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Gender and digital advisory tools assessment in Ghana FEBRUARY 2024

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GENDER AND DIGITAL ADVISORY TOOLS ASSESSMENT IN GHANA

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List of Acronyms

Acronym

AEAs	Agriculture Extension Agents
APIs	Application Programming Interfaces
CICs	Community Information Centres
DAES	Directorate of Agricultural Extension Service
DCS	Directorate of Crop Services
FBOs	Farmer-Based Organisations
ICT	Information and Communication Technology
MoFA	Ministry of Food and Agriculture
PPRSD	Plant Protection and Regulatory Services Directorate
RAS	Rural Advisory Services
WIAD	Women in Agricultural Development

Executive Summary

The availability of digital technologies for farmers holds the potential to enhance access to digital resources and opportunities. However, research suggests a gender disparity in the adoption of Information and Communication Technologies (ICTs), especially in low-income

countries. This gender digital divide is not limited to women farmers but extends to women service providers, agriculture extension agents, and agro dealers.

CABI's PlantwisePlus program has been recognized for its potential to address gender disparities in agriculture. Despite the existing literature, there are noticeable gaps in research on gender and digital advisory services in Ghana. Limited studies specifically focus on the utilization patterns of PlantwisePlus digital tools by women agriculture service providers. In this context, this study aims to build on previous research and delve deeper into gender-related barriers that agriculture service providers face in accessing and utilizing digital tools promoted by CABI and other stakeholders in the agriculture sector.

The objective of this study was to understand what works in bridging the gender gap in access and use of digital tools for agriculture, by both agriculture service providers and farmers in Ghana. The assessment was conducted in the Bono and Ashanti regions of Ghana using qualitative research methods, including key informant interviews, in-depth interviews, and focus group discussions. Two districts were selected from each of the two selected regions for the study using the purposive sampling method. The two districts were purposively selected from the designated program areas where CABI and other organizations promote digital tools in agriculture in Ghana.

Agriculture service providers were also chosen using purposive sampling methods for in-depth interviews, with equal representation of men and women service providers. Focus group discussions with men and women farmers were conducted in two villages from one district per region, ensuring a mix of age groups in each focus group. The men and women farmers living in the selected program areas where CABI and other organizations promote digital tools in agriculture were chosen using purposive sampling methods.

The findings of the study show a huge gender gap among extension service and agro-input providers, and this naturally posed challenges for access and use of PlantwisePlus digital tools as well as other digital tools in Ghana. The study findings showed that at the national level, access, and use of PlantwisePlus digital tools among the extension service leadership was high. However, there were more men than women at the leadership and governance positions at the national and regional levels. Gender disparities regarding access and use of PlantwisePlus digital tools were not pronounced at the national and regional levels as compared to the community level. At the community level, most farmers did not use the PlantwisePlus digital tools due to smartphone constraints, low level of education and language barrier, lack of technical knowledge, and digital literacy. However, women were more affected by the limitations to access and use of PlantwisePlus digital tools than their male counterparts. Most of the digital tools were not designed with a gender lens and therefore contributed to the inequalities among men and women farmers in terms of access and use of digital tools.

Generally, there was less awareness of PlantwisePlus digital tools at the community level among all genders. However, the level of access and use of other digital tools was relatively higher among male farmers than their female counterparts. Male farmers had more access and utilisation than female farmers because they were better placed and financially empowered to access more information about the benefits of digital tools for the dissemination of extension and advisory services from their networks. The gender digital divide became more pronounced with age. Some of the services provided were more patronised by males because of their specific needs and interests. For example, males and especially young males were involved in agrochemicals and fertilizer applications and therefore naturally accessed and used the drone services platforms for spraying agrochemicals and fertilizer applications. This suggests that digital extension and advisory tools should be designed and tailored to the specific needs of men and women.

The study findings also showed that most of the youths (both extension agents and farmers) were more literate and ICT savvy than the older adults, so they were more willing to use digital

tools than the aged. The men especially the male youth had the right skills and intuitive knowledge to operate modern devices effectively than their female counterparts. In situations where women did not have access and control over land and therefore did not have their own farms due to cultural limitations also contributed to less access and use of digital tools for extension and advisory services among women. At the community level, women were less likely to own smart phones than men due to financial constraints. This suggests that women farmers need to be well educated on advantages of investments in smart phones for enhanced access and use of digital tools for extension and advisory services. The study findings showed that the use of these digital tools could help reduce the effect of cultural barriers to access to extension services by women farmers in communities where men did not allow their wives to interact with male extension officers.

The gender-specific challenges to access and use of digital tools for extension and advisory services became more pronounced at the community level than at the national and regional levels. These challenges include:

- 1) High illiteracy and English language barrier especially among women farmers
- 2) Financial constraints and inadequate access to smartphones especially among adult women farmers
- 3) Low digital skills among adult women than adult men
- 4) High cost of Internet bundles/Internet bundle affordability problems, and
- 5) Low participation of women in decision making including decision to access extension and advisory services in Muslim communities.

Access and use of digital tools among young and adult women farmers is critical for agricultural development in Ghana, given their significant roles in the agricultural value chains. However, the reach of digital tools among women farmers, particularly in rural communities is highly limited, and the gender gap in smartphone ownership is even wider due to lack of access to basic infrastructure and services.

The following recommendations were drawn from the study findings to improve access and use of PlantwisePlus digital tools and other digital tools in Ghana:

1. Development of apps that can be used offline and that are tailored to the specific needs of women and men to improve access to gender-responsive extension and advisory services.
2. Capacity building and training of AEAs and agro-input dealers at the district levels on access and use of PlantwisePlus digital tools with a special focus on females. This will also help reach out to more women farmers, help them manage their farms independently and close the gender gap.
3. Use women-led information network platforms designed to link women farmers groups to extension and advisory services delivery to reach out to more farmers at the community level and link-up with other digital agro-innovation hubs to reach out to more women.
4. Financial Support - Women farmers will be inclined towards digital tools with substantial support in terms of training and financial assistance to acquire smart mobiles phones and internet data– For instance could use Village Savings and Loans scheme for women groups.

