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Framework for Incorporating Gender Equality and Social Inclusion (GESI) Elements in Climate Information Services (CIS)

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Abstract: We advance a gender equality and social inclusion (GESI) framework for incorporating climate information services (CIS), which is now becoming central due to the ongoing climate change and climate variability. We understand gender as a social construct of who women and men are supposed to be. Gender inequalities seem to be enduring such that, despite innovations in agricultural and climate information technologies, unequal gender power dynamics will still emerge. As far back as the 1960s, the gendered inequalities in accessing technologies could be identified. Such a historical analysis clearly shows that the different technological solutions are clearly embedded within the society in which they evolve in. The paper uses a literature review methodological approach whilst informing the implementation of an ongoing Accelerating Impacts of CGIAR Climate Research for Africa (AICCRA) Project. The findings reveal that unless women are intentionally included in designing and developing agricultural technologies, specifically climate information systems, there is a danger that women will be excluded from the benefits. Conway's law clearly stipulates that technological innovations are not neutral as they are a projection of the values of their creators. It is, therefore, central to grasp the values of creators of different technological solutions and innovations. The key findings are built around the espoused conceptual framework, which has five indicators, namely: (1) gender targeting by intentional design, (2) collection of sex-disaggregated data, (3) conduct an analysis of the sex-disaggregated data, (4) dissemination of the technological options and (5) conduct continuous monitoring of gender and ongoing empowerment evaluation. The five indicator domains are further complemented by their respective assumptions. Our GESI recommendations are on the five selected indicator domains. These domains must be used within the three focal development areas: agricultural data hub, climate information services training, and flood and drought indicators, which are all being implemented in Zambia. Other AICCRA Project countries are Ethiopia, Ghana, Kenya, Mali, and Senegal. This paper engages why CIS has not gained significant traction in Africa, as it has not genuinely incorporated the differential gender technological nuances.

Keywords: gender framework; technology; Climate Information Services (CIS); sex-disaggregated data; Zambia; Africa



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1. Introduction

More broadly, access and control of climate information services (CIS) and agricultural technologies are determined by the underlying gender relationships. Gender is a socially constructed definition of women and men (Connell, 1987) [1]. Gender is different from sex. Sex is defined as the biological characteristics of men and women. Gender identities are based on the different roles, tasks, and responsibilities of men and women in a given context. Gender relationships are shaped by context-specific social and cultural norms, which may change over time. Gender relations are also based on power relationships which reflect society's structures governing how men and women should behave in public/community and private/household spheres. Gender relations are intersectional in that they interact with other social attributes, such as class, ethnicity, age, religion, caste, and others (Carastathis, 2014, Crenshaw, 1991, Nightingale, 2011, Pirtle & Wright 2021) [2–5]. It is also important to note that gender relations may change over time, as they are not static. Women, in some instances, have the agency to transform the unequal gender system, which is primarily based on patriarchy (Autio et al., 2021, Farnworth, 2010, Lawless et al., 2019, O'Hara and Clement, 2018, Petesch, Badstue and Prain, 2018) [6–10]. Feminism advocates 'for equal rights/responsibilities for women and men as well as gender similarity' (Ogletree, Diaz1 and Padilla, 2019:1576) [11]. This paper will not focus on feminism as it ranges from cultural to liberal feminism, which is not the remit of this endeavor (Donelson 1999; Swirsky and Angelone 2014; Tong 2007) [12–14].

Gender inequalities are persistent in such a way that they appear despite the innovations within the broader agricultural and climate information services arenas. Historical trajectories going back to the early 1960s demonstrate the symbiotic relationship between technical innovations and the society in which the innovations are produced (Sterling, 2021, Stamp, 1989, Chambers, Pacey and Thrupp, 1989) [15–17]. Sterling (2021) [17] observes that if women are not deliberately involved during the planning and progression of agricultural innovations, it could then be possible for women to be excluded from agricultural innovation supposed to help them cope with climate change and climate variability. According to Conway's law, any technology reflects the values of its creator (Sterling, 2021) [17]. It is therefore key to unpack the values, norms, and belief systems of the creators of innovations in technology and their related solutions. Intersectionality, which considers vulnerabilities such as disability, would double or treble the gender gap in mobile phone ownership in developing countries (Sterling, 2021) [17]. Technological innovations are specifically disadvantaging women in terms of accessing CIS (Huyer, 2019) [18]. Therefore, it is important to understand the gendered nuances of technological usage better. COVID-19 has also shown the importance of digital information. Since digital access is gendered, it has also meant that women and other vulnerable groups have been further marginalized, as they cannot access information to the same level as men.

2. A Brief Contextual Overview of Gender in Zambia

Before the change of government in 2021, Zambia had a ministry specifically responsible for gender, established in 2012. Now, gender is under the Cabinet Office. Zambia is a signatory to about 22 regional and international conventions, including the Convention on the Elimination of All Forms of Discrimination against Women (CEDAW), the International Covenant on Economic, Social and Cultural Rights (ICESCR), and the International Covenant on Civil and Political Rights (ICCPR).

Nationally, the key policy instruments on gender are the Zambian Constitution of 2016 (Article 259(1)(b)), the Gender Equity and Equality Act No. 22 of 2015, and the National Gender Policy of 2014 (Zambia, 2020) [19]. The Gender Policy aims at redressing the existing gender imbalances and provides equal opportunities for both men and women to engage in the transformation of the country (Zambia, 2014) [20]. The gender policy identified climate change as one of the critical challenges negatively affecting women.

Climate change adversely affects women whose livelihoods largely depend on natural resources for food, wood fuel, and water. The impact of climate change on water resources ultimately results in household food insecurity and shortage of water (Zambia, 2014) [20].

In addition, the former Minister of Gender and Child Development noted the importance of women in Zambian agriculture and the challenges they face (FAO, 2018) [21].

