Agenda setting brief - 8

FROM DIGITAL DIVIDE TO OPPORTUNITY

Digital Solutions to Transform Food, Land and Water Systems for Gender Equality, Youth Empowerment and Social Inclusion

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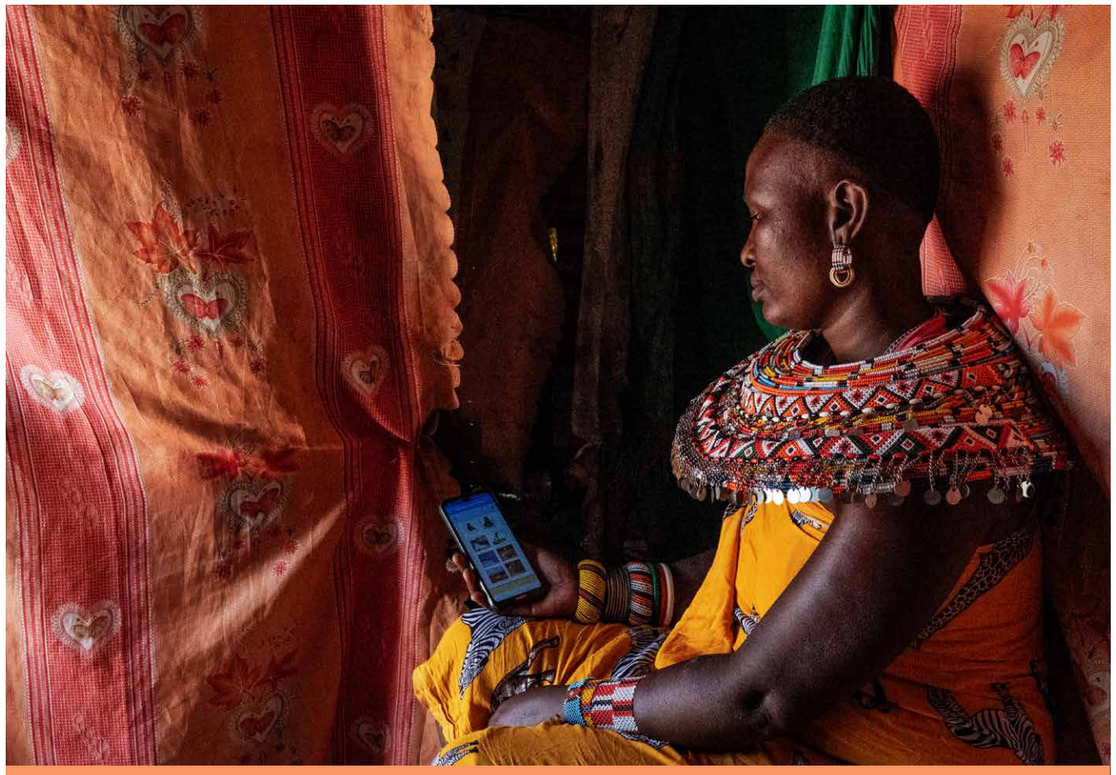
CGIAR GENDER EQUALITY AND INCLUSION

CGIAR DIGITAL TRANSFORMATION



A Samburu mother enters nutrition data into an app © ILRI/Kabir Dhanji

INTRODUCTION

Digital and data-driven innovations in food, land, and water systems (FLWs) are rapidly transforming the agri-food landscape.

A recent review identified around 1,400 active digital for agriculture (D4Ag) solutions, covering advice, markets, finances, supply chains, and entrepreneurship (Beanstalk AgTech 2023). Digital innovations offer opportunities to enhance agricultural productivity, environmental sustainability, and to better connect smallholder farmers to markets, but digital solutions may also exacerbate social exclusion.

As the digital revolution proceeds, it becomes critical to understand the impacts on productivity and income, but also impacts on smallholders across a spectrum of sociodemographic groups, and unintended environmental externalities. The digital transformation of agriculture is multi-faceted. Concentrating on just one or a few aspects is insufficient. Challenges include infrastructure access (electricity, mobile, or internet connectivity), affordability (ability to pay for digital tools and services), awareness, skills and literacy (Roberts and Hernandez 2019). Certain groups–such as women, rural youth, the poor, and people with disabilities or limited formal education–face greater barriers to digitalization (Staab et al. 2024).

Without the understanding to transform inequalities, digitalization could deepen gender inequalities and even create new forms of discrimination (Staab et al. 2024; Sterling 2021). Some fear that digitalization might even make for a new form of gender inequality (Judy Wajcman et al., 2020). As the CGIAR institutionalizes digital innovations to drive transformative changes in FLWs, it is crucial to understand and address gender inequality and social exclusion, so that digital innovations can catalyze greater social inclusion.

Digital innovation in FLWs is the design, integration, and implementation of digital tools that are used in three broad areas: (1) as a platform for delivering services, such as financial and information, and for facilitating access to input and output markets; (2) in data collection methods, metrics, and tools; (3) and in data processing and analytics. In each area, combinations of *gender-responsive and gender-transformative* strategies offer promises for advancing gender equality and social inclusion in FLWs. This promise makes several assumptions. First, *gender-responsive* digital innovations are attuned to existing gender biases and social inequities, such as gender-based differences in affordability and awareness of digital tools and the abilities (e.g., literacy and digital skills) to use them. That is, gender-responsive strategies are designed and implemented to level the digital playing field for equitable reach and benefit across demographic groups. Second, *gender-transformative* digital innovations are designed to address underlying sources of inequities by empowering women and socially disadvantaged groups as they transcend social injustices through their own actions. This more ambitious approach to advancing gender equality views digitalization as a pathway for reshaping social structures and reversing inequalities within the FLWs. Later sections of this brief offer examples of the two sets of strategies from low- and middle-income countries.