1. Introduction

1. Background and context of the assessment

In recent years, there has been a significant increase in the availability of digital technologies for farmers. These technologies hold the potential to enhance access to services in rural

areas, minimize transaction costs, optimize resource utilization, and boost resilience to shocks. However, the adoption of Information and Communication Technologies (ICTs) may also contribute to the exacerbation of existing inequalities, particularly affecting rural women in low-income countries who contend with the intersecting challenges of digital, rural, and gender divides (FAO, 2018; FAO, 2023).

Research suggests that numerous ICTs for agriculture solutions exhibit a gender disparity, with a lower proportion of women users compared to men (Chassin, 2022; CABI, 2022). This gender gap in technology usage is attributed to factors such as limited access to the internet and digital devices among women in low and middle-income countries. Notably, the gender mobile ownership gap is 19% in South Asia and 13% in Sub-Saharan Africa, while the gender mobile internet gap is even more pronounced at 41% in South Asia and 37% in Sub-Saharan Africa (FAO, 2023; Shanahan, 2022).

Numerous studies highlight the existence of a gender gap in digital access, especially in Ghana. Doss et al. (2018) emphasizes that women in rural areas often have limited access to digital technologies due to factors such as lower rates of mobile phone ownership and internet usage. This disparity is further exacerbated by socio-cultural norms that restrict women's formal interaction with technology, particularly in the context of agricultural information services (Nguyen et al., 2020). The restricted access of women to mobiles and mobile internet is further explained by factors including financial constraints, lower levels of literacy, and digital skills among rural women.

In certain conservative cultures, social norms act as additional barriers, preventing women from owning smartphones or accessing social media platforms (Müller et al., 2022). Even when women have access to mobile devices, barriers such as lack of awareness and adherence to gender norms may impede their utilization of digital agriculture services (Chassin, 2022). This digital gender divide is not limited to women farmers but extends to women service providers, agriculture extension agents, and agro dealers. Studies reveal a notable imbalance, with a higher number of male users compared to female users in platforms like CABI academy and Plantwise digital tools (CABI, 2022; Thakur and Mugambi, 2022).

Research by Amoako-Gyampah et al. (2019) points out specific challenges faced by women agriculture service providers in Ghana. These challenges include limited access to training programs for digital tools, lower levels of digital literacy, and societal expectations that discourage women from engaging in technology-enabled advisory roles. Such challenges contribute to the underrepresentation of women in the use and provision of digital advisory services in agriculture.

CABI's PlantwisePlus program aims to enhance climate-smart plant health practices by providing responsive digital advisory tools to agriculture service providers. These tools include the Plantwise Knowledge Bank¹, Plantwise Factsheets Library App², simulator games on pest diagnostic and crop management³, CABI Academy⁴, CABI BioProtection portal⁵, and Crop App Index⁶. However, it is crucial to ensure that these tools are accessible to both men and women agriculture service providers and equally benefit male and female farmers.

CABI's PlantwisePlus program has been recognized for its potential to address gender disparities in agriculture by reaching and benefiting women in different agricultural contexts.

¹ A free online resource that gathers plant health information from across the world. 15,000+ pieces of content, including, Pest Management Decision Guides, Factsheets for Farmers, species pages, photosheets, manuals, and video factsheets. <https://plantwiseplusknowledgebank.org>

² A free Android and iOS app with up-to-date information that supports the diagnosis and safe management of crop pests.

³ A free Android app that shows you how to investigate and diagnose common plant health problems and improve your skills in advising farmers to make the right decisions while facing plant health challenges in the field.

⁴ Brings together CABI's expertise in plant health and diseases to create a range of online interactive training courses. www.academy.cabi.org

⁵ A free tool to enhance the awareness and uptake of biocontrol and biopesticide products. <https://bioprotectionportal.com/>

⁶ The Crop App Index is an easier way to discover information to support decision-making. <https://cropappindex.org/>

The recognition of the Plantwise program can be attributed to its holistic approach, combining gender-sensitive initiatives with sustainable agricultural practices. The program's success lies in its ability to adapt to diverse local conditions, engage local communities, and foster collaborative partnerships, making it a standout solution in the effort to promote gender equality in agriculture. However, there is a need for further investigation into the extent to which the program considers and addresses the specific needs and challenges faced by women in accessing and using digital tools for advisory services (Kwadzo et al., 2021).

While acknowledging the challenges, some studies provide insights into opportunities for improving gender inclusivity in digital advisory services. Adekola and Akinnuwesi (2022) propose tailored training programs that address the specific needs of women in digital literacy and advisory services. Additionally, the development of user-friendly interfaces and mobile applications that consider the context and constraints of women in rural areas could enhance their engagement with digital tools (FAO, 2020).

In conclusion, the literature review highlights the persistent gender disparities in digital access within the agricultural sector in Ghana. Existing literature underscores the potential of gender-sensitive approaches in digital agriculture services to advance inclusion. This involves understanding contextual factors contributing to the exclusion of certain groups, tailoring information content and communication formats to be relevant and accessible to women and addressing the specific needs of excluded groups (FAO, 2018; Alvi et al., 2021; Chassin, 2022; Müller, 2022).

