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Navigating Gender Barriers:

Empowering Kenyan Women Smallholder Farmers with
Agronomic and Climate Information Access.



DECEMBER 2023



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1.0 Executive summary

While the agricultural sector employs over 60 per cent of the Kenyan Population, 70 per cent of which lives in rural areas and engineers, the sector's 34.2 per cent contribution to the Country's Gross Domestic Product (GDP) (KALRO, 208, KNBS, 2019). Even though the agricultural sector's contribution to the GDP was valued at 3.04 trillion (KNBS, 2019), its real potential exists in its return on investment. A unit percentage growth in the agricultural sector is estimated to drive approximately 1.6 per cent overall growth in GDP. Similarly, one unit growth in the agricultural sector is two to four times more effective in raising income among the poorest compared to other sectors. As such, this sector is one of the drivers of the 10 per cent annual economic growth envisioned in the Kenya Vision 2030. This vital contribution is primarily driven by the 75 per cent of women employed in the sector and smallholder farmers farming in 0.2 to 3Ha pieces of land.

Despite the sector's contribution to the economy and the integral role of women, women still experience challenges such as input access, mechanization, credit, climate-related shocks, and low agricultural literacy, among other. Crucial to the solution to these problems is relevant, timely and effective information access by the women, meeting their information needs, eventually helping them to make informed decisions to come over the challenges of input, mechanization, credit, climate adaptation access and utilization. Further, information improves the literacy levels. Even though agricultural information service provision is bestowed upon the county government's department of agriculture and livestock and specifically the directorate of agricultural education and extension, persistent challenges have had huge implications for women smallholder farmers' information access and utilization. While the obstacles spread wide across several spectrums, including policy, social roles and norms, technology, logistics and infrastructure, information content and form, organization and community, little is known about the specific gender barriers and potential solutions to inclusivity in access to agronomic and climate-related information among women.

Agrifin DISF: Addressing Gender Gaps in Digital Technologies project commissioned an innovative participatory research approach to unearthing the barriers and opportunities related to women smallholder farmers' access to and utilization of agronomic and climate related information for increased agricultural productivity and economic empowerment. A combination of desk review, survey, key informants' interview and focus group discussion techniques were used—similarly, descriptive statistics and qualitative research methods were employed to analyze the data.

The significant barriers to agronomic and climate-related information access by women smallholder farmers included gender-competing roles, limited access to extension and advisory services and resources, restricted women's participation in farmer groups, unfavorable policy environment for the agricultural extension sector, lack of awareness of existing information sources, limited access to smartphone, low digital literacy, and information affordability.

Similarly, gender barriers hindering the utilization of agronomic and climate-related information were found to include information relevance, gender roles and norms, limited access to labour and time poverty, limited access to inputs, mechanization, credit and markets, and limited access to land. The barriers were categorised into individual, interpersonal/household, community, organisation, policy, and technological levels.

Farmers require knowledge and actionable agronomic and climate-related information instead of data and information. The information relevance barriers are partially contributed to by the information providers who fail to give actionable knowledge but rather give data. Farmers and many service providers cannot analyze data and information to actionable knowledge for implementation. The information the women farmers require varies across the entire agricultural value chain. Extension players and farmers were found to lack the data and information analytic capacities to process and transform information to actionable knowledge palatable to the women farmers.

The common primary agronomic and climate information sources included digital solutions (mobile phone SMS, Webpage, USSD, Appa), mass media (TV, Radio), common interest groups, volunteer groups and government extension agents. Agro-vet dealers were also mentioned among the volunteer groups. While each of these fell short of providing effective information access to farmers, combining more than two approaches proved effective despite the numerous challenges each approach has. However, digital platforms, common interest groups, and mass media were preferred for information access. Further, common interest groups, volunteer groups and traditional extension models were required to boost the utilization of information in addition to the preferred access approaches. Moreover, common interest groups, demonstrations, group approaches, courses and ICT-based approaches were noted as preferred women-focused approaches. No single approach could, however, be effective enough to meet all farmers' information needs.

Even though these information sources exist, women farmers are largely unaware of their existence, availability and use unless deliberate efforts are made to bring them to their doorsteps. There is no single information point where farmers could get to know the various information sources even before diving into the specific agronomic and climate-related information they need. Similarly, Digital solutions were noted to be reliable information sources for farmers. However, several challenges in the digital ecosystems exist which require critical attention. The generalized information in the digital platform requires advancement to address specific issues within farmer areas. Similarly, digital literacy, affordability, restrictions, digital divide, digital trade, gendered digital talent pool, and digital governance for women in agriculture require deliberate efforts to bridge the gaps.

Neither private, public, nor non-governmental extension service providers could claim to provide effective extension advisory services to smallholder women farmers through the preferred women-focused approaches. Inefficiency in resource allocation, duplication of efforts, lack of collaboration, and coordination among the service providers and research organizations were some of the vast policy gaps identified as persistent in the sector. While some areas and value chains received sufficient and duplicated extension services from several providers, some areas and crops were utterly neglected.

It was recommended that future programming aimed at resolving women smallholder farmers' access and utilization should focus on Strengthening the Digital Ecosystems for Women Farmers, infusion of Social Behavior Change in Programs, use of multiple extension approaches, building collaboration, Co-creation, Learning and Adaptive Management in agricultural extension, building data analytics and knowledge product development capacity of extension player, and strengthening formation and institutionalization of farmer organizations at the grassroots level.

Key Highlights

Barriers to Inclusive agronomic and Climate Related Information Access

- Gender-competing roles,
- Limited access to extension and advisory services and resources,
- Restricted women's participation in farmer groups,
- Unfavourable policy environment for agricultural extension sector,
- lack of awareness of existing information sources,
- limited access to smartphone,
- low digital literacy, and
- Affordability

Barriers to Inclusive agronomic and Climate Related Information Utilization

- Information relevance,
- gender roles and norms,
- limited access to labour and time poverty,
- limited access to inputs,
- mechanization, credit and markets,
- limited access to land

Way Forward for the Future

- Strengthening the Digital Ecosystems for Women Farmers;
- Embedment of Social Behavior Change in Programs;
- Use of multiple extension approaches;
- Building collaboration, Co-creation, Learning and Adaptive Management in agricultural extension,
- Building data analytics and knowledge product development capacities of extension player,
- Strengthening formation and institutionalization of farmer organizations at the grassroots level.

2.0 Introduction

2.1 Background

Women farmers in Kenya, as in most of the global South, play a crucial role in food production and agricultural development. However, they often face unique challenges and barriers in accessing relevant and timely information to enhance their farming practices and improve their livelihoods. Mercy Corps' AgriFin's DISF: Addressing Gender Gaps in Digital Technologies project, in partnership with The Bill and Melinda Gates Foundation, sought to understand the barriers and explore gender-driven modifications to contextualize content to make it more accessible for women and study the effect on uptake and engagement. The project's primary goal was to understand the barriers that limit or prevent women smallholder farmers in Kenya from accessing essential agronomic and climate-related information.

By understanding these challenges, the project aimed to propose gender-driven modifications to content, ensuring it is relevant, accessible, and understandable for this demographic. The project adopted a gender-sensitive lens, considering the intricate web of social, economic, and cultural factors that influence women's participation in agriculture in Kenya. By truly incorporating women farmers' perspectives and lived experiences, the project sought to develop content that genuinely resonates with their needs and realities. This report is a product of three outputs of the AgriFin DISF: Addressing Gender Gaps in Digital Technologies project. The products included a desk review report, research methodology and participatory research reports.

