsalve opened the session by emphasizing the need to bridge the gap between high-level scientific models and hyper-local agricultural realities. While digital and AI-driven innovations have long been part of agricultural development, she underscored that customization to local contexts remains a key challenge.

Hyper-localization is crucial because many AI solutions—though scientifically sound—lack relevance at the local level. Low trust and poor localization were identified as major barriers to adoption, customization, and iterative improvement of digital tools. Without addressing these issues, digital tools risk becoming unused or ineffective.

The presentation identified a persistent disconnect between the world of agronomic models (e.g., climate analytics, soil and crop science) and the daily decision-making context of smallholder farmers. This disconnect becomes more pronounced when attempting to scale innovations, often resulting in tools that fail to meet real farmer needs.

To address this, she outlined six strategies for how AI can help bridge this divide:

1. **Local knowledge amplification**: Integrating various fragmented data sources—such as field reports from extension agents, chatbot queries from farmers, and local government data—can empower advisory services with more context-aware and informed decision-making.
2. **Retrieval-augmented generation (RAG)**: RAG is a technique that enhances a traditional Large Language Model (LLM) by incorporating specific, localized content to make its answers more focused and relevant. This method is being used to hyper-localize models like ChatGPT for practical applications, such as providing advice to farmers. In trials in Africa, farmers found standard ChatGPT's recommendations to be too high-level; while the information sounded plausible, they did not trust it enough to act upon it. RAG addresses this gap by grounding the LLM's responses in specific, trusted data, making the output more practical and actionable.
3. **Multilingual and dialect adaptation**: Beyond just translating text between major languages, this approach includes translating technical or scientific outputs (e.g., research papers) into actionable recommendations in local dialects, a crucial factor in accessibility and trust.
4. **User-based personalization**: Moving beyond general farmer typologies or recommendation domains, AI offers the ability to create individualized profiles and recommendations tailored to each farmer's production system.
5. **Corpus validation and ground truthing**: AI can help identify gaps in existing local content, signaling where new data collection is needed to strengthen the advisory system.
6. **Human-in-the-loop feedback loops**: Farmers, extension agents, and local institutions should not only receive AI-generated recommendations but also play a role in validating and refining them. This contributes to more robust, adaptive AI systems.

## Framework for AI-powered advisory services

Monsalve introduced a framework organizing AI-based advisory services along two dimensions:

- **AI features** (the tools and capabilities):
    - AI chatbots
    - Model marketplaces (e.g., for weather, pests, fertilization)
    - Crowd-sourced data collection
    - Push alerts, WhatsApp training modules, benchmarking tools
    - One-on-one technical assistance
- **Localization strategies** (the adaptation mechanisms):
    - Channels: audio, IVR, SMS, offline/low-tech formats
    - RAG and community content integration
    - Prompt engineering to guide LLM behavior
    - Local semantics (e.g., terms used for crops/pests in different communities)
    - Text-to-image generation
    - Language and dialect customization

These tools are being applied to topics such as pest and disease management, seasonal forecasting, climate adaptation, and grain quality improvement.

## Use cases and examples

Andrea shared real-world examples where these strategies have been deployed:

- **Wheat rust monitoring in Africa**:
  Using RAG, CIMMYT automated the generation of rust surveillance reports, increasing coverage from 10 to 40 countries per month.

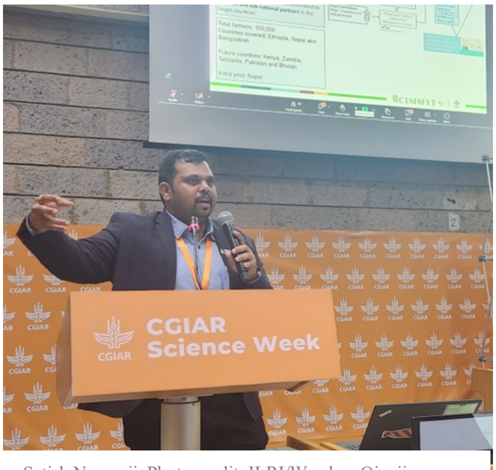
- **Benchmarking in Mexico**:
  Farmers receive comparative yield data and practices from their neighbors, which builds trust and facilitates learning.
- **Extension agent feedback loops**:
  In-field agents validate chatbot responses, which are then used to retrain the system for higher local accuracy.
- **Seasonal forecasting for plots in Mexico**:
  AI reads and contextualizes general climate forecasts to generate plot-specific maps and advice.