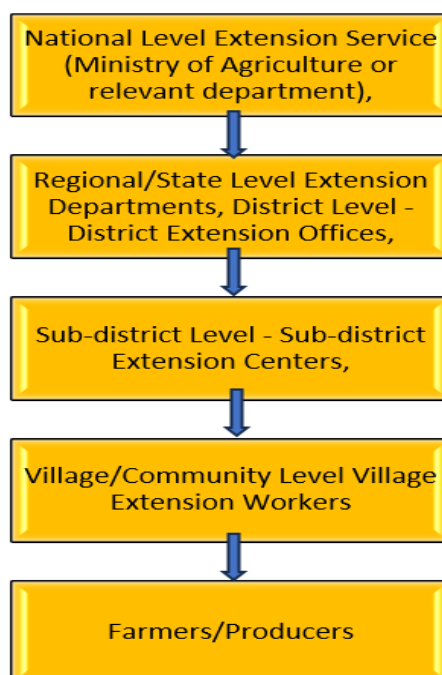
Despite the existing literature, there are noticeable gaps in research on gender and digital advisory services in Ghana. Limited studies specifically focus on the utilization patterns of PlantwisePlus digital tools by women agriculture service providers. Moreover, there is a dearth of research exploring the intersectionality of gender with other factors such as age, education, and socio-economic status in influencing women's access to and use of digital advisory services in agriculture. While some studies have explored access and use of PlantwisePlus Digital tools, with a focus on challenges faced by users, including women service providers (CABI, 2022), there is a need for a more exclusive examination of gender-related barriers faced by agriculture service providers.

In this context, this study aimed to build on previous research and delve deeper into gender-related barriers that agriculture service providers face in accessing and utilizing digital tools promoted by CABI and other stakeholders in the agriculture sector. Additionally, the study will investigate the alignment of the content of CABI digital tools with women farmers' agricultural roles and explore unmet needs. Given the PlantwisePlus program's goal to reach lead farmers with digital advisory tools, the study will also examine trends in men and women farmers' use of digital advisory services.

Table 1. Key Participants, Target, and Impact Groups Coverage

Key Participants	Impact or Target Group
Public Agriculture Service Providers	MOFA Directorate of Agricultural Extension Services, Plant Protection and Regulatory Service Directorate (PPRSD), E-extension Directorate and Agriculture Extension Agents (AEAs).
Private Agriculture Service Providers	Esoko, and Farmerline,
Farmers	Plant Doctors, Agro-input dealers, and

Flow Diagram of Extension Services in Ghana



2. Purpose and evaluation objectives

The study aimed to understand the gender gap in access and use of digital tools for agriculture among agriculture service providers and farmers in Ghana. The study focused on the access and usage of PlantwisePlus digital tools and other digital tools by men and women agriculture service providers.

The assessment explored the challenges faced by women service providers in accessing and using digital tools and how they differ from those faced by their male counterparts. Additionally, the study investigated how service providers use digital tools to provide advice to farmers and how the content of information aligns with the information needs of women farmers. The assessment was conducted using qualitative research methods, including key informant interviews, in-depth interviews, and focus group discussions.

The main objective of the study was to conduct gender and digital advisory services assessment in Ghana. The scope/objectives were to:

- Assess the status of access and use of PlantwisePlus digital tools by men and women agriculture service providers in Ghana. This task involved gathering data through key informant interviews with relevant stakeholders to understand the current level of utilization of PlantwisePlus tools by both genders.
- Investigate the use of other digital tools by men and women agriculture service providers in addition to PlantwisePlus. This task required conducting in-depth interviews with agriculture service providers to identify and analyze the various digital tools they use outside of PlantwisePlus.
- Examine the challenges faced by women service providers in accessing and using digital tools and compared them to the challenges experienced by male service providers. This task involved conducting qualitative interviews to understand the specific barriers faced by women and how they differ from those faced by their male counterparts.

- Explore how agriculture service providers, including extension agents, plant doctors, and agro-dealers, utilize PlantwisePlus and other digital tools to provide advice and support to farmers. This task required gathering insights from interviews to understand the strategies employed by service providers in utilizing digital tools to deliver agricultural advice.
- Evaluate the extent of alignment of information shared through PlantwisePlus digital tools with the information needs of women farmers, including their engagement in agricultural activities and value chains. This task involved analyzing the content of the digital tools and comparing it to the specific needs and roles of women farmers.
- Identify the group of men and women farmers who directly access digital advisory services. This task required conducting focus group discussions with men and women farmers to understand their level of engagement with digital tools and advisory services.
- Explore the drivers and barriers to women farmers' access to digital advisory services and determined which form of digital communication is more accessible to women farmers. This task involved analyzing the data from focus group discussions to understand the factors that facilitate or hinder women farmers' access to digital tools and advisory services.

3. Evaluation Questions

The following are key research questions the study sought to address:

- 1) What is the status of access and use of PlantwisePlus digital tools by men and women agriculture service providers?
- 2) Outside of the PlantwisePlus digital tools, what other digital tools are used by men and women agriculture service providers?
- 3) What are the challenges for access and use of digital tools among women service providers and how do they differ from challenges faced by male service providers?
- 4) How do service providers use PlantwisePlus and other digital tools to provide advice to farmers?

4. Methodology and Study Design

4.1 Study Site and Sample Selection:

The assessment was conducted in the Bono and Ashanti regions of Ghana. The consultant selected two districts from each region using the purposive sampling method. The two districts were purposively selected from the designated program areas where CABI and other organizations promote digital tools in agriculture in Ghana. The districts have also been actively involved in the CABI's PlantwisePlus program. Table 2 provides the details of geographic coverage of the assessment.

Table 2. Geographic Area and Population Coverage

Region	District	Community
Ashanti	Ejisu Ejura	Ejisu-Asosuanso Ejura Zongo
Bono	Sunyani East Dormaa West	Sunyani East, Nkrankrom Dormaa Gyaase

Agriculture service providers were also selected using purposive sampling methods for in-depth interviews, with equal representation of men and women service providers. Focus group discussions with 10 groups of men and 10 groups of women farmers were conducted in two villages from one district per region, ensuring a mix of age groups in each focus group. The men and women farmers living in the selected program areas where CABI and other organizations promote digital tools in agriculture were chosen using purposive sampling methods.

4.2 Data collection methods and tools:

The following data collection tools were employed:

- Key informant interviews with agriculture extension and plant protection departments, private sector organizations, and non-governmental organizations promoting digital tools for agriculture.
- In-depth interviews with agriculture service providers (extension agents, plant doctors, and agro dealers) using a semi-structured questionnaire.
- Focus group discussions with men and women farmers living in the selected program areas where CABI and other organizations promote digital tools in agriculture.