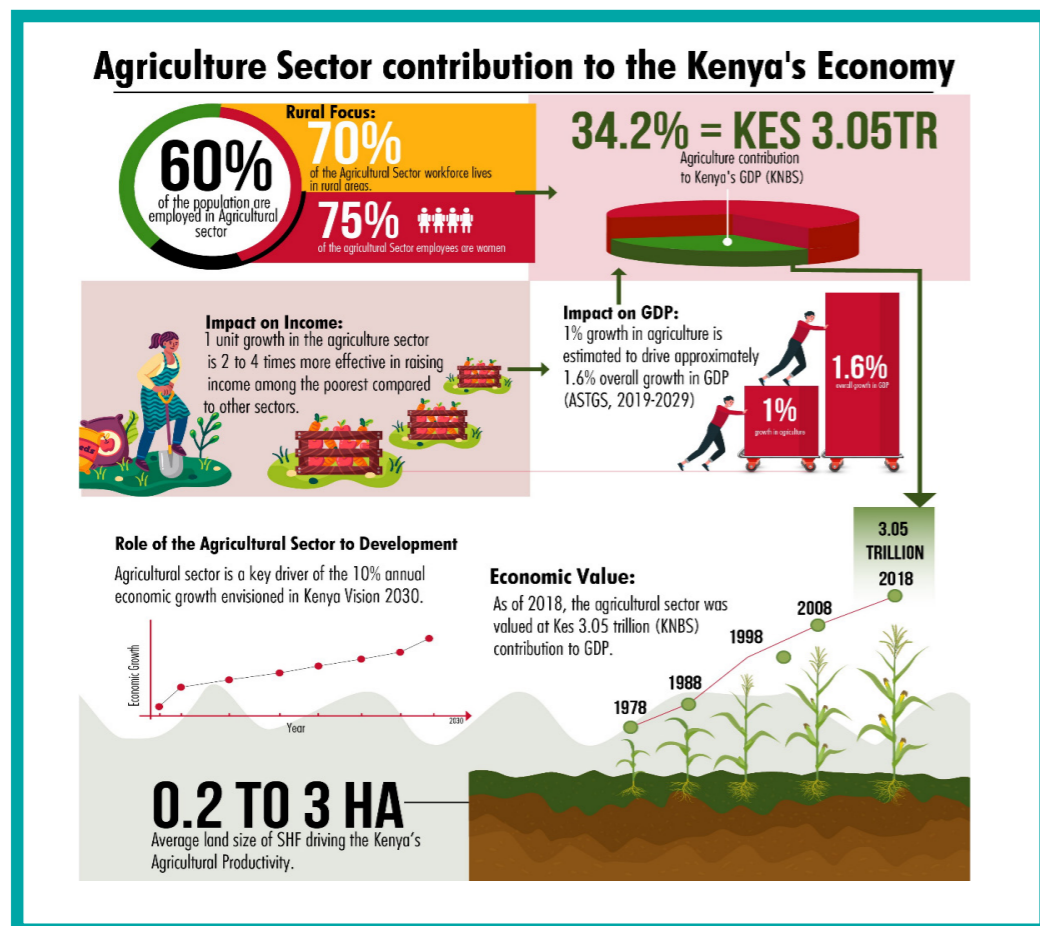


Figure 1: Agricultural Sector Contribution to the Kenyan's Economy

2.2 Over View

While the agricultural sector employs over 60 per cent of the Kenyan Population, 70 per cent of which lives in rural areas and engineers, the sector's 34.2 per cent contribution to the Country's Gross Domestic Product (GDP) (KALRO, 208, KNBS, 2019). Even though the agricultural sector's contribution to the GDP was valued at 3.04 trillion (KNBS, 2019), its real potential exists in the return on investment. A unit percentage growth in the agricultural sector is estimated to drive approximately 1.6 per cent overall growth in GDP. Similarly, one unit growth in the agricultural sector is two to four times more effective in raising income among the poorest compared to other sectors. As such, this sector is one of the drivers of the 10 per cent annual economic growth envisioned in the Kenya Vision 2030.

The sector potential is driven by smallholder farmers, farming on an average land size of 0.2 to 3 hectares. Moreover, according to the International Labour Organization, ILOSTAT database (2019), women account for approximately 75 per cent of the agricultural labour force in Kenya compared to 51 per cent for Kenyan men. Women, therefore, drive not only agricultural productivity but also the growth of the GDP. Could the potential to achieve food security be in women in Agriculture? This calls for deliberate efforts to address women's issues in agriculture.

While Kenya's main agricultural products include maize, sugarcane, tea, coffee, and horticulture crops, the production is characterized by low inputs, fertilizers and other new technologies (ibid).

Moreover, climate change and its related shocks have recently been the major hindrance to agricultural productivity. Persistent delay or failure to address the compounded challenges limiting agricultural productivity- prominent in the list being the climate change shocks; poor or lack of access and utilization of climate information to reduce uncertainty, support farmer decision-making and mitigate against the climate risk; and unfavorable gender roles in agriculture-, has made improved agricultural productivity, increased food availability, increased incomes and enhanced food and nutrition security an elusive goal to achieve.

Pivotal to the solution to these problems is access to and utilization of agronomic and climate-related information. Availability and access of relevant data to farmers about the challenges they face, such as inputs availability and use, new technologies, markets and climate change effects, among others, will reduce uncertainty and support correct decision-making at individual and household levels, eventually increasing food security. However, little would be achieved in the gender roles challenge front without further deepening the understanding of the relationship and linkages between the three spectrums of knowledge areas.

Even though the role of agricultural information dissemination is bestowed on agricultural extension services provided by the County Governments in Kenya, several challenges exist within the sector. The devolution of the agricultural extension services to the county government (as per the Kenyan Constitution 2010) while leaving the research and innovation arm at the national government and failing to provide transparent information and technology flow pathways to the extension agents from the research institution is the first hindrance to information flow through this channel.



Similarly, research and innovation require a feedback loop from the farmers through the extension agent, which was not catered for in the new dispensation. Further, counties have different priorities in development and research, a discretion bestowed upon the county's leadership, which in many cases, has failed to prioritize agricultural research and information dissemination. As such, budgetary allocation to agricultural extension remains low, the ratio of extension officers to farmers is high (1:1000), and the quality and expertise of new extension offices recruited are determined by factors other than expertise and experience. In areas where the extension services are functional, a mere 15 per cent of the extension agents are women, and only 5 per cent of extension service resources are passed to women.

Alternative extension approaches and platforms have emerged in response to the existing gaps. These include field days, group approaches, radio programs, farm demonstrations, shows and exhibitions, individual farm visits, residential courses and seminars, farmers' tours and visits, farmer-to-farmer extension, commodity-based extension systems, ICT-based extension platforms, common interest groups, focal areas, farmer field schools, face to face on-farm demonstration, the film shows, adaptive on-farm trials, barazas common interest groups (CIG) training, monthly training, community-based extension approach among others. However, these alternatives also have shortfalls ranging from costs, reach, ability to refer, and frequency, which hinder women's access to agricultural information as single approaches fail to meet the extension approach effectivity threshold.

One would argue that Kenya's digital ecosystem is considered advanced compared to other African countries, while that is true to a large extent, with some of the strengths of Kenya's digital ecosystem being in the infrastructure and adoption, digital economy and digital society, rights and governance and are considered relatively mature and favourable for digital innovations, deeply rooted points of weaknesses exist within these critical strengths, and which include the digital gender divide, digital gender finance service divide, digital literacy, affordability, gendered digital talent pool among others. Perhaps digital extension services would bridge the gap in agricultural information dissemination. However, until the eminent gaps in the digital ecosystems are thoroughly researched with a gender lens, the implementation of revolutionary digital solutions will remain elusive.

To understand the gender barriers to accessing and utilizing agricultural information among women in the Kenyan agricultural space, the Agrifin DISF: Addressing Gender Gaps in Digital Technologies project commissioned an innovative participatory research approach to unearth the barriers and opportunities and advise future programming strategies. This document aims to improve understanding of the barriers that limit or prevent women smallholder farmers in Kenya from accessing essential agronomic and climate-related information. By understanding these challenges, the document proposes gender-driven modifications to content, ensuring it is relevant, accessible, and understandable for the target audience.

2.3 Significance of addressing gender barriers in accessing information and resources

This section seeks to investigate the existing gender disparities in information access (i.e., extension and advisory services), identify their underlying causes, evaluate their consequences, and propose potential recommendations for rectification. Despite their indispensable role, women encounter more incredible difficulty than men in accessing information and crucial resources like land, credit, and productivity-enhancing inputs, practices, and agricultural services. Alarming global statistics further emphasize the urgency of addressing this issue: Globally, 15 per cent of extension agents are women, and women receive a mere 5 per cent of extension services. Only less than 10 per cent of the credit allocated to farmers reaches women. Women possess only 2 per cent of titled land (USAID Report on Effective Gender Integration Practices for Agriculture, 2010). Gender equity brings returns. Research by IFPRI highlights the economic benefits of investing in women: Kenyan women farmers witnessed a remarkable 22 per cent rise in yields when they were provided with equal access to education and agricultural inputs. In Burkina Faso, achieving gender equality in access to agricultural inputs resulted in a notable increase of 10 to 20 per cent in agricultural output. Studies conducted in sub-Saharan Africa, South Asia, Latin America, and the Caribbean consistently demonstrate that improved women's status correlates with positive outcomes for both their health and that

of their children. These compelling data emphasize the urgent requirement to enhance women's access to extension services, credit facilities, and productive resources. This imperative extends beyond improving women farmers' circumstances; it also directly contributes to promoting agricultural sustainability and economic growth in Kenya.

The gender gap in food insecurity has grown; in 2021, 31.9 per cent of women in the world were moderately or severely food insecure compared to 27.6 per cent of men.”(FAO, 2021).

Reducing the gender gap leads to gender empowerment, which is one of the critical enablers to increased productivity, economic independence, and improved livelihoods for women farmers. Empowerment in agriculture was found to improve dietary diversity and household nutrition status among female farmers in numerous African countries (Kassie et al., 2020; Jones et al., 2020; Murugani & Thamaga-Chitja, 2019) as well as farm productivity (Diirro et al., 2018). The potential economic gains from reducing the gender gap translate into significant poverty reduction and improved nutritional outcomes. Empowering farmers is therefore worth pursuing as it has a positive association with desirable development outcomes, including improved food and nutrition security.