Major facets of gender inequalities still exist, especially among rural women employed in the agriculture sector, who constitute 76% of the agricultural labor force. These include women's limited access to and control over productive resources, services, and markets (FAO, 2018: Preface) [21].

In Zambia, the constitution and legal system are supreme. However, there is a challenge in the dualistic legal system; formal law on the one hand and the traditional governance systems based on patriarchal cultural beliefs and norms on the other (Zambia, 2020) [19]. The constitution's article 11 acknowledges equal rights between men and women, while Article 23 accepts personal and customary law embedded within patriarchy and norms that treat men and women differently (Zambia, 2020) [19].

The Zambian Land Policy through the Lands Act of 1995, Chapter 184, stipulates that for state land disposal, 50% of the land must be sold to women. The policy is a positive move, but it is also worth noting that the state in Zambia owns only 6% of the land. The remaining 94% of the land is under customary ownership and is allocated by traditional leaders through chiefs (Zambia, 2020) [19]. Therefore, to transform land ownership in Zambia, chiefs also need to allocate land to women. Based on current statistics, few women own land in Zambia compared to men. In addition, approximately 32.7% of women in rural areas own land, which is much higher than the 6.8% of women who own land in urban areas (Zambia, 2020) [19].

The 2020 Gender Report further notes that technology is transforming societies such as Zambia through access to information and increased market access. However, the report cautions that information communication technology (ICT) could further reinforce the gendered inequalities as well as inequalities between urban and rural areas (Zambia, 2020: 87) [19]. Access to and utilization of ICTs is skewed towards urban areas.

"There are many factors influencing ICT access and usage in Zambia. However, income, education (literacy), lack of awareness, and social position have been cited as some of the key factors in this regard. The main barriers to accessing Internet services include: lack of appreciation of a need for the internet, lack of skills to use Internet services, and the high cost of required equipment. Other reasons include: lack of knowledge of how to use the internet, lack of appropriate devices, lack of interest in Internet services, and lack of access to these services" (Zambia, 2020: 87) [19].

Unequal access to and usage of both Internet and e-commerce services suggests that a significant majority of women and those in rural communities is cut off from certain information that is only accessible via the internet. It also means that this group is cut off from engaging in online trade (buying and selling), learning, as well as email communication. The same can be said of women with no access to the Internet (Zambia, 2020: 87) [19].

Mobile phone ownership in urban areas in Zambia was 71% (ZICTA, 2018) [22]. In rural areas, ownership was 42%. Youth in the 10–34 age group accounted for 72% of internet usage (ZICTA, 2018) [22]. Approximately 77% of the male-headed households owned a mobile phone, with about 65% of the female-headed households owning a mobile phone. Therefore, AICCRA's climate information services (CIS) need to consider such gendered dimensions as it designs solutions for communicating climate information that targets both female and male farmers using appropriate channels for communication.

Zambia has an approved ICT for Development Policy. The ICT policy recognizes agriculture as a key target for digitization. For example, Zambia's national ICT policy goal is to improve productivity and 'competitiveness of the agricultural sector through the use of ICTs in the planning, implementation, monitoring and the information delivery process' (Ali et al., 2016) [23]. There is broad political support for the digitization of agriculture and services in Zambia. Political will and support at high levels are prerequisites to scaling

digital services in any African country. Fifty-six per cent of Zambia's population is rural and highly dependent on agriculture (World Bank, 2022) [24]. However, most rural farmers do not have access to modern agricultural knowledge and information. The limited reach of extension agents makes using ICTs critical for spreading climate information services. However, in Zambia, it has been suggested that the poor access of women to ICTs will limit their participation in climate-smart agriculture and other "green economy initiatives" (Namukombo, 2016) [25].

"Zambia had about 71% of the men listening to the radio compared to 45% of the women. For television, men almost double (48% against 26%) the number of women who are able to watch television. About 58% of the men were also found to own a mobile phone or active Subscriber Identity Module card as compared to 37% of the women" (Namukombo, 2016) [25].

Access to mobile phones and other ICT services such as the internet are also biased towards urban areas, especially along railway lines.

3. Why Gender Matters Technological Innovations and Climate Information Services

Literature on gender and technology, more broadly, has demonstrated that women tend to benefit less than men do from technological innovations within the agricultural sector (Stamp, 1989, Maharjan, Bauer, and Knorr, 2012, Drechsel, Hope and Cofie, 2013, Shrum and Miller 2011, Klingentalicia et al., 2021) [16,26–29]. According to the big data platform, "the coming years will be characterized by unprecedented rates of innovation at the intersection of digital technologies and life sciences that—if harnessed and applied—can provide the tools humanity needs to adapt to or mitigate some of its most pressing challenges such as climate change" (CGIAR, 2021) [30].

Women, rural dwellers, and the marginalized communities make up most of those without digital connectivity due to systemic barriers including affordability, access to digital skills and education, language and literacy obstacles and perceived relevance and social norms" (Sarbani Banerjee Belur and Ingrid Brudvig, 2021). Female farmers generally tend to have limited access to agricultural extension information (Spielman et al., 2021) [31]. Some female extension staff further re-enforce such patriarchal views as they also view men as the farmers who must be called to agricultural extension meetings (Mapedza et al., 2017) [32].

Climate Information Services aim to provide information to smallholder farmers to be able to adapt and reduce their vulnerability to climate variability and climate change. Therefore, access to the information will be a first step in how a farmer could use that knowledge to adapt to climate change and variability. Given that women are disadvantaged in access to agricultural technologies and extension services, lack of access to CIS further aggravates their vulnerability to climate change. Gender is central in shaping production, consumption, and reproduction in any given society. McOmber et al. (2013) [33] note that communication channels often exclude women from CIS. Figure 1 shows a simplified diagram of why gender matters in CIS from the household, farm, community, landscape/region, and national to the global level (Huyer, 2019) [18].