(1) Many **digital platforms** have been designed for accessing finance, advisory services, markets, and other resources (Baumüller 2018). These platforms can be used anywhere at any time, in any place with an Internet connection. This could overcome mobility and time barriers faced by women, could reach low-literacy groups (via IVR- Interactive Voice Response and other voice-based messaging in local languages), and could foster learning through wider peer networks. However, like analog and phygital (hybrid physical and digital) approaches, digital delivery platforms face challenges when trying to reach, benefit, and empower women and other disadvantaged groups. This is due to the digital access divides mentioned above, and the failure to involve diverse groups in the design, and adaptation of tools to fit their needs. Unless deliberate steps are taken to overcome these issues, digital innovations are unlikely to transform women's lives.

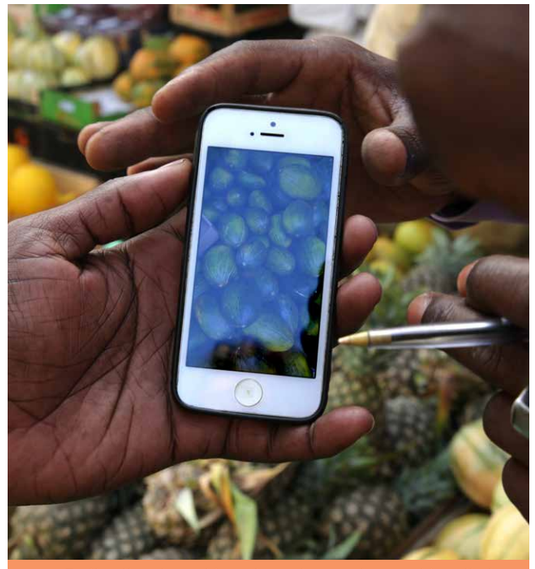
The importance of human-centred design (HCD) in digital technology is well recognized and valued in agricultural research for development (McCampbell et al. 2023; Ortiz-Crespo et al. 2021; Steinke et al. 2022). However, the widespread adoption of this approach within the CGIAR faces several challenges, including limited awareness and insufficient capacity to implement HCD (Müller et al. 2024). While HCD aims to incorporate the diverse needs and circumstances of end-users, it does not specifically target any socially marginalized groups, which distinguishes it from inclusive design (ID). ID specifically considers marginalized groups and strategizes collaboration with them to design digital tools that are later shared with broader user groups (Steinke et al. 2022). A potential drawback of ID is the risk of backlash from other groups by focusing exclusively on marginalized groups. Collectively, HCD and ID both hold merit for advancing gender and social inclusion in digital services in FLWs.

(2) **Methods and metrics** that leverage digital technology could reduce the cost and improve the quality of data collection and capture dimensions that cannot be easily collected with pen and paper. When designed with equity and inclusion goals, digital data approaches can reduce research bias by facilitating accessibility of data and enabling rigorous gender and intersectional analyses. For example, the growing use of phone surveys during the COVID-19 pandemic revealed the pros and cons of doing phone versus in-person interviews. Phone surveys can be cost-effective if women have equitable access to mobile phones. However, where women are obliged to use speakerphones, respondents could be at risk when responding to sensitive questions about finances and intrahousehold issues (Alvi et al. 2022). Specialized digital apps have also been developed to collect high-frequency data on gender-relevant topics such as diets and time use (Gelli et al. 2024; Mulder et al. 2024). Such data collection methods can ease respondent's burden while improving data quality.

The digital ecosystem is large and rapidly expanding. However, social inclusion and gender are not key drivers of digital innovations (Aker et al. 2016; Burns et al. 2022). Digital tool designers and project implementers need clear guidance, examples of best practices, and standardized measures of digital inclusion in FLWs (Dittmer et al. 2024; Steinke et al. 2024). The Multidimensional Digital Inclusiveness Index (MDII), a recent CGIAR innovation, can standardize inclusiveness in digital tools in FLWs (Martins et al. 2023). Co-designed with a wide range of actors and currently being piloted across FLW systems, the MDII serves multiple purposes. It enables co-design and evaluates inclusiveness in digital tools. It provides the framework for inclusivity certification. And it makes policy recommendations on digital inclusivity.

(3) Artificial intelligence (AI), such as machine learning (ML) models, and big data techniques for **data processing and analytics**, are easier to use with machine-readable, AI-ready datasets that are findable, accessible, interoperable and reusable (FAIR). FAIR principles require that datasets be well-documented with detailed metadata, including the context of data collection and any potential limitations, making it easier to identify biases during AI development. Here, our biggest concern is data sparsity, inadequacy, and bias in the stock of data assets and knowledge used for machine learning, AI, and other predictive approaches. Inputs from critical decolonial, gender, and heterodox scholarship continue to remain underrepresented in scientific research, especially in AI-supported studies. This increases the risk of reverting back to old-school, business-as-usual approaches. Additionally, more and better data from low- and middle-income countries is crucial to increase algorithmic fairness and model accuracy.