### Organizational approach and value proposition

CIMMYT's approach involves selecting scalable use cases, conducting data input and AI analysis, applying hyper-localization techniques, and iterating based on user feedback. The value proposition is not a single AI product but an open infrastructure and framework that supports diverse digital services (chatbots, dashboards, training, etc.) and allows organizations to plug in their own models or datasets. This framework lowers the barrier to innovation and supports use cases that are often neglected due to technical or financial constraints. Monsalve closed by inviting feedback and collaboration on emerging use cases and localization strategies. She emphasized that true transformation requires not just reaching farmers, but listening to and co-creating with them, alongside a broad ecosystem of actors—from data providers to market actors and public institutions.

## Use cases

### Presenter: Satish Nagaraji, ICT for development specialist, CIMMYT



Satish Nagaraji. Photo credit: ILRI/Wandera Ojanji.

Nagaraji continued from the earlier presentation by Andrea, expanding on CIMMYT's practical applications of generative AI in agricultural advisory services, with a focus on hyper-localization, multilingual delivery, and human-AI complementarity.

### Key innovations and use cases

1. **Localized LLM-based language-AI for agriculture guidance (LAG) farmer query responses**: CIMMYT is deploying a generative AI-based framework called language-AI for agriculture guidance (LAG), tailored to respond to farmer queries in local languages. This system has been implemented in India (e.g., Bihar), Kenya, and Mexico, each using region-specific compendiums and language corpora. Farmers send queries via WhatsApp in their local language and receive AI-generated responses in audio format. In regions like Bihar, where local extension services are integrated, farmers can escalate queries for human follow-up if the AI response is insufficient. This hybrid model is expanding to crops such as maize, rice, mung bean, potato, wheat, and sorghum across the three continents.
2. **AI-enabled voice-based data collection**: Addressing the high cost and low scalability of manual field data collection, CIMMYT piloted an automated voice survey system using Interactive Voice Response System (IVRS). Farmers respond to pre-recorded calls, and their answers are processed using AI techniques such as Named Entity Recognition (NER) and Named Entity Disambiguation (NED) to extract structured data from audio inputs. This system has been piloted in Bihar and is being extended to Spanish, Nepali, and Bangla-speaking regions, with future plans for the Chichewa-speaking "Chinyanja Triangle" (Malawi, Zambia, Tanzania).
3. **AI-generated and infographic-based disease advisories**: In partnership with a wheat rust early warning system involving multiple institutions, CIMMYT is exploring generative AI to summarize and produce national-level advisories from complex disease model outputs. The goal is to automate both the generation of text-based advisories and their transformation into infographics for better dissemination by national and sub-national partners. The current system reaches over 100,000 farmers in Ethiopia, Nepal, and Bangladesh, with plans for broader scaling.
4. **Additional AI-powered use cases**:

a. Weather advisories: AI is used to generate visual weather maps based on predictive models in Mexico, which are shared with farmers via WhatsApp.

b. Market intelligence: In collaboration with the Government of Maharashtra, multi-layered data integration is being developed to help farmers forecast market trends and identify optimal selling windows.

c. Soil health and sustainable intensification: Pilots in Malawi are using retrieval-augmented generation (RAG) to support extension agents with English-language advisory tools.

d. Seed dealer mapping: AI-based named entity recognition is being applied to identify and catalog seed dealers to assist farmers in locating reliable sources.

e. AgriTotal academy: A WhatsApp-based learning platform offering micro-courses in local languages, integrated with AI for responsive Q&A support.

## Voices, choices, and channels: Designing advisory services for small-scale producers

This session highlighted the Agriculture Information Exchange Platform (AIEP), an initiative focused on closing the information access gap for smallholder farmers with low literacy and digital skills. Through collaboration among four cohorts—Digital Green, DeHaat with Dalberg, IRRI with CIMMYT, and Viamo—the project co-designed and tested AI-powered, open-source digital advisory tools in Bihar (India) and Kenya. These tools feature local language support, personalized content, and are delivered through multiple channels, including WhatsApp, IVR, and SMS. The session shared key achievements, insights from user co-creation and testing, and discussed the potential for scaling this modular and gender-sensitive architecture to better serve marginalized farming communities.

### Panel discussion: Cohort learnings from AIEP

Moderator: Kirti Pandey (Open AgriNet)

Panelists:

- Christian Merz (GIZ)
- Nereah Okanga (Digital Green)
- Nancy Winder (Viamo)
- Mayank Jain (Sumarth/Dynac)
- Prakashan Chellattan Veettil (IRRI)
- Joe Munene (Opportunity International)
- Melvin Mutai (Safaricom)


Christian Merz, GIZ, contributing during the panel discussion on cohort learnings from AIEP. Other panelists (from left): Joe Munene, Opportunity International, Nereah Okanga, Digital Green, Nancy Winder, Viamo, Mayank Jain, Sumarth/Dynac. Photo credit: ILRI/Wandera Ojanji

### Opening remarks: Kirti Pandey, Open AgriNet

Pandey introduced the session by contextualizing the AI Accelerator Program (AIAP), which is funded by the Gates Foundation and commissioned by Fair Forward at GIZ. The initiative aims to bridge the information access gap for smallholder farmers with low literacy and digital skills by developing open-source, AI-powered, gender-sensitive advisory tools. The program has supported five cohorts consisting of over 30 organizations, which collaboratively designed and tested minimum viable products (MVPs) using large language models (LLMs) in Bihar (India) and Kenya. The tools deliver personalized advisory content through multichannel interfaces including voice, text, and chat apps.