The first gear is to understand who has access to CIS. Here, it is important to understand how the information is tailored for both men and women. Gender is a key consideration for accessing CIS (Ouedraogo, et al. 2022) [34]. If the CIS is structured and delivered towards men as farmers, this will mean that women would have lost outright at the beginning of the process.

Gear 2 looks at assets. Having received the CIS information, what do you then do with that information? Here, we review the importance of assets (capabilities) essential for farming, such as land, technology, and tools. In most studies, women do not seem to have access to key assets central to responding to climate change to improve their livelihoods.

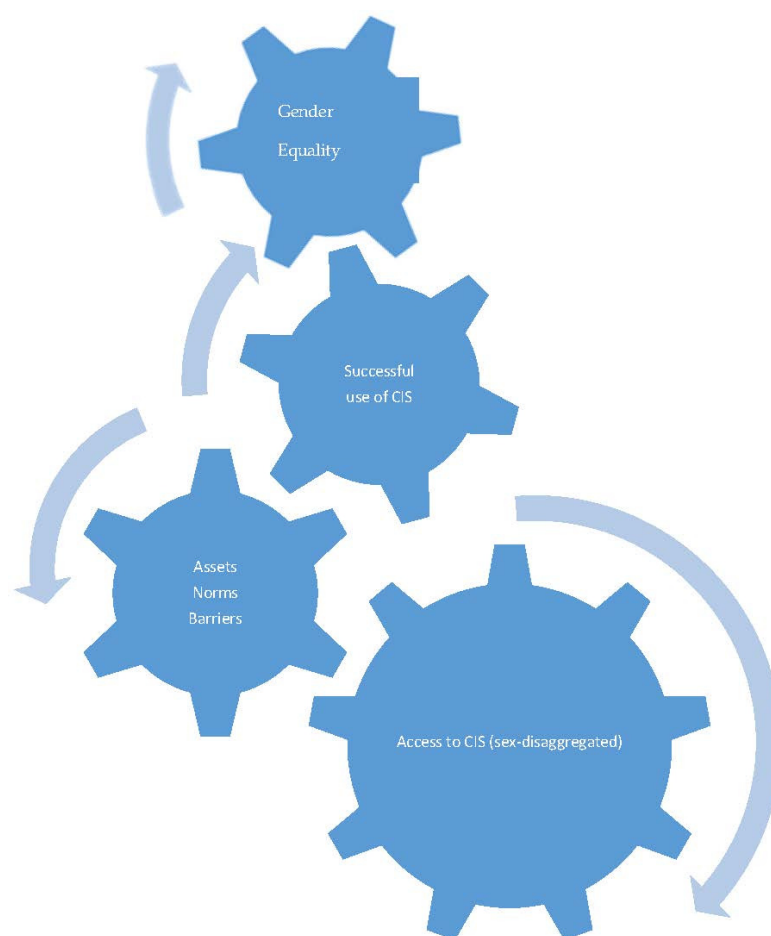


Figure 1. Why Gender Matters in Climate Information Services (CIS).

Gear 3 is a successful application of the CIS information with the assets to adapt to climate variability and climate change.

Gear 4 shows the gender empowerment stage, where women who have been empowered through appropriate CIS have both access and control of the benefits from climate-smart agriculture and are exercising their agency at the household, farm, community, national, and global levels (Huyer, 2019) [18].

Huyer et al. (2017) highlight why it is important to consider gender and social inclusion for CIS, as briefly summarized in the following section.

3.1. Differing Roles, Decisions and Control of Resources can Influence the Climate Information Needs of Rural Women

A good understanding of who does what, when, and why will help target the recipients of the CIS. To better understand the exclusion of women in CIS, it is important to debunk the idea that agriculture is often perceived as a preserve of men who own land. Women are often perceived as helping the male landowners, especially within the patriarchal nature of most of sub-Saharan Africa (Peters, 2013, Peters, 2002) [35,36]. While there are fewer pockets of matrilineal societies, research in Malawi, for instance, highlights the importance of uncles' decision-making power on land allocation and transfer for women in matrilineal systems (Mapedza et al, 2017) [32]. Women tend to have an important role in farming in sub-Saharan Africa. However, when it comes to decision-making and control of resources, women face a significant disadvantage (Ahlers and Zwarteveen, 2009, Drechsel, Hope and Cofie, 2013, Dzanku, Tsikata and Ankrah, 2021, Fortmann and Bruce, 1993, Leder, Clement and Karki, 2017, Quisumbing and Kumar, 2014, Quisumbing, 2003, Sundberg, 2017, Huyer, 2016, Carr et al., 2015, Carr, 2016a, Carr, 2016b) [26,37–47]. Understanding

gendered access to land, water, finance, etc. takes us a step further in understanding that CIS requires land and other resources based on which climate change adaptation decisions must be operationalized. A grounded understanding of roles, decisions, and control of landed resources is central to outcomes of CIS for women.

3.2. Meeting Rural Women's Service Needs Requires Attention to Communication Channels That May Differ from Those Used to Reach Men

Most mediums used for communication have often assumed that farmers are all the same. This assumption has entailed designing generic solutions which do not explore the differentiated interests and requirements of both women and men. The assumption is that men are the farmers, so all solutions are tailored toward the needs of men. Such a perspective seriously disadvantages women. It is important to note that communication channels are gendered. This is influenced by the gendered educational differences, and differences in access and control of the means of communications such as mobile phones and radios. Such an understanding will require that appropriate communication channels be used and the timing of the communication. Women often suffer from 'time poverty' as they have domestic chores to perform in addition to productive roles (Blackden and Wodon, 2006) [48]. When would it be convenient for women to get the CIS communication? In what format and language are all important considerations?

