InfoNote

Towards Inclusive Climate Information Services: What We Learned and What Comes Next

Experiences from AICCRA, 2021-2025

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January 2026

Key messages

- Climate information services improve resilience only when women, youth, and marginalized groups can access and act on them. Tailored content, co-production, and trusted delivery channels are essential.
- Innovations such as gamification, inclusive AI, and gender-responsive benefit analysis improve decision-making and expand who benefits from CIS.
- If distributed inclusively, forecasts can act as an equalizer within households, enabling women and men to make more collaborative and climate-smart decisions.
- Sustaining impact requires mainstreaming gender-responsive CIS approaches into national systems, extension curricula, and policies.

Accelerating climate variability continues to threaten the livelihoods of millions of smallholder farmers in Africa (Trisos et al., 2022; Wollburg et al., 2024). Climate information services (CIS), distributed via multiple channels such as radio, SMS, bulletins/newspaper and/or mobile phone applications, are one mechanism through which smallholder farmers are able to increase their anticipatory and adaptive capacity (Chaudury et al., 2023). Yet, access to timely, accurate, and actionable climate information remains deeply unequal (Appiah et al., 2025). Even when available, women, youth, and marginalized groups often lack the channels, resources, and decision-making authority (Sprout, 2022; Nyoni et al., 2024) needed to act on climate information — limiting resilience and reinforcing existing inequalities (Gumucio et al., 2019).

Between 2021 and 2025, the Accelerating Impacts of CGIAR Climate Research for Africa (AICCRA) project worked across six countries to expand the reach, usability, and inclusivity of climate information services (CIS). Through partnerships with national meteorological agencies, ministries of agriculture, extension services, universities, community organizations and the private sector, AICCRA supported co-production processes, participatory tool development and deployment, i.e. via digital innovations such as the AgDataHubs, RiceAdvice, and Lersha's extension platform, the collaborative development of climate risk management in agricultural extension (CRMAE) curricula, and localized advisory systems.

This InfoNote synthesizes learnings from five years of implementation (2021-2025) across Ethiopia, Ghana, Kenya, Mali, Senegal, and Zambia. In the first section, we underline the importance of understanding differential CIS access and needs. We then highlight the use of co-production processes to design more inclusive CIS. Lastly, we outline practical strategies to design and deliver inclusive CIS, identify innovations that show promise for scale, and provide actionable

recommendations for policymakers, practitioners, and researchers, as well as identify persistent barriers and evidence gaps

Understanding Differentiated CIS Access and Needs

AICCRA experience across six countries confirms that climate information needs, access pathways, and the ability to act on information are not uniform among smallholder farmers. Gender, age, livelihood roles, and social position shape how people receive, interpret, and use CIS (Gumucio et al., 2020; Nyoni et al., 2024). Understanding these differentiated needs is a prerequisite for designing inclusive and effective CIS.

Gendered differences in access to CIS

Across AICCRA countries, women and men often access climate information through different channels, at different times, and for different purposes. These differences are shaped by gender roles, literacy levels, access to technology, and control over productive resources (Gumucio et al., 2020; Mapedza et al., 2023).

Evidence from Senegal (***Table 1***) shows that radio remains the most accessible CIS channel for women when programming aligns with women's daily responsibilities. Community radio programs reached 274,677 farmers across three regions, with women comprising almost half (49%) of listeners (Yessoufou et al., 2022). However, women tended to listen in the evening after their household and care work, while men accessed information earlier in the day. These temporal differences have important implications for programming schedules and message delivery.

In Ghana, CIS delivery through the Esoko platform revealed clear gender patterns in format preferences. Voice-enabled messages were the most common format overall and were particularly important for women, reflecting lower literacy levels and constraints in phone ownership and usage. Word-of-mouth dissemination through social networks was the second most common access pathway, while text messages and video-based content were less accessible to women, especially in rural areas (Asare-Kyei et al., 2022).

In Kenya, intra-household studies demonstrated that women and men often access different types of climate information even within the same household. Wives were more likely to receive weather forecasts, while husbands had greater access to early warning information and adaptation advisories. Preferences also differed, with men favoring extension officers, print media, television, and local leaders, while women preferred radio and social groups as trusted CIS sources (Ngigi & Muange, 2022; Bullock et al., 2022).

These findings underscore that household-level measures of CIS access can mask important gendered differences and that CIS systems designed around a single user profile risk reinforcing existing inequalities (Sprout, 2022).

Youth and marginalized groups

While much of the available evidence focuses on differences between men and women, AICCRA experience also points to differentiated needs among youth and other marginalized groups. For example, youth often face barriers similar to women, including limited access to land, credit, and formal decision-making structures, which shape how climate information is perceived and used (Nyoni et al., 2024).

Citizen science initiatives supported under AICCRA suggest a promising pathway for engaging youth and marginalized farmers more equitably. Where access and opportunities were provided, women and youth participated in data collection and feedback processes at rates comparable to men, indicating that exclusion is driven more by structural constraints than by lack of interest or capacity (Asare-Kyei et al., 2022; Dinh et al., 2022).

Table 1: *Radio listening times by sex and region in Senegal (Yessoufou et al, 2022).*

Time slots	REGIONS				GENDER	
	KAFFRINE	LOUGA	THIES	ALL	MALE	FEMALE
Before 9H	78	45	54	54	72	38
Between 9H and 12H	32	17	29	28	16	39
Between 12H and 15H	71	28	49	48	69	29
Between 15H and 18H	46	6	23	22	26	19
After 18H	67	84	62	65	59	70

However, evidence gaps remain, particularly in systematically capturing youth-specific CIS needs and outcomes across countries. This highlights the need for more intentional disaggregation beyond sex to include further intersectional factors, including age and socioeconomic status, in CIS monitoring and evaluation (Mapedza et al., 2022).