## Project overview: Christian Merz, GIZ

Christian provided a detailed summary of the Agricultural Information Exchange Platform (AIEP) and its evolution:

- Problem statement: Over 1,300 digital solutions exist across LMICs, but adoption by small-scale farmers remains low, largely due to poor integration, fragmentation, and lack of user-centric design for those with low literacy or digital skills.
- Objective: AIEP seeks to deliver personalized, localized, multimodal advisory services that provide the right information at the right time in the right format, using generative AI to enhance relevance, adaptability, and learning over time.
- Use case example: Rose, a woman farmer in Kenya, uses her feature phone to ask a question in her local dialect and receives an AI-generated response in the same dialect—tailored and continuously improving through interaction.
- Implementation approach:
  - Open call for proposals in 2023 yielded 133 applications, 27 shortlisted, and 5 final cohorts selected.
  - Participating organizations included Digital Green, Dynac (Sumarth), YAML, DeHaat, Opportunity International, and others.
  - Cohorts met quarterly for physical reviews and collaborated through monthly sprints, user testing, and end-user research.
- Key features across solutions:
  - Use of IVR, chatbots, mobile apps
  - Integration of local language processing
  - Emphasis on user feedback and behavior learning
  - Shared architecture and service modules among cohorts
- Progress metrics:
  - Digital Green: Over 30,000 users
  - Dynac: 1,200+ users in Bihar
  - YAML: Recently scaled to 6,800 users
  - DeHaat: Approx. 2,000 users
  - Opportunity International / Digifarm: 380 users in Kenya; pilot launched in London
- Challenges noted:
  - Interoperability and data integration
  - Sustaining user engagement
  - Scaling across diverse linguistic and digital contexts

Merz also introduced short demonstration videos (technical issues prevented full playback), showing real-world interactions using voice and text-based chatbots.

## Panel discussion highlights

The panel featured four of the five participating cohorts: Dynac, Digital Green, Viamo, and Opportunity International. The conversation centered on three key areas:

1. User insights:
   Panelists shared that farmers appreciated local language support, voice interfaces, and quick, actionable advice. However, trust in AI-generated content, particularly in voice form, remains a concern among users.

2. Design and deployment challenges

- Building tools for feature phones remains a necessity.
- Alignment with existing behavioral habits (e.g., WhatsApp use) is critical.
- Ensuring accuracy, explainability, and transparency in AI outputs is ongoing work.

3. Plans for scaling:

- Dynac is exploring partnerships with local cooperatives to expand in Bihar.
- Digital Green is targeting wider deployment through existing field agent networks.
- Opportunity International is planning further rollouts in Kenya and sub-Saharan Africa.
- Viamo emphasized the role of IVR systems to maintain inclusivity for low-literacy users.

**Mayank Jain (Sumarth/Dynac): How has your partnership with CGIAR (particularly IRRI and CIMMYT) helped leverage existing data and improve advisory services through Dynac's MVP?**

Jain emphasized that partnerships with CGIAR institutions, especially IRRI and CIMMYT, were foundational to Dynac's development. These research institutions provided access to validated agronomic datasets—such as those from the Cereal Systems Initiative for South Asia (CSISA)—offering baseline demographic, cropping, and production data that helped shape the MVP for local relevance.

He explained the synergy between top-down CGIAR data and grassroots-level, peer-validated data from other partners like IKSL. While CGIAR data informed scientifically sound, district-level advisories, IKSL's two-decade experience in digital extension provided real-time, farmer-validated insights. This combination allowed Dynac to move toward more personalized, scalable advisories.

Additional partnerships included:

- Dexian, which is working at the frontier of agri-extension technologies with multiple datasets from public-private collaborations.
- Gramalaya, which contributes market-focused and localized advisory content.
- Samarth, Dynac's implementing arm, serving as the last-mile connector and real-time feedback loop for MVP testing and validation.

Together, these collaborations enable Dynac to bridge scientific knowledge with grassroots realities, leading to a dynamic and responsive advisory solution tailored to individual farmer needs.

