Leveraging AI for Inclusive Climate Services in Kenya (and Beyond)

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November 11, 2025

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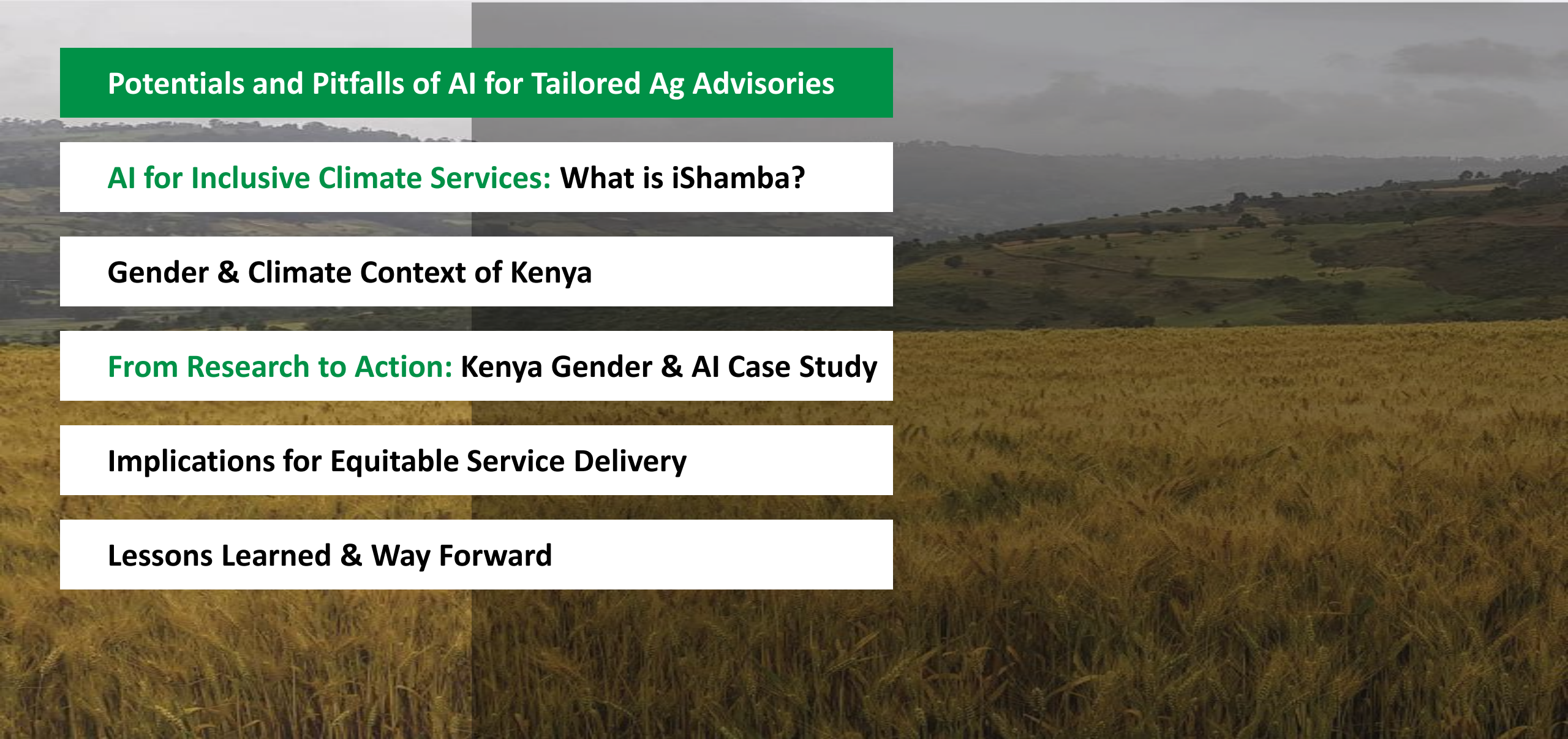
Overview of the Presentation



Potentials and Pitfalls of AI for Tailored Ag Advisories

AI for Inclusive Climate Services: What is iShamba?