The role of bundling CIS with advisories to address livelihood-specific needs

AICCRA experience across countries demonstrates that the usefulness of CIS depends on how well advisories align with farmers' specific livelihood activities. Women, youth, and marginalized groups often manage distinct crops, livestock, or agri-food enterprises that are not adequately addressed by generalized agro-advisories focused on dominant value chains (Gumucio et al., 2020; Huyer et al., 2023a).

In Kenya, participatory research highlighted that farmers' climate information needs vary by livelihood system. Focus group discussions emphasized the importance of tailoring CIS content for livestock keepers, rainfed crop producers, and mixed farming systems, rather than assuming uniform needs at the household or community level (Bullock et al., 2022). Failure to differentiate by production system limited the perceived relevance and uptake of advisories, particularly among women and youth managing smaller livestock or subsistence crops.

Similarly, AICCRA implementation in Ethiopia (***Box 1***) supported the use and scaling of user-centric digital agro-climate advisory platforms, such as LERSHA, as delivery mechanisms for localized climate information integrated with practical agronomic guidance. By bundling climate advisories with recommendations that support decisions on planting dates, input use, and climate risk management, these platforms respond to the types of choices smallholder farmers make across diverse agricultural activities and production contexts.

This approach is particularly important from a gender and social inclusion perspective, as women, youth, and marginalized farmers often manage diverse and smaller-scale livelihood activities that are not well served by generalized advisory systems (Gumucio et al., 2020; Mapedza et al., 2023; Huyer et al., 2023a). Implemented within Ethiopia's broader digital agriculture ecosystem and aligned with national initiatives such as the Ethiopian Digital Agro-Climate Advisory Platform (EDACaP), AICCRA's contribution focused on strengthening the integration and use of climate information within farmer-facing services that now reach tens of thousands of smallholder farmers (World Bank, 2025).

BOX 1: Ethiopia Case Example—
A Comprehensive Model for Gender-Responsive CIS

Under AICCRA, Ethiopia implemented a comprehensive approach to gender-responsive climate information services (CIS) that combined digital delivery with community-based outreach. Gender-Smart Climate Information and climate-smart agriculture (CSA) advisories were delivered across 169 districts, using tailored communication channels designed to improve accessibility for women. These included voice messages to address literacy barriers and dissemination through trusted Development Agents (DAs) and community platforms, helping ensure that climate information reached women farmers through familiar and credible channels.

Content and delivery approaches were further adapted to reflect women's agricultural activities and roles, with advisories tailored to home gardens, poultry, and small-scale crop production. AICCRA also supported capacity building for women extension agents and promoted community-based dissemination models that engaged women's groups and cooperatives. These peer-based approaches facilitated shared learning and support, strengthening women's engagement with CIS while remaining embedded within existing extension and community structures.

In Senegal, AICCRA implementation emphasized the use of sex- and age-disaggregated focus group discussions to identify differentiated production priorities and climate risks among farmers (Kebe et al., 2022; Kumar et al., 2022; Thiaw et al., 2024). Evidence from the 2022 agricultural campaign shows that climate and agro-advisories were tailored to locally relevant crops and livelihood activities through multiple dissemination channels, including community radio and extension services, improving

alignment with farmers' decision-making contexts (Kebe et al., 2022). Gender-differentiated analyses further highlighted variations in climate risk perception, access to climate information, and adaptation strategies among women and men, reinforcing the need for livelihood-relevant and socially inclusive CIS design (Kumar et al., 2022). These approaches contributed to improved access to and use of CIS and climate-smart practices, particularly where advisories reflected locally relevant production systems and livelihood strategies, including those prioritized by women and youth (Thiaw et al., 2024).

Constraints and opportunities shaping access and implementation of CIS

Access to climate information alone does not guarantee its use. Evidence from AICCRA across countries reveals how multiple constraints shape farmers' ability to act on CIS, and that they are often gendered and socially differentiated. Across contexts, unequal access to resources, services, and decision-making authority limits the capacity of women, youth, and marginalized groups to translate climate information into adaptive action, even when information is available (Mapedza et al., 2023; Kumar et al., 2022; Thiaw et al., 2024). Key constraints identified include limited access to digital technologies, affordability of mobile services and internet data, network coverage, literacy, and time availability. In Senegal and Ghana, evidence shows that women's access to CIS is strongly shaped by delivery format and timing, with radio and voice-based services more accessible than text-based messages, and listening times constrained by domestic responsibilities (Yessoufou et al., 2022; Asare-Kyei et al., 2022). In Kenya, intra-household dynamics further constrain women's access to certain types of climate information and advisory services, despite nominal household-level access (Bullock et al., 2023).

These access constraints are often compounded by structural barriers to action. Across AICCRA countries, women consistently face more limited access to credit, inputs, land, and decision-making power, reducing their ability to implement climate-informed recommendations even when advisories are received (Gumucio et al., 2020; Mapedza et al., 2023; Kumar et al., 2022). AICCRA evaluation evidence confirms that such resource constraints significantly shape whether CIS use translates into adoption of climate-smart practices (Thiaw et al., 2024).

Social and institutional factors also play a critical role in mediating CIS uptake. AICCRA experience shows that engagement in social networks and collective structures—including producer organizations, savings and loans groups, and mixed-gender farmer groups—can facilitate information sharing, collective interpretation of forecasts, and joint decision-making, increasing the likelihood that climate information leads to action (Mapedza et al., 2023; Bullock et al., 2023). Conversely, CIS systems that rely on single delivery channels or assume uniform access to resources and authority risk excluding farmers facing greater structural constraints, particularly women, youth, and other marginalized groups (Nyoni et al., 2024; Thiaw et al., 2024).