3.3. Gender Steps

In the mission to address gender within CIS, this paper provides different steps toward gender equality, from gender exploitative to gender transformation, as shown in Figure 2.

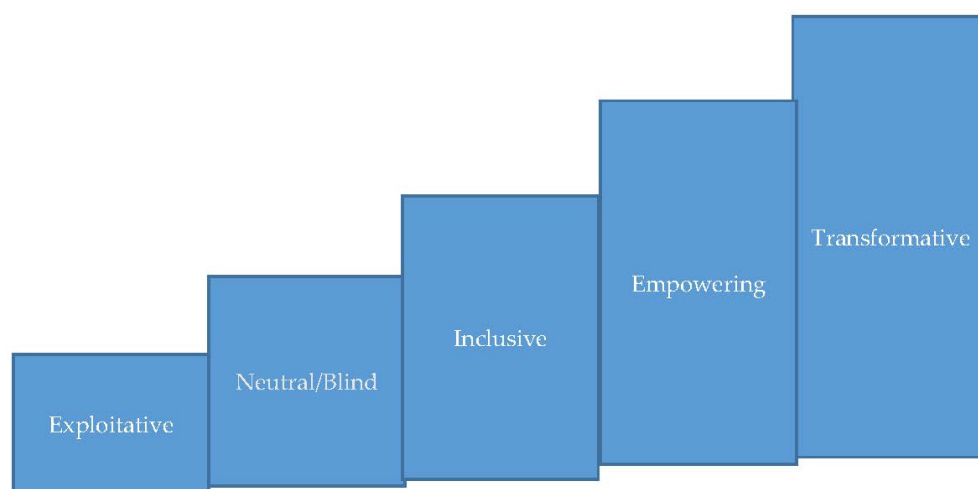


Figure 2. Steps towards Gender Equality in Climate Information Services.

Whilst the steps towards gender equality in CIS are visual “steps”, this does not mean they are sequential. The outlined steps only show the progression from a less desirable gender state to a more desirable state of gender inclusion. Different actors, projects, organizations, or countries may pursue different pathways and trajectories as they move from an undesirable state to the desired state of gender transformation. It is also possible to regress to a less desirable gender state. The different step descriptions, which build on the Swiss Development Cooperation (SDC, 2021) [49] gender guidance, are briefly outlined in the next section.

Exploitative gender: This approach does not consider gender in designing and planning development interventions. Women are not targeted by development interventions. This approach intentionally or unintentionally reinforces or exacerbates gender inequalities by planning development interventions that exploit rather than promote women’s interests (Nindi, 1994; Palumbo and Scieurba, 2018) [50,51]. Using this approach will not help women benefit from CIS interventions.

Neutral/Blind: This approach does not recognize the role of gender in influencing development outcomes. Such a view assumes that gender does not impact development outcomes or interventions. For example, gender-neutral development interventions on adaptation to climate change around Lake Faguibine created an increased work burden for women (Djouidi and Brockhaus, 2011) [52]. If this approach is used, it means that the differential requirements of women in CIS will not be addressed.

Inclusive: This approach includes gender concerns in the designing and implementing of development interventions. This entails looking at gaps in women's participation. Timu and Kramer (2021) [53] illustrate this with a focus on how agricultural insurance analyses gender gaps before identifying how to increase insurance uptake by women. Being inclusive might not address equity of outcomes (Timu and Kramer, 2021) [53]. This approach will begin to address women's needs in CIS, but it falls short of addressing why women are disadvantaged. The underlying patriarchal foundation is not questioned.

Empowering: These interventions consider women's agency to benefit from designing and implementing development interventions. The Women's Empowerment in Agriculture Index (WEAI) framework provides an effort on how empowering agricultural interventions are across different developing country contexts (Alkire et al., 2013, Aregu, et al., 2018, Doepke and Tertilt, 2014, Elias et al., 2021, IFPRI, 2012, Kabeer, 1999, Meinzen-Dick et al., 2017, Murray-Rust et al., 2001, Myers et al., 2022, Njuki et al., 2021, O'Hara and Clement, 2018, Pyburn and van Eerdewijk, 2021, van den Bold et al., 2013) [9,54–65]. Whilst women's agency to access CIS will enable their empowerment, it is important to note that CIS on its own is not adequate. For meaningful empowerment, other factors need to be taken into account. For instance, the socio-cultural norms governing roles and responsibilities for women and men need to be better understood and changed. The other considerations are collective action/group processes and how they meaningfully engage women, ICT content that addresses women's priorities and preferences, and formats that are accessible to women (e.g., pictures in climate advisories). This is important as inclusion of women into groups, such as Radio Listening Clubs in Rwanda, which went beyond access to CIS to increase access and control of incomes earned as a result of climate smart agriculture (CSA), was shown to be empowering to women (Ingabire, 2021; Huyer et al., 2019; Huyer et al., 2021) [66–68].

Transformative: This view realizes the importance of changing social norms, cultural practices and beliefs at the societal level, to attain gender equality for positive development outcomes. A gender differentiated CIS approach will shift the loci of the norms and culture and enable empowering social transformation for women. CIS which is gender blind will contribute towards the perpetuation of gender inequalities. A transformative lens entails changing unequal gender relations to promote shared power, control of resources, decision making and leadership at different levels; and support for women's and men's empowerment is central for this approach. According to IDRC (2018) [69], a gender transformative approach is "striving towards changes that address the root causes of gender inequality, moving beyond the individual to the structural" (see also Archambault, 2016, Leder and Sachs, 2019, Cole et al., 2014, Alkire et al., 2013, IFPRI, 2012, Jakimow, 2012, Kabeer, 2001, Mayoux and Parpart, 2000, Meinzen-Dick et al., 2017, Njuki et al., 2021) [54,58,60,63,70–75]. IDRC (2018) [69] further notes that a gender transformative approach has to be based on a feminist approach, which addresses the following four principles:

1. Meaningfully include and empower women and girls.
2. Understand diversity and consider the context.
3. Challenge power and promote equality.
4. Design and use research for purposeful action.