Table 3. Data Collection Tools

Data Collection Tool	Description of Data Captured	Respondents/Sources of Information/Documents to be Reviewed	Number
Key Informant Interview	<ul style="list-style-type: none"> • Number and type of digital advisory tools available in Ghana. • How the tools are promoted or popularized to extension agents and farmers. • Information about their current use and barriers to access and use. 	<ul style="list-style-type: none"> • National level: Directorate of Agriculture Extension Services, Plant Protection, ICT wing in MoFA. • Regional level: Agriculture Extension Directorate line offices, government extension, and plant protection departments (at national and regional levels). • The relevant staff of Farmerline and ESOKO. • Assessment or evaluation reports produced on the different digital tools. 	<ul style="list-style-type: none"> • 3 Officers at the national level were interviewed. • 2 officers were interviewed. One from each selected region. • 2 Key Informant Interviews were conducted. One from Farmerline and one from ESOKO.
In-depth Interviews with Agriculture Service Providers	<ul style="list-style-type: none"> • Practice using PlantwisePlus and other digital tools for agriculture. • Barriers to access and use of digital tools for agriculture. • Use of information from digital tools to advise farmers. • Information needs of women farmers and the extent to which available digital tools respond to these needs. 	<ul style="list-style-type: none"> • Extension agents, plant doctors, and agro dealers working in CABI program sites (at regional and district levels). 	<ul style="list-style-type: none"> • 3 Women and 3 men Agriculture extension agents and plant doctors in each of the four districts were interviewed. • 4 Women agro-dealers-1 in each district. 4 Men agro Dealers-1 each district.
Focus Group Discussion	<ul style="list-style-type: none"> • Practice using digital advisory tools among farmers. 	Men and women farmers living in CABI program areas and program areas of other organizations promoting digital tools.	<ul style="list-style-type: none"> • 20 focus groups were conducted

	• Barriers and facilitators for access and use of digital tools.		
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4.3 Data Analysis:

Qualitative methods were employed for data collection and analysis. The data collected were transcribed and coded for themes and patterns related to the research questions. The analysis provided insights into the challenges and opportunities for women agriculture service providers and farmers in accessing and using digital tools.

4.4 Outputs of the Assessment:

The assessment generated recommendations on strategies to enhance the accessibility and usability of PlantwisePlus digital advisory tools for women agriculture service providers and farmers.

5. Analysis & evaluation findings

5.1 Access and Use of plantwiseplus digital tools by men and women agriculture service providers

This section delves into the status of access and use of PlantwisePlus digital tools, focusing on the dynamics between male and female agriculture service providers. Recognizing the importance of gender inclusivity in technological adoption, this study aims to unravel the disparities, challenges, and opportunities that exist within the digital realm of Ghana's agricultural sector. By shedding light on the current situation, we aim to provide valuable insights for policymakers, development practitioners, and stakeholders, paving the way for informed strategies that promote equitable access and utilization of digital tools in Ghana's agricultural landscape.

CABI's mission is to improve people's lives by providing information and applying scientific expertise to solve problems in agriculture and the environment. To help achieve this mission, CABI, through the PlantwisePlus programme, developed digital advisory tools to help make the agricultural sector more attractive to young farmers, reach more women farmers, and bring practical agricultural knowledge to agricultural extension officers and smallholder farmers to help them grow healthier, nutritious, and profitable crops. The PlantwisePlus digital tools include PlantwisePlus Knowledge Bank, Pest Diagnostic Simulator, Crop Pest Diagnosis Course, Crop Management Simulator, and Crop Pest Management Course. The rest are CABI Bio-Protection Portal, Plantwise Factsheet Library, Crop Sprayer App, and Fertilizer Optimizer Tool.

The PlantwisePlus digital tools or apps have the following functions:

- The PlantwisePlus Knowledge Bank is a free online tool that retrieves plant health information from worldwide to users.
- The Plantwise Factsheet Library App provides up-to-date information to support Crop Sprayer App and enables users to calculate the quantity of pesticides to use based on user-inputted values when treating their crops.
- The BioProtection Portal enhances the awareness and uptake of biocontrol products.
- Fertilizer Optimizer App helps users optimize their fertilizer investments based on user-specific inputs including crops grown, expected crop sale prices, and fertilizer prices.
- The Pest Diagnostic Simulator App shows how to investigate and diagnose common plant health problems.
- The Crop Management Simulator App also helps users improve their skills in advising farmers to make the right decisions while facing plant health challenges in the field.

To find out whether the digital tools or apps are yielding their intended purpose, digital service providers, agricultural extension officers, plant protection officers, agro-input dealers, and

farmers were asked to share their experiences with using PlantwisePlus digital tools for agriculture, and the specific features or functions they have found most useful in their work. The results obtained are categorised under national, district, and community levels.

Access and use of PlantwisePlus digital tools at the National level

The organisations interviewed at the national level were five (5) these were MOFA Directorate of Agricultural Extension Services, Plant Protection and Regulatory Service Directorate (PPRSD), E-extension Directorate, Esoko, and Farmerline. Findings showed that the CABI PlantwisePlus digital advisory tools are well-known at the national level. However, in terms of access and usage, it was the MoFA Agricultural Extension Directorate, Esoko, and PPRSD that often used the PlantwisePlus digital advisory tools. Officers from PPRSD acknowledged that there were more apps on the PlantwisePlus platform but the digital tools they often used concerning the service they provide were the Plantwise Factsheet library and the PlantwisePlus Knowledge Bank to manage the pests and diseases on crops. Esoko connects to the PlantwisePlus platform through their APR to obtain information which enables them to expand their reach to the farming communities.