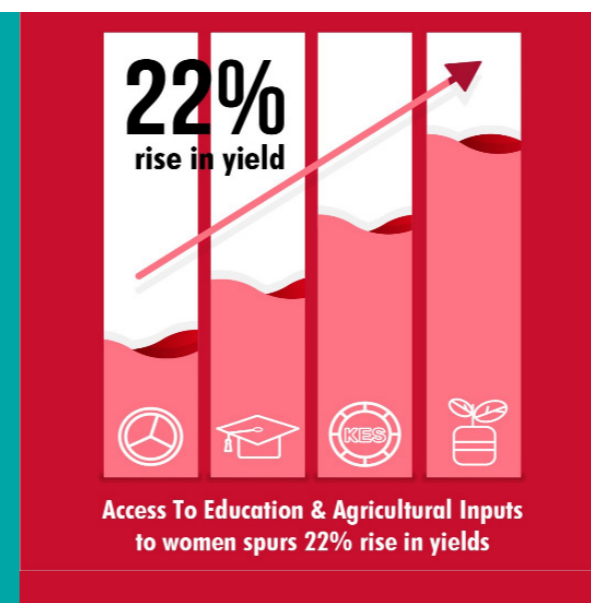


Figure 2: Impact of women access to education and farm inputs

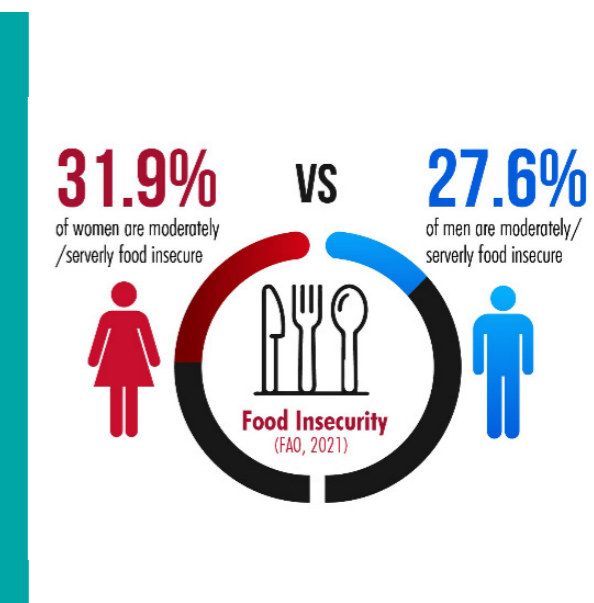


Figure 3: Gender disparity on food insecurity

3.0 Methodology

Previous studies dwelling on the convergence points between gender, climate change, and access and utilization of agricultural information to increase women's participation in agriculture, increase productivity, and tap into the opportunities for the future and which are specific to Kenya were limited. On one hand, there were studies depicting challenges brought by climate change to agricultural production and how that affected women, while on the other hand, there were studies that showcased the existing agricultural information, models of dissemination, and women's access to this information. However, studies focusing on women in agriculture and their access to agronomic information and climate resilience information were hard to come by. There was a need to find the emergent knowledge points between these existing bodies of knowledge.

A combination of desk review and participatory research methods was employed to help collect,

analyse, and comprehend the knowledge that would bridge the gap and inform the actionable way forward. While the desk review brought together the existing knowledge in the literature on the subject areas, it also showed significant gaps. A participatory survey, focus group discussion, and Key informants research designs were employed to gather specific information that could give insights into the existing gaps and solidify recommendations for future interventions. This was, however, done in only two counties, namely Machakos and Nyandarua counties, which were considered representative of the larger Country and women in agriculture. The participatory research targeted women in agriculture, specifically their access to and utilization of agronomic and climate-related information. The two counties were purposively selected due to the farming activities, women's participation in farming, and existing agricultural information-sharing mechanisms within the counties.



4.0 Finding of the assignment

This section delves into the findings of both desk review and participatory research methods. The findings are framed to answer specific research questions that provide flow to the reader and enhance understanding of the lessons learnt, insights, outcomes and action points.

Learning Question 1: What are the gender barriers/gaps hindering women's access and utilization of Agronomic and climate-related information?

The challenge in accessing information refers to various factors that hinder women farmers' access to essential agricultural information. This includes access to extension and advisory services, technologies, knowledge-sharing platforms, and the sociocultural, economic, and institutional factors contributing to these disparities.

The analysis of the specific challenges that Kenyan female farmers face in accessing climate information services in Nyandarua and Machakos Counties, Kenya, revealed significant challenges in operation. These challenges manifest across various aspects, including lack of awareness on where to find relevant agricultural information, limited access to digital smartphones and digital literacy skills, language barriers that hinder comprehensibility of information by the actors (women farmers), busy schedules managing both house chores and farming restricting their access to real-time information and high cost of airtime in subscribing to information platforms such as Digi shop. Furthermore, it is worth noting that these challenges extend beyond the immediate production node of the value chain and have far-reaching implications for the broader market access and gender-transformative aspects of the counties' agriculture.

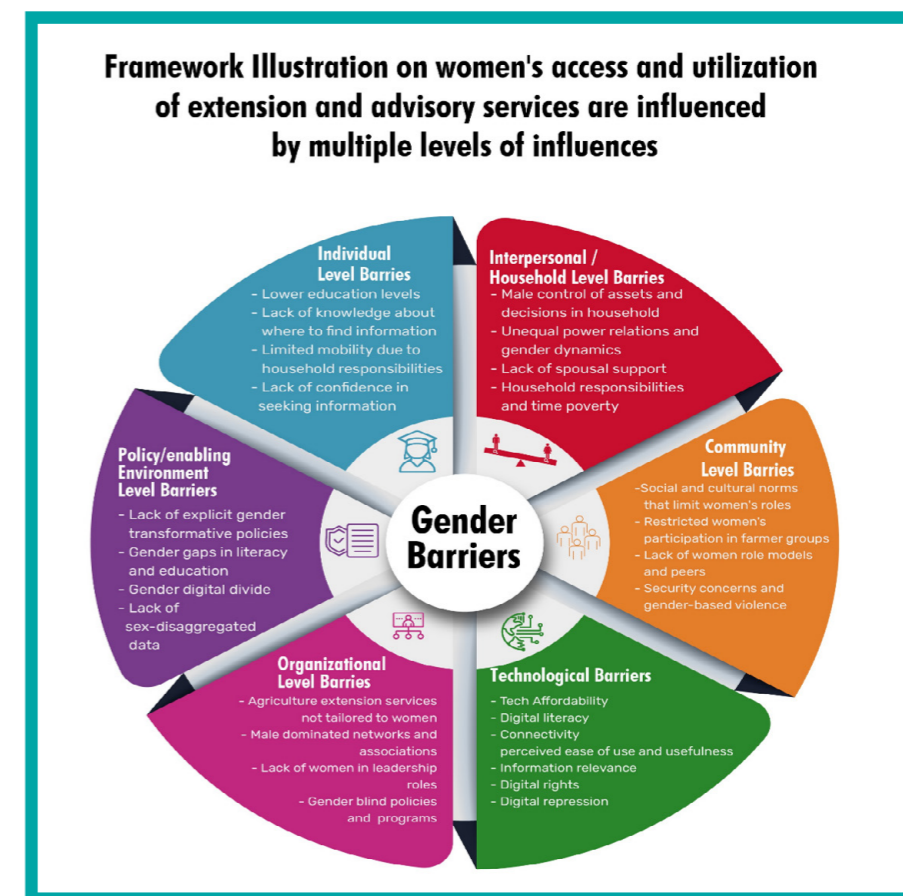


Figure 4: Categories of gender barriers to women's access and utilization of agronomic and climate-related information to education and farm inputs

The study explored the intrigues of each of the factors to develop valuable learning which could inform future interventions. Similarly, the challenges hindering the utilization of agronomic and climate-related information among women farmers included limited access to resources such as land, inputs, financial credit facilities, gender roles, limited access to labour, and quality of the information received, among others.

We split the barriers to information access from those of information utilization. At the same time, the detailed barriers could be categorized into six categories (See figure 4) namely Individual, household, community, organizational, digital technology, and policy level barriers; specific components of these categories more often than not overlap on several category levels. Therefore, we elaborate our findings based on the specific barriers without category classification.

i. Gender barriers hindering access to agronomic and climate information by women farmers

a. Gender-competing roles

The competing responsibilities among women farmers have proved to be a hindrance to information access and participation in agricultural production. While women would want to concentrate on agricultural production-related jobs, other responsibilities such as domestic/household chores and child-rearing equally compete for her time. As such, women in agriculture have minimal time to seek agricultural information and engage in productive agricultural roles.

One would argue that the women could delegate house chores by hiring existing labour to support them, however, this argument would fail the test of time because of the level of poverty with which women in agriculture live and hence the inability to afford alternative labour. Worse still, social beliefs, gender roles and responsibilities bundle women together with house chores and the inability of women to own productive assets. These incapacitates the alternative labour options for house chores among women in agriculture. Deliberate intervention focusing on promotion of quick access agricultural information platforms, could help increase women's participation.

b. Limited access to extension and advisory services and resources

Research shows that women form only 15 per cent of extension personnel, and a mere 5 per cent of extension resources reach female farmers. Gender disparities in accessing extension services and agricultural training persist. This issue has been identified as one of the factors contributing to gender-based productivity gaps in agriculture (Bello et al., 2021; Onyalo, 2019; Palacios-López & López 2015; Larson et al. 2015; Ragasa et al. 2013). In many sub-Saharan African countries, women encounter obstacles in accessing extension services due to societal norms that hinder their mobility and participation in agricultural training. Even though private, public, and non-governmental organizations provide extension services, several challenges exist for each category of service providers.

