<AI & Equality> African Toolbox | Case study

Design by Inclusion in AI Development: Uganda's Cassava Farming Initiative

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Introduction

In the cassava fields of Tororo, Uganda, a critical lesson about AI development was about to unfold—one that would challenge fundamental assumptions about how agricultural technology should be designed and deployed. When Daisy Salifu and her team arrived to scale an existing AI tool for cassava disease detection, they thought they understood the problem they were solving. The technology had been developed elsewhere, tested, and was ready for broader implementation. What they discovered through their "design by inclusion" approach would reshape their understanding of user-driven AI development.

The cassava farmers of Tororo had their own priorities. While researchers focused on early disease detection—a technically sophisticated solution that showcased AI capabilities—farmers were most concerned about soil analysis, nutrient management, and understanding which cassava varieties would thrive in their specific conditions. This misalignment between developer assumptions and user needs became a teachable moment that would influence AI development methodology across Africa.

Daisy Salifu's research, conducted as part of the broader AI for Development initiative, posed a fundamental question: "Could design by inclusion be a handed tool that can bring success in the integration of AI in agriculture?" The Uganda cassava project became a living laboratory for testing this hypothesis, revealing both the potential and the pitfalls of scaling AI solutions without genuine community involvement from the beginning.

The Challenge: When AI Solutions Miss the Mark

The cassava farming communities of Uganda represent the complexity of agricultural AI deployment in Africa. Women and resource-poor smallholder farmers make up more than half of Africa's farming population, yet they remain the lowest adopters of innovative agricultural technologies. This adoption gap isn't simply about access or education—it's fundamentally about relevance and inclusion in the design process.

When AI tools are developed without deliberate inclusion efforts, they can unintentionally deepen existing gender and social disparities. The Uganda project provided a clear example of this risk: an AI tool developed for disease detection was being scaled to communities whose primary concerns lay elsewhere in the agricultural value chain.

The existing AI tool had been developed through conventional agricultural technology approaches:

- **Top-down problem definition** by researchers and technical experts
- **Focus on technically sophisticated solutions** that demonstrated AI capabilities

- **Limited community input** during the initial development phase
- **Emphasis on scaling** proven technology rather than validating local relevance

This approach, while technically sound, missed the fundamental principle that effective AI must address the actual priorities of its intended users, not the assumed priorities of its developers.

Design by Inclusion:
A Methodological Innovation

The Uganda project became an opportunity to test a different approach: "design by inclusion," which Daisy Salifu defines as "developing technology to provide the best possible coverage of diversity within the user population." This methodology goes beyond simple consultation to create genuine participatory development where marginalized communities have agency in defining both problems and solutions.

Core Principles of Design by Inclusion

The approach encompasses several key principles that differentiate it from conventional AI development:

1. **Intentional engagement** with marginalized communities, including women smallholder farmers, people living with disabilities, and elderly farmers
2. **Active participation in design,** development, and deployment processes
3. **Recognition that grounded knowledge** or lived experiences of users is as valuable as expert technical knowledge
4. **Collaborative approach** that works from the ground up rather than top-down
5. **Safe space creation** for authentic participation from all community members

The Uganda Implementation

The Uganda project targeted cassava farmers in Tororo, taking advantage of an existing agricultural development initiative to test the design by inclusion methodology. The team intentionally included diverse farmer groups:

- **Women farmers** who form the majority of cassava producers
- **Men farmers** with different perspectives on agricultural priorities
- **Elderly farmers** with extensive traditional knowledge
- **Farmers with disabilities** whose needs are often overlooked in technology design

The methodology began with community dialogue designed to understand farmers' actual priorities rather than validating predetermined solutions.

The Community Dialogue Process

The heart of the design by inclusion approach was the community dialogue process, which created safe spaces for authentic participation from all farmer groups. This process revealed critical insights that would have been missed through conventional technology scaling approaches.

Creating Safe Environments

The team made several intentional decisions to ensure authentic participation:

- **Gender-Separated Groups:** Women farmers and male farmers were facilitated in separate sessions to address power dynamics and cultural constraints that might prevent women from speaking freely in mixed groups.