## Session learnings and emerging insights

- Personalization and localization: The combination of generative AI and localized datasets is crucial for building trust and relevance among smallholder farmers. Tools must account for dialect, literacy levels, and contextual farming needs.
- Data interoperability and integration: A common architecture that supports data interoperability across partners enhances the scalability and adaptability of advisory solutions.
- Voice and feature phone interfaces: Voice-based interfaces that work on basic mobile phones are critical to reach digitally marginalized groups, particularly women and elderly farmers.
- Collaborative ecosystems: Cohort-based collaboration allows organizations to share learnings, avoid duplication, and iterate rapidly based on end-user feedback.

## Videos and demonstrations

Although technical issues prevented full playback, short demo videos from different cohort MVPs were introduced:

- YAML showcased an IVR-based chatbot capable of responding to agricultural queries in local Indian dialects.
- Dynac demonstrated both mobile app and IVR solutions for real-time advisory in India.
- Digital Green, DeHaat, and Opportunity International also briefly shared their interfaces and field testing experiences.

**Nancy Winder (Viamo): Viamo has long experience working with IVR solutions across multiple sectors. How has your user adoption journey in agriculture differed from other sectors such as health, education, or financial literacy?**

Nancy Winder highlighted Viamo's longstanding use of interactive voice response (IVR) as a channel for digital training and advisory services, particularly in underserved and digitally disconnected communities. IVR is accessible on basic mobile phones and does not require internet access, making it especially suitable for reaching smallholder farmers. She shared several examples from Viamo's work across agriculture and other sectors:

- **Kenya and India (in partnership with GIZ):**
  Viamo built an AI-powered IVR tool allowing farmers to call a toll-free hotline using basic phones and ask questions in their local languages—Swahili, Hindi, or English. The tool delivers instant, AI-generated agronomic advice. A key innovation is the accompanying dashboard that aggregates queries and responses, enabling Viamo to optimize content and delivery and better support farmers at scale.
- **Nigeria (health sector):**
  A similar IVR-AI solution was developed for community health workers who operate in remote areas. The tool enables them to call in real time to seek treatment guidance and case support, thus improving decision-making while on duty.
- **Sudan (agriculture in conflict zones):**
  In response to difficult access conditions, Viamo deployed its IVR-AI tool to provide agricultural advice to farmers in conflict-affected areas. Again, using basic mobile phones, farmers could get information on pest management, soil fertility, and general farming practices despite infrastructure limitations.

**Comparison of sectors – adoption insights:**
Nancy noted that agriculture saw particularly strong user engagement compared to other sectors. Farmers consistently demonstrated eagerness to learn, apply, and share knowledge, driven by a clear desire to improve their livelihoods. However, she emphasized that strong engagement was also observed across sectors such as:

- Health (e.g., community health worker tools)
- Education (e.g., teacher training)
- Disaster response and
- Financial literacy

In all these contexts, the *IVR platform has proven to be a reliable tool for behavioral change and knowledge transfer.* When combined with AI, the tool becomes even more powerful—providing localized, real-time, inclusive, and free support to those who need it most.

## Key takeaways from the Viamo intervention

- *IVR remains a highly effective, scalable solution* for reaching farmers and other underserved groups.
- *AI integration* enables dynamic, multilingual, real-time advisory that goes beyond static content delivery.
- *The sectoral versatility of IVR* + AI solutions underscores their broader potential in global development.
- *Dashboards for data aggregation* are instrumental in improving tools iteratively and ensuring responsiveness to user needs.
- Farmers have shown *strong motivation and uptake*, especially when tools are offered in their language, free of cost, and on platforms they already use.

## Digital Green's PharmaChat Experience: User acquisition, retention, and scale strategy

Nereah Okanga presented Digital Green's journey with AI-driven advisory services through their PharmaChat platform, which currently hosts over 170,000 users across India, Kenya, Ethiopia, and Nigeria. The platform has fielded more than 1.8 million user questions to date.

**User acquisition strategy:**

- **Multi-channel onboarding**: Combines digital advertising (e.g., Facebook communities) with in-person onboarding sessions in Kenya and Bihar, often coordinated with local governments to build trust and legitimacy.
- **Prerequisite preparation**: Farmers are asked to bring smartphones with mobile data preloaded to onboarding sessions, as the application is Android-based.

- **Localized support**: Visual aids and tutorials are crucial, especially for women and elderly farmers. Training includes how to download the app, navigate it, and ask effective, ‘smart’ questions.

**Retention tactics:**

- **Smart question templates** help users learn how to engage productively with the chatbot.
- **Peer learning**: Women farmers are paired together during onboarding to encourage active participation and boost confidence.
- **Community champions**: Highly engaged users (“super users”) are recruited as community champions, encouraging uptake among their peers and expanding the platform’s reach organically.