Standardized indices like the Women's Empowerment in Agriculture Index (WEAI), the Women's Empowerment Metric for National Statistical Systems (WEMNS) and MDII could alleviate this concern, since standardization ensures that the data adheres to common protocols, promoting interoperability across datasets. Ensuring that AI models are trained on data that adequately represents underrepresented groups is essential for producing technically-sound and socially inclusive-recommendations. Representative AI/ML could address questions on the root causes of structural constraints and therefore lead to transformative solutions.



Fruit seller shows his watermelon produce on his cell phone. He uses his mobile connection for marketing and trading at the Sandiniery market in Dakar, Senegal. © Melissa Cooperman/IFPRI

KEY ESTABLISHED RESEARCH METHODOLOGIES, INNOVATIONS OR SOLUTIONS WITH SCALING POTENTIAL

In the digital for agriculture (D4Ag) domain, inclusiveness transcends the mere access and availability of digital tools. It requires embedding the complexities of socio-economic and gender inequalities into the foundational principles of digital innovation.

CGIAR and partners are pioneering more gender-responsive and socially inclusive digital solutions that tackle the digital divide, accessibility, and gender-based violence, among other problems. However, despite the growing interest in these innovations, there is a gap in impact studies, particularly regarding their effects on smallholders, women, and youth in FLWs.

Theoretical research in this area has generated principles and guidelines to ensure that digital innovations benefit marginalized groups, stressing inclusivity, social justice, and gender equity (D'Ignazio and Klein 2023; Manzar et al. 2023; Aneja et al. 2024). As agricultural digitalization gains momentum, the need for a roadmap becomes increasingly crucial, one that prioritizes gender-responsive and gender-transformative methods to drive the development of equitable and scalable digital solutions.

CGIAR's Guide on Gender-Responsive Digital Technologies in the Agrifood Systems and User Research Toolkit (uxtools4Ag) are pioneering guidelines for designing inclusive digital products in agri-food systems. They emphasize a user-centered design that prioritizes the intersectional needs of women and marginalized communities. These resources promote digital solutions that integrate appropriate data, user insights, and partnerships to promote digital inclusion. They address the digital gender gap by providing gender-responsive methods, women-focused designs and innovation that integrates diverse perspectives.

Stakeholders within D4Ag need to comprehend the intersectional factors affecting adoption of digital solutions. According to the Gender Digital Divide Index (GDDI) Report (2022), only 10% of available D4Ag solutions focus on multiple use cases. Of these, a few digital platforms that are leading the way by systematically bundling complementary innovations to address the complex challenges in agri-food systems. These include Lersha (Ethiopia), Ricult (Thailand and Pakistan), Apollo Agriculture (Kenya and Zambia), Agrorite (Nigeria), nurture.farm (India), Growagric (Kenya), and DeHaat (India). These platforms integrate many digital services—such as finance, advisory, market access, enterprise development, and information—providing holistic solutions that eliminate inefficiencies and generate economic value for diverse groups of farmers, especially women and youth.

For instance, the CGIAR Gender Equality (HER+) initiative partnered with Lersha, an innovative digital platform used in Ethiopia to support the Veggies for Planet and People (V4P&P) project (Endrias et al. 2023). It focuses on providing digitally-enhanced agricultural services to vegetable-producing smallholders, particularly women, to produce high-value crops using organic inputs and to improve their income through premium sales. By bridging the gender gaps in access to farm inputs, machine services, and climate-smart advice through technology, it offers comprehensive market links, and financial services through multiple channels, such as mobile apps, call centers, and local agents (Endrias et al. 2023). Lersha emphasizes inclusivity, particularly for women and youth. The platform's accessibility through multiple channels ensures that it can cater to diverse user needs and literacy levels while integrating local agricultural practices to amplify its usefulness and acceptance.

The STIBs Dashboard (Socio-technical-innovation bundle dashboard) developed by HER+, aggregates datasets from global organizations like the CGIAR GENDER Impact Platform, FAO, and USDA, offering AI-ready data for supporting the (co-)design of gender-responsive, socio-technical innovation bundles across multiple FLW systems. It provides gender-disaggregated data, and insights on climate resilience and women's empowerment, among others. The STIB Dashboard can help scale-up inclusive digital interventions.

Master Farmer Pass Network (MFPN) is another leading gender-responsive digital innovation that provides smallholders, especially women, with secure digital identities through partnerships with local banks. These digital identities act as gateways to essential services, including access to agricultural inputs, financial services, and advisory tools. By bundling financial and non-financial services and empowering women with formal identities, MFPN is enhancing their financial independence, enabling them to participate in markets, and improving access to resources and knowledge. This innovation drives transformative change by addressing gender-based barriers and local norms and by building capacities among women farmers.

Digital methods for data collection include high-frequency phone surveys and the Food Recognition Assistance and Nudging Insights (FRANI) application. These key, gender-responsive methods offer scalable, cost-effective solutions to address the challenges that women farmers face. High-Frequency Phone Surveys (Giner et al. 2022; Baragwanath 2021) are a new tool for gathering real-time data on households and individuals during global crises, such as COVID-19. These surveys, when adapted with gender-responsive approaches, can capture detailed information about women and other vulnerable groups, especially in regions with limited access to internet. By targeting the women in the household, these surveys collect more comprehensive data on female labor burdens, food security, and access to resources. Listening to women's voices facilitates more targeted interventions. However, access to phone devices and digital skills are still common bottlenecks.