Gender & Climate Context of Kenya

From Research to Action: Kenya Gender & AI Case Study

Implications for Equitable Service Delivery

Lessons Learned & Way Forward

Potentials and Pitfalls of AI for Tailored Agricultural Advisories

Potentials (Benefits) ✅	Pitfalls (Risks) ⚠️
🎯 **Personalized advice** – Tailors recommendations using weather, soil, and crop data	🗂️ **Data gaps & bias** – Poor datasets can lead to inaccurate or unfair advice
⏱️ **Real-time support** – Provides instant guidance via apps or chatbots	🔗 **Over-reliance** – Possible neglect of local knowledge and traditional practices
🌍 **Scalable & multilingual** – Reaches millions in local languages	📶 ❌ **Digital divide** – Limited access to smartphones and connectivity excludes vulnerable groups
🌦️ 🚨 **Early warnings** – Predicts pests, droughts, and market changes	🔒 **Privacy concerns** – Risks around ownership and misuse of farmers' data
🤝 **Inclusive access** – Extends services to women, youth, and marginalized farmers	🔀 **Context mismatch** – Advice may be impractical or culturally inappropriate

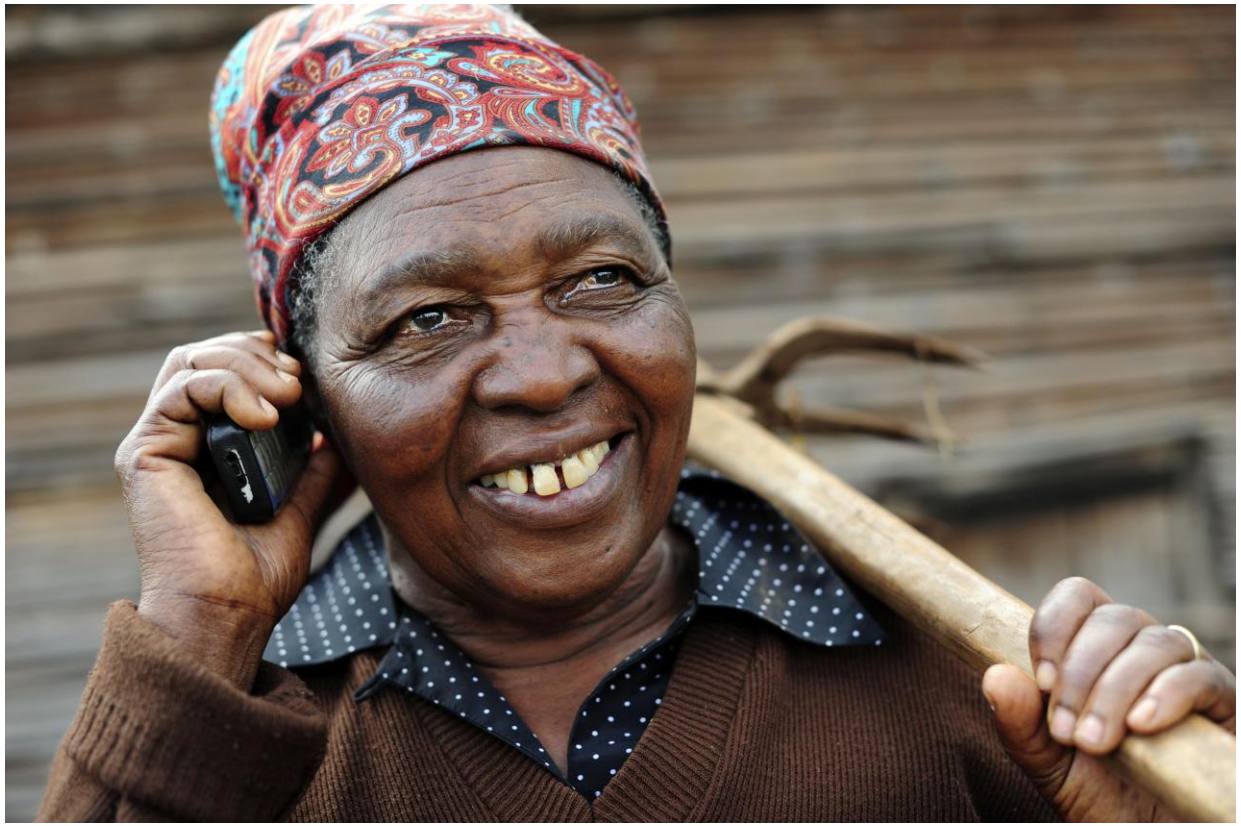
What is iShamba?

iShamba is a private digital agricultural information service in Kenya that provides **550,000+ farmers** with real-time, tailored advice through **SMS**, **voice**, and **WhatsApp**.