**Scalability approach:**
Digital Green is currently focused on controlled rollouts in specific regions of Kenya and Bihar to refine their understanding of user needs beyond advisory services—such as access to markets, inputs, and credit. Plans to scale involve:

- Building a 360-degree service ecosystem through public-private partnerships.
- Adopting multi-channel access (IVR, USSD, SMS, mobile apps) to ensure inclusivity for users with feature phones.
- Co-developing solutions with ecosystem actors to address the fragmented nature of digital agriculture services.

## Business model and integration – Opportunity International and Digifarm

Joe Munene of Opportunity International emphasized the importance of sustainable business models that are rooted in delivering tangible value to smallholder farmers.

**Pilot and learning approach:**

- A pilot project in partnership with Digifarm (Safaricom) and GIZ has been launched, focusing on the potato value chain in Nyahururu, Kenya.
- The goal is to generate lessons from a controlled setting—one crop, one region, and in limited languages (English and Swahili, with vernacular to follow).

**Business model considerations:**

- The service must align with the full agricultural cycle: pre-production, production, post-harvest, and market access.
- AI-powered advisory is not viewed as a standalone product but as a feature integrated within a broader digital ecosystem.
- Monetization models under consideration include B2B partnerships (e.g., input suppliers), subscriptions, and donor/government-supported approaches.
- The value proposition must remain centered on increasing yield, productivity, and income for farmers—only then can the service be sustainably priced or subsidized.

**Conclusion**

This panel provided a comprehensive overview of the current state and future potential of AI-powered agricultural advisory services tailored for small-scale farmers. The AIEP initiative, with its collaborative, open-source, and user-centered approach, offers promising models for scaling inclusive, localized, and dynamic solutions using GenAI. However, key challenges in data governance, gender sensitivity, and cross-platform interoperability remain at the forefront as the project enters its next phase.

## Analyzing Earth Observation data Using AI

Charles Spillane. Photo: ILRI/Wandera Ojanji.

Presenters: Charles Spillane and Jemima O'Farrell, University of Galway

In this session, Spillane and J O'Farrell from the University of Galway, focused on the development and application of AI and satellite-based Earth Observation (EO) to monitor and evaluate climate change adaptation in agriculture. Their central contribution is the Tracking Adaptation Progress in Agricultural Systems (TAPAS) platform, a novel, AI-enabled tool designed to assess agricultural adaptation at multiple spatial scales.

Spillane emphasized the urgent need for scalable, interoperable systems to measure the effectiveness of adaptation efforts across national and landscape levels, especially given the estimated 20 million km² of agricultural land at climate risk, impacting over 2 billion livelihoods. He highlighted the platform's potential to guide climate finance decisions and to standardize how adaptation outcomes are measured across regions.

O'Farrell presented use cases demonstrating the platform's capabilities:

- **Senegal River Valley**: Using deep learning and satellite data, the team assessed a USD 170 million United States Agency for International Development (USAID) investment in irrigation infrastructure aimed at boosting rice production. While the intervention initially succeeded in expanding double-cropping and productivity, results showed a sharp post-COVID 19 decline due to poor canal maintenance and invasive weeds. Satellite-based monitoring helped identify infrastructure degradation and offered actionable insights.
- **AI for climate adaptation attribution**: A model was trained on historical climate-agriculture data to predict crop outcomes under current climate conditions. By comparing predicted versus actual outcomes, the team could infer adaptation (better-than-expected performance) or maladaptation (underperformance), allowing targeted exploration of effective or failing interventions.
- **Monitoring Alternative Wetting and Drying (AWD)**: In collaboration with IRRI, a machine learning-based algorithm was developed to monitor AWD practices in rice paddies, aimed at reducing methane emissions. Preliminary results showed ~88% accuracy, with work ongoing to improve reliability for potential farmer incentives.
- **Soil moisture monitoring in Malawi**: A colleague developed a robust satellite-based algorithm to track soil moisture at scale. Findings helped distinguish areas with higher drought resilience and indicated where conservation agriculture was effective.
- **Groundnut mapping and beyond**: Another AI-based mapping initiative focused on groundnuts in Malawi was successfully executed despite limited ground-truth data. Plans are underway to expand this work to 20+ crops under the "Like the Dead" project, enhancing crop-specific intelligence at scale.

Finally, O'Farrell noted ongoing work on urban food systems and multidimensional poverty mapping, integrating EO data to explore food access and sustainability in cities.

**Key takeaways**

- The TAPAS Platform provides a scalable, geospatial tool to track adaptation progress and measure investment impacts using EO and AI.
- Post-intervention evaluation using satellite data can reveal weaknesses such as infrastructure degradation and offer early signals of maladaptation.
- Integrating remote sensing with predictive modeling allows for a more nuanced understanding of climate resilience outcomes.