FRANI, an AI-powered mobile application, helps users track food consumption and offers nudges to improve dietary habits (Braga et al. 2024). This tool is particularly beneficial in resource-constrained settings where traditional dietary assessments are expensive and labor-intensive. FRANI captures real-time data on dietary intake, which can be disaggregated by gender to identify nutrition gaps among women and girls, who are often at higher risk of malnutrition. Its personalized nudges based on consumption data empowers women by promoting healthier food choices and improving household nutrition. This low-cost, scalable app is accessible to rural women, enhancing their participation in digital nutrition interventions.

Both of these methods provide real-time, disaggregated data on women's specific needs and challenges. By recognizing the unique barriers women face—such as limited digital access and unequal dietary roles within households—these tools offer insights that can drive tailored interventions. These methods incorporate gender-sensitive questions that account for limited access and literacy levels and outdated infrastructure, so they can be applied in diverse contexts, promoting digital inclusion, and gender equity in agriculture and nutrition.

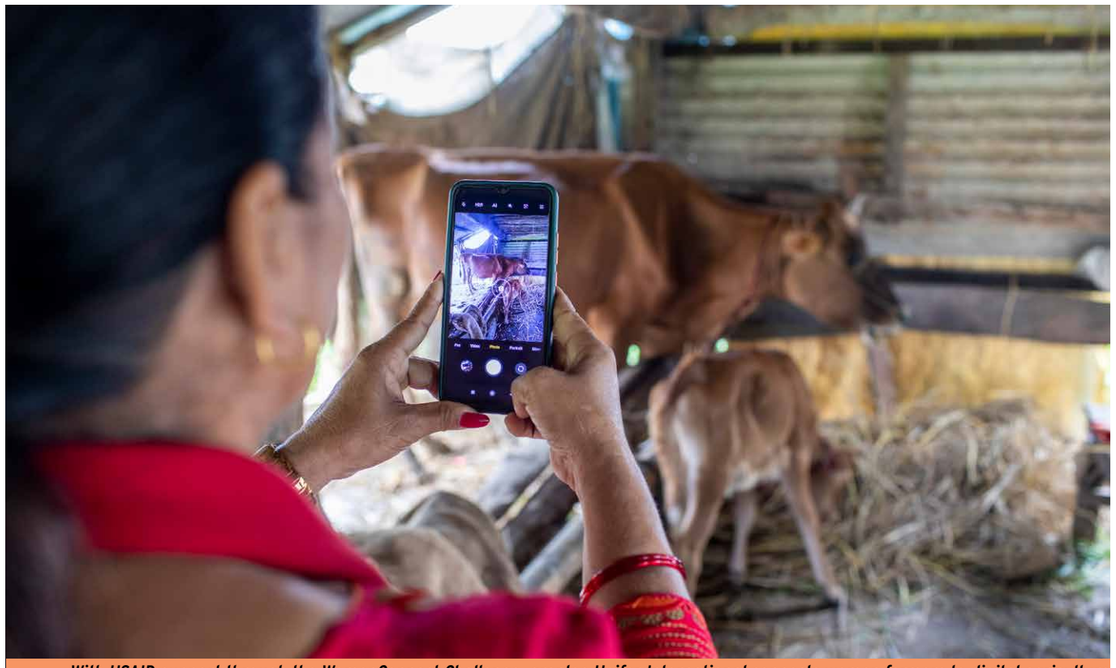
Despite the proliferation of D4Ag solutions (Beanstalk AgTech 2023), gender and intersectional considerations are still poorly integrated into these solutions. The gap between technology and impact must be bridged if these innovations are to reach women and change their lives. The Multidimensional Digital Inclusiveness Index (MDII), developed by the CGIAR's Digital Innovation Initiative, translates theoretical concepts of digital inclusiveness into a practical tool. Guided by eight principles - accessibility, transparency, methodological rigor, adaptability, intersectionality, simplicity, flexibility, and clarity - the MDII evaluates co-participation, design, problem relevance, digital data governance and risks, intended and unintended outputs, and outcomes. The tool's seven dimensions under three categories (Beneficial Impact, Social Consequences, Stakeholder relationships) help align online and offline tools for assessing a wide range of parameters, including a participatory feedback approach designed especially for "digital marginalized" users.

The MDII can standardize inclusiveness assessment, offer certification, provide predictive analysis and strategic guidance for digital innovation. The MDII is currently being piloted to evaluate rigor, relevance, efficacy, and efficiency. All these features aim to create a collaborative platform for diverse stakeholders in agri-food, water, and land sectors.

CGIAR's GenderUp scaling method offers guidance to scale digital agricultural innovations in a gender-responsive and socially inclusive way. GenderUp helps to understand the gendered implications of digital solutions and to anticipate unintended negative consequences for different groups.

Beyond the above examples, there are many other digital solutions and methods that can advance gender equality and social inclusion. For example, M-PESA makes it easier for women to use money and to take part in formal economy. GSMA's Mobile Survey Toolkit collects data through mobile surveys with women farmers. Digital Green's Participatory Video methodology that uses videos to engage women farmers in data collection. SenseMaker for digital ethnography combines the scale of numbers with the explanatory power of narrative to collect experiences and challenges facing women in agrarian communities. Gender and GIS guidelines provide stepwise guidance on how to undertake a gender analysis that will inform the production of GIS applications for agricultural monitoring. These methods offer a wealth of opportunities to empower women and youth in FLWs, from improving access to markets and financial services to enhancing their participation in decision-making.