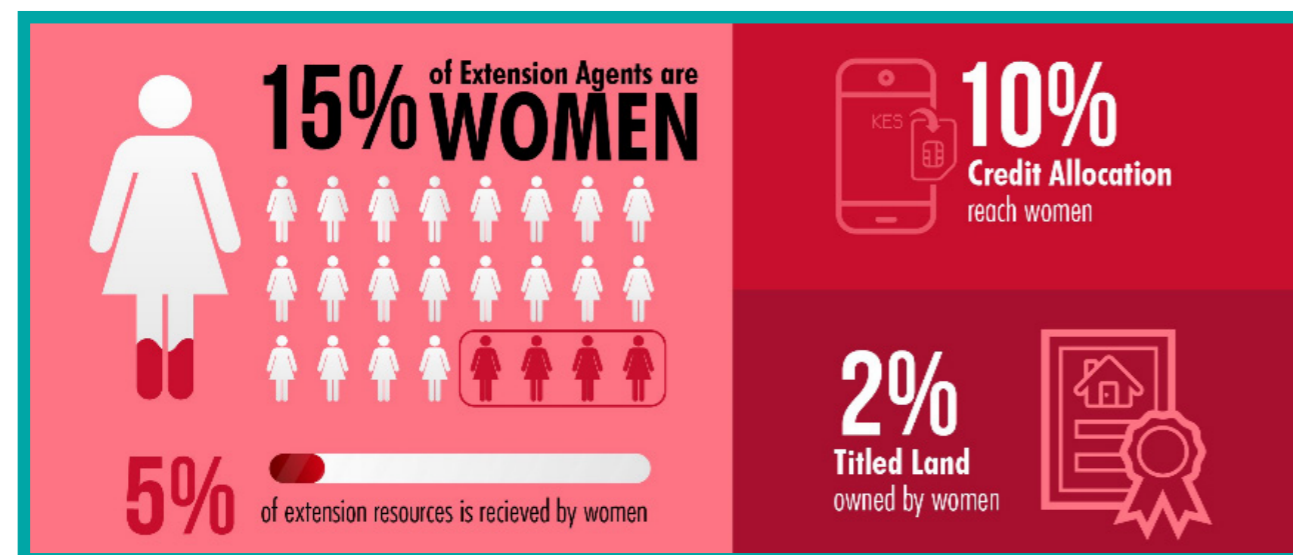


Figure 5: Women participation and access to extension services and resources

While profits drive the private sector interest, tilting their concentration on large-scale farmers with high-value crops, NGOs are known to provide short-term project-based, narrow, goal-oriented extension within niche geographical areas of interest and might target SHF and large-scale farmers. The public sector extension on the other hand, is known to be costly. The devolution of the agricultural extension services to the county government (as per the Kenyan Constitution 2010) while leaving the research and innovation arm at the national government and failing to provide transparent information and technology flow pathways to the extension agents from the research institution is the first hindrance to information flow through this channel.

Similarly, research and innovation require a feedback loop from the farmers through the extension agent, which was not catered for in the new dispensation. Further, counties have different priorities in development and research, a discretion bestowed upon the county's leadership, which, in many cases, has failed to prioritize agricultural research and information dissemination.

As such, budgetary allocation to agricultural extension remains low, the ratio of extension officers to farmers is high (1:1000), and the quality and expertise of new extension offices recruited are determined by factors other than expertise and experience. For instance, in Uganda, even though smallholder maize farmers received relatively few extension visits overall, women managing maize plots received even fewer visits than their male counterparts. This disparity was attributed to biases among male extension officers, who often target men perceived as the household heads and primary decision-makers (Larson et al., 2016).

The increasing utilization of digital extension services has proven beneficial for women in specific contexts, such as Machakos County and the Wajohi area in Nyandarua County. Women farmers with access to at least one ICT4 tool exhibited greater involvement in decision-making processes and improved productivity. Furthermore, using the DigiShop and Digi cow to access agricultural information and credit has effectively enhanced livestock farm productivity in Machakos, with a more substantial positive impact observed for livestock and crop farms managed by women.



c. Restricted women's participation in farmer groups

Access to networks and social connections empowers women by providing them with access to information, fostering gender equality attitudes, and enhancing their productivity (Kosec et al., 2023). Social entities such as cooperatives and farmer-based organizations have demonstrated their effectiveness in disseminating agricultural knowledge to women smallholder farmers, which, in turn, contributing to their productivity improvement.

In Ghana, for instance, the heightened productivity of women rice farmers can be attributed to their involvement in farmer-based organizations, which facilitate their access to agricultural information and the adoption of technologies such as high-yielding and disease-resistant rice varieties, as well as inorganic fertilizers (Addai et al. 2021). Membership in farmer-based organizations gives women access to extension services (Bello et al., 2021).

Aryal and Kattel (2019) argue that when women involved in agriculture organize themselves into farmer cooperatives, these institutions enhance their confidence in active participation in agriculture. Additionally, they enable women to save money and access credit for purchasing inputs to enhance their crop yields. It is important to note that a mere 2 per cent of women, in contrast to 13 per cent of men, are members of agricultural cooperatives. Men are five times more likely than women to hold leadership positions within these cooperatives (Chan & Barriento, 2010). This disparity implies that women are underrepresented in membership and leadership roles within agricultural cooperatives.



Insights

- Who are the private, nonprofit and public extension service providers?
- Where is the single knowledge repository of extension Advisory service providers in the county and for each region?
- How could this be developed and institutionalized?
- How can the sector be regulated?



Figure 6: Women participation in farmer groups

d. Policy/enabling environment for the agricultural extension sector

The agricultural extension policy in Kenya has faced several challenges, including an ageing and diminishing workforce, reduced funding for operational purposes, the absence of participatory technology development, and ineffective methods of packaging and disseminating information. These policies cannot also manage conflicting messages directed at farmers, leading to unnecessary competition, redundant efforts, and a general lack of coordination among extension providers in Kenya (Kibbet et al., 2006). Furthermore, women's limited participation in national and regional policy-making processes, their underrepresentation in national statistics, and their low involvement in extension services in Kenya have resulted in the neglect of issues that are of significant concern to women in the design and implementation of numerous development policies and programs (World Bank, 2007). Worse still, the low budgetary allocation to extension services, the declining number of extension staff with an increasing number of farmers, and the devolution of extension services while leaving the research and innovation at the national level continue to hinder the extension services' access to women.

e. Lack of awareness of existing information sources

Awareness of reliable information sources among women farmers was found to be low within the study areas. Not only was this on the different platforms but also on how to access them and where to get information on any future new platform introduced. Further, verifying the reliability and authenticity of the information provided on some platforms, such as ICT-based solutions, was impossible for the women. As such, the incentive to follow and tap into new platforms was low, if not nonexistent.



Insights

- Gender roles and norms prohibiting women from participating in farmer groups
- Farmer-based organization plays an important role in information dissemination
- Could inbuilt social behavior change interventions within programs be of help?
- Digital extension platforms which have been successfully adopted, attributes their success to the farmer-based organizations through which the application dissemination was done

f. Limited access to Smartphones

Smartphones are known and preferred because of their ability to install and operate application software, such as agricultural extension application software. Similarly, their connectivity feature to the internet facilitates the use of different applications and information access. Further, the capacity to show all audiovisual, audio and written communication makes them exemplary tools for providing agricultural information and demonstrations. However, the cost of smartphones has proved to be beyond the reach of many women farmers. This limits their information access to feature phones that only facilitate SMS, USSD and phone calls. This is not just because of the cost of production and logistics but also because of the government taxes levied on the smartphone product. This is a significant barrier to accessing agronomic and climate information.

g. Digital literacy

The study found that women farmers' digital literacy was generally low. In some pockets, like in Wanjohi, the digital literacy of female farmers was high compared to the rest of Nyandarua county. On the contrary, women in Machakos County were found to have low digital literacy but were able to use digital extension platforms such as digishop and Digicow to the extent that they could access information through these platforms.

This success was however attributed to the membership in common interest groups from where they not only got agronomic and climate-related information but also learn how to use and access information from the digital solutions available to them. In a case where a country has a possible comprehensive solution to be explored, digital literacy among women farmers remains a hindrance to adopting and using digital solutions. As such, the go-to-market for such interventions must bundle with common interest groups and traditional extension agents.