- **Same-Gender Facilitation:** Women's groups were led by female facilitators, men's groups by male facilitators, ensuring comfort and cultural appropriateness.

- **Recognition of Existing Knowledge:** The process began by acknowledging and documenting farmers' existing expertise in cassava cultivation, validating their knowledge before introducing new technological possibilities.

- **Collaborative Atmosphere:** Rather than presenting predetermined solutions, facilitators created space for farmers to articulate their own understanding of challenges and potential solutions.

The Critical Discovery: Misaligned Priorities

The community dialogue revealed a fundamental misalignment between the AI tool's focus and farmers' actual priorities:

- **Researcher Focus:** Early disease detection using AI image recognition
- **Farmer Priority #1:** Soil analysis to assess nutrients, examine suitable cassava varieties, and detect soil pathogens
- **Farmer Priority #2:** Pest and disease identification for timely intervention
- **Farmer Priority #3:** Market access and price management, including storage solutions and cooperative formation

This misalignment was particularly significant because it occurred at the scaling stage of a project that had already been developed and tested elsewhere. The farmers' top priority—soil analysis—wasn't addressed by the existing AI tool at all, while their second priority—pest and disease identification—was covered but wasn't their most urgent need.

Understanding the Full Agricultural Value Chain

The community dialogue process revealed that farmers think holistically about their agricultural challenges. They don't compartmentalize issues into discrete technical problems that can be solved by individual AI applications. Instead, they see interconnected challenges that require integrated solutions:

- **Soil Health and Variety Selection:** Farmers wanted to understand which cassava varieties would perform best in their specific soil conditions, requiring both soil analysis and variety recommendation systems.
- **Market Integration:** Even the most successful crop production is meaningless without market access and fair pricing, leading farmers to prioritize cooperative formation and storage solutions.
- **Holistic Pest Management:** Rather than focusing solely on disease detection, farmers wanted integrated pest management that included understanding soil conditions that might predispose crops to disease.

The Uganda project generated several crucial insights about effective AI development that

Lessons Learned: Critical Success Factors

goes beyond technical considerations to address social and institutional factors.

1. Understanding Priority Needs is Key

The most fundamental lesson was that AI tool design must align with users' highest priority needs, not developers' technical capabilities or interests. The misalignment discovered in Uganda demonstrates the risks of scaling AI tools without validating local relevance.

Implication for AI Development: Before any technical development begins, comprehensive community dialogue must establish what problems users actually want to solve, not what problems developers think need solving.

2. Farmers Have Diverse Knowledge

The community dialogue revealed that different farmer groups—women, men, youth, elderly—have different knowledge levels and different access to technology. This diversity is a strength that can enhance AI development when properly leveraged.

- **Women farmers** brought detailed knowledge about daily crop management, soil conditions, and household food security implications.
- **Young farmers** had different perspectives on technology adoption and were more willing to experiment with digital tools.
- **Elderly farmers** possessed deep traditional knowledge about varieties, soil management, and local climate patterns that could enhance AI training data.
- **Co-development that brings these diverse groups together** ensures that farmers can learn from

each other and benefit equitably, regardless of educational background or age.

3. Empowerment Through Collaboration

The process of sitting together, interacting, and discussing agricultural challenges empowers users by increasing their awareness of AI technology possibilities while validating their existing knowledge and expertise.

- **Increased AI Awareness:** Farmers gained understanding of how AI could potentially address their challenges, but in the context of their own priority-setting rather than predetermined technical solutions.
- **Value Recognition:** The process acknowledged that local knowledge is equal to expert knowledge, recognizing that farmers facing daily agricultural challenges possess crucial insights for AI development.
- **Community Relationship Building:** The collaborative process strengthened community relationships and built potential for cooperative formation—something farmers identified as important for accessing storage facilities and market power.

4. Gender-Sensitive Facilitation is Crucial

The separate, safe space approach proved essential for authentic participation from marginalized groups, particularly women farmers.