A digital repository helps to curate the evidence on what works for women and youth across FLWs, and to collect, analyze and use data, and to promote the collaborations needed to advance gender goals more systematically. The CGIAR GENDER Equality and Inclusion resource hub includes publications, datasets harvested through Guardian (the Global Agricultural Research Data Innovation Acceleration Network), as well as methods, tools, and training courses. The hub is a valuable resource, facilitating the exchange of knowledge and expertise. This resource hub demonstrates how digital tools can enhance collaboration and provides a centralized go-to-place for stakeholders to access guidance on advancing gender equality in FLWs.



With USAID support through the WomenConnect Challenge, grantee Heifer International connects women farmers to digital agriculture content to improve production and help them scale their businesses. © Narendra Shrestha for DAI.

In 2010 post-earthquake Haiti, Belleus Pierre, a 31-year-old merchant, benefited from the Mobile Money (T-Cash) program, which provided her with a steady income by selling food staples and facilitated easy cell phone transactions. © Mercy Corps

A FUTURE AR4D AGENDA

A forward-looking research agenda on digital technologies can enhance the gender equality, youth empowerment, and social inclusion of CGIAR's Science Programs. We will integrate cutting-edge research on digital frontier technologies, big data analytics, and AI and ML across the CGIAR, focusing on equitable food, land, and water systems, to accelerate transformative change.

This research will push D4Ag to its full potential, while addressing knowledge gaps in gender-responsiveness and social inclusion. Transforming FLWs demands a two-track approach: 1) closing the digital gender gap; and 2) pioneering inclusive solutions. This requires foundational research on reducing the digital gap regarding gender and other intersectionalities. It will guide the creation of more accessible and inclusive digital solutions, and avoid exacerbating existing inequalities, a common unintended consequence of digital services. Secondly, there is a need for cutting-edge frontier research that explores novel applications of digital technologies, big data analytics and AI & ML to hasten transformative change for equitable FLW systems. Cross-cutting themes include intersectionality, ethical AI, climate change, and digital security and privacy, particularly for women who suffer higher risks of gender-based violence (GBV). Furthermore, integrating a GESI lens into AI policies will ensure sustainability and equitable implementation.

Implementing this research agenda across the CGIAR depends on all Science Programs and Accelerators adopting the principles of digital inclusion. This research agenda cannot be left just to the Digital Transformation Accelerator. But the gender team of the Digital Transformation Accelerator, ideally in collaboration with the Gender Equality and Inclusion Accelerator, could advise on how to set up collaborative spaces (e.g., a community of practice or platform) and identify (co-funded) use cases for promoting those principles and carrying this research agenda forward.

The proposed research agenda is structured into three categories: A) overarching research B) specific questions about digital ecosystems and C) digital innovations: (1) digital platforms, (2) methods, metrics, and tools for data collection, and (3) data processing and analytics using AI, machine learning, and big data techniques.

A. Overarching Research Questions:

1. What are the forms and dimensions of the digital gender gaps, and how can we better understand their complexities and intersections to effectively address them?

2. How can digital technologies, data, and AI catalyze empowerment and transformative change for women, youth, and socially excluded groups, without exacerbating existing inequalities?

3. What strategies can achieve transformative change at scale and at the needed pace, engaging diverse stakeholders in the digital ecosystem, particularly where expertise on gender equality and social inclusion is limited?

4. How can we challenge conventional design norms and create digital tools that are accessible to diverse users, by centering the needs and perspectives of marginalized groups?

B. Digital ecosystems

Proposed research questions for advancing inclusive digital ecosystems (Figure 1):

1. What solutions can help create an inclusive digital ecosystem, ensuring that digital tools and data are accessible, easy to use, and trustworthy, while addressing digital gaps in access, affordability, literacy, and content relevance?

2. How can digital ecosystems be redesigned to avoid perpetuating gender and social biases and promote transformative change?

   2.1. What are key design features and processes to ensure that digital solutions are demand-driven, demand-responsive, trusted, and human-centred? How can these solutions build on and strengthen existing user systems and networks (e.g., WhatsApp groups) for a diversity of users, women, youth, and populations we seek to support through greater social inclusion?

   2.2. From a gender equality, youth and social inclusion perspective, what are priority areas that require digitalization and what are areas where analog, or hybrid physical-digital approaches remain more effective?

   2.3. How can governments, private sector and development and R4D actors and organizations incentivize the development and use of women- and youth-empowering digital technologies in FLW systems while ensuring ongoing usability and adoption?

   2.4. What are the types of partnerships and policy interventions required to create an enabling ecosystem for fostering inclusive digital innovations and driving sustainable, equitable change?

3. What are the trade-offs and negative externalities of digitalization across sectors, including from the perspectives of water, energy, food, environmental sustainability, and human costs? How to balance trade-offs across gender equality, youth and social inclusion and the other impact areas (poverty reduction, livelihoods & jobs, environmental health & biodiversity, nutrition, health & food security, climate adaptation & mitigation)? For example, how to balance trade-offs between easing drudgery and losing jobs with automation technology (Acemoglu and Restrepo 2019).