Building digital skills to promote technology use, which is also a key focus of the GoK, private sector actors, and donors among women farmers, is important. This may range from fundamental digital skills such as using a device and password protection to more advanced topics such as cybersecurity, cyber hygiene, and data management, consistent with a range of competencies associated with digital literacy.

h. Information Affordability (Digital affordability, Data costs and subscription)

The Alliance for Affordable Internet (A4AI) ranks Kenya 37th of 61 countries in terms of affordability of Internet access. As of 2017, Kenya's mobile broadband data costs stood at 1 GB for 4.01 per cent of the Gross National Income (GNI per capita), almost twice A4AI's benchmark of 1 GB of mobile broadband data available for 2 per cent or less of GNI per capita. High taxes, borne mainly by the consumers, often make the cost of data even more expensive. For example, a rural public school might reasonably be able to afford connectivity for less than 5,000 KES/month. Yet, local Mobile Network Operators typically package 5 Mbps at 15,000 KES, and have little incentive to develop packages or even bundles that are affordable in that context. Kenyan women are significantly affected by this issue, exceptionally because their incomes can be pretty low. (USAID Digital Frontier, 2020).

Access to agricultural information has proved to be expensive for women in agriculture. Previous studies have shown that women spend between Kes 100 and 500 on internet bundles weekly. This can prove very expensive given that these SHFs have little income from farming once or twice a year after harvesting. Similarly, the subscription cost to private agricultural information provision platforms is equally beyond the reach of many women farmers.

i. Gender barriers hindering utilization of agronomic and climate-related information by women farmers in Kenya

a. Information Relevance

Information content, form, format, and language determine the palatability of the information by the women farmers. The finding of the study showed that the education levels of women farmers are generally low; as such, their understanding of data, transformation into information and knowledge ready to be utilized is quite tricky.

Kenya scores only 41.3 (out of 100) concerning the amount of locally relevant content developed, according to GSMA's Mobile Connectivity Index. Kenyans—particularly people in rural areas, older people, and women—may not use the Internet because there is little digital content that they perceive to be relevant to their daily lives. Access to the Internet does not necessarily change a person's behaviour or spur new interests (USAID Digital Frontier 2020) but the relevance and palatability of the information accessed and consumed. Female farmers require knowledge and skills but not data and information. Many platforms provide data and information, hence the women's inability to utilize the information.

While most of the information provided through mobile phones, Radio and TV is general, the information provided by extension agents and through common-interest groups is specific to women farmers' needs. Similarly, extension agents provide knowledge, as opposed to data and information, from other platforms. The level of interaction between extension agents and farmers and between farmers themselves in the common interest groups enhances understanding and learning, which brings real change. Therefore, the information provided to women farmers by extension agents and common-interest groups is likely to be utilized compared to those received through radio and mobile phones (internet), among others.

b. Gender Roles and norms

A probe into the impact of gender roles, norms, and dynamics on the ability of Kenyan women farmers to make decisions related to climate adaptation presented persistent challenges on gender roles, norms and dynamics within the two counties. Cultural norms had a significant impact on how women got involved in the overall farming decisions. While women bear substantial farming responsibilities in Nyandarua, they had a cultural restriction in land ownership and access to finances. In Machakos, women dominate the farming activities, which is however limited by the deeply entrenched traditions that restrict them from livestock ownership and purchase as well as decision-making capabilities. This has had negative outcomes limiting women farmers from accessing finances and having total control over it. As such, with all the training women are likely to receive, this may be a waste of time since they are not able to make any decisions, and neither can they access the finances to support them in their vision projects. They simply have no resources to use in utilizing the information received, thanks to gender roles and norms.



When do Women farmers consider agricultural information reliable

- It comes from perceived experts
- It comes from individuals in their social network
- They can see that the information is useful
- They can assess the quality of the information for themselves

c. **Limited access to factors of production (labour, inputs, mechanization, credit, market, land resources and time poverty)**

Palacios-López and López (2015) demonstrated that addressing credit and labour-market failures is likely to have a more pronounced impact on households headed by women than those headed by men. It is essential to recognize that productive resources beyond land access play a pivotal role. This includes addressing challenges related to women's access to male household labour and implementing policies that facilitate women farmers' access to labor-saving technology (Torkelsson and Onditi 2018).

Research conducted by the World Bank and ONE Campaign (2014) underscores that, on average, female farmers often reside in smaller households with fewer male members—potentially resulting from factors like widowhood, divorce, or husbands' migration. In countries such as Malawi, Niger, and Tanzania, women farmers tend to employ fewer male labourers in their fields, resulting in lower returns compared to male farmers. Several studies shed light on additional factors contributing to productivity disparities. These include women's unpaid labour on their husbands' farms, time constraints, limited access to male labour, and gender-based violence (Djurfeldt et al., 2019; van der Meulen, 2018).

Women's lower technical efficiency can be attributed to time constraints arising from their involvement in household chores, household size (larger households entail more chores), and restricted access to high-quality agricultural inputs. In Ghana, women farmers grapple with time burdens and scarcity, leading to lower productivity in comparison to their male counterparts (Atakli and Agbenyo 2020). Even though this is barrier was witnessed beyond the boundaries of the Kenyan Case and little attention should be provided to it in future programming, implementors should aware and keep a close eye on any of its characteristics emerging in the Kenyan women in agriculture society.

In a comprehensive study conducted across African nations, spanning East (Ethiopia, Kenya, Uganda, and Tanzania) and West (Senegal, Mali, Niger, Burkina Faso, and Ghana) African regions, it was observed that female farmers faced more pronounced challenges compared to their male counterparts. These challenges encompassed difficulties in acquiring and effectively utilizing high-quality seeds, cultivating drought-tolerant, pest-resistant, or disease-resistant crop varieties, and utilizing essential commercial inputs like fertilizers, pesticides, and herbicides, all of which are vital for sustaining agricultural productivity (Perez and Barahona 2015). Information about inputs, input markets, input use and choice of inputs is vital for the farmers.

However, women in agriculture lack this information. This is not just because of the lack of awareness of the sources of this information but also because social and cultural norms assign the role to men. Similarly, the level of education and training of female farmers limit their information-seeking behaviour. As such, women are limited in accessing farm inputs and where and when they do, their costs are usually exorbitant as a result of information asymmetry among players. Although there is limited evidence on the impacts of land ownership on productivity, it does determine people's access to credit, which, in turn, is critical for women to access good quality inputs at the right time to ensure high productivity. When a woman farmer has this in their possession, it is an opportunity for them to utilize agronomic and climate information in pursuit of higher productivity. The fact is that the majority of the farms are jointly owned, and having joint ownership will enhance women's decision-making and access and enhance productivity, leading to overall gains. Studies show that only 2% of the land in Kenya belongs to women.



Women Smallholder farmers Information Seeking Behaviors

a. Learning Question 2: What agronomic and climate-related information do women farmers need?

In order to understand the gender barriers and develop concrete recommendations, it is important to understand the information-seeking behaviours of the target recipient. Women in agriculture were found to seek various categories of knowledge in a problem-solving package. Below are some of the agronomic and climate-related information.

- When to plant which crops
- Favorable crops for the geographical areas, soil type, climate and return on investment of the women farmer
- What variety to plant
- How to detect soil fertility deficiency
- What fertilizer to apply, when and how
- Pest and disease identification, control and management of diseases
- New technologies
- Input market sources and prices
- Climate early warning information
- Climate adaptation mechanisms

While existing information sources would provide information such as temperature, expected rainfall, pests and disease names and symptoms, seed varieties, and fertilizer names, among others, women farmers' information needs includes more than just data but rather solutions informed by the data.

Eminent gaps exist in the quality and relevance of the agronomic and climate-related information provided by the providers. Farmers require knowledge solutions, and therefore, there is a need to develop the capacities of information providers to move from data and information and develop actionable knowledge products to farmers for dissemination.

Lessons learnt and possible programmatic actions:

- Women farmers have low literacy levels
- They require actionable knowledge products, not data and information
- Current information providers lack the capacity to analyze different datasets and develop knowledge products that are palatable to women farmers it.
- Interventions targeting information service providers and aiming at building their capacities to move from sharing data and information to developing and sharing actionable knowledge products.
- Artificial intelligence systems development and deployment interventions, which could help fill the gap of data analytics and production of actionable knowledge products for dissemination, could be considered



b. Learning Question 3: Which are the primary sources of climate-related information for Kenyan women farmers, and how are they currently access and used to in farming practices.

Accessibility and utilization of climate-related information was also studied and the results revealed varied findings across the two counties. Overly, the key primary sources of climate-related information were mobile phones, which are used in getting climate-related information either through short messages, texts, online searches and social media platforms. Mass media (Tvs and radios), extension service providers, common interest groups and farmer to farmer learning were also used as sources to climate related information.

While extension service provision was also a form of information dissemination, challenges relating to it included inadequate staff, for instance, in Nyandarua County, one ward officer was expected to serve a region of four wards. The majority of the female farmers from the study used mobile phones. These tools have been instrumental in the provision of real-time climate updates for the farmers, fostering learning, positive adaptation to climate changes and adoption of new technologies related to climate changes.

While many agronomic and climate-related information sources were identified, women farmers preferred Extension agents, Mobile phones (Short messaging

services (SMS), Internet search, social media), Radio, Television, community advisory services providers, and common-interest groups. Even though several platforms for sharing agronomic and climate-related information exist, the major hindrance to women farmers was the lack of awareness of these platforms.