Services Provided:

- Weather & climate forecasts
- Crop & Livestock Management Tips
- Market Price Updates

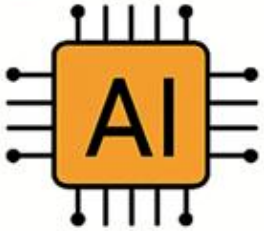
Bridging Gender Gaps in Digital Agro-Advisories: Leveraging AI for Inclusive Services in Kenya



❓ Motivating question:

How can we harness the power of AI to create more ***gender-responsive*** and ***gender-sensitive*** advisory services for Kenyan farmers?

Climate & Gender Context in Kenya



Women perform the majority of agricultural labor in Kenya but are 15-25% less likely to access digital climate advisory services.

Climate change and variability are increasing risk of: erratic rainfall, prolonged dry spells, and pest/disease outbreaks.

Women need tailored advisories to support their adaptation.

Without inclusive design, digital advisories using AI for tailored services can unintentionally reinforce gender inequalities.

From Research to Action 🎬

What We Did: Before designing or training an AI system for tailored and inclusive advisories, we first needed to understand **existing gender-related biases** in iShamba's advisory system, to account for them and address them.

→Undertook analysis of gender-disaggregated data collected over **5 years** from iShamba's SMS advisory platform, via raw dataset of over **9,000 queries** submitted by women farmers.

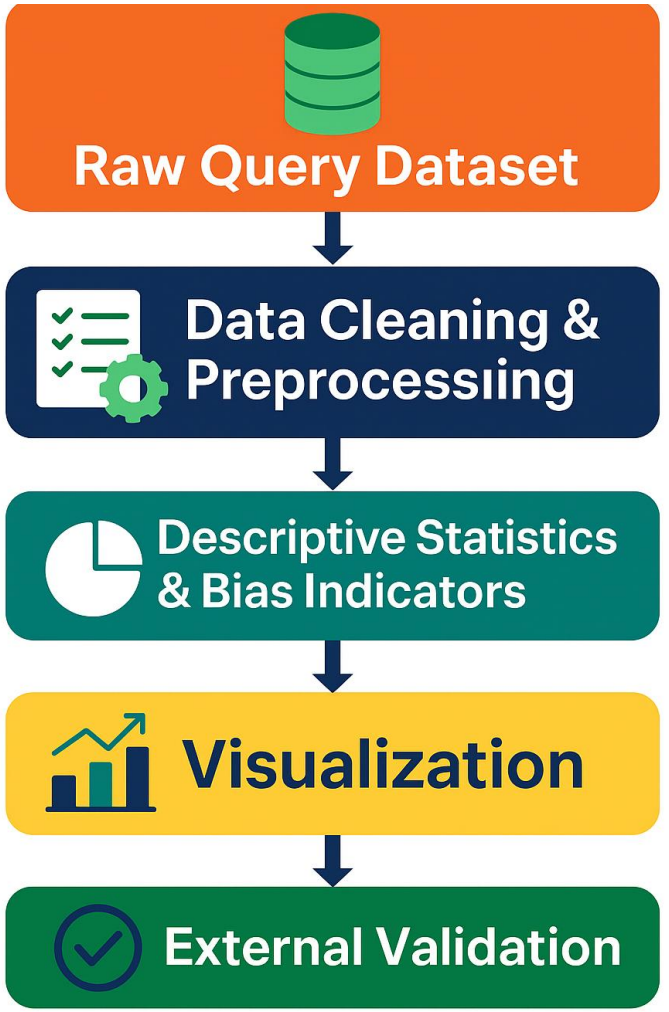
Goal: Synthesize the results and implications of identified patterns of gendered bias in user engagement and query resolution to provide **actionable guidance** to iShamba to strengthen its advisory services and inform AI system design.