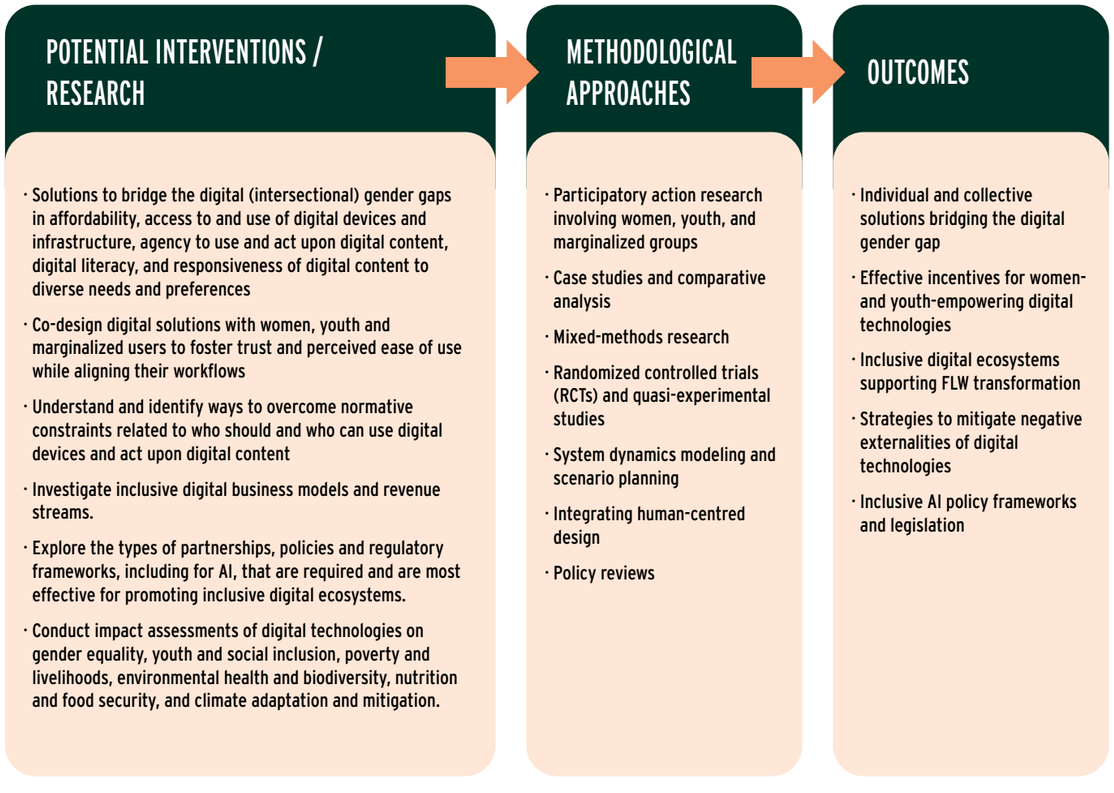


Figure 1: Pathways from Research to Outcomes for Inclusive Digital Ecosystems

C. Proposed research on digital innovations

(1) Digital platforms (Figure 2)

1. What are the best indicators of gender- and socially inclusive digital technology and how can the CGIAR monitor digital inclusion in a standardized way?

2. What makes digital technologies and delivery platforms empowering and transformative? And what ensures their use?

   2.1. How do gender norms influence digital technology adoption and use?

   2.2. How and why do the impacts of digital interventions—e.g., on awareness and knowledge, agricultural productivity, market access, and income—vary by gender and other social identities?

   2.3. Which digital interventions and strategies have demonstrated effectiveness and cost-efficiency in empowering diverse gender and social groups and challenging structural inequalities in FLW systems (including discriminatory norms, and GBV, and limited agency, resources, and voice)?

   2.4. How can digital technologies be designed and scaled to overcome structural barriers to empowerment and equitable participation in FLWs?

   2.5. How can we build on best practices of inclusive digital solutions in other sectors such as health, mobile finances, early warning systems, etc.?

   2.6. What prevents digital technology adoption and how can we ensure inclusive adoption and usability for all?

3. How do we tap into the digital familiarity, creativity, and networks of rural youth to enhance their engagement and empowerment in FLW systems?