A male officer from the MoFA Agricultural Extension Directorate also had this to say: “When we were developing the plant clinic, we used the CABI platform to get a lot of information which some of our officers are using to provide solutions to farmers’ challenges. CABI used to send me updates on agricultural information weekly but now I have not been getting it unless I go to their platform where I use Google to search for information for my personal use” (Interview with MoFA AED, November 2023)

On the contrary, an officer from the E-extension directorate emphasized that they do not use the CABI PlantwisePlus digital advisory tools directly. He explained that the digital service providers normally make themselves available to the E-extension directorate to inform them about the kind of digital services they provide and request the support of the directorate to help them reach out to more farmers. However, the E-extension directorate does not have that kind of relationship with CABI, but they were aware that the PPRSD collaborates with CABI. This collaboration was confirmed by the officers from PPRSD who confessed that CABI helped them to develop pest risk analysis tools and plant clinics. Therefore, their collaboration with CABI has enhanced the quality of delivery and boosted their speed at work, especially with pest risk analysis. A female PPRSD officer had this to say:

“We previously had to google to search online for pests that could attack crops on cases that our clients brought to us. However, the pest risk analysis app informs us about the likely pests and diseases that can attack crops. Also, the app gives lists of pests and diseases that are not yet present in the country but can follow imported crops into the country. In that case, we decide whether to allow those crops to come in or not” (Interview with an officer from PPRSD, November 2023).

This shows that the prejudice of male dominance in access to and control of digital advisory tools is not the same across all levels. At the national level, women like their men counterparts, equally have access and control of digital services. The female PPRSD officer categorically stated that the work they do is the same whether as a man or a woman, and anyone with a smartphone can access the PlantwisePlus digital platform. Therefore, women do not have specific needs for access and control of digital tools. The ability of women at the national level to have access to and control of digital tools might be because they have attained the same higher level of education as men. Also, on the same job and qualification, women have access to the same training given to men, unless a female was not available during a specific training on digital advisory tools because of maternity leave or other engagement. Additionally, women with the same qualifications as men in the same job have the same financial resources to afford smartphones. However, it was testified that the youth are more digitally inclined than

the elderly, therefore, the youth (male and female) have more control when it comes to the use of digital advisory tools.

Access and use of PlantwisePlus digital tools at the Regional Level

The regional PPRSD and the regional extension officers of MoFA in the Ashanti and Bono regions were interviewed. These positions were all occupied by men, and they all had access to, and adequately utilised the CABI PlantwisePlus digital advisory tools. Some of the officers interviewed claimed to be facilitators who trained other officers and the elite group farmers on how the PlantwisePlus platforms work. The male dominance in the employment of regional PPRSD and extension officers is consistent with the study of Antwi-Agyei and Stringer (2021) who attributed the limited female recruitment as agricultural extension agents to structural barriers which restrict females access to the educational levels needed to become extension agents. This means that although the recruitment of regional PPRSD and extension officers were done on merits, more females might not be available with the requisite qualifications to be employed.

Although a regional extension officer confidently said he uses all the PlantwisePlus digital tools for training and personal diagnosis and enquiries, the digital tools generally mentioned by the officers were the PlantwisePlus Knowledge Bank, Plantwise Factsheet Library, Crop Management Simulator Apps, Crop Sprayer App, and the Fertilizer Optimizer App⁷. The officers explained that they use the Plantwise Factsheet Library and the Plantwise Knowledge Bank a lot with farmers, especially when there is a need to find a lot of facts, as an extension officer, for farmers by way of disease recognition and diagnosis.

When the officers were asked to share their experiences with using PlantwisePlus digital tools for agriculture, one regional extension officer was able to back his claim of utilizing all the platforms, when he explained that:

“All the platforms work with our information stored in there. So, when you are searching for a particular disease which has occurred in a specific country, you select that country to obtain valid information on the disease or pest and the corresponding recommendations that are location specific. This is because the approach used to fight diseases or pests in specific locations might differ from how other countries manage it. The only setback is that those platforms cannot work offline so you always need internet which is not stable in Ghana” (Interview with a regional extension officer, November 2023).

This shows that the CABI PlantwisePlus platform enables PPRSD and Extension officers, especially women, to track or monitor the inflows of foreign crops into the country and the specific recommendations to treat diseases or pests associated with them. Access to such information on the PlantwisePlus platform equips women to gain confidence to deal with male farmers. Farming activities are dominated by males and male farmers normally perceive female extension officers as not capable of teaching them about farming as compared to the male extension agents (Khursheed et al., 2020), a problem, they believe, emanated from cultural and social constraints. A built capacity of women in the PlantwisePlus digital tools would, therefore, equip female extension agents to confidently diagnose diseases and pests, and issue appropriate recommendations to farmers to gain their trust. Therefore, the inability of the PlantwisePlus platform to work offline and the frequent requirement of internet, which is not stable in Ghana affect women more, especially the youth who have not gained enough experience as extension officers.

⁷ A free Android app that helps the user optimize their fertilizer investments. Based upon user-specific inputs including crops grown, expected crop sale prices, and fertilizer prices.

A regional PPRSD officer also highlighted some features and functions of the PlantwisePlus digital tools. He enlightened that CABI has trained and provided tablets to plant doctors and has equipped them to diagnose pests and diseases associated with crops. Occasionally, these plant doctors visit communities for consultations where they sit and allow farmers to come with samples of what is wrong with their crops. Normally when Plant Doctors see something unusual on crops, they try to diagnose it based on the knowledge they have. If the officers are unable to diagnose it at a glance, they compare what the farmer brought to what is in the Plantwise Factsheet library to enhance a quick diagnosis and a recommendation to manage the disease or pest on the crop. Therefore, the PlantwisePlus digital tool is important for Plant Doctors to diagnose and give accurate or precise recommendations to farmers.

This is how the PlantwisePlus digital tools work, and it has helped farmers to reduce or eliminate the indiscriminate use of pesticides, which might work but the side effects may not be good for the farmers and consumers. The tablets with the PlantwisePlus digital tools have helped the agriculture officers to also update themselves and build their capacity and confidence in the interaction with farmers because they have something handy to refer to.