Overall, AICCRA experience highlights that effective and inclusive CIS design requires attention not only to differentiated information needs, but also to the structural, social, and institutional conditions that enable or constrain climate-informed decision-making. Addressing these constraints is essential for ensuring that CIS contribute to equitable resilience outcomes rather than reinforcing existing inequalities.

Co-Producing Gender-Responsive CIS Content

AICCRA experience suggests that inclusive climate information services (CIS) benefit from attention to gender equality and social inclusion (GESI) at the stages where climate information content is generated, interpreted, and translated into decision support. Rather than focusing solely on dissemination, AICCRA emphasized co-production approaches that engaged different user groups and intermediaries—including farmers, extension and advisory service (EAS) providers, policymakers, researchers, and service providers—in processes intended to better reflect differentiated livelihood activities, decision-making contexts, and constraints (Mapedza et al., 2023; Dinh et al., 2022).

Across AICCRA countries, participatory processes such as sex- and age-disaggregated focus group discussions, seasonal planning meetings, and feedback mechanisms were used to inform the identification of priority climate risks, production systems, and decision points for women, men, and youth. Evidence from implementation reports and evaluations indicates that these approaches helped tailor CIS content to local contexts and surface differences in information needs across livelihood groups, while also revealing persistent constraints to inclusive use (Bullock et al., 2023; Kebe et al., 2022; Thiaw et al., 2024).

Co-producing gender-responsive CIS content through agricultural extension and advisory services (EAS) curricula

AICCRA supported the integration of GESI considerations into agricultural EAS training systems by working with national partners to co-design and adapt the Climate Risk Management for Agricultural Extension (CRMAE) curriculum to be gender-sensitive and gender-responsive. This work addresses commonly reported gendered and socially differentiated barriers to CIS access and use by strengthening how EAS providers are trained to communicate and contextualize climate information (Hansen et al., 2024).

Co-development processes involved more than 70 institutions across AICCRA countries and reflected partner-identified gaps in existing curricula, including limited attention to gender-sensitive communication, household decision-making dynamics, indigenous knowledge, agricultural insurance, and climate justice. In response, AICCRA contributed to the development of GESI-focused curriculum modules adapted to selected country contexts, including Senegal, Zambia, Kenya, and Ghana (Hansen et al., 2024).

The revised curricula provide guidance and illustrative tools intended to help EAS providers recognize and address inequities in CIS access and use, including through more inclusive communication and participatory seasonal planning processes. Embedding these materials within accredited EAS training systems represents an initial step toward strengthening advisory capacity, while outcomes remain contingent on broader institutional and resource conditions (Hansen et al., 2024; Huyer et al., 2023a).

Gender-responsive Cost-Benefit Analysis (CBA)

AICCRA explored gender-responsive approaches to Cost-Benefit Analysis (CBA) as a means of strengthening how the benefits, costs, and trade-offs associated with CIS investments are assessed and communicated. Conventional CBA approaches for CIS tend to emphasize aggregate economic outcomes, often with limited attention to the benefits of risk reduction, or to distributional effects within households or across social groups.

In response, AICCRA-supported methodological work examined how gender equality and social inclusion considerations could be incorporated into CBA frameworks to better reflect differentiated decision-making contexts and outcomes associated with climate-informed practices (Timu et al., 2021; Timu & Kramer, 2022; Kramer & Timu, 2022).

This methodological development was informed by empirical research on intrahousehold decision-making and gendered trade-offs related to agricultural and climate-informed investments. Evidence from multiple studies highlighted how costs, benefits, labor requirements, and risk exposure associated with climate-smart practices and advisory use can differ for women and men within the same household, with implications for how CIS benefits are interpreted and valued (Kramer et al., 2023a; Kramer et al., 2023b).

Co-production played a central role in translating these analytical insights into applied tools and training materials. AICCRA convened stakeholder consultations with CIS practitioners, researchers, and institutional partners to identify which costs and benefits were most relevant for decision-making and feasible to assess in practice. These consultations informed the design and refinement of gender-responsive CBA tools and training resources, including attention to non-market benefits, risk reduction, and distributional effects (List et al., 2022).

AICCRA also supported capacity development activities to pilot and test gender-responsive CBA for CIS with practitioners. Training was delivered through online and in-person formats in partnership with the CGIAR Gender IMPACT Platform and the Institute for Meteorological Training and Research (IMTR) World Meteorological Organization Regional Training Center (WMO-RTC), with a focus on building awareness and analytical skills related to gender equity considerations in CIS investment, program design and CBA (Kramer et al., 2024; Murage et al., 2024).

Efforts were also made to embed gender-responsive CBA for CIS within selected regional and continental capacity development institutions as a pathway toward broader uptake. In particular, with support from AICCRA, the CBA for CIS module was validated and incorporated into Africa-wide training programs at IMTR, and integrated into regional e-learning platforms through the Regional Universities Forum for Capacity Building in Agriculture (RUFORUM), supporting use within academic and professional training settings (Grossi & Murage, 2025; Murage et al., 2025; Kramer et al., 2025a; Kramer et al., 2025b). These efforts highlight pathways for institutionalization, while recognizing that sustained uptake depends on mandates and resourcing beyond the project period.

Co-producing gender-responsive CIS content for policymakers and negotiators

AICCRA also supported co-production of gender-responsive CIS content for policymakers and negotiators through the AGNES Leadership and Advanced Courses on Climate Information Services. These courses were developed in collaboration with the African Group of Negotiators Expert Support (AGNES) and informed by ex-ante needs assessments that identified demand for CIS capacity development explicitly addressing equity, inclusion, and differentiated vulnerability in climate decision-making contexts (Gamoyo et al., 2025a).