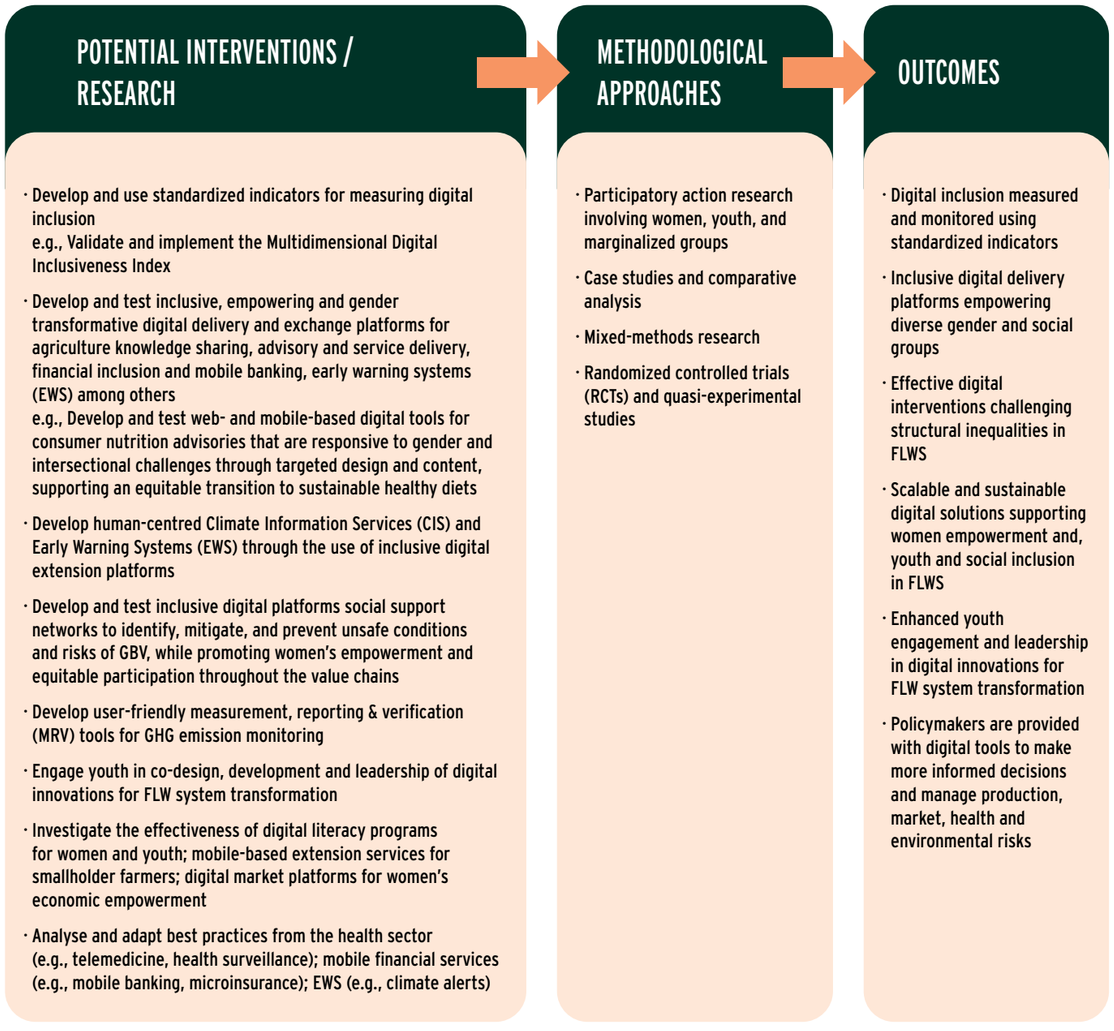


Figure 2: Pathways from Research to Outcomes for inclusive digital platforms

(2) Methods, metrics, and tools for data collection with digital technology (Figure 3)

1. How to ensure that digital tools collect unbiased data that is representative of the diversity on the ground while remaining transparent and explainable to diverse users?

2. How to ensure that collection, analysis, and resulting action through big data, alternative data sources (e.g., GIS, citizen-generated data) reflects diverse realities on the ground while ensuring trust in data-driven decisions?

3. How can data be responsibly collected, shared, and leveraged for AI analytics and large language models (LLMs), ensuring that results reflect everyone's needs and preferences, and particularly reducing the invisibility of marginalized groups, such as women, youth, and socially excluded communities, in policy and development planning?

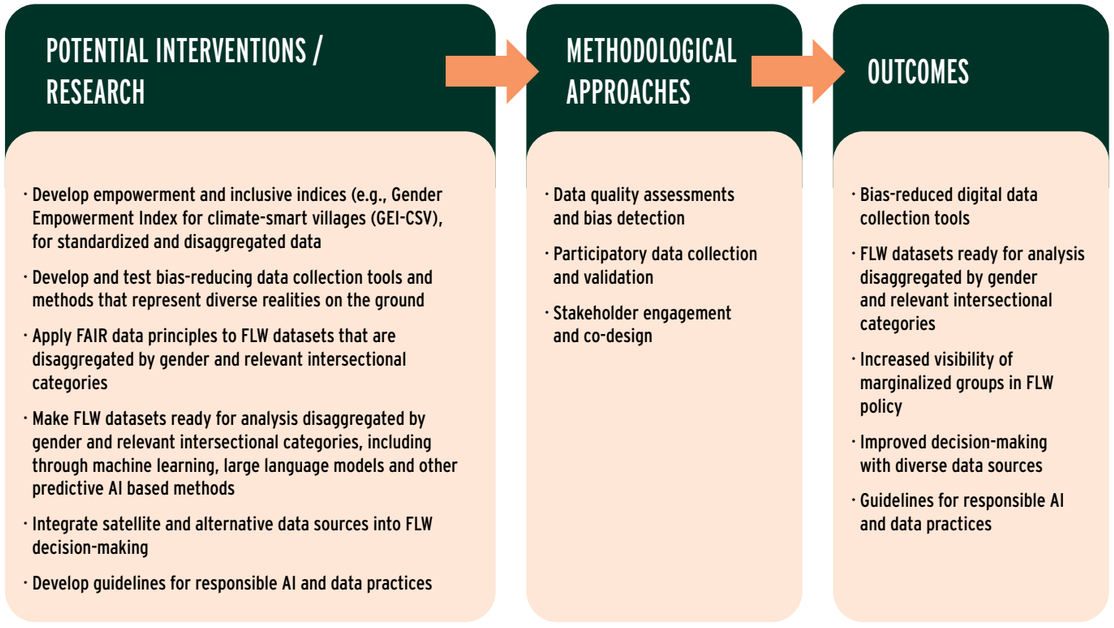


Figure 3: Pathways from Research to Outcomes for effective data collection using digital technology

(3) Data processing and analytics using AI, machine learning, and big data techniques (Figure 4)

1. How to keep AI from perpetuating or exacerbating existing gender and social biases, while ensuring fairness and transparency in model design? What principles should guide the use of AI in research to promote inclusivity, gender responsiveness, and transformative gender outcomes?

   1.1. How to ensure that the architecture of AI models does not perpetuate or create gender or social biases?

   1.2. How to ensure that the data that feeds into AI models is well-documented, balanced, representative, and unbiased and allows for analysis by gender, and other intersectional variables?