The transformative approach is very important for women to benefit from CIS as it seeks to change norms and agency at a societal level, which curtail the access and control over benefits from the received information. This approach looks at changing the whole system instead of tinkering with the gender margins. By virtue of women

having access to CIS adapted for their specific requirements, this will enable them to make appropriate responses which will see them benefiting from increased agricultural output, increased knowledge, and increased opportunities (Huyer et al., 2021) [76]. This will potentially change norms, agency, and opportunities around what women can and cannot do (Huyer et al., 2021; IDRC, 2018) [69,76].

3.4. Despite Obstacles, Women Farmers Who Access Climate Information Use and Benefit from It

Whilst women face barriers to accessing CIS, it is important to note that women are not victims in all instances, as some women are exercising their agency by accessing climate information and using it for their increased benefit (Huyer et al., 2017) [77]. Agency, which is an aspect of empowerment, can further be defined as capturing “conscientization—the emergence of critical awareness and action for change” (Yount et al. 2020:2) [78]. Several studies have been conducted on how CIS is empowering women. For instance, UNECA (2018) [79] demonstrated that one of the pathways is through the ‘use of local corporate partnerships for tailor made CIS dissemination’ and economic empowerment, as was the case in Nigeria through community radios, use of megaphones, peer to peer learning, as well as ESOKO’s innovation in Ghana with use of text messages on rainfall patterns, pricing and appropriate seeds. UN Women (2021) [80] used different pathways, with one of them being access to finance through digital micro-insurance services to reduce effects of disasters and increased resilience; under development in Liberia, Mali and Senegal. Ingabire (2021) [68] noted that radio listening clubs provided an effective pathway for economic and social empowerment, through access to CIS and improved livelihoods. Beal et al. (2021) [81] further identified methodological approaches, such as participatory action research (PAR), as being instrumental in increasing CIS services to women and youths resulting in group analysis of gender roles and dynamics, along with increased adoption of climate smart agriculture (CSA). The different pathways are increasing women’s agency through increased status and leadership in the household and community, resilience towards climate change, and, increasingly, controlling income earned.

Climate Information Services Have the Potential to Empower Women

As discussed above, gender-responsive climate information services offer an opportunity to transform agricultural production and contribute to the transformation of agrarian communities. In the long term, they contribute toward positive changes in gender norms.

3.5. Evidence of Positive Example of the Use of CIS by Women

CIS can be used by women as the recently concluded Climate Change Agriculture and Food Security (CAAFS, 2022) [82] Program has demonstrated that it is possible to use gendered CIS to empower and transform women’s livelihoods (Huyer et al., 2021) [67]. Some experiences from the field are summarized based on the literature review by Gumucio et al., 2020. This was one of the most extensive, covering 14 sub-Saharan countries, four countries from South and South East Asia, one country from Oceania (Papua New Guinea) and one country from North Africa (Egypt). These studies indicate that it is important to design interventions considering the differential CIS requirements based on gender. Such an approach will ensure that women benefit from CIS and improve their livelihoods.

3.5.1. Gender Differences in Access to CIS

Most studies showed the differences in accessing CIS based on the communication channels. This was more of a response to the provided CIS without basing it on the gendered demand for the information. This is important to understand as the channels or the medium of communication will significantly influence whether women will receive the CIS (Gumucio et al., 2020, Gumucio et al., 2018, Huyer, 2017) [77,83,84].

3.5.2. Gendered Rates of Access to CIS

The differential access to group processes and differential access to ICT between men and women were said to be important contextual factors (Gumucio et al., 2020) [83]. These were further reinforced by socio-cultural norms which shape the differential resources available to men and women and hence the differential CIS demands. Gumucio et al. further demonstrate that access to CIS was gendered based on a literature review focusing on the weather forecast, seasonal forecast, onset forecast, pest and disease early warning, extreme event forecast, drought early warning, and historical data in Kenya, Malawi, Senegal, Tanzania, and Uganda (Coulibaly et al., 2017, Coulibaly et al., 2015a, Coulibaly et al., 2015b, Ngigi, Mueller and Birner, 2017, Twyman et al., 2014). [85–89] These studies, for instance, demonstrated that there were some CIS that men were statistically significantly more likely to access than women were. In some instances, women were accessing some CIS statistically significantly more than men were (Gumucio et al., 2020) [83]. In Rwanda, for instance, Coulibaly et al. (2017) [85] note that women had more significant access to historical data than men did. In six districts in Kenya, women had statistically significant better access to weather forecast data than men did. Whilst CIS is important, it should be integrated with a broader adaptation approach for food security at the local level. It should also be seen as a tool for women to plan and control their own production, household and community activities. This can inform aspects of CIS gender data collection, design, and implementation to ensure that the gender differential access and use of CIS information are grounded within the broader gender context (Sterling, 2021) [17].

3.5.3. Access to Information through Media and ICT

Gumucio et al. 2020 note that there is increased access to information through interactive radio and ICT to communicate agriculture and climate information to farmers (Davis, Tall and Guntuku, 2014, Hampson et al., 2014, Mittal, 2016, Tall, 2014a). [90–93] Whilst radios and mobile phones are important, men tend to own such communication channels, which further marginalizes women (CICERO, et al. 2017, Coulibaly et al., 2017, Hampson et al., 2014, Kyazze et al., 2012, Owusu, Yankson and Frimpong, 2017, Tall, 2014a, Tall, 2014b, Tall, 2015a, Tall, 2015b, Partey et al., 2020, Stats4SD, 2017) [85,85,91–100]. In instances where women access the radios and mobile phones, some studies have shown that women are more likely to face technical challenges due to low levels of literacy (Caine et al., 2015, CICERO, 2017, GSMA, 2012, Partey et al., 2020, Owusu, 2017, Scott, Mckemey and Batchelor 2004) [94,96,97,101–103]. Therefore, channels for CIS should, in a participatory manner, evaluate the appropriateness and suitability of the different channels for women's specific circumstances.