Lack of awareness of where to find relevant information was not only about the existence of the platforms but also about how to access these platforms and the reliability, authenticity and credibility of the available sources. Where farmers get information from Agro-Vet dealers, for example, the tendency that the Agro-vet's advice is biased toward promoting the products he/she is stocking and with higher margins is higher than the farmers' interest in getting a genuine and authentic solution. The Agrovet advice usually carries the day and takes advantage of the farmers' ignorance.

Information relayed through an Extension agent is likely to contextualize information for the specific needs and locality as compared to TV, Radio and Mobile phones. Women organizations such as common interest groups facilitate learning among members and leverage the knowledge of all women members, proving an easier avenue for ensuring that they adapt to climate change as well as mitigate against its impact



c. **Learning Question 4:** What are the preferences, needs, and communication channels of Kenyan women farmers regarding climate-related information and agricultural resources

The study assessed Kenyan women farmers' extension approach preferences, needs, and communication channels regarding climate-related information and agricultural resources. This entailed conducting a comprehensive analysis of the different channels of communication used and reasons as to why they preferred them. With evolving times and changes, digital presence was key, hence the preference for online presence through the use of mobile phones to search for climate-related information and agricultural information updates.

An example of such platforms included Digi shop in Machakos, which helps women overcome climate-related challenges by accessing real-time updates. Older women farmers still prefer traditional forms of communication such as radios and TV; however, this should be relayed in their local languages for them to relate. In Machakos, collaborations with startups and learning from successful initiatives like DigiCow were being used and preferred by the farmers. This, therefore, calls for tailored media strategy interventions for each region as per the preference of women farmers.

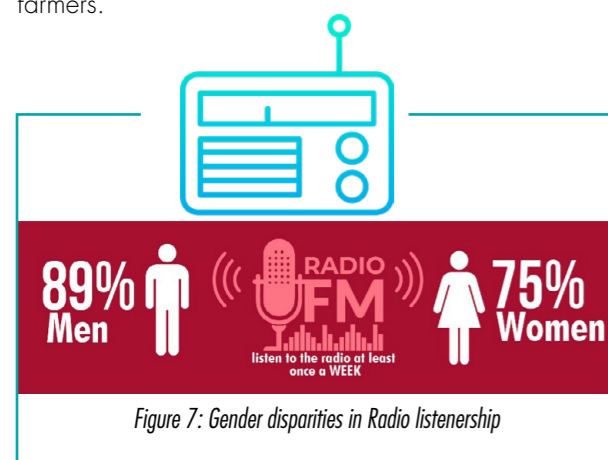


Figure 7: Gender disparities in Radio listenership

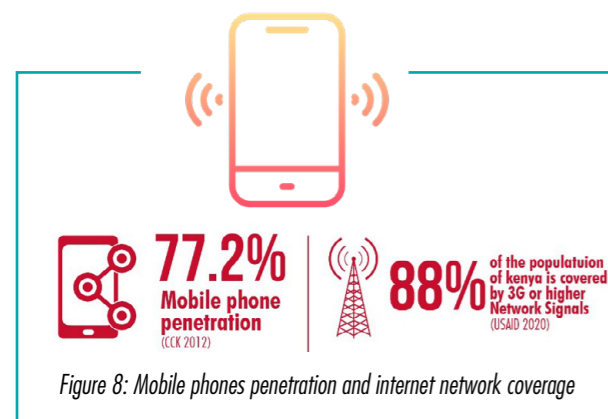


Figure 8: Mobile phones penetration and internet network coverage

d. **Learning Question 5:** What are some of the efforts in place towards bridging agricultural information access gaps?

In 2012, Kenya's Ministry of Agriculture introduced the National Agricultural Sector Extension Policy (NASEP) (GOK, 2012), outlining strategies to address current and future challenges in providing farmers with the necessary services to enhance their agricultural productivity. Presently, Kenya's extension system is predominantly administered by the public sector. However, the government is increasingly adopting hybrid service delivery models that involve private-sector entities and farmer-to-farmer extension. Like many other extension systems, Kenya faces constraints stemming from declining human and financial resources (ibid.). The ratio of frontline extension workers to farmers, standing at 1:1000, falling significantly short of the FAO-recommended ratio of one officer for every 400 farmers. The government was now transitioning towards a system that encourages farmers to "demand and access appropriate quality extension services from the best providers, resulting in higher productivity, increased incomes, and an improved standard of living" (ibid.). This shift, moving away from top-down, supply-driven assistance, necessitates the empowerment of farmers to communicate, share information, and request the knowledge they require. Part of Kenya's vision for this more responsive and demand-driven extension system is to harness ICTs and other mass media to increase coverage and improve information sharing.

Existing Efforts for change by the GoK

- From traditional top-down extension approaches to the Introduction of participatory extension approaches to improve participation, learning and adoption at policy level
- Entry of private sector and farmer-to-farmer extension services
- Leveraging on ICT for extension
- Focus on more women-targeted approaches

e. **Learning Question 6:** Which Women-Focused and targeted Extension approaches are working for Kenyan women farmers?

Common interest groups emerged as one of the revolutionary and pivotal extension strategies with women in Machakos. While it provided a forum for sharing vital agronomic and climate change information, it also provided a platform for learning how to access agronomic information from a mobile phone extension platform. Further, it also provided socialization, exposure opportunities to other inputs and credit for women farmers.

The common interest groups (CIGs) approach emerged as particularly effective due to its social orientation and multiple entry points, which make it adept at mobilizing women (NALEP 2009; RoK 2007). For instance, it includes the formation of localized social support groups. This approach is also seamlessly integrated into NALEP (NALEP 2009: 13 & 66).

Women-focused extension approaches

- Common-interest groups
- Demonstration
- Group approaches
- Courses
- ICT based approaches

One of NALEP's key objectives was to ensure the integration of gender considerations into various extension activities. This task falls under the purview of the Gender Section within the Extension Services Division of the Ministry of Agriculture and Livestock Development. NALEP outlines a variety of approaches and techniques designed to benefit rural women. The CIGs approach has participatory and social characteristics.

These embedded characteristics include:

- Value addition and partnerships interventions. These interventions were applied to encourage women to engage and adopt agri-based income-generating technologies (NALEP 2009: 13)
- Participatory analysis of poverty and livelihood dynamics (PAPOLD). This analytical framework employs a multi-sectoral approach of problem identification (NALEP 2009: 13-14).
- Resource-oriented approach. This characterized the early stage of initiation of CIGs (RoK 2007)



Figure 9: Extension agents' perception on Radio extension services

Other chosen methods for reaching women are (for instance, NALEP 2011; RoK 2008, 2007, 2010).

- Demonstrations: female farmers prefer demonstrations when compared to male farmers.
- Group approaches are specifically preferred by female farmers
- Courses: Residential courses are popular with women, though men usually make up the majority of participants. This is attributed to women being tied down by family responsibilities and husbands not allowing them to attend
- ICT: Very popular with women, especially in peri-urban settings

f. Learning Question 7: What are the trends and developments in Extension Advisory Service delivery approaches

Effective extension programs are often characterized by their robustness, flexibility, responsiveness, and ability to empower farmers to make informed decisions and improve their livelihoods.

- Private extension services tend to favor prosperous areas and high-value crops, neglecting economically disadvantaged regions with low-value crops. Non-profit organizations, while making efforts, have limited capacity. To support impoverished communities, expanding services beyond production assistance is crucial

- Public extension services are costlier compared to private and non-profit alternatives. Given resource constraints, optimizing allocation by avoiding overlap in areas where private and nonprofit systems are more cost-effective is a prudent strategy. This would enable directing public resources toward underserved farmers in remote regions. The effectiveness of extension services, whether public or private, depends on agricultural research productivity. Disseminating practical technologies and management practices is essential. This underscores the interdependence of agricultural research and extension services, necessitating sufficient public funding for both.

Public, Private and NGO Partnership for effective extension services

- Neither private nor public sector extension providers can claim to fully provide effective extension services.
- Inefficiency in resource allocation, duplication of efforts, lack of collaboration and coordination of efforts, by extension, service providers and research organizations is one key weakness in the sectors

Learning Question 8: What are some of the Emerging good practices for improving Extension Advisory Service delivery systems

In today's agricultural landscape, it is essential to promote inclusivity and innovation in delivering vital services. To achieve this, three strategic approaches have emerged:

- Fostering gender-inclusive agricultural extension and advisory systems using farmer group strategies
- Providing agricultural extension and advisory services through volunteer-based programs
- Utilizing information and communication technologies (ICTs) for the delivery of agricultural extension and advisory services

Nowadays, EAS providers are adopting ICTs, including SMS and IVR, in their programs. For example, Mali Shambani radio program uses SMS to engage farmers, increasing listenership by up to 20% when sending SMS 30 minutes before a broadcast (Sullivan, 2011).

KiMI (formerly Farmers Voice Radio) plans to add post-show SMS messages for farmers to save information, enhancing interaction and offline connections. Equipping extension officers with ICT tools and training can enhance their trust in and use of mobile technologies.