## Artificial intelligence in genebank management and use–the International Rice Genebank

Presenter: Venuprasad Ramaiah, research unit leader, Fit-for-Future Genetic Resources, IRRI

Ramaiah presented an in-depth overview of how AI is transforming the management and use of crop genetic resources in genebanks, using the International Rice Genebank (IRG) at IRRI in the Philippines as a use case. With over 132,000 accessions from 134 countries, IRG is among the most comprehensive rice collections globally. Despite its reputation as a well-maintained and highly utilized genebank, there remains a significant opportunity to modernize operations and expand the utility of the collection.

**Key highlights:**

**1. AI for routine genebank operations**

- **Seed sorting and cleaning**: Automated using robotics with built-in AI/ML algorithms, replacing manual labor.
- **Seed viability testing:** Semi-automated systems using robotics and AI now handle the previously labor-intensive process.
- **Seed characterization**: AI-enabled tools such as the Videometer can assess seed descriptors via image analysis, replacing manual measurements.

**2. Advanced trait analysis**

- **Panicle architecture and biomass**: Previously unmeasurable or laborious traits are now being assessed using ML models, mobile apps, and drone-based imaging, enabling high-throughput phenotyping.
- **Digital grain identifier**: An in-house ML classification model trained on the entire collection allows for seed authentication and prediction of accession identity based on image inputs.

**3. Understanding and visualizing genetic diversity**

- AI tools have enabled “bird’s eye view” visualizations of morphological variation across the collection, providing insight comparable to high-density genotyping.
- Intra-accession variation can now be quantified, enhancing decision-making for breeding and distribution.
- AI has been used to infer the geographical origin of certain accessions, such as tracing the Italian variety Astiglia to its probable Asian origins—insights previously only available through genomic sequencing.

**4. Data management and user experience**

- Integration of genebank databases with large language models (LLMs) allows for natural language querying, facilitating broader and more democratic access to genebank information, especially for non-specialists.

**5. Accelerated screening for climate-resilient traits**

- Using an AI-driven approach, IRRI screened over 60,000 accessions—nearly half the genebank—in one season for flood, drought, and salinity tolerance.
- By contrast, only ~18,000 accessions were screened for flood tolerance in the previous 45 years. This approach, supported by a competitive Google grant (2023), significantly reduces both time and cost, enabling faster identification of materials suited for climate adaptation.

# Artemis: AI-powered digital phenotyping for public breeding in the Global South

**Panelists:**

- David Guerena, Alliance of Bioversity International and CIAT
- Lennart Woltering, Alliance of Bioversity International and CIAT
- Violet Lasdun, Alliance of Bioversity International and CIAT
- Stephen Mutuvi, Alliance of Bioversity International and CIAT
- Juan Lucas Restrepo, Alliance of Bioversity International and CIAT
- Gustavo Teixeira, CIMMYT

Panelists discussing Artemis, a Tanzania-based initiative that deploys AI-powered digital phenotyping to enhance public breeding programs across the Global South. Photo: ILRI/Wandera Ojanji.

## Overview

This session focused on Artemis, a Tanzania-based initiative that deploys AI-powered digital phenotyping to enhance public breeding programs across the Global South. Moderated by Lennart Woltering, the session combined technical presentations with broader reflections on innovation, frugal technology, and the role of partnerships in making AI-based phenotyping accessible and impactful.

## Key presentation highlights

### David Guerena, Alliance of Bioversity International and CIAT

**1. The problem: human error in phenotyping**
David Guerena introduced the foundational challenge: traditional phenotyping relies heavily on human observation, which is time-consuming, subjective, and error prone. Even in simple traits like plant stand count, high inter-observer variability was documented. This unreliability increases with complex traits such as pod or flower count.

**2. The opportunity: AI and computer vision**
To address these challenges, the team explored computer vision-based phenotyping using affordable tools–specifically smartphones–which are accessible to most breeders, even in resource-limited contexts. Unlike drones and robotics, smartphones offer scalability and flexibility, including the ability to capture plant structures under the canopy.

**3. From prototypes to field-ready tools: "Bruno"**
Manual smartphone photography proved laborious, prompting the creation of a simple phenotyping cart—nicknamed Bruno. Through iterative prototyping (from "V0 crap" to "V9 functional"), the team developed a frugal yet effective solution made from local materials like bicycle parts and welding components. Bruno now enables a 30-second scan per plot, dramatically improving both efficiency and data quality.