Methodology (Part 1)

Data Source & Scope: Analyzed five years of text-based queries (2020–2025) from women farmers using the iShamba platform, focusing only on SMS and text channels to prepare for future AI-driven advisory tools.

Dataset Composition: Included query text plus metadata such as submission date, classification category, farmer GPS location, and county-level data.

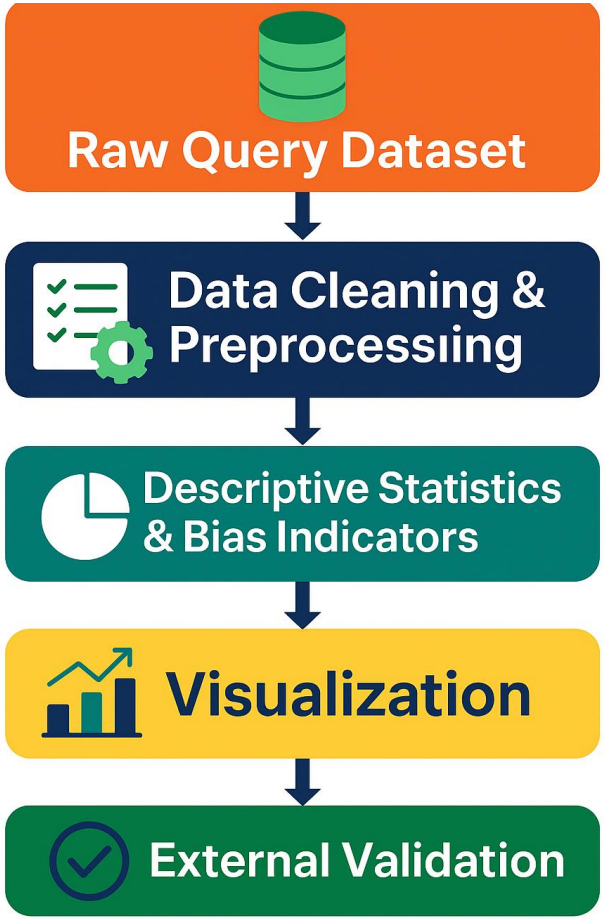
Processing & Cleaning: Used Python (pandas, matplotlib) and basic NLP techniques to clean data by removing test entries, one-word or non-English messages, and duplicates, reducing the dataset from 9,000 to 2,792 unique queries while preserving representative repeated questions.



Methodology (part 2)

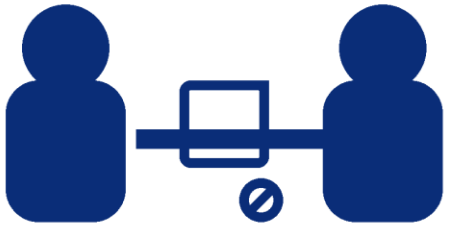
Validation & Bias Detection: Cross-referenced external datasets (e.g., regional farming population statistics) to identify underrepresented regions and calculated bias metrics like gender distribution, referral rates, query length, and language use, with language classified through a keyword-based dictionary and manual review.

Limitations & Outcomes: Despite challenges like mixed-language queries and incomplete metadata, the methodology effectively uncovered key gender bias trends using descriptive statistics and highlighted regional gaps in platform usage.

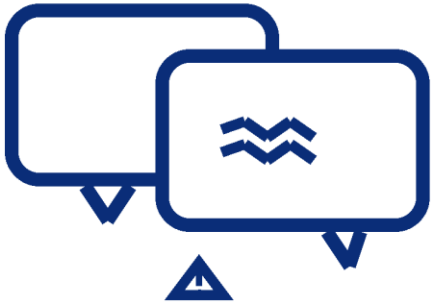


Key outcomes: *Gender-related biases*

1. Referral bias: Women's queries were significantly *more likely to be escalated* to other agricultural officers, veterinary experts, or external agents. This occurred because their queries were often shorter, mixed-language, or required specialized diagnosis, which frontline agents could not resolve remotely. Escalation translates into higher costs for users through travel expenses, service fees, and *delayed responses* that risk worsening farm losses.