Their role as trusted information intermediaries can be strengthened through greater knowledge of ICT-enabled services, promoting ICT adoption among farmers. A Farm Radio International survey found that 61% of extension agents believe radio participation can improve their reach and extension efforts (Sullivan, 2011). Content development: Universities and other educational institutions have a significant role in preparing extension workers with scientifically grounded information

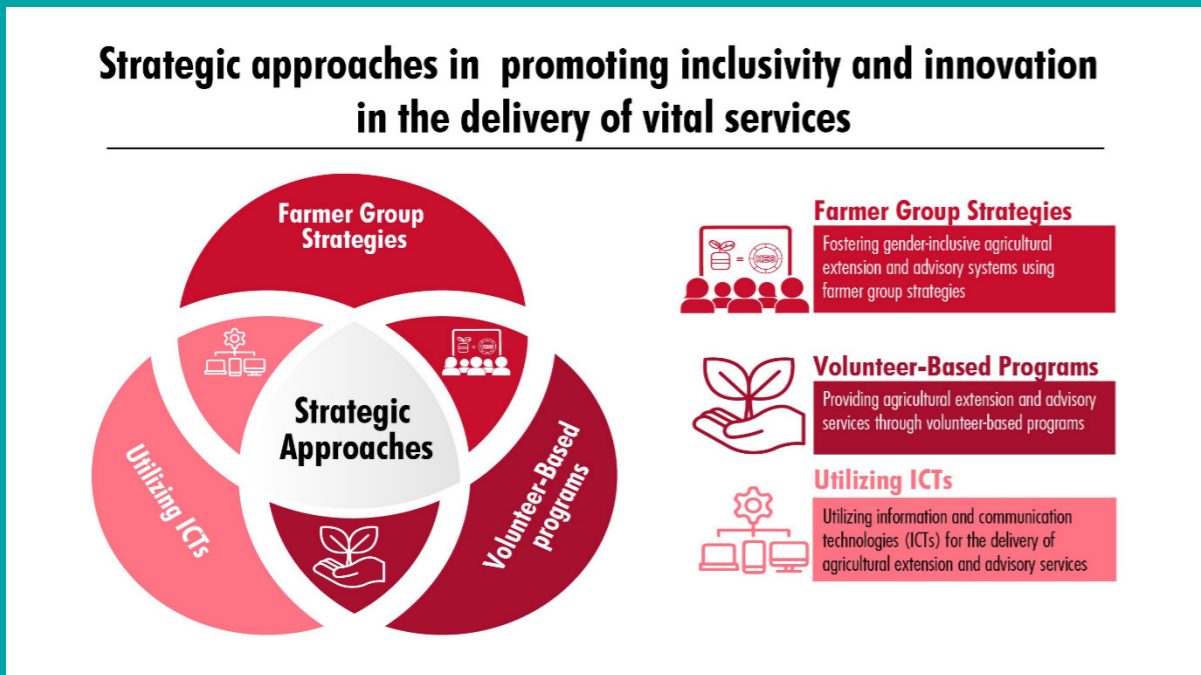


Figure 10: Strategic extension approaches in promoting inclusivity and efficient service delivery

5.0 Conclusion

The major barriers to agronomic and climate-related information access by women smallholder farmers include gender-competing roles, limited access to extension and advisory services and resources, restricted women's participation in farmer groups, unfavourable policy environment for agricultural extension sector, lack of awareness of existing information sources, limited access to smartphone, low digital literacy, and information affordability. Similarly, gender barriers hindering the utilization of agronomic and climate-related information were found to include information relevance, gender roles and norms, limited access to labour and time poverty, limited access to inputs, mechanization, credit and markets, and limited access to land. The barriers were categorized into individual level, interpersonal/household level, community level, organization level, policy and technological level barriers.

Farmers require knowledge and actionable agronomic and climate-related information instead of data and information. The information relevance barriers are partially contributed to by the information providers who fail to give actionable knowledge but rather give data. Farmers and many service providers lack the ability to analyse data and information to actionable knowledge for implementation. The information the women farmers require varies across the entire agricultural value chain. Extension players and farmers were found to lack the data and information analytic capacities to process and transform information availed to them to actionable knowledge palatable to the women farmers.

Common primary agronomic and climate information sources included digital solutions (mobile phone SMS, Webpage, USSD, Appa), mass media (TV, Radio), common interest groups, volunteer groups and government extension agents. Agro-vet dealers were also mentioned among the volunteer groups. While each of these fell short of providing effective information access to farmers, combining more than two approaches proved effective despite the numerous challenges the approach has. However, digital platforms, common interest groups, and mass media were preferred for information access. However, common interest groups, volunteer groups and traditional extension models were required to boost utilization of information in addition to the preferred access approaches. Further, common interest groups, demonstrations, group approaches, courses and ICT-based approaches were noted as preferred women-focused approaches. No single approach could, however, be effective enough to meet all farmers' information needs.

Even though these information sources exist, women farmers are largely unaware of their existence, availability and use unless deliberate efforts are made to bring it to their doorsteps. There is no single information point where farmers could get to know the various information sources even before diving into the specific agronomic and climate-related information they need. Similarly, Digital solutions were noted to be reliable information sources for farmers, however several challenges in the digital ecosystems exist which require critical attention.



The generalized information in the digital platform require advancement to address specific issues within farmer areas. Similarly, digital literacy, affordability, restrictions, digital divide, digital trade, gendered digital talent pool, digital governance for women in agriculture require deliberate efforts to bridge the gaps.

Neither private, public or non-governmental extension service providers could claim to provide effective extension advisory services to smallholder women farmers through the preferred women-focused approaches. Inefficiency in resource allocation, duplication of efforts, lack of collaboration, and coordination among the service providers and research organizations were some of the huge policy gaps identified as persistent in the sector. While some areas and value chains received sufficient and duplicated extension services from several service providers, some areas and crops were completely neglected.



6.0 Recommendations

6.1 Strengthening the Digital Ecosystems for Women Farmers

The digital ecosystem comprises of stakeholders, systems, and an enabling environment that, together, empowers people and communities to use digital technology to access services, engage with each other, and pursue economic opportunities. Even though Kenya's digital ecosystem is considered mature compared to other African Countries, major weakness exists along the gender divide. A gender approach for strengthening the digital ecosystem is key to empowering Smallholder Women Farmers in accessing and utilizing agronomic and climate-related information. Figure 11 shows the digital ecosystems framework and helps to enhance the understanding of the recommended approach to strengthening the digital Ecosystem. The Digital ecosystem is not weak in its entirety but only in Key areas with gender inclusion bias, which the recommendation will focus on. These will include:

i. Strengthening the Digital Talent Pool for Women:

The Digital Talent Pool is the training and equipping of workers for a future-focused digital economy. Findings showed that only 15% of women are involved in extension service provision and only 5% of the extension resources reach women. Similarly, with Digital solutions cited as key solutions to the extension problems, experts with agricultural knowledge, extension skills and computing and informatics experts are not only hard to come by but also the expert area is nonexistent in Kenya. It is only the University of Nairobi which has attempted to develop a Master's course in agricultural information and communication management aimed at developing experts in these areas, however, the course has not received as many students, let alone women. Partnering with such institutions to offer gender-focused short courses targeting female extension service providers and aimed at improving their digital talent pool will be critical in the long term. Targeting female students in Agriculture with similar long-term courses at Undergraduate, master's, and doctorate levels will also help to grow the digital talent pool for future digital solutions for extension and ensure women's participation.

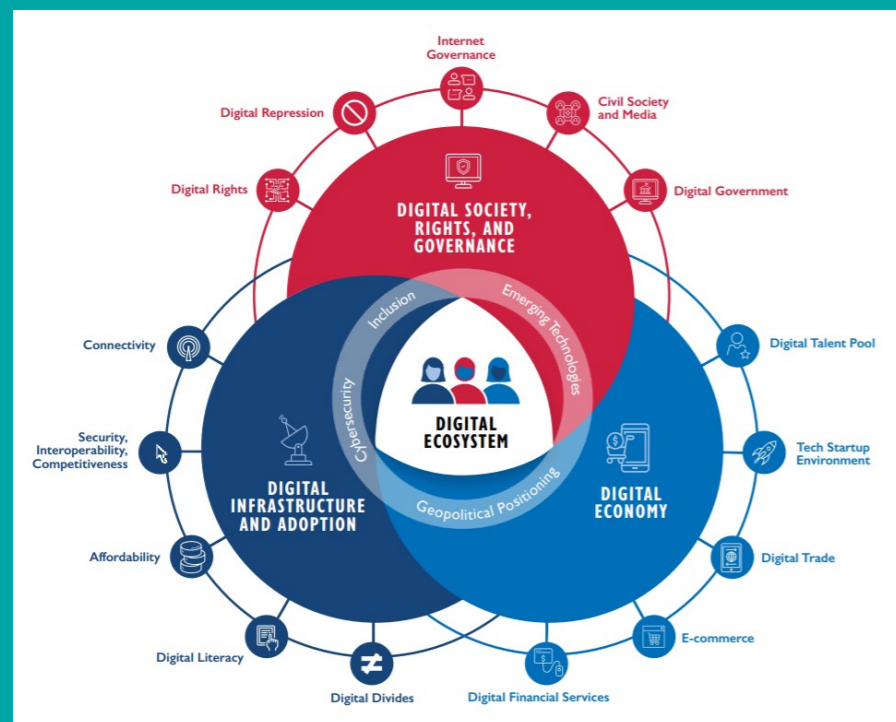


Figure 11: Digital Ecosystem framework (Source USAID, Digital Frontier 2020)