Another regional PPRSD officer expressed his joy and appreciation to CABI for the training he received as a Plant Doctor, and how the PlantwisePlus digital platform has helped him in executing his duties. The PPRSD officer had this to say.

“CABI, over the years, has been very helpful to the growth of agriculture. I got to know CABI around 2014 when they trained us as plant doctors. Since then, they have helped in plant health and disease diagnosis tremendously. Wherever I find myself and there is any issue concerning crop pests or disease, I fall on the PlantwisePlus digital tools. The use of the PlantwisePlus knowledge bank and the Plantwise factsheet library has helped some of us come out with the right diagnosis and the corresponding recommendations on crop pests and diseases” (Interview with Regional PPRSD Officer, November 2023).

When the regional officers were asked to share notable successful stories or case studies on how the PlantwisePlus digital tools have supported their decision-making process, one officer had this to say.

“The tomatoes federation invited me to the field to show me some diseases that were happening to their crops. Initially, I could tell it was a tomato blight but there are two types - early blight and late blight which was difficult to deal with if one was not a plant pathologist. So, while I was trying to ask them what the symptoms were, I started populating the PlantwisePlus platform and before they could end their description, I got the diagnosis and the recommendation. So, that day I will say the App came to my rescue because the tomato federation people were big men like national chairmen from the tomatoes farmers association and they believed in me a lot” (Interview with MoFA Regional Agricultural Extension Officer, November 2023).

Another success story shared, was when a regional PPRSD officer was called to see an oil palm plantation containing about four thousand seedlings infested with a disease. He got there to witness that all the seedlings were burning without knowing the cause. So, he urgently diagnosed the problem using the CABI PlantwisePlus platform and issued a recommendation. Within three days after the application of the recommendation, they were able to salvage the rest of the oil palm seedlings.

Generally, the testimonies given by the regional officers show that the training by CABI on the use of the PlantwisePlus digital tools has boosted the knowledge, skills and confidence of Plant Doctors and Extension Agents tremendously to diagnose and offer recommendations to farmers. However, no woman from the research area has benefited from such training at the

regional level since all the positions of regional PPRSD and Extension officers were occupied by men as explained by Antwi-Agyei and Stringer (2021).

Nonetheless, the regional officers offered the following recommendations:

- Interventions on PlantwisePlus digital platforms should be nationwide inclined to ensure that no woman is left behind in the use of digital advisory tools.
- Most district extension agents are conversant with other digital tools such as the Plantix but they need more training to use the PlantwisePlus digital tools.
- There is a need to modify the PlantwisePlus platforms to work offline to enable officers to use it on the farm, especially where there is no network.

Status of access and use of PlantwisePlus digital tools at the District Level

Four Districts/Municipalities were selected for the study. These were the Ejisu, Ejura, Sunyani East, and Dormaa West Districts/Municipalities. In all these Districts/Municipalities, Plant Doctors, Agro-input dealers, and Agriculture Extension Agents (AEAs) were interviewed. Similar to the national and regional levels, Males dominate when it comes to the employment of district Plant Doctors, Agro-input dealers, and Agricultural Extension Officers due to the factors explained by Antwi-Agyei and Stringer (2021).

Plant Doctors

Unlike the regional PPRSD and extension officers who were all males, one, out of the four district Plant Doctors employed at the research area was a female due to the limited number of females available with agricultural extension background. These Plant Doctors were part of those trained by CABI therefore, they were all familiar with the PlantwisePlus digital platform. In addition, all the Plant Doctors had tablets and smartphones which contained PlantwisePlus digital apps. They elaborated that the PlantwisePlus digital tools had features that were used to capture farmers' biodata, the crops they cultivate, and the problems farmers presented at plant clinic schedules.

This data, as well as the biodata of the Plant Doctor who captured them, were stored on the tablet and at the repository of the national PPRSD office. This makes it possible for the Plant Doctors to reference and get back to farmers to deal with unfinished situations or obtain feedback to be sure whether the recommendations issued to farmers worked or not. According to the Plant Doctors, the Knowledge Bank app on the PlantwisePlus platform helps them to diagnose diseases or pests quickly to offer recommendations to farmers who attend plant clinic sessions.

The Plant Doctors acknowledged that their training with CABI has equipped them tremendously to offer their services to farmers. Occasionally, they acquire additional training or capacity-building to support them in providing effective services to farmers using the PlantwisePlus digital tools. Some of them had quarterly training meetings at the regional offices whereby questions bothering their minds were presented for clarification to prevent any future wrong diagnosis. Others also regularly practised with the PlantwisePlus platform. They believe that the more they put data into the apps for diagnosis and recommendations, the more they become well-equipped with the application. Additionally, Plant Doctors also use other resource platforms such as Plantix to search for further information.

Counting how the PlantwisePlus digital tools support their decision-making process in activities such as pest diagnosis, crop recommendation or product selection, the only female Plant Doctor at the research area had this testimony to share:

“At times when I go through the pest and disease infestation on the field on my own, it becomes difficult for me to identify most of the diseases and pests. However, with the help of the PlantwisePlus digital tools, I’m able to identify specific diseases and recommend appropriate solutions to farmers” (A District Plant Doctor, December 2023).

Another Plant Doctor who was fortunate to be part of CABI national trainers for Plant Doctors also shared this success story:

“I managed some vegetable farmers in the Western region who were having Bacteria soft rot issues. I used the Plantwise Factsheet Library and went through challenges on cabbage, specifically on the leaves or diseases that affect the bulb. I noticed that the symptoms I came across in the app were matching what I was facing on the field. So, I took the recommendation from the app and asked the farmers to apply the treatment prescribed in the Factsheet. Within 2-3 weeks, it worked. So, it became a solution that was communicated to other farmers” (A District Plant Doctor, December 2023).