Gumucio et al. 2020 [84] note that the CCAFS study sites in climate smart villages in Kaffrine, Senegal showed that women and men had similar rates of use of the types of climate and weather information except for early drought warning where more men made use of that information to inform agricultural decisions (Twyman et al., 2014) [89]. Where gender CIS requirements are taken into account, women can benefit and can have more climate resilient livelihoods based on the information received.

4. Research Approach

This paper is based on secondary literature review on CIS and gender equality. A special focus was on the Consultative Group on International Agricultural Research (CGIAR) Research Program on Climate Change, Agriculture and Food Security (CCAFS). CCAFS conducted significant research on Climate Change with a considerable contribution to Climate Information Services and gender. Phases 1 and 2 of CCAFS began in 2011 and ended in 2022. The ongoing Accelerating Impacts of CGIAR Climate Research for Africa (AICCRA) immediately succeeded CCAFS. AICCRA focuses on six countries: Ethiopia, Ghana, Kenya, Mali, Senegal, and Zambia. The paper is based on a CCAFS follow-up program that also uses the ongoing AICCRA project to offer a gender equality and social inclusion (GESI) framework that will inform gender inclusion. The Zambia AICCRA

activities cover three broad areas, which are: (1) knowledge generation and sharing of effective CIS, (2) partnerships for delivery, and (3) supporting the uptake of CSA innovations through piloting

5. Discussion: Barriers to Gender Equality and Inclusion in CIS

Several barriers make it more difficult for women to access CIS. This section is informed by the IWMI (2020) conceptualization, which was more broadly on gender and agricultural water management, but neatly speaks to the CIS as well. According to Sterling (2021), who tried to understand why women are not using agricultural applications, “for digital technologies to be part of any development solution, practitioners must first address the myriad of real-life barriers and inequities surrounding technology use” (Sterling, 2021) [17].

5.1. Entry Barriers

Entry barriers stop women from accessing CIS. Such barriers could be illustrated by the unequal access to assets, such as land, water and financial resources, the lack of capabilities to pursue investments using CIS and the lack of agency. Lack of agency for women is usually a result of unequal power dynamics that undermine women’s agency. Whilst, some women might still exercise agency, such agency is exercised within very restrictive conditions, which represent significant barriers.

The second set of entry-level barriers includes socially defined roles, identities, responsibilities, and opportunities, which are complex and further compound inequalities through the intersection of gender, age, class, race, ethnicity, religion, and caste (IWMI, 2020) [104]. One socially defined barrier takes the form of time poverty, where women have domestic chores demands on their time in addition to other demands on their time (Simelton and Kawarazuka, 2019) [105]. One female farmer, cited by Henriksson et al. (2021: 509) [106] in Malawi remarked, “I am busy working in the household or out in the field, and not always where my radio is or where the car with the speaker drives around” (Henriksson et al, 2021) [106]. This means that the socially defined roles make it very difficult for women to access and use CIS, as they already have chores which take up a significant part of their daily duties. Other barriers include lack of control over use of the CIS technology, such as radio; lack of input into CIS content and format, and lack of income to pay for the use of ICT such mobile phones (Huyer et al., 2021; 2019) [18,76].

The third aspect of entry-level barriers is the complex and intersecting barriers. Most of the societal roles in sub-Saharan Africa comprises of ‘complex inequalities, through intersections, including gender and age, class, race, ethnicity, religion, caste, and disability (IWMI 2020:5) [104]. Therefore, women will already be disadvantaged by being women and not based on their capabilities. The impact of patriarchy also varies and is differentiated even amongst women in an intersectional manner with the interplay of factors such as age, level of education, place of residence (rural vs. urban), race, ethnicity, and religion.

Example: Implications for CIS in Zambia.

Accessing CIS faces an intersection of disadvantages making it difficult for women to access and benefit from CIS. Most of the CIS dissemination mechanisms assume that the recipient can read and benefit from such information. However, most women tend to be less educated, not because they do not want to, but because patriarchal norms tend to give schooling preferences to boys and then girls. Unequal power dynamics might also undermine women from benefiting from CIS information. Hence, for Zambia, we recommend a gendered understating of CIS through the agricultural data hub, climate information systems, and flood and drought indicators.

5.2. Structural Barriers

These are more deeply ingrained barriers. The first set of barriers are on “gender inequalities across institutions (households, community, local to global market, state and civil society entities)” (IWMI 2020: 5) [104]. From households, community, local to global markets, and state and as well as civil society institutional arenas, the gendered rules of

the game are tilted against women. Therefore, disadvantages for women are multiple and multi-sited and re-enforce each other. This makes it more difficult for women to access climate information services. For those who exercise their agency, this will largely be an uphill fight, as barriers must be removed from the household to the global level.

The second structural barriers are “cultures of privilege, hierarchy and exclusion at scale and lack of tools to assess and act on dimensions of power” (IWMI, 2020: 5) [104]. Cultures of privilege, which are ingrained in patriarchy, mean that “socially prominent individuals” (Roncoli et al., 2011) [107] who are enjoying privileges would want to maintain the status quo. Women who receive the brunt of such cultural privileges might help enforce the same system for their daughters and daughters-in-law (Carr, Fleming and Kalala, 2016a) [38].