2. Language bias: A strong correlation was observed between English-language queries and the quality or length of responses. *Non-English queries, or those written in informal or local dialects, often received shorter and less informative responses*. This likely reflects a mix of factors, including agent proficiency being higher in English, response templates designed primarily in English, and the tendency for non-English queries to be shorter or more ambiguous, making them harder to answer in detail.



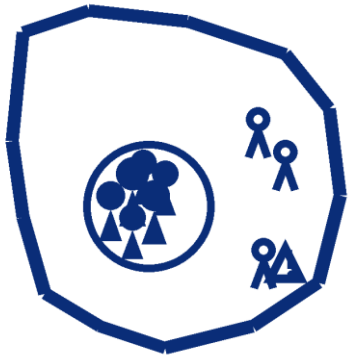
Key outcomes: *Gender-related biases*

3. Brevity and ambiguity: Women's queries tended to be very short, often fewer than five words, and lacked context. This brevity led to *misinterpretation or generalized advice that failed to address specific needs*.

3. Duplication: Many women's queries repeated the same phrasing or questions, often because *earlier attempts went unanswered or were misunderstood*. While exact duplicates were filtered out, one representative copy of each was retained, so these reflect unique entries. Frequently repeated examples included queries such as 'What is the best fertilizer for maize?' and 'How can I control Fall Armyworm?,' showing persistent information needs among women farmers.