- **Safe Space Creation:** When women and marginalized groups are mixed with wealthier or more powerful farmers, inferiority complexes can prevent authentic participation. Separate facilitation addressed these power dynamics.
- **Authentic Expression:** In women-only groups, participants expressed themselves clearly about their needs and priorities in cassava production. This authentic expression was essential for understanding genuine user requirements.
- **Cultural Appropriateness:** Same-gender facilitation respected cultural norms while ensuring that all voices were heard in the design process.

5. Co-Development Works

The project demonstrated that farmers can effectively participate in all stages of AI tool development when given genuine agency in the process.

- **Feeling Valued and Heard:** Farmers who participate in co-development feel valued and heard, which increases their likelihood of adopting and adapting AI tools that emerge from the process.
- **Easier Adoption:** When farmers have been part of the development process, they more easily embrace and adopt tools because they understand how the tools address their own identified needs.
- **Sustainable Implementation:** Co-development creates ownership that extends beyond the initial deployment phase, supporting long-term sustainability and adaptation.

The Training Component: Co-Created Capacity Building

Following the community dialogue, the Uganda project included hands-on training on the existing AI tool, but even this training was co-created rather than predetermined. The training modules were developed together with farmers based on what they identified as their learning needs.

Collaborative Module Development

Rather than using standard training materials, the team worked with farmers to identify:

- **What they needed to learn** about smartphone use and AI tool operation
- **How they preferred to learn** through hands-on demonstration and peer teaching
- **What barriers they faced** in accessing and using digital agricultural tools
- **How the training could address** their specific context and capabilities

Feedback for Tool Improvement

The training process generated valuable feedback for improving the AI tool itself:

- **Interface design suggestions** based on farmer interaction with the technology
- **Feature requests** that would better serve farmer workflows
- **Technical adaptations** needed for local infrastructure and device capabilities
- **Integration possibilities** with farmers' existing agricultural practices

This feedback loop demonstrated how training can serve not just capacity building but also iterative tool improvement when farmers are treated as co-developers rather than passive recipients.

Methodological Innovation: A Scalable Framework

The Uganda project's most significant contribution was developing a replicable methodology for design by inclusion in AI development. Daisy Salifu and her team created a "Gender Equality and Social Inclusion Framework for AI Adoption in African Agriculture and Food Systems" that has been documented in academic literature and is being scaled across multiple contexts.

Framework Components

The framework includes several key components that can be adapted to different agricultural contexts:

1. **Community Entry Strategies** for building trust and establishing collaborative relationships
2. **Participatory Dialogue Methods** for authentic community engagement
3. **Safe Space Facilitation** techniques for including marginalized voices
4. **Priority Assessment Tools** for understanding user-defined needs
5. **Co-Development Processes** for involving communities in technical design
6. **Training and Capacity Building** approaches that build local ownership
7. **Monitoring and Evaluation** methods that measure empowerment and adoption

Academic and Policy Impact

The framework development resulted in a manuscript under review in the Journal of AI and Society, providing academic validation for the design by inclusion approach. This documentation ensures that the methodology can be replicated and adapted across different agricultural contexts and crop systems.

Current Limitations and Future Directions

The Uganda project team acknowledged several limitations that provide direction for future research and implementation:

Single Case Study Limitation

The project represents only one example of design by inclusion methodology applied to an AI tool at the scaling level. While it generated valuable insights, broader validation requires testing across multiple projects and development stages.

Recommendation: Replicate the design by inclusion methodology across diverse agricultural contexts and crop systems to strengthen the evidence base and refine the approach.

Scaling-Stage Intervention

The Uganda project involved an AI tool that was already developed and being scaled, rather than testing design by inclusion from the beginning of the AI development lifecycle. This limited the team's ability to demonstrate how the methodology might influence fundamental technical design decisions.

Future Direction: Apply design by inclusion methodology from the earliest stages of AI development to test its impact on technical architecture, model selection, and system requirements definition.