Implications for CIS in Zambia

The structural barrier outlined above makes it difficult for women to access and benefit from CIS. Whilst the GESI Framework was developed using research data from AICCRA in Zambia, the framework has global application. Hence, in designing the GESI Framework globally, such an understanding is important in that it is not just about having the CIS communicated but understanding the visible and invisible barriers that might make it challenging for women to use the CIS they access. In this respect, we are also working with state and non-state partners to leverage for change in the norms and barriers which negatively affect women.

5.3. Systemic Barriers

Systemic barriers are established based on existing ways of governance or cultural practices. The first systemic barriers are “climate challenges, agro-ecological specificities and markets that do not consider the needs and realities of the most marginalized” (IWMI: 2020: 5) [104]. CIS is a response to climate challenges, which might target those who are best positioned to make the practical changes to adapt to climate change and climate variability. Such recipients of the solutions tend to be exclusionary, as they do not account for the requirements of the poor, vulnerable and marginalized amongst whom women are the majority.

The second systemic barrier is “knowledge, technology and economies that assume homogeneity, or ignore further inequalities” (IWMI: 5). Lack of differentiation of the recipients of the CIS needs to be sex-disaggregated based on knowledge, technology, and economies. The CIS needs to differentiate customers so that it is based on a differentiated understanding of men, women, and other vulnerable groups. A differentiated understanding will enable tailoring solutions for the different target groups. This will be an inclusive approach as it looks at the various actors and identifies solutions built on their existing opportunities and limitations instead of a blanket solution that will not be appropriate.

The third systemic barrier is the “distance, disconnect, language, skillsets and other exclusion barriers that disable individual and/or collective initiatives to transformative change” (IWMI, 2020: 5) [104]. Women who are far away from the capital, who cannot speak English, and do not have the skillsets to use and apply CIS cannot benefit. The geography of the farmers could render them less accessible to those providing CIS. Chambers’ seminal work on rural development articulately notes the biases by development practitioners towards easily accessible by road, i.e., roadside biases (Chambers, 1983) [108]. These challenges, coupled with other barriers at individual and collective levels, will further prevent women from accessing CIS and make them less likely to transform their lives and livelihoods in the face of climate change and climate variability. These systemic barriers reflect an intersection of several systemic barriers that create a vicious cycle of poverty for women. Unless development interventions have a grounded understanding of such barriers, well-meaning attempts will not transform livelihoods for women, youths, and vulnerable communities.

Table 1 summarizes the opportunities for including gender equality and social inclusion within the CIS within the three CIS components: the agricultural data hub, training, flood, and drought indicators. The agricultural data hub is a database which will comprise of the agricultural and climatic data at national level with disaggregation to regional, district, ward and community level which will be used for planning and more specifically for CSA. The table looks at gender considerations in column 1, which is linked to the assumption. The specific gender activity questions are then paused under the respective CIS activities.

Table 1. Framework for incorporating Gender in CIS.

Gender Consideration/Indicator	Agricultural Data Hub <i>This Aims to Provide a Consolidated Data Hub on Agriculture, Weather, Climate and Commodity Markets Data</i>	CIS Training <i>This Encompasses Training on Climate Information Systems Which Will Be Provided to Government Department Who Will Further Train the Farmers</i>	Flood and Drought Indicators <i>These Are Indicators to Be Developed So That They Will Be Used for Planning and for the Implementation of an Early Warning System</i>
<p>1. Gender Targeting by Design</p> <p>Assumptions Who is targeted (men/women)? Who benefits? Who is systematically excluded? (power dynamics between various social & ethnic groups)</p>	<ul style="list-style-type: none"> How was gender consideration taken into account? What are the differential preferences for women, youths and men? 	<ul style="list-style-type: none"> Was a gender training needs assessment conducted (lectures, exercises, hands-on practical, project work)? What are the preferred training needs for women, youths and men? What are the preferred training modalities for women, youths and men? 	<ul style="list-style-type: none"> Are the indicators designed taking into account women, youths and men's interests into account? What was the role of women, youths and men in deciding on the indicator focus?
<p>2. Sex disaggregated data collection</p> <p>Assumption <i>Intentionality must be demonstrated to collect sex-disaggregated data</i></p>	<ul style="list-style-type: none"> Does the Data Hub have sex-disaggregated data? If no sex-disaggregated data is being collected, what are plans to ensure that sex-disaggregated data is collected? 	<ul style="list-style-type: none"> Is gender-segregated data being kept for both the short term training and embedded in the educational systems? If there is low participation by women, what is being done to rectify this? 	<ul style="list-style-type: none"> Are the indicators sex-disaggregated? Are we able to understand the differential impact of drought on women, youths, and men?
<p>3. Analysis of sex-disaggregated data</p> <p>Assumption <i>Sex-disaggregated data needs to be analyzed to inform CIS activities and decision making</i></p>	<ul style="list-style-type: none"> Is the sex-disaggregated data being analyzed as part of the Analytics? How is gender data being visualized? How are the automated decisions reflecting gender analytics? 	<ul style="list-style-type: none"> Is sex-disaggregated data being analyzed for climate-sensitive training? If yes, what decisions are being made by agricultural extension based on the training analysis? 	<ul style="list-style-type: none"> Is sex-disaggregated data being analyzed? What drought and flooding decisions are being informed by the analysis?
<p>4. Dissemination technological options</p> <p>Assumption <i>The technological options selected to disseminate CIS has implications on gendered access</i></p>	<ul style="list-style-type: none"> How is the agricultural data hub going to be accessible to the different users? What is the accessibility of the technology for women, youths and men? 	<ul style="list-style-type: none"> What are the medium for the different training modules? What are the considerations for women, youths, and men regarding technological options? What is the language used for training, especially at the local level? When is the training conducted? (Suitable for women, youths). Where is the training conducted? (gendered convenience) 	<ul style="list-style-type: none"> What are the technological choices for disseminating drought and flood indicators? What language is used? What is the most appropriate technology to reach women, youths and other vulnerable people?