Based on these findings, CIS content—including GESI considerations—was intentionally integrated into both leadership-oriented and technically focused course offerings. This included the introduction of CIS concepts into the AGNES Leadership Course and the design of a more in-depth Advanced Course, with curriculum content covering gender-responsive CIS design, equity in access and use of climate information, and ethical considerations related to power, bias, and representation in climate governance (Gamoyo et al., 2025b; AGNES et al., 2025).

The courses combined technical instruction with applied and participatory learning approaches. Monitoring and evaluation evidence from the Advanced Course indicates gains in participant knowledge and engagement, including improved understanding of CIS functions, applications, and inclusion-related challenges (Sagliocco et al., 2025).

Follow-up studies and alumni tracking provide examples of how participants have applied CIS concepts within professional contexts, including references to the use of climate information in policy dialogue, program design, and coordination processes. While not constituting systematic impact, these findings provide indicative evidence of pathways through which gender-responsive CIS capacity development may influence practice over time (Gamoyo et al., 2025c).

Reflections from facilitators and partners emphasized the value of situating gender-responsive CIS content within broader discussions of leadership, governance, and institutional decision-making. The AGNES courses are positioned as one contribution within a wider ecosystem of capacity development for African climate negotiators and policymakers, offering space to interrogate how climate information intersects with social and gender inequalities in policy processes (Mohamed, 2025).

Emerging approaches: Gender-responsive AI and co-produced advisory content

AICCRA also examined gender and inclusion considerations in the context of AI-enabled advisory systems, recognizing the potential for automated tools to either mitigate or reinforce existing inequalities. Synthesis of this work highlights risks associated with gendered data gaps and algorithmic bias if inclusion is not explicitly addressed in system design (Grossi et al., 2025).

AICCRA-supported analyses applied bias-aware and human-centered design principles to selected AI-driven advisory systems, incorporating gender-disaggregated data analysis and user feedback into system assessment and refinement processes (Ng'ang'a & Ghosh, 2025a). Empirical analysis of historical query data from women farmers using the iShamba platform informed recommendations for improving inclusivity in digital agro-advisory services, while noting limitations related to platform reach and data representativeness (Ng'ang'a et al., 2025b; Ng'ang'a et al., 2025c).

AICCRA shared emerging evidence and lessons from this work through regional and global learning fora, including the 2025 CGIAR Gender Conference in Cape Town and the CGIAR GESI Accelerator webinar series on Gender-Responsive Climate Information Services, with the aim of fostering dialogue and peer learning rather than promoting prescriptive solutions (CGIAR Gender Equality & Inclusion Accelerator, 2025a; CGIAR GESI Accelerator, 2025b; Grossi, 2025; Gitau & Grossi, 2025).

Strengthening Inclusive Delivery Systems

Access to climate information services (CIS) depends not only on the availability or relevance of the information produced, but on the delivery systems through which information is communicated, interpreted, and acted upon at the "last mile." AICCRA experience indicates that even when CIS content is gender-responsive, delivery systems can constrain who receives, trusts, and uses climate information if they do not account for differentiated access to technologies, social norms, and decision-making structures (Mapedza et al., 2023; Dinh et al., 2022). In response, AICCRA supported multiple delivery pathways intended to strengthen inclusion across digital, institutional, and community-based CIS systems.

Reaching the "last mile" through collective and community platforms

Across AICCRA countries, delivery strategies sought to work through existing collective platforms—including women's groups, village savings and loan associations (VSLAs), cooperatives, and community organizations—that already play a role in information sharing, risk management, and collective decision-making. These platforms can help mitigate individual-level barriers related to phone ownership, literacy, time availability, and confidence in using climate information, particularly for women farmers (Gumucio et al., 2020; Bullock et al., 2023).

In Ghana (***Box 2***), Village Savings and Loans Associations (VSLAs) and CSA Hubs became effective information hubs as well as savings collectives, while in Ethiopia women-led Community Based Breeding Programs increased women's and youth's technical capacity, and incomes.

Mali women's rice parboiler associations became platforms for capacity development, knowledge sharing, production and processing improvements, all part of women-led agri-businesses based in the associations. (Huyer & Obeng-Adamaa et al, 2023; Gondwe et al, 2025; Huyer et al., 2023b).

Evidence from AICCRA implementation in Senegal, complemented by descriptive evidence from other country contexts, suggests that group-based dissemination and discussion of forecasts can support shared interpretation of climate risks and response options, and may create more accessible engagement spaces for women and marginalized farmers than individualized channels alone (Thiaw et al., 2024; Yessoufou et al., 2022; Koech et al., 2024; Chesoli, 2025). While such approaches do not eliminate structural inequalities, they can complement digital and extension-led delivery by anchoring CIS within trusted social networks (Alliance Bioversity International–CIAT, 2024).

Gender-responsive extension and intermediary roles

Agricultural extension and advisory services (EAS) play a central intermediary role in translating climate information into actionable guidance. AICCRA supported efforts to strengthen inclusive delivery through EAS by promoting gender-responsive communication practices and by working through extension agents trained to adapt climate information to local production systems and household decision-making contexts (Hansen et al., 2024).

BOX 2: Ghana Case Example—*Community CSA Hubs Model to Generate CIS Content*

Under AICCRA in Ghana, deliberate efforts were made to increase women's participation in Climate-Smart Agriculture (CSA) hub governance and coordination structures. At the district level, CSA hub working groups included officers from the Women in Agriculture Development Directorate (WIAD), with additional efforts to bring more women into hub membership. Across 13 district CSA hubs, women accounted for 42 of the 218 members, and four of the district hubs were chaired by women, indicating some progress in women's leadership within coordination platforms.

At the community level, AICCRA set a target of at least 40% women's participation across 65 community CSA hubs to ensure that climate champions and local change agents reflected gender diversity. In practice, women represented 1,318 of the 2,785 total members across these community hubs. While participation levels varied across locations, these figures illustrate how explicit participation targets and engagement strategies can increase women's representation in community-based CIS and CSA coordination structures.