Context-Specific Adaptation

While the framework is designed to be scalable, each implementation requires adaptation to local cultural, social, and agricultural contexts. More research is needed on how to maintain methodological consistency while adapting to diverse contexts.

Comparative Analysis: Design by Inclusion vs. Conventional AI Development

The Uganda project provides a clear comparison between conventional AI scaling approaches and design by inclusion methodology:

Conventional Approach (Pre-Dialogue)	Design by Inclusion Approach (Post-Dialogue)
Problem Definition: Researchers identify disease detection as priority based on technical capabilities	**Problem Discovery:** Community dialogue reveals soil analysis as top farmer priority
Solution Development: AI tool developed for image-based disease recognition	**Solution Alignment:** Recognition that existing tool doesn't address primary user needs
Scaling Strategy: Deploy existing tool across multiple locations with standard training	**Adaptation Strategy:** Either modify existing tool or develop new solutions based on user priorities
Success Metrics: Adoption rates and technical performance indicators	**Success Metrics:** Community empowerment, relevance to user needs, and sustainable adoption

This comparison illustrates why design by inclusion requires more time and resources initially but may result in more effective and sustainable AI implementations.

Impact Beyond the Pilot: Influencing AI Development Practice

The Uganda cassava project's influence extends beyond its immediate implementation to impact broader discussions about AI development methodology in African agriculture.

- **Policy Influence:** The documented framework has informed policy discussions about agricultural technology development, emphasizing the need for user-centered approaches that go beyond technical considerations to address social inclusion and gender equity.
- **Academic Contribution:** The project has contributed to academic literature on participatory technology development, providing empirical evidence for the effectiveness of design by inclusion approaches in AI development.
- **Methodological Replication:** Other AI development initiatives across Africa are adapting the design by inclusion methodology, testing its applicability across different crops, technologies, and cultural contexts.

Lessons for AI and Human Rights

The Uganda cassava project offers several critical insights for AI development that respects and promotes human rights:

- **Inclusion Must Be Intentional**
Inclusion of marginalized communities in AI development doesn't happen by default. It requires deliberate methodology, resource allocation, and sustained commitment throughout the development process.

- **Local Knowledge is Valuable**
Farmers possess significant expertise that enhances AI tool effectiveness. This knowledge is not just useful for implementation—it's essential for defining what problems AI should solve and how solutions should be designed.

- **Process Matters as Much as Product**
The collaborative approach itself builds capacity and community coherence. The process of engaging communities in AI development has value beyond the technological outcomes.

- **Co-Development Creates Ownership**
When communities participate meaningfully in AI development, they feel valued and heard, leading to more sustainable adoption and adaptation of technological tools.

- **Mismatch Prevention Requires Early Engagement**
The most sophisticated AI tool fails if it doesn't address users' actual priorities. Early and ongoing community engagement is essential for ensuring that AI development serves genuine needs rather than developer assumptions.

Looking Forward:
Scaling Design by Inclusion

The Uganda cassava project demonstrates that design by inclusion can bridge the AI adoption gap among marginalized farmers through collaborative engagement. As this methodology scales across Africa, several key principles emerge for sustainable implementation:

- **Systematic Integration**
Design by inclusion must be integrated systematically into AI development processes, not added as an afterthought or optional component. This requires institutional commitment and resource allocation for community engagement throughout the development lifecycle.
- **Cultural Adaptation**
While the core principles of design by inclusion are transferable, implementation must be adapted to local cultural, social, and agricultural contexts. This requires local expertise and sustained community relationships.

- **Capacity Building**
Successful scaling requires building capacity among AI developers, researchers, and partner organizations to facilitate authentic community engagement and manage participatory development processes.

- **Evidence Building**
Continued documentation and evaluation of design by inclusion implementations will strengthen the evidence base and support adoption by academic institutions, funding organizations, and policy makers.