Table 1. Cont.

Gender Consideration/Indicator	Agricultural Data Hub <i>This Aims to Provide a Consolidated Data Hub on Agriculture, Weather, Climate and Commodity Markets Data</i>	CIS Training <i>This Encompasses Training on Climate Information Systems Which Will Be Provided to Government Department Who Will Further Train the Farmers</i>	Flood and Drought Indicators <i>These Are Indicators to Be Developed So That They Will Be Used for Planning and for the Implementation of an Early Warning System</i>
5. Ongoing Gender Monitoring, and Empowerment Evaluation <i>Assumption</i> <i>Monitoring and empowerment evaluation offers an opportunity to assess gender performance and learn to make adjustments of the ongoing activities</i>	<ul style="list-style-type: none"> • Is there use and access of the data hub by women, youths and men? • What is being done to encourage women and youths—if they are not using the data hub? • What are the potential complementary pathways for increasing women, youths and men? • Do women have knowledge, resources and agency to make use of the Agricultural Data Hub? 	<ul style="list-style-type: none"> • How is training impacting on women and men? • What are the emerging demands from women and men? • What changes need to be made to ensure that the interests of women, youths and men are differentially addressed? • Are we tracking sex-disaggregated data over time? • Do women have knowledge, resources and agency to participate and benefit from the CIS Training? 	<ul style="list-style-type: none"> • What are trends of drought on women, youths and men? • How are women, youths and men being differentially impacted by floods? • What are the coping mechanisms for drought and flooding for women, youths, and men? • What are the possible solutions specifically for women, youths and men? • Do women have knowledge, resources and agency to make use and benefit from flood and drought indicators information?

Implications for CIS at Global Level

Table 1 shows different components of the proposed framework and how the different gendered systemic barriers could be removed for AICCRA for the agricultural data hub, CIS training, and flood and drought indicators. Firstly, gender targeting by design, for instance, seeks to understand who is targeted, who benefits, and who is systematically excluded and will delve into power dynamics and agency issues. Secondly, sex-disaggregated data collection is intentionally performed. Thirdly, an analysis of sex-disaggregated data must be conducted, going beyond collecting data, which are never analyzed. Fourthly, the dissemination of technological options must be informed by sex-disaggregated data analysis as this has implications on access to CIS. Fifthly, ongoing gender monitoring and empowerment evaluation offer an opportunity to evaluate gender advances and draw upon experiences to fine-tune the ongoing development interventions.

5.4. Linking the GESI Framework with the Transformative Approach

The application of the GESI Framework would be more impactful if it is implemented in the context of empowerment and gender transformative approach. Transformation tends to take time, but we believe that the long-term goal of using CIS should be aiming at the transformation of gender relationships, structural inequalities, agency, leadership, and decision making and through the changes in norms and cultural practice, not just tinkering at the margins. Such an approach would address structural inequalities as opposed to the symptoms of the inequalities. Norms and cultural practices take time to change, and CIS alone might not be able to change norms and cultural practices. This paper argues that CIS should be seen as one of the multi-pronged approaches which are contributing towards the chipping away of norms and cultural practices hindering women from effectively engaging and transforming food systems within the current climate change context.

Table 2 indicates some of the empowerment and transformation indicators of a transformative approach to CIS.

Table 2. Indicators for Gender Empowerment and Transformation through CIS.

Empowerment:
<ul style="list-style-type: none"> • Better access to information to manage agricultural risk • Better access to information through mobile-based agro-advisories • Better crop diversification/any change in cropping pattern • Increased participation in decisions over use of income • Increased participation in decision making related to changes in agriculture production • Increased income
Transformation indicators
<ul style="list-style-type: none"> • Improved participation in village level decision making • Increase in senior positions held by women/men in community level groups, producer or youth organizations • Increased participation in a political program or institution at local/village level • Increased participation in a political program or institution at sub-national or national level • Increased confidence in speaking in public

Sources: Abonesh et al., 2022; Alkire et al., 2003; Hariharan et al., 2020. [54,109,110]

6. Conclusions

Climate information services offer a mechanism for the improved resilience for small-scale farmers' livelihoods to better cope with climate change and climate variability. The AICCRA Zambia project, through the agricultural data hub, training, and drought and flood indicators, provides evidence for enhancing smallholder farmer households. For the CIS to be gender inclusive and promote resilience for male and female farmers, development practitioners must ask questions at different stages to ensure that gender considerations and barriers are removed. The proposed GESI framework offers a mechanism for enhancing gender transformation within CIS. The removal of barriers will enable women, youths, men, and people with other vulnerabilities to have equal access to CIS to climate-proof their agricultural production. Climate services have great potential for transforming women's agricultural production in Zambia. If the CIS is built on a patriarchal ecosystem, this will further reinforce gender biases and stereotypes, further reinforcing the marginalization of women. Our espoused conceptual framing endeavors to provide a path towards incorporating gender considerations within CIS and to further enhance food and nutrition security systems across the whole globe.

7. Recommendations

This paper notes that one of the main challenges global food systems face concerns climate change and climate variability. Therefore, practitioners might apply our proposed GESI framework to ensure that any responses to climate change and variability through CIS enhance equality through transforming production systems to benefit both men and women. Interventions led by the WorldBank, CGIAR, funding agencies, and national governments in developing countries need to realize that gender intentionality should be at the core of such efforts to achieve sustainable development outcomes. Gender intentionality is not just good to have but is at the core of human-centered food systems transformation.

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for projects and programs that boost economic growth, reduce poverty, and improve poor people's lives. IDA is one of the largest sources of assistance for the world's 76 poorest countries, 39 of which are in Africa. Annual IDA commitments have averaged about \$21 billion over circa 2017–2020, with approximately 61 percent going to Africa.

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