**4. Model accuracy and trait complexity**
The accuracy of AI models varies by crop and trait. Traits that are easily visible to the human eye—like bean pods—yield better model performance than those obscured by occlusion or similarity (e.g., cowpea tendrils resembling pods). The team emphasized the importance of fit-for-purpose models: no one-size-fits-all solution exists for phenotyping across crops.

**5. The cost of training AI: Annotation bottlenecks**
Developing effective AI models requires annotated images. For segmentation models, annotating a single image can take 10-20 hours. Given the CGIAR's diversity of crops and traits, this represents a substantial workload. To address this, the team has established a 50-person annotation unit in the Philippines working full-time on model training data.

**6. Open technology and scaling**
The Artemis project is building a comprehensive tech stack including images, annotation libraries, and AI models that are being packaged as global public goods. The aim is to serve breeding programs globally, particularly National Agricultural Research Systems (NARS) in low-resource settings.

**7. Beyond technology: Purpose and partnerships**
Guerena emphasized that AI is not an end in itself but a means to address global development challenges–malnutrition, poverty, food insecurity–by empowering the people closest to those issues. This includes investing in interdisciplinary teams (AI, breeding, human-centered design) and maintaining partnerships (e.g., with Google Research) to drive innovation.

**Key takeaways**

- **Human phenotyping is unreliable**; AI offers consistent, scalable alternatives, especially via smartphone-based tools.
- **Frugal innovation**—like the Bruno cart—can dramatically reduce barriers to adoption in low-resource settings.
- The **main bottleneck is image annotation**, which requires time, labor, and infrastructure.
- Technology must be *fit-for-purpose*, centered on user needs, and focused on global development goals, not just innovation for innovation's sake.
- **Interdisciplinary teams and partnerships** are essential to translate AI potential into actionable tools for public breeding.

## Stephen Mutuvi, AI engineer, Alliance Bioversity-CIAT & Violet Lasdun, PhD candidate, London School of Economics

This session showcased the Artemis initiative, a cutting-edge digital phenotyping project leveraging AI tools—including speech recognition and large language models (LLMs)—to bridge critical gaps in participatory agricultural research. The discussion focused on how these technologies are enabling more inclusive, scalable, and context-sensitive data collection in Global South contexts, especially within rural and low-resource environments.

Mutuvi opened by highlighting the limitations of traditional data collection in rural communities due to infrastructure and literacy barriers. He emphasized the value of collecting open-ended speech data directly from farmers, allowing researchers to better understand local needs and preferences, particularly in the context of plant breeding. This shift moves away from structured surveys—which impose pre-defined categories—and instead supports bottom-up insights, where data emerges organically from farmer voices.

Mutuvi introduced SIKIA, a forthcoming product named after the Swahili word for "listen." The tool processes audio interviews via automatic speech recognition (ASR) models such as WISPA—particularly suited for low-resource languages like Swahili—and uses LLMs for natural language understanding. These models enable automatic transcription, sentiment analysis, and even emotion detection without requiring manual labeling or fine-tuning.

The use of open-ended, voice-based responses enhances inclusivity, particularly for populations with lower literacy levels, and enables large-scale, nuanced data collection with reduced logistical burdens.

Lasdun then presented a detailed use case from the Development Smart Innovation through Research in Agriculture (DeSIRA) project in Tanzania. This case study focused on participatory variety selection (PVS) in common bean trials, a context where farmer feedback is essential yet traditionally difficult to scale.

To address the trade-off between depth (nuanced, qualitative insights) and breadth (large, representative datasets), the project recruited local youth enumerators from 40 remote villages–many considered inaccessible during rainy seasons. These enumerators collected open-ended audio responses from 480 farmers during trials using the tricot methodology, a decentralized approach in which farmers compare three crop varieties on their own farms.

The recorded interviews were transcribed using ASR models, then analyzed using LLMs to extract opinions, assess sentiment, and identify underlying themes through topic modeling. Notably, the researchers used OpenAI's embedding models and clustering techniques to semantically analyze thousands of individual farmer statements, identifying traits such as taste, cooking time, pod maturity, and plant vigor—often in highly context-specific terms.

These insights were then visualized and analyzed for demographic trends. For example, women tended to prioritize taste and cooking qualities, while men more frequently cited agronomic traits. A playful yet insightful finding also revealed that women communicated their preferences more efficiently, while men tended to be more verbose.

The analysis also allowed for trait prioritization and variety evaluation, helping breeders understand which characteristics resonate most with different farmer groups. Importantly, these insights emerged directly from farmer voices rather than pre-imposed survey categories, leading to richer, more actionable data.

In closing, Mutuvi noted that the ultimate goal of SIKIA is to support researchers across domains—from agriculture to health and education—by providing a flexible, AI-powered platform that transforms audio input into structured, actionable insights. He also mentioned plans to integrate multimodal inputs, such as photographs, to further enrich analysis in use cases like disease detection.