Some of the focus areas of these proposed digital talent pool development courses should include techniques such as using Artificial intelligence systems in agricultural extension. Such skills will equally help generate specific actionable knowledge required by the farmers from various data- which is currently a gap identified in the study. Short Courses for Farmers, Professional training of women in Artificial Intelligent Systems for Extension,

ii. Strengthening the Digital Trade:

Digital trade refers to delivering products and services online. Digital Farm Input and output aggregation and trade for smallholder farmers is one big gap that exists for women. Access to inputs, mechanization, markets and other productive resources was noted as one of the gender barriers to utilizing agronomic and climate-related information. Strengthening the digital ecosystem to facilitate women smallholder farmers' trade in input and output supply and distribution will incentivize access and utilization of agronomic and climate information. Supporting digital startups to develop demand and supply aggregation of input and output from women smallholder farmers will increase their profitability and income and, hence, women empowerment. This will further spur the adoption and use of digital solutions, providing relevant and useful information to the women smallholder farmers.

iii. Tech Startup Programming Approach Strengthening:

A start-up environment refers to New businesses focused on innovative products and rapid growth. While many of the applications that have succeeded in the corporate world have been developed using the top-down approach and their adoption enhanced through training and internally compelled use, farmers, on the other hand, lack the organization through which compelled use enforcement would be implemented, and the choice to use the solution is dependent on individual and other digital ecosystem factors. Similarly, the number of smallholder farmers is large, - so training initiatives fail to reach all farmers. As such, few applications targeting farmers have succeeded in small pockets through common-interest farmer groups through which training on the use and usefulness has been conducted. Much more would be achieved if the application design process would take the bottom-up approach where a thorough farmer engagement is undertaken to collect farmer initial systems requirements before the development which are then used to guide the development process.

This will produce and implement more farmer-friendly solutions and provide relevant information, hence improving perceived ease of use and usefulness, which finally provides exponential adoption and use. Most of the current solutions have been guided through a top-down approach, which later lead to retrofit requirements, leading to loss of resources, time and low adoption and use.

iv. Digital Literacy

Digital literacy is the ability to access, manage, understand, integrate, communicate, evaluate, and create information safely and appropriately through digital devices and networked technologies for participation in economic, social, and political life. This requires competencies such as computer literacy, information and communication technology (ICT) literacy, information literacy, and media literacy. Cyber hygiene and media and information literacy are important components of digital literacy. Cyber hygiene is the ability of an individual to stay safe and secure online through routine practices.

Media (or information) literacy is an individual's ability to search for and critically evaluate available information (data, news articles, reports, etc). Digital literacy influences the adoption of digital tools and services but should also be considered for other digital ecosystem pillars. Pillar II covers the government's capacity to develop digital policies and programs that account for women with varying digital (and media) literacy levels and Pillar III highlights the importance of digital literacy in building the digital talent pool. Digital literacy is also connected to Cybersecurity, one of the cross-cutting areas.

Cybersecurity looks at mitigation and prevention across an entire digital ecosystem of risks, which includes an individual's ability to operate safely online. Women smallholder farmers and existing extension service providers lack this knowledge and hence the need to develop capabilities of the stakeholders on digital literacy. This will also help smallholder women farmers access relevant information using digital platforms.

v. Connectivity, Affordability and Digital Divides

Connectivity infrastructure refers to the foundational components that enable the use of data, devices (e.g., mobile phones), and other internet services and systems. Despite Kenya having up to 88% connectivity to the 3G network and above and having up to 78% mobile phone penetration, women smallholder farmers were found to be barred from agronomic and climate-related information due to connectivity. On the other hand, affordability measures the cost of connectivity relative to local income.

Device, maintenance, and data costs and were found to be a deterrent to widespread mobile phone and internet use, which eventually reduces agronomic and climate-related information access among the smallholder women farmers. Findings also showed that the cost of connecting a school would be cheaper than individual data costs for connection. Similarly, common interest groups were found to be a preferred extension approach not just for the dissemination of agronomic and climate-related information but also for learning and using digital solutions to access information. The digital divide is the distinction between those who have internet and/or mobile phone access and can use digital communications services and those who are excluded from these services.

Digital divides can stem from social norms or inequities in access, literacy, income, or availability of relevant content. Establishing common interest groups, setting their meeting points in areas with connectivity and facilitating the joint purchase and use of internet bundles will reduce the connectivity barriers, improve individual women's connectivity affordability, and improve adoption through the common interest groups.

While the affordability issues are largely dependent on the government levies on connectivity and gadget costs and would require longer-term solutions such as advocacy for levies reduction, the short-term initiative of setting up common interest groups, facilitating joint meetings in areas with connectivity and coordinating the co-funding of connectivity cost and gadget purchase financing would help the women smallholder farmers.

6.2 Social Behavior Change in Programming

Social and behaviour change (SBC) aims to empower individuals and communities and lower structural barriers hindering people from adopting positive practices and societies becoming more equitable, inclusive, cohesive and peaceful. Social roles and norms were noted as one of the barriers to access and utilization of agronomic and climate-related information by smallholder women farmers.

Incorporating SBC and SBC communication within interventions aimed at increasing Smallholder women farmers' access and utilization of agronomic and climate-related information would help change behaviour now and into the future. An investigation to the elements of society and the specific content of each element that barres' women from participating in agriculture and accessing and utilizing agronomic and climate-related information would be required to underpin the specific issues, unearth the entry points, inform the SBC strategy and identify the SBCC channels to be used. Further, the developed strategy should be incorporated within all interventions related to this problem.

6.3 Joint Extension Approaches to Programming

No single extension approach was found to be effective, but rather a combination of ICT-based, Farmer groups, Volunteer groups, and traditional approaches. Similarly, neither public, private and non-governmental extension service providers were found to meet the extension service demand effectively. Further, demonstrations, courses, instructional materials, and formats were found to be effective with smallholder women farmers. As such, future programming should consider a combination of extension approaches which transfer agronomic and climate-related knowledge through demonstration, courses and instruction materials. Some of the ICT Based solutions recommended included Digital applications (SMS, Web Pages, USSD-driven solutions, Apps, podcasts, Youtube), Radio, and Television.

6.4 Collaboration, Co-creation, Learning and Adaptive Management of Agricultural Extension

At policy level, women farmers' barriers to agronomic and climate-related information were cited to include the constitutional split and devolution of agricultural extension, from research and innovation and failure to provide clear information flow and research plan mechanisms between the research institutions, county government and the national government. Further barriers were noted in the duplication of extension approaches by public, private and non-governmental organizations due to a lack of transparency, coordination, co-creation, layering, sequencing and integration. Worse still, other areas would go without receiving extension services while others would have more than needed support. While a constitutional change would be a long-term intervention, it takes time to achieve, however, leveraging on the existing structures and existing institutions using Collaborative learning and Adaptive Management approaches and strategy

through Joint Work planning, co-creation of intervention, co-funding, joint monitoring and evaluation among partners while capturing learning and using the outcomes to adaptively manage current and future extension challenges, would resolve the problem in the short run.

The study also noted that Smallholder women farmers were not aware of the various information sources and providers. Through collaborative forum convened under the council of governors and bringing together all the research institutions, all counties' departments of agriculture and specifically extension, all private extension providers, all digital extension service providers and farmer cooperative representatives would not only help to take stock of all players but create the forum for Collaboration, Joint planning, implementation and leaning. This will eventually increase information flow from research to extension and also provide a feedback loop from farmer, extension to research, which further improves extension services. More still the initiative will eliminate duplication, improve efficiency in resource use, and reduce misinformation and competition among player. Figure 12 show the Collaborative learning and Adaptive Management Approach framework

Extension providers' capacity to transform data into information, information into knowledge and package the knowledge in a form, format, and language palatable to the smallholder women farmers was found to be low. Capacity development initiatives targeting extension officers' data analytics, communication and knowledge management skills would support information repackaging efforts to boost information access, utilization and adoption. This recommendation could be tied to the digital literacy, digital talent pool and the collaborative learning adaptive management approaches recommended above.

While crucial climate and agronomic data is collected and shared with farmers every day in unpalatable form and format, opportunities continue to be lost. Several players anizations at the grassroots level Support Sacco developments at the ward levels and ensure proper linkages of such cooperatives to farmers to ensure they easily access finances. Saccos play a key role in ensuring the provision of finances to farmers.

Their development at ward levels will create strong linkages for women farmers to access finances and enhance their abilities to seek funds. With such developments, female farmers will be able to overcome the financial challenge and use the same to mitigate climate change.



Figure 12: Framework Collaborative Learning and Adaptive Management Approaches (USAID Learning Lab Sep 2016)

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