These revelations communicate how the PlantwisePlus digital tools have contributed to the decision-making of both male and female district Plant Doctors. There was no identified barrier between men and women Plant Doctors with regards to access, usage, and control of the PlantwisePlus digital tools. This might be due to the high level of education attained by women Plant Doctors and their ability to afford smartphones and mobile phone credit data. On training, the female Plant Doctor interviewed acknowledged that CABI has done a great job in strengthening their capacity to identify diseases and pests with the help of the PlantwisePlus applications to offer the right solutions to farmers. As explained above, dealing with male farmers is difficult for women Plant Doctors and extension officers due to factors explained by Khursheed et al. (2020).

Also, training Plant Doctors in the PlantwisePlus digital tools has increased farmers' access to extension services, especially for women in the research area. This is because women have limited access to agricultural extension services (IFPRI, 2020) due to factors such as cultural constraints, low literacy levels, non-availability of female extension staff, mobility, and lack of self-confidence. However, the organisation of plant clinic sessions by Plant Doctors and the use of digital tools have made extension services easily accessible to women and the youth who are less experienced.

Agriculture Extension Agents (AEAs)

Agriculture Extension Agents (AEAs) are responsible for providing knowledge and technical information to enable farmers to understand sustainable production and make the right decisions about their farming activities. The work of AEAs is enhanced by the accessibility and usage of digital advisory tools that improve their knowledge and boost their confidence in diagnoses of crop pests and diseases, and the issuing of appropriate recommendations. This explains why CABI introduced and trained national, regional, and district PPRSD and Plant Doctors on PlantwisePlus digital tools with the expectation that they would also train other AEAs to equip them with accurate, relevant, and up-to-date information on crop pests and diseases.

However, interviews with the AEAs in the four selected districts revealed that apart from the Plant Doctors, no AEA had personally used any of the PlantwisePlus digital tools before. This was not peculiar to any gender; both men and women AEAs had not used it, although some were aware of the existence of CABI PlantwisePlus digital tools. This revelation was contrary to what was said by a regional Plant Doctor who said that when the PlantwisePlus apps came, they gave them to the extension officers at the districts so, they were all using them as a useful tool for their daily activities.

To find out why the AEAs were not using the PlantwisePlus digital tools, they were asked whether there was any training or capacity-building programme in place to support them to effectively use the digital tools. Unfortunately, most of them disclosed that there was no such programme in their districts. One AEA gave the following response:

“We have not been given any training, but we are on the job so, we learn to find out more things on the job. The first time on the job is usually difficult but as time goes on, we continue to learn and become better” (Interview with a district AEA, December 2023).

Another AEA had this to say:

“Since I was recruited, the only training programme I have ever had was a training concerning climate change and that was where the CABI’s PlantwisePlus application was mentioned, but it wasn’t a major training. We are yet to have a major training on the use of these digital advisory tools” (Interview with a district AEA, December 2023).

The lack of training, and use of the PlantwisePlus digital tools would affect the decision-making process of AEAAs, especially the women. This is because women have to go the extra mile to be accepted by male farmers due to cultural barriers as explained by (Khursheed et al., 2020). Knowledge on the use of the PlantwisePlus applications would go a long way to boost the confidence of women to diagnose diseases and pests on the field, and offer appropriate recommendations to win the trust of farmers, especially the males.

The unexpected responses from the AEAAs about the lack of training on PlantwisePlus digital tools led the team to find out from a district Plant Doctor who was part of the CABI national trainers on digital tools, why AEAAs from his district had not acquired any training on the PlantwisePlus digital tools. The following response was given:

“Indeed, we haven't done any training since the PlantwisePlus was introduced. Some of the officers you interviewed are new AEAAs and they haven't heard of the PlantwisePlus digital tools. I think for the past few years, there haven't been any funds to support the training of staff. So, the staff who have joined MoFA within the last two years have not had this opportunity but for those who come to me one-on-one to inquire, I do educate them. So, it's a question of funding. Since CABI is no longer sponsoring us financially, the district and the municipal assemblies have also relaxed. They are not supporting us. So, all these activities we are doing, we are just volunteering. We just educate our farmers as part of our extension activities, but I can't go beyond my operational area. All I do is within my operating communities and sometimes, when a friend invites me to support him technically at the community level, we try to chip in the PlantwisePlus activities. I discussed with my director recently that, for next year, they have to plan and put it in their budget so that we can train the AEAAs to be able to manage their farmers on their own instead of some of us having to move to a different operational area which happens to be a financial burden on us” (Interview with a district Plant Doctor, December 2023).

Another Plant Doctor, on the question of what strategies they have employed to promote and popularise the PlantwisePlus digital tools among the AEAAs, had this to say:

“The CABI PlantwisePlus application cannot easily be transferred to the AEAAs, but the Plantix application can be downloaded from the Google Play Store. The Plantix can detect the pest or disease and give you the recommended biological control. I have used Plantix on many farms and I made AEAAs download them. The AEAAs take pictures of the crops with the Plantix, then it tells them the problem they are dealing with” (Interview with a district Plant Doctor, December 2023).

The AEAAs who are using the Plantix digital tool confirmed that it gives them confidence because they are sure of what to tell farmers. So, why could the AEAAs simply use the Plantix app but the PlantwisePlus app could not be easily transferred to them? That statement was contrary to what was said by the national PPRSD officer who assured that anyone with a

smartphone could access the PlantwisePlus digital advisory tools or apps. Indeed, when the AEAs were asked how digital tools support their decision-making process in activities such as pest or disease diagnosis or offering recommendations to farmers, some of them mentioned the use of the Plantix app and how they use it. A district AEA described the use of the Plantix as follows:

“What you do with the Plantix is, you take a picture when there's a disease, then you press send. It captures the picture and gives you the disease, the cause, and what you're supposed to do to solve it” (Interview with a district AEA, December 2023).