## Presenters: Jacob van Etten, director, Digital Inclusion, Alliance of Bioversity and CIAT and Gustavo Teixeira, Automation and Mechanization lead, CIMMYT

van Etten presented a compelling case for the use of AI-powered tools in agricultural research, particularly in the field of public breeding. The presentation emphasized how artificial intelligence, when deployed in the context of the Global South, offers transformative potential by taking breeding research beyond controlled experimental conditions and into real-world farming environments

He introduced two AI applications: digital visual phenotyping and speech-to-text technologies. These tools aim to improve the relevance and effectiveness of breeding efforts by enabling the collection and analysis of data directly from the field and from farmers' experiences. This approach moves away from traditional ideal-condition breeding and toward a more context-sensitive science.

**Key themes**

1. **Recontextualizing breeding research**
   Van Etten highlighted how traditional breeding research often fails to translate well into real-world environments. Drawing a comparison with social psychology experiments in labs that do not predict consumer behavior, he argued for embedding scientific research directly in farmers' fields and communities to capture the true performance and utility of crop varieties.

2. **AI in the field – beyond the desk**
   AI in agriculture is not limited to computational models; it also involves tangible, on-the-ground innovations like the development of simple yet essential tools (e.g., pushcarts for data collection) and standard operating procedures (SOPs). These physical and procedural foundations are critical to enabling AI to function effectively in rural environments.

3. **Capturing farmers' insights through speech-to-text**
   AI tools such as speech recognition allow researchers to extract rich, contextual data from farmers that would not emerge through structured surveys. For example, in Costa Rica, farmers opted for an early-maturing bean variety not for its yield, but because it allowed for timely onion cultivation—providing higher overall income due to seasonal market prices.

4. **AI to enhance qualitative research capacity**
   The role of AI in transcribing, analyzing, and even guiding qualitative interviews was emphasized. Van Etten proposed that AI could train researchers in interview techniques and context-aware questioning before they enter the field, thereby enhancing the quality of qualitative data collection.

5. **Toward a holistic tool ecosystem for breeding**
   Van Etten advocated for the integration of AI with on-farm testing, market intelligence, and qualitative research to build an interconnected ecosystem of tools. This would enable breeding programs to align more closely with farmers' needs and to design "breakthrough products" that address unanticipated but critical issues.

## Implications and future directions

The session underscored that breeding for impact in the Global South requires not just better genotypes, but better understanding of how those genotypes perform in real-world, socioeconomically complex contexts. AI, in this vision, serves as both a catalyst and a connector—linking phenotyping, farmer voice, market data, and agronomic practices.

Van Etten concluded by stressing the importance of continued investment in this area, emphasizing that AI in agriculture must be grounded in field realities and user needs to achieve its full transformative potential.

Teixeira, global shared services leader for breeding resources at CIMMYT, spoke about the institutional maturity now present within CGIAR and national programs to adopt digital phenotyping tools effectively. He recounted how, since joining CGIAR in 2018, he had witnessed significant progress in readiness—from better-defined market intelligence to improved breeding program management. Teixeira highlighted the urgency of digitization for reducing phenotyping costs, enhancing data standardization, and attracting younger scientists to the field. He underscored the critical role of tools like Artemis in accelerating variety development, not only in on-farm trials but also within controlled research station environments. According to Teixeira, the ecosystem of digital tools under development is poised to reshape breeding workflows in the near future.

## Q&A highlights and audience engagement

Several audience members posed technical and strategic questions, prompting detailed responses from the panel.

- **Agronomist's perspective**: A participant reflected on the challenges of large-scale, lengthy surveys and expressed interest in using voice recognition tools to streamline data processing. In response, speakers noted ongoing efforts to develop AI-supported, semi-structured interview models. They clarified that while voice AI won't replace structured surveys entirely, it adds substantial value where nuanced, in-depth information is required—such as income source profiling or disease management practices.

- **AI hallucination and dialect variability**: A participant raised concerns about AI hallucination and transcription accuracy in multi-dialect Swahili contexts. Steve addressed these concerns by explaining how tightly constrained prompts and ground-truth validation helped manage hallucination. He acknowledged the need for dialect-specific training data, particularly in low-resource language settings like Swahili, and emphasized the necessity of preparing 500–1,000 training examples to fine-tune transcription models effectively.

- **Cultural and adoption barriers**: A question from Fardosa focused on socio-cultural resistance to new technologies in areas with informal land tenure systems. The panel acknowledged such barriers and emphasized the importance of data privacy, informed consent, and farmer trust-building to facilitate adoption and participation.

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