Evidence synthesized through AICCRA highlights that extension agents—particularly female agents and those trained in gender-responsive approaches—can help bridge gaps between digital systems and farmers, facilitate dialogue within households and groups, and support interpretation of probabilistic forecasts (Huyer et al., 2023a). However, the effectiveness of EAS-mediated delivery remains shaped by broader institutional capacity, incentives, and coverage, reinforcing the importance of combining extension with other delivery channels.

Multi-channel dissemination to address differentiated access

AICCRA experience reinforces that no single dissemination channel is inclusive across all user groups. Differences in literacy, language, connectivity, affordability, and time availability mean that women and men often rely on different channels to access CIS. To address this, AICCRA supported multi-channel delivery approaches that combined digital advisories, radio, extension-led dissemination, and community-based meetings (Ouedraogo et al., 2024).

Evidence from Kenya and Senegal indicates that radio and voice-based channels remain particularly important for women farmers, while digital channels may be more accessible to farmers with higher literacy or connectivity. Combining channels can therefore help reduce exclusion risks associated with reliance on any single delivery pathway, while allowing climate messages to be reinforced and discussed across platforms (Yessoufou et al., 2022; Ngigi & Muange, 2022).

Participatory Scenario Planning (PSP) as an inclusive delivery architecture

Participatory Scenario Planning (PSP) represents a delivery and coordination mechanism that brings together meteorological services, extension providers, local authorities, community representatives, and farmers to jointly interpret seasonal forecasts and identify context-specific response options. AICCRA supported PSP processes as a way to strengthen inclusive delivery by creating structured spaces for dialogue, negotiation, and knowledge exchange at local and sub-national levels (Ouedraogo et al., 2024).

In Kenya, AICCRA contributed to efforts to improve coordination among PSP implementers through multi-stakeholder consultations and agreed action plans, with the aim of reducing fragmentation and strengthening alignment across institutions involved in CIS delivery (Koech et al., 2024). These processes focused on coordination and delivery rather than on producing new forecasts.

PSP processes supported under AICCRA also sought to recognize and integrate indigenous and local knowledge systems alongside scientific forecasts. Evidence from Baringo County illustrates how indigenous indicators and local expertise were incorporated into PSP discussions, including through the participation of indigenous leaders and women, helping to contextualize forecasts for livestock-dependent livelihoods (Tam, 2024; International Livestock Research Institute, 2024).

Digital tools were explored as enablers of PSP coordination and timeliness, rather than as substitutes for face-to-face engagement. AICCRA experience indicates that digital platforms can support information sharing and organization across PSP actors, while inclusive delivery continues to depend on facilitated interaction and trusted intermediaries at the community level (Sotelo et al., 2024).

Digital and AI-enabled delivery systems: inclusion risks and feedback mechanisms

Digital and AI-enabled advisory systems offer opportunities to improve the timeliness and personalization of CIS delivery, but also pose risks of reinforcing exclusion if design and deployment do not account for gendered access and data biases. AICCRA-supported analyses highlight that AI-driven advisories require careful attention to who is represented in data, how recommendations are generated, and how information reaches end users (Grossi et al., 2025; Ng'ang'a & Ghosh, 2025a).

Empirical analysis of historical query data from women farmers using the iShamba platform informed recommendations for improving inclusivity in digital advisory delivery, while also noting limitations related to platform reach and representativeness (Ng'ang'a et al., 2025b; Ng'ang'a et al., 2025c). Human-centered design approaches, including gender-sensitive focus group discussions in Kenya, were used to better understand how different users engage with digital advisories, and how trust, comprehension, and usability shape uptake at the last mile (Giraldo Mendez & Grossi, 2025). These findings underscore that AI-enabled systems function as part of broader delivery ecosystems rather than as standalone solutions.

Integrating gender and social inclusion into ag-data hubs

AICCRA also addressed inclusive delivery at the system level through guidance on integrating gender and social inclusion into ag-data hubs—centralized platforms designed to aggregate data and support the generation and dissemination of agro-climate advisories. The AICCRA guideline on integrating gender and social inclusion into ag-data hubs outlines practical steps for embedding GESI considerations across consultation, data selection, advisory design, dissemination, and user feedback processes (Huyer et al., 2023a).

The guideline emphasizes early consultation with women, youth, and marginalized groups; tailoring advisory formats and channels to different users' needs; and using ag-data hubs to support, rather

than replace, intermediary-led and group-based delivery. It also highlights the importance of disaggregation, feedback mechanisms, and institutional partnerships to support more inclusive delivery through data-driven systems (Huyer et al., 2023a).

Taken together, AICCRA experience highlights that strengthening inclusive CIS delivery requires attention to multiple, interconnected elements: collective and community platforms, gender-responsive intermediaries, multi-channel dissemination strategies, participatory coordination mechanisms such as PSP, inclusive digital and AI-enabled systems, and system-level guidance for ag-data hubs. While these approaches do not resolve all structural barriers to inclusion, they provide practical insights into how delivery systems can be designed to better align with the realities of women, youth, and marginalized farmers.

Innovations that Enable Inclusion

Persistent gender and social inequalities in access to and use of climate information services (CIS) require more than incremental improvements to existing delivery systems. Under AICCRA, a set of innovations were explored to address inclusion challenges that conventional CIS approaches have struggled to overcome, including barriers related to literacy, decision-making authority, data bias, and the limited actionability of climate information. Rather than focusing on scale or impact, these innovations generated practical insights into how CIS design and implementation can better enable inclusion when aligned with users' lived realities.

Gamification as an innovation in climate decision support

AICCRA piloted gamification-based approaches in Zambia as a departure from one-way dissemination of climate information. By using facilitated games to simulate seasonal scenarios and response options, this approach enabled AICCRA to better understand how participants use climate information to explore uncertainty, decide what to plant as CIS alleviate ambiguity, and how climate information influences decision-making and bargaining within households, in an interactive format (Kramer et al., 2023).