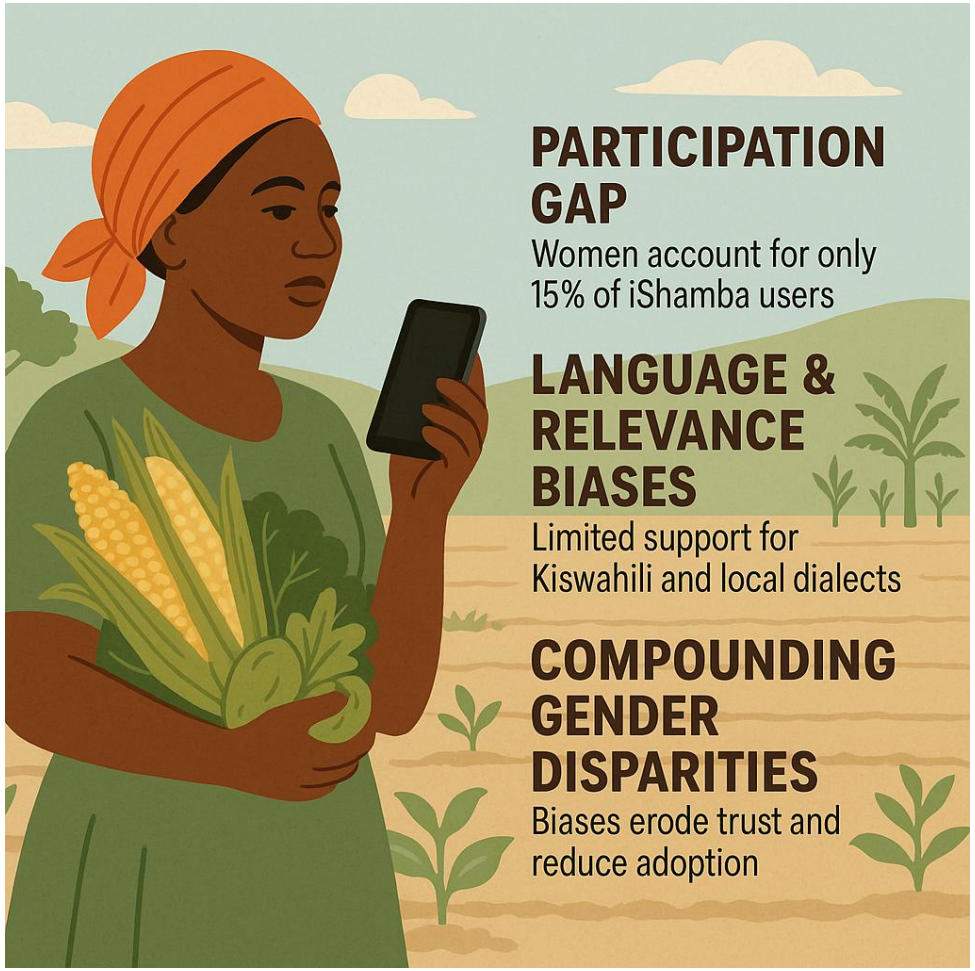
Key outcomes: *Gender-related biases*

5. Regional bias: There was *uneven representation across geographic regions*, with some counties such as Bungoma and Kakamega overrepresented. *This pattern reflects broader digital divides*, since counties with better network coverage, higher population density, and more commercial farming activity were more active on the platform. It also relates to historical outreach, as these regions had stronger exposure to the Shamba Shape Up TV program and NGO-led promotions, which increased awareness and adoption of iShamba compared to more remote or marginal counties.



6. Measurement and units inconsistency: *Women frequently used local measurement units* (e.g., "debe," "gorogoro"), which were not consistently interpreted or acknowledged in responses.

Implications for Equitable Services Delivery



Participation Gap: Women account for only 15% of iShamba users, due to barriers like low phone ownership, limited digital literacy, high mobile service costs, and restrictive social norms.

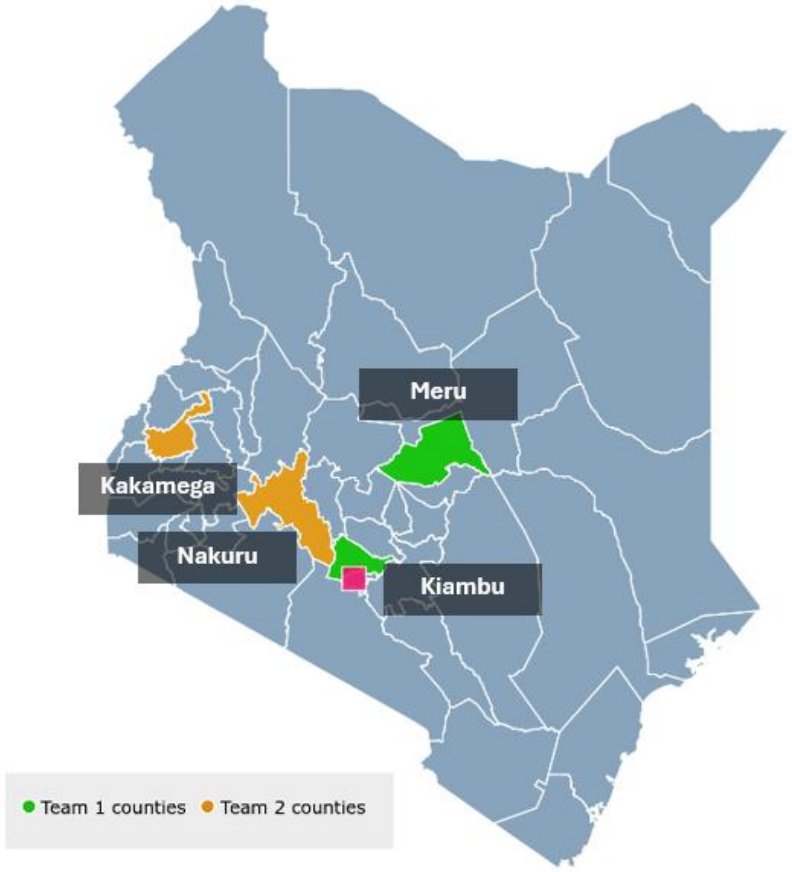
Language & Relevance Biases: Limited support for Kiswahili and local dialects leads to miscommunication, while women's agricultural priorities (e.g., food crops, small livestock, household nutrition) are underrepresented in advisory content.

Compounding Gender Disparities: These biases erode trust, reduce adoption, and risk deepening inequalities in agricultural knowledge, productivity, and resilience without intentional inclusive design.