   1.3. What are the methods and guidelines for consistent and meaningful gender and intersectional analysis based on (secondary) open access data, big data, and methods driven by machine-learning?

2. How can the sources of AI models be re-engineered to include literature that questions the status quo (including critical, feminist, decolonial, gender, heterodox scholarship) in order to re-imagine FLWs transformation through a GESI lens?

3. How can digital twins incorporate diverse realities and allow gender and intersectional analysis?

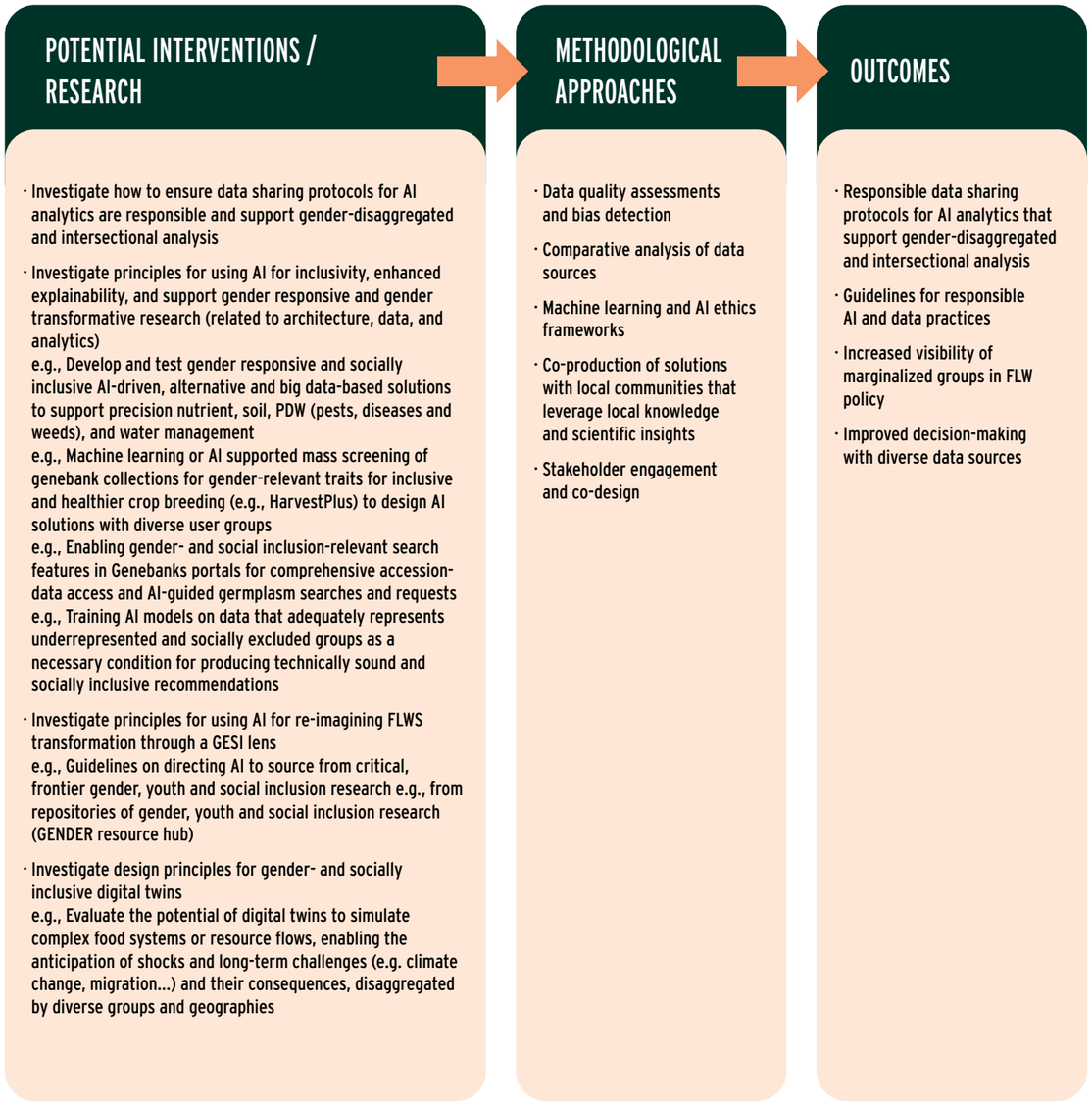


Figure 4: Pathways from Research to Outcomes for ethical and inclusive data processing and analytics using AI, ML and big data techniques

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ABOUT THIS SERIES

This brief produced jointly by the CGIAR Gender Equality and Inclusion Accelerator and the CGIAR Science Programs, is one in a series of agenda-setting briefs that aim to further develop an agenda for strategic areas of gender and social inclusion research within the new portfolio of CGIAR Science Programs and Accelerators, and inform the development of gender and inclusion strategies for these moving forward. The briefs are the culmination of a collaborative work that started during the CGIAR GENDER Science Exchange 2024 that convened 72 gender researchers from across the CGIAR to bring together experiences, ideas and insights from across centres, that can help in developing a gender strategy for the SP in the future.

About CGIAR Gender Equality and Inclusion (GENDER Accelerator)

CGIAR Gender Equality and Inclusion is CGIAR's Accelerator working to put equality and inclusion at the heart of food systems research and development. The Accelerator leads strategic and innovative research that advances gender equality, opportunities for youth, and social inclusion across CGIAR's Food, Land and Water Systems portfolio.

Cover: Transforming wheat research in South Asia through digital agriculture tools © Daljit Singh

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