What distinguishes this approach as an innovation is the shift from information provision to experiential learning between researchers and farmers. The Zambia experience illustrates how game-based tools can lower literacy barriers and create space for dialogue and reflection, including for women and youth, whilst improving researchers' understanding of how CIS affects decision-making, in ways that text-based or individualized advisories often do not provide (Kiogora et al., 2024).

Bias-aware and human-centered AI as a design innovation

AICCRA's work on AI-enabled advisories introduced an explicit focus on gender and inclusion within the design of automated systems—an area where such considerations are frequently absent. Rather than treating inclusion as an external add-on, this work examined how gendered data gaps, user representation, and interface design shape the relevance of AI-driven recommendations (Grossi et al., 2025; Ng'ang'a & Ghosh, 2025a).

Empirical analysis of women farmers' historical queries on the iShamba platforming Kenya revealed systematic differences in advisory needs that are often obscured in aggregated datasets, informing recommendations for bias-aware model development (Ng'ang'a et al., 2025b; Ng'ang'a et al., 2025c). Human-centered design methods, including gender-sensitive focus group discussions in Kenya, further highlighted how trust, comprehension, and usability influence engagement with digital advisories (Giraldo Mendez & Grossi, 2025). Together, these efforts represent an innovation in how AI-enabled CIS are conceptualized and refined, rather than a claim about expanded reach or impact.

Bundling CIS with complementary services to enhance actionability

Another area of innovation involved moving beyond standalone climate advisories toward bundled approaches that link CIS with complementary services, such as extension support, agronomic guidance, financial services, or participatory planning processes. Evidence from AICCRA contexts suggests that bundling can help address constraints related to risk, affordability, and implementation capacity that limit the usability of climate information, particularly for women and marginalized farmers (Ouedraogo et al., 2024).

The innovation here lies in reframing CIS as part of a broader decision-support package, rather than as an isolated information product. By aligning climate information with services that enable response options, bundled approaches offer insights into how CIS can be made more actionable without assuming equal access to resources.

Participatory Scenario Planning as an institutional innovation

While participatory approaches to climate communication are not new, AICCRA-supported Participatory Scenario Planning (PSP) processes illustrate an innovation in how CIS delivery is institutionally organized. PSP functioned not only as a dissemination mechanism, but as a coordination and negotiation platform that brought together meteorological services, extension providers, local authorities, and community representatives to jointly interpret forecasts and agree on response options (Ouedraogo et al., 2024).

Innovations within PSP included efforts to strengthen coordination among implementers (Koech et al., 2024), deliberate inclusion of indigenous knowledge systems alongside scientific forecasts (Tam, 2024; International Livestock Research Institute, 2024), and the identification of selective use of digital tools to support coordination without replacing face-to-face engagement (Sotelo et al., 2024). These examples highlight PSP as an institutional innovation that enables more inclusive interpretation and use of climate information through process design rather than technology alone.

Ag-data hubs designed with gender and inclusion in mind

AICCRA also explored innovation at the system level through the development of ag-data hubs designed to integrate gender and social inclusion considerations from the outset. Guidance on integrating GESI into ag-data hubs emphasized early consultation with diverse users, disaggregation of data, feedback mechanisms, and multi-channel dissemination as core design principles (Huyer et al., 2023a).

The Kenya AgData Hub provides a concrete example (See ***Box 3***) of how these principles have been operationalized within a national platform that links digital advisories with radio, call centers, and community-based processes (Chesoli, 2025). The innovation here lies in treating ag-data hubs as inclusive delivery infrastructures rather than purely technical repositories, while recognizing ongoing challenges related to governance, sustainability, and equitable access.

Navigating innovation through the AICCRA Innovation Catalogue

Beyond the examples highlighted in this section, AICCRA has documented a broader set of innovations through the AICCRA Innovation Catalogue, an interactive platform that allows users to explore innovations by theme, country, and alignment with the Sustainable Development Goals, including SDG 5 (Gender Equality) (AICCRA Innovation Catalogue, 2025). The catalogue provides a practical entry point for practitioners and policymakers seeking to identify and adapt

BOX 3: Kenya Case Example—*Gender and Social Incusion in th Ag-Data Hub Delivery System*

In Kenya, AICCRA has supported the evolution of the Kenya Agricultural Observatory Platform into a national AgData Hub that integrates climate, agricultural, market, and community-generated data to support the delivery of localized advisories through multiple channels, including web and mobile platforms, SMS and USSD services, radio programming, call centers, and linkages with Participatory Scenario Planning (PSP) processes (Chesoli, 2025).

As documented in the AICCRA Kenya AgData Hub InfoNote, this multi-channel delivery architecture was designed to address differentiated access among farmers, including women and marginalized groups who may have limited access to smartphones, data, or digital literacy. The InfoNote describes how the Hub combines automated digital advisories with human-mediated channels—such as call centers, radio, and extension-linked PSP workshops—to support comprehension, trust, and usability of climate information across diverse farming contexts, while also noting ongoing challenges related to institutional coordination, sustainability, and equitable access (Chesoli, 2025).

The Kenya example illustrates how ag-data hubs can function as delivery infrastructures that link digital systems with community-based and intermediary-led channels, while highlighting the importance of governance, partnerships, and sustained investment to support inclusive delivery over time.

approaches that contribute to more inclusive CIS and related climate-smart agriculture initiatives.

Taken together, these innovations illustrate that enabling inclusion in CIS requires shifts in design logic as much as new tools. Across contexts, the most promising innovations under AICCRA emphasized interaction over transmission, design over default assumptions, and coordination over fragmentation. While many of these approaches remain context-specific and exploratory, they generate valuable insights into how CIS systems can evolve to better reflect the realities of women, youth, and marginalized farmers.