The cassava farmers of Tororo continue their agricultural work, but their participation in this project has influenced how AI development approaches community engagement across Africa. Their voices, initially misaligned with the existing AI tool, have become part of a growing movement toward more inclusive and effective agricultural technology development. The soil they tend—the subject of their highest priority need—remains at the center of their agricultural concerns, reminding AI developers that effective technology must grow from the ground up, rooted in the actual needs and knowledge of those who will use it.

Mapping the AI Lifecycle HRIA Framework for the Uganda Cassava Initiative

1 Stage 1: Objective and Team Composition

The project began as a scaling initiative for an existing AI tool but evolved into a test of design by inclusion methodology. Through community dialogue, the team discovered fundamental misalignment between predetermined objectives (disease detection) and community priorities (soil analysis). This revelation prompted a reconceptualization of both objectives and team composition.

HRIA Framework Alignment:

- **Purpose & Context:** The project revealed how scaling AI without community input can perpetuate exclusion of marginalized farmers, particularly women and resource-poor smallholders.
- **Effects of the System:** The existing tool benefited technically sophisticated users but missed the primary needs of intended beneficiaries, demonstrating how AI can unintentionally deepen disparities.
- **Empowering Affected Communities:** The design by inclusion approach gave farmers genuine agency to redefine the problem and assess whether existing solutions served their needs.
- **Team Composition:** The team included diverse farmer groups (women, men, elderly, disabled) as legitimate experts whose knowledge was valued equally with technical expertise.

Key Human Rights Considerations:

The project highlighted how predetermined objectives can violate the principle of meaningful participation. True human rights alignment requires communities to have agency in defining what problems AI should solve, not just how to implement predetermined solutions.

2 Stage 2: Defining System Requirements

The community dialogue process revealed that system requirements must emerge from user-identified priorities rather than technical capabilities. Farmers' requirements centered on integrated agricultural support: soil analysis for variety selection, market access solutions, and storage facilities through cooperative formation.

HRIA Framework Alignment:

- **Involving Affected Communities**: Requirements definition involved extensive community consultation with intentional inclusion of marginalized groups through safe space facilitation.
- **Explainability Considerations:** The system needed to provide explanations relevant to farmers' actual decision-making processes—soil health, variety selection, market timing—rather than disease identification alone.

- **Ecosystem of Values:** The initiative revealed tensions between technical sophistication (disease detection accuracy) and user relevance (soil analysis for production decisions), requiring conscious prioritization of user needs.

Key Human Rights Considerations:
Requirements must reflect user dignity and agency. The Uganda project showed how technically impressive requirements (AI disease detection) can miss fundamental human needs (soil health, food security, economic viability) if not grounded in community priorities.

3 Stage 3: Data Discovery

The project revealed that existing AI training data, while technically valid, didn't address farmers' priority needs. Data discovery needed to encompass soil health, variety performance, and market information—areas not covered by the disease detection focus.

HRIA Framework Alignment:

- **Data Origin:** The existing tool's training data was collected without input from Ugandan farmers, missing local soil conditions, variety preferences, and agricultural practices.
- **Data Bias:** The focus on disease detection reflected researcher priorities rather than farmer needs, representing a form of bias that marginalized user knowledge and priorities.
- **Documentation:** The project documented the misalignment between existing data and user needs, providing evidence for more inclusive data collection approaches.

Key Human Rights Considerations:
Data collection must reflect user priorities and contexts. The Uganda case demonstrates how technically sound data can still be inadequate if it doesn't address the problems communities actually face.

4 Stage 4: Selecting and Developing a Model

The existing model was technically sophisticated but addressed the wrong problem from the farmers' perspectives. The project revealed the need for models that integrate soil analysis, variety recommendation, and market information rather than focusing solely on disease detection.

HRIA Framework Alignment:

- **Model Type and Explainability:** The disease detection model was explainable but irrelevant to farmers' top priorities, demonstrating that explainability must address users' actual decision-making needs.
- **Fairness Aspects:** The model was unfair in that it addressed problems identified by researchers rather than the diverse needs of different farmer groups (women's soil concerns, youth's market interests, elderly farmers' variety knowledge).

- **Environmental Impact:** Model development resources were misallocated toward technically impressive but less relevant capabilities.