Others also revealed that they Google to help them to diagnose diseases or pests on crops. A female AEA had this experience to share:

“Most times when I see pests on the fields, what I do is I take a picture of it. For instance, if it's an okra farm, I take a picture of the pest on the okra, search on Google and compare the picture to the ones available online. At least you can get one similar picture, and you can apply their chemicals and recommend some to farmers” (Interview with a district AEA, December 2023).

This shows that digital tools immensely support the decision-making process of both male and female AEAs, especially the youth who are more digitally inclined. It is believed that if AEAs are willing to Google and download Plantix applications to help them diagnose diseases and pests on crops to offer recommendations to farmers, then they will be more than ready to learn on the CABI PlantwisePlus digital tools.

The downside aspect of the story is that during AEAs trying their best to diagnose pests and diseases with the help of Google, some can make mistakes and issue wrong prescriptions to farmers. This can be detrimental to the health of the farmers and consumers at large. This uncertainty was evidenced when the AEAs were asked to explain methods they put in place to ensure that the information they derived from the digital tools was accurately interpreted and effectively communicated to farmers. While some AEAs explained that they fall on their District Development Officers (DDOs) or PPRSD officers when they are not sure about what they find online, others also dwell on trial and error. A district AEA has this to say;

“For the farmers, they understand the plant diseases on their own. Mostly when we diagnose disease on the farm because we are not plant doctors, we try certain recommendations with the farmer and if it works, then it becomes part of our knowledge, and we recommend it to any other farmer whose crops show similar symptoms” (Interview with a district AEA, December 2023).

For AEAs, particularly women, receiving training on the PlantwisePlus digital tools is crucial since it will empower them to make knowledgeable decisions and win over male farmers. Put another way, the PlantwisePlus digital tools would shield the farmer's whole investment from loss if the AEA's suggested course of action proves ineffective.

Agro – Input Dealers

Although all the AEAs were not using the CABI PlantwisePlus digital tools, they were better off when they were compared to the agro-input dealers. At least some of the AEAs knew about the PlantwisePlus digital tools due to their interactions with the Plant Doctors. On the contrary, all the agro-dealers interviewed knew nothing about the PlantwisePlus digital tools, irrespective of the gender of the dealer, although only one agro-dealer interviewed was a female while the other three were males.

Also, they did not know much about crops and the kind of diseases or pests that attack them, let alone equipped with the capacity to recommend any chemical for treatment. This was proved when the agro-input dealers were asked whether there had ever been a situation where farmers came to them complaining about pests or diseases destroying their farms for

them to use the internet or any digital tools to find out what the pest and disease was, based on the description of the farmer, and the possible recommendation to address the problem. The dealers categorically stated that they had never done that before. One agro dealer confessed with the following statement:

“We just take advice from those we buy the goods from (suppliers of agrochemicals) and give it to our customers (farmers)” (Interview with a district agro-input dealer, December 2023).

Yet, these agro-input dealers use their discretion to sell any chemicals to farmers to apply to their crops. When the agro-input dealers were asked whether they had ever received any training on the use of digital tools, all of them responded no. One agro-dealer had this to say;

“Initially when we started operating this shop, the officers called to teach us about the chemicals but not the usage of any digital app. We search on our own and ask the suppliers of the chemicals” (Interview with a district agro-input dealer, December 2023).

Another input-dealer added his voice with the following appeal;

“I think CABI should try and always have contact with the agro-input-dealers because the farmers are closer to us than the extension officers. The extension officers will only see the farmers when they visit them on the field, but farmers often come to us to buy. So, the best thing I can say is that CABI should always be in contact with agro dealers so that we can also give you more challenges that farmers are facing. Most of the time when the officers come for training, they don't target the agro-input dealers. Meanwhile, the extension agents are between the farmers and the dealers so sometimes, CABI should focus on the dealers more because before farmers even buy one bottle of chemical, it's the dealers that give them the information they need on how to apply those chemicals on the crops” (Interview with an Agro-input dealer, December 2023).

This statement by the input dealer presupposes that farmers may have wrong prescriptions if agro-input-dealers are not well equipped with the knowledge of agro-chemicals and their functions, and the use of digital tools to help them make the right decisions.

The agro-input dealers were not using any digital tools that could help them access information about disease diagnosis and recommendations. Those who were found using WhatsApp or other digital apps were using them to market their products. One agro-input dealer mentioned an app called MERGE SALES which enables him to stay in contact with his farmers by keying their information in the app. Others said they use WhatsApp for the same purpose.

To help popularise the CABI PlantwisePlus digital tools and encourage AEAs and Agro-input dealers to use the app, the following recommendations were suggested:

- MoFA PPRSD and Agriculture Extension Directorate should provide Plant Doctors and AEAs with waterproof bags to protect their tablets or smartphones, pamphlets or fliers, or any other reference materials to the field to prevent damage by rain when on motorbikes.
- CABI and PPRSD should develop apps that can be used offline to access information in remote areas where internet connectivity is a challenge.
- PPRSD and CABI should find the time and resources to train all the AEAs in the districts, especially women, on the use of PlantwisePlus digital tools.
- CABI and PPRSD should design and conduct a gender sensitive training for agro-input dealers on the diagnosis of plant pests and diseases, and the use of PlantwisePlus

digital tools to enable them to make the right decisions concerning issuing agro-chemicals to farmers.

Access and use of PlantwisePlus digital tools at the community level

Smallholder farmers contribute significantly to improving the food security status of many households and socio-economic development in Ghana. However, farmers' exposure to important information such as improved varieties of seed, crop management, patterns in crop prices and marketing are essential to increase farmers' capacity to optimise the use of their resources (Kumar et al., 2020). This is why the MoFA AEAs have made it a priority to be close to farmers and to guide them through their farming processes.

Focus group discussions with the young and older male and female farmers revealed that the relationship between farmers and AEAs, accessibility of AEAs, and delivery of extension services to farmers have improved tremendously with the introduction of digital advisory services (DAS). Farmers can reach out to extension officers on phone and WhatsApp.

On the question of the kind of digital tools farmers use for their