Lessons Learned & Way Forward

Strategy	Description	Key Techniques
Augment Training Data with Women-Focused Scenarios	Include more queries and dialogues from women's agricultural and home-based activities and enterprises, such as kitchen gardens, nutrition, and small stock care. Use simulated data if needed.	Simulated Q&A, workshops with women, technical specialist feedback
Rebalance the Training Dataset	Balance male and female-origin queries in training, either by down-sampling male queries or up-weighting female ones to avoid gender skew.	Training data resampling and class reweighting
Incorporate Gender Tags in Metadata	Include gender as an input feature to help tailor AI responses contextually while ensuring careful use to avoid stereotyping.	Context-sensitive NLP, gender-aware recall patterns, human oversight
Promotion and Outreach to Increase Women Users	Conduct gender-targeted outreach, use female ambassadors, and create a welcoming UX to increase women's platform participation.	Social proof, village ambassadors, UX design for inclusivity
Gender Monitoring Metrics	Track and report usage metrics by gender, including user ratio and satisfaction, to evaluate and adjust inclusion efforts.	KPI tracking, satisfaction ratings, accuracy drift monitoring

Lessons Learned & Way Forward



- **Human-centered design workshops** for improved AI gender-responsive and sensitive advisories using AI (GPT) ongoing with **120 farmers** (80 women, 40 men) in 4 counties (Oct 6-10):
    1. Meru
    2. Kiambu
    3. Kakamega
    4. Nakuru

...thanks to CGIAR GESI Accelerator support!

Refining GPT-5 Agricultural Advisory: Key Insights

Baseline vs. RLHF Performance: We increased the rate of satisfactory answers (those scoring 1 and 2 in all four dimensions) from 62% in the baseline to 83% with the RLHF model.

Dimension	Score 2	Score 1	Score 0
Accuracy & Context-Specificity:	Scientifically accurate and minor errors. Provides sound agronomic recommendations.	Minor errors or omissions.	Incorrect, misleading, or unsound advice.
Clarity & Actionability	Very clear, well-structured, and actionable (e.g. specific steps or dosage).	Somewhat clear but ambiguous or lacking detail.	Confusing, not actionable, or lacks economic consideration.
Inclusivity (Gender Responsiveness & Accessibility)	Inclusive and respectful. Avoids assumptions, uses accessible language, explains terms.	Neutral but may lack inclusivity or use some jargon.	Biased, exclusionary, or too technical for average farmers.

Baseline GPT-5: 1.53 accuracy, 62% satisfactory

Refined GPT-5 (RLHF): 1.95 accuracy, 83% satisfactory

Human feedback raised accuracy, clarity, and inclusivity. Refinement targeted six bias types and improved bilingual, context-aware responses.

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Insights on Access, Trust, Digital Channels, and AI-Assisted Advisory Evaluation Across Kiambu, Kakamega Counties of Kenya

Access & Trust
- Farmers rely on radio and extension officers
- Youth prefer interactive digital forums
- Women depend on group trainings and peer sharing

Digital Channels
- WhatsApp, SMS, and YouTube lead in usage
- Barriers: language, connectivity, literacy
- Digital champions boost inclusion and confidence

Information Needs & Timing
- Key needs: rainfall, pests, planting, markets
- Timing peaks at planting and pest seasons

AI Advisory Review
- Farmers reviewed 10 AI-generated advisories (0–2 score)
- Criteria: clarity, accuracy, relevance, contextual fit, usefulness
- Appreciated speed, asked for local examples and simple language

Blending trusted human channels with emerging digital and AI tools builds informed, climate-resilient farmers.

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Further Reading 📖

Nganga K. Ghosh A. 2025. Bias-Aware AI in Agricultural Extension: Enhancing Equity and Inclusivity Through Human-Centered Design. AICCRA InfoNote. Accelerating Impacts of CGIAR Climate Research for Africa (AICCRA). https://hdl.handle.net/10568/174306

Nganga K, Grossi A, Wanjau A. 2025. Advancing Gender Equity in Digital Agro-advisory through Inclusive Artificial Intelligence (AI): Bias Analysis and Strategic Recommendations from the iShamba Platform Based on Five Years of Female Farmers' Queries. AICCRA Working Paper. Accelerating Impacts of CGIAR Climate Research for Africa (AICCRA). https://hdl.handle.net/10568/175290

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