Persistent Barriers and Evidence Gaps

Evidence generated throughout the AICCRA project highlights several persistent barriers and evidence gaps that shape the inclusivity and effectiveness of climate information services (CIS). These constraints reflect both structural conditions that limit the use of CIS and limitations in the current evidence base produced under the project.

Barriers to inclusive use documented through AICCRA implementation

AICCRA country implementation reports and evaluations consistently document that access to climate information does not automatically translate into use or action, particularly for women and marginalized farmers. Evidence from Senegal and Kenya indicates that even where CIS reach women through radio, group-based dissemination, or extension-linked processes, the ability to act on advisories remains shaped by access to complementary resources and decision-making authority at household and community levels (Yessoufou et al., 2022; Thiaw et al., 2024).

Digital delivery constraints have also been repeatedly noted. Analyses from digital advisory platforms and ag-data hubs highlight gender-differentiated access to phones, data, and digital literacy, which influence who can engage with SMS-, app-, or AI-based services (Ng'ang'a et al., 2025b; Chesoli, 2025). While multi-channel delivery and intermediary support were used to mitigate these constraints, AICCRA evidence indicates that digital divides remain a limiting factor in several contexts.

Time constraints and competing responsibilities are highlighted in AICCRA qualitative studies and human-centered design work, particularly in relation to women's participation in trainings, participatory planning processes, and feedback mechanisms. Moreover, focus group discussions conducted in Kenya document how time availability and household responsibilities shape engagement with CIS and digital advisories, influencing consistency of use rather than initial access (Nganga et al., 2023c, Giraldo Mendez & Grossi, 2025).

Institutional constraints identified through AICCRA synthesis

AICCRA synthesis outputs identify institutional coordination and sustainability as recurring constraints. Working papers on Participatory Scenario Planning and national CIS coordination highlight fragmentation among actors involved in climate information production, dissemination, and use, even where inclusive delivery approaches are in place (Koech et al., 2024; Ouedraogo et al., 2024).

Evidence from National Frameworks for Climate Services (NFCS) and National Frameworks for Weather, Water, and Climate Information Services (NFWWCS) suggests that institutionalized coordination mechanisms can support more consistent user engagement and gender-responsive delivery. However uneven implementation, financing constraints, and capacity gaps limit the ability of these frameworks to fully institutionalize inclusive CIS delivery across sectors and scales (Ghosh et al., 2025).

Similarly, guidance on integrating gender and social inclusion into ag-data hubs emphasizes that inclusive design principles require sustained institutional commitment and resourcing to move beyond pilot phases. AICCRA evidence from Kenya indicates that while inclusive design features can be incorporated into platform architecture, long-term sustainability and equitable access depend on governancd arrangements beyond the platform itself (Huyer et al., 2023a; Chesoli, 2025).

Evidence gaps identified through AICCRA research and evaluation

AICCRA evaluations and learning reports also highlight important gaps in the available evidence. While participation, reach, and short-term learning outcomes were documented for several interventions—including training courses, PSP processes, and digital advisory platforms—systematic evidence on longer-term behavioral change and livelihood outcomes remains limited. This limitation is explicitly noted in evaluation outputs and reflects the time horizons and methodological challenges associated with CIS impact assessment under the project (Thiaw et al., 2024).

Youth-specific CIS needs and outcomes also represent a particular evidence gap identified in AICCRA synthesis work. Although youth participated in multiple activities and platforms, evidence on differentiated youth-specific engagement and outcomes across livelihood pathways is fragmented and not systematically collected across countries (Nyoni et al., 2024).

Finally, while innovations such as AI-enabled advisories, gamification, and ag-data hubs generated insights into inclusive design and engagement, these findings are exploratory. Comparative evidence on their effectiveness relative to other delivery approaches remains limited, and AICCRA documentation on these approachs and innovations has tended to emphasize learning and design adaptation rather than demonstrated impact (Ng'ang'a & Ghosh, 2025a; Kiogora et al., 2024).

Lessons emerging from AICCRA evidence

Taken together, AICCRA evidence suggests that advancing inclusive CIS requires continued attention to delivery conditions, institutional coordination, and learning systems that extend beyond project cycles. The documented barriers and evidence gaps point to the need for stronger integration of GESI within national coordination frameworks, improved documentation of long-term outcomes, and sustained investment in approaches that combine climate information with complementary services and support mechanisms.

By grounding these implications explicitly in AICCRA implementation experience and research outputs, a realistic and evidence-based foundation for future CIS programming, research, and policy engagement can be drawn.

What Comes Next: Recommendations for Policymakers, Researchers and Practitioners

Based on five years of implementation, research, and learning under AICCRA, the following recommendations translate evidence from AICCRA-supported activities into actionable directions for strengthening gender-responsive and socially inclusive climate information services (CIS). They are organized for policymakers, researchers, and practitioners, recognizing their distinct roles in shaping inclusive CIS systems.

For Policymakers

AICCRA evidence underscores that inclusive CIS outcomes depend on institutional frameworks, coordination mechanisms, and sustained public investment, rather than on project-based delivery alone.

1. **Institutionalize inclusive CIS within national coordination frameworks.**
   Evidence from National Frameworks for Climate Services (NFCS) and National Frameworks for Weather, Water, and Climate Information Services (NFWWCS) shows that participatory co-production, multi-sector coordination, and gender-responsive delivery approaches are more likely to persist when embedded in formal mandates, governance structures, and workplans. Policymakers should ensure that gender and social inclusion objectives are explicitly integrated within these frameworks rather than treated as standalone initiatives.