Key Human Rights Considerations:
Model selection must serve user empowerment rather than technical demonstration. The Uganda project shows how sophisticated AI can still violate human dignity if it doesn't address genuine needs.

5 Stage 5: Testing and Interpreting Outcome

Testing revealed the fundamental misalignment between tool capabilities and user needs. Community feedback showed that while the disease detection tool worked technically, it didn't address farmers' primary concerns about soil health and variety selection.

HRIA Framework Alignment:

- **Testing Context and Outcomes:** Testing occurred with actual intended users (cassava farmers) who provided authentic feedback about relevance and utility.
- **Operation Manual:** Training materials were co-created with farmers, but the training revealed that even well-designed capacity building couldn't overcome fundamental misalignment between tool capabilities and user needs.

Key Human Rights Considerations:
Testing must evaluate whether AI genuinely empowers users to address their identified priorities. Technical functionality is insufficient if the system doesn't serve human dignity and agency.

6 Stage 6: Deployment & Post-Deployment Monitoring

The project demonstrated that successful deployment requires alignment between tool capabilities and user priorities from the beginning. Even excellent community engagement and training cannot overcome fundamental misalignment in problem definition.

HRIA Framework Alignment:

- **Deployment:** The community had agency to assess the tool's relevance to their needs and provide feedback about its limitations, demonstrating genuine participation in evaluation.
- **Monitoring:** The project monitored not just technical performance but community assessment of relevance and utility, leading to insights about the need for different AI solutions.

Key Human Rights Considerations:
Deployment must serve community empowerment rather than technology adoption for its own sake. The Uganda project demonstrates that communities must have the right to reject AI solutions that don't serve their identified needs.

Integrated Analysis: Design by Inclusion Throughout the AI Lifecycle

The Uganda cassava project demonstrates several critical principles for human rights-aligned AI development:

- **User Priority Definition:** Communities must have agency to define what problems AI should solve, not just how to implement predetermined technical solutions.

- **Authentic Participation:** Meaningful participation requires safe spaces, cultural appropriateness, and recognition that local knowledge is as valuable as technical expertise.

- **Relevance Over Sophistication:** Technical sophistication is meaningless if AI doesn't address users' actual priorities and decision-making needs.

- **Early Engagement:** Community engagement must begin at problem definition, not just implementation. Late-stage participation cannot overcome fundamental misalignment.
- **Continuous Adaptation:** AI development must be responsive to community feedback throughout the lifecycle, including the possibility that existing solutions may need fundamental reconceptualization.

- **Empowerment Metrics:** Success must be measured by community empowerment and relevance to user needs, not just technical performance or adoption rates.

The Uganda experience provides a crucial counter-narrative to conventional AI scaling approaches, demonstrating that technical success is insufficient without human rights alignment throughout the development lifecycle.

About the case study and author

This case study analyzes research conducted by the African Technology Policy Studies Network (ATPS), in collaboration with the International Centre of Insect Physiology and Technology (icipe), Kenya and Kumazi Hive (Ghana) that focused on Strengthening the Capacity of Women and Marginalized Communities in Africa's Agriculture and Food Systems to Harness the Potentials of Artificial Intelligence Technology in alliance with Artificial Intelligence for Agriculture and Food Systems (AI4AFS) project in Uganda titled "Scaling Smartphone-Based Tools for Early Crop Diseases Detection and Monitoring" led by Dr. Godliver Owomugisha of Busitema University, Uganda, with partners Community Development Foundation, Uganda, and Nyakasozi Tukooreamwe Coffee Farmers' Co-operative Society Limited, Uganda, between 2022–2024

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Other contributors to this case study are Caitlin Kraft-Buchman, Emma Kallina, and Sofia Kypraiou, authors of the original *Framework to AI Development: Integrating Human Rights Considerations Along the AI Lifecycle* upon which the Toolbox structure is based. Additional contributors are Amina Soulimani and Pilar Grant, from Women at the Table and the <AI & Equality> Human Rights Initiative.