2. **Support participatory co-production as a core function of CIS systems.**
   AICCRA experience demonstrates that participatory processes—such as Participatory Scenario Planning and user–provider dialogue—improve the relevance and usability of climate information by aligning advisories with local priorities, livelihood contexts, and decision-making processes. Policy support for regular, resourced co-production mechanisms is essential to sustain these benefits.

3. **Invest in delivery systems and intermediaries to increase reach.**
   Evidence from AICCRA countries indicates that multi-channel delivery—combining digital platforms, radio, extension services, and community-based dissemination—increases the likelihood that CIS reach women, youth, and marginalized farmers. Policymakers should prioritize investments in delivery infrastructure and intermediary capacity, rather than focusing exclusively on information production.

4. **Ensure sex-disaggregated data and accountability mechanisms are embedded in CIS systems.**
   AICCRA documentation highlights that sex- and age-disaggregated data are essential for identifying who is reached, who benefits, and where gaps persist. Policymakers should require routine disaggregation, reporting, and accountability mechanisms within

national CIS systems to support evidence-based inclusion.

5. **Link CIS to complementary services to enhance uptake.**
   Evidence from AICCRA contexts shows that CIS are more actionable when bundled with extension support, livelihood-relevant services, or risk management mechanisms. Policies that enable coordination across agriculture, finance, and social protection sectors can help ensure that climate information translates into feasible action.

For Researchers

AICCRA research and evaluation outputs identify priority areas where stronger and more systematic evidence is needed to advance inclusive CIS design and policy.

1. **Strengthen evidence on long-term outcomes beyond reach**
   While AICCRA documented short- and medium-term empowerment outcomes—such as access to information and participation in decision-making—evidence on longer-term transformation remains limited. In an analysis of 33 gender-relevant AICCRA-supported innovations mapped to the reach, benefit, empower, transform framework (RBET), although all 33 reached and benefited women, only three were deemed transformative (Ewell & Moore, 2025). Researchers should prioritize measurement frameworks that go beyond reach of women or agricultural investments and incomes to also capture both empowerment and transformation outcomes, including changes in leadership, institutional participation, and voice (***Table 2***).

2. **Resource Monitoring, Evaluation, Learning, and Impact Assessment (MELIA) systems to capture inclusive outcomes over time.**
   Addressing documented evidence gaps requires sustained investment in MELIA. AICCRA experience indicates the need for longitudinal and mixed methods approaches capable of tracking differentiated outcomes for women, men, and youth across contexts and over time.

3. **Generate comparative evidence on inclusive delivery and innovation.**
   Innovations explored under AICCRA—such as AI-enabled advisories, gamification, ag-data hubs, and participatory delivery mechanisms—have generated valuable design insights but remain largely exploratory. Comparative research is needed to assess how these approaches perform relative to conventional delivery models under different institutional and socio-economic conditions.

4. **Improve evidence on youth engagement and differentiated user groups.**
   AICCRA synthesis highlights fragmented evidence on youth-specific CIS needs and outcomes. Researchers should develop more systematic approaches to understanding how different segments of

Table 1: *From Empowerment to Transformation: Implications for Measurement*

Empowerment indicators (individual / short- to medium-term)	Transformation indicators (systemic / longer-term)
Better access to information to manage agricultural risk	Improved participation in village-level decision making
Better access to information through mobile-based agro-advisories	Increased participation in senior positions held by women/men in community-level groups, producer organizations, or youth organizations
Better crop diversification and/or changes in cropping patterns	Increased participation in political programs or institutions at local or village level
Increased participation in decisions over use of income	Increased participation in political programs or institutions at sub-national or national level
Increased participation in decision making related to changes in agricultural production	Increased confidence in speaking in public
Increased income	—

youth and marginalized groups engage with CIS across livelihood pathways.

5. **Strengthen documentation and synthesis of implementation evidence across countries.**
   AICCRA experience highlights the value of cross-country synthesis in identifying patterns in inclusion, delivery, and use of CIS. Researchers should invest in systematic synthesis of implementation evidence—including qualitative learning from pilots and innovations—to support learning beyond individual country contexts.

For Practitioners

Evidence from AICCRA implementation highlights practical actions that practitioners can take to design and deliver more inclusive CIS.

1. **Prioritize participatory co-production to improve relevance.**
   AICCRA experience shows that co-producing CIS content with users improves alignment with decision contexts and livelihood priorities. Practitioners should integrate participatory methods throughout the CIS cycle, from design to feedback and adaptation.

2. **Use multi-channel delivery to increase reach and reduce exclusion.**
   Practitioners should continue combining digital, radio, extension-led, and community-based dissemination rather than relying on single channels. Multi-channel delivery has been shown to mitigate access barriers related to literacy, connectivity, and affordability.

3. **Tailor CIS content and formats to improve adoption.**
   Tailoring advisories by livelihood, **farmer identity**, and decision context—using accessible formats such as voice, visual tools, or facilitated discussion—improves usability and reduces reliance on individual digital access.

4. **Leverage innovation to expand agency, not complexity.**
   AICCRA innovations demonstrate that tools such as gamification and bias-aware AI can expand users' agency by supporting understanding, reflection, and informed choice. Practitioners should adopt innovations selectively and ensure they are embedded within trusted delivery systems.

5. **Bundle CIS with services that enable action.**
   Practitioners should design CIS delivery with actionability in mind, linking advisories to extension support, technologies, or services that enable users—particularly women and marginalized farmers—to act on climate information.

Conclusion

Taken together, AICCRA evidence suggests that inclusive CIS require more than improved forecasts or digital tools. Participatory co-production improves relevance; multi-channel delivery increases reach; tailored content improves adoption; innovations can expand agency; bundling drives uptake; disaggregated data makes inclusion visible; and institutionalization is required for scale. Translating these insights into sustained impact will depend on continued coordination, resourcing, and learning beyond individual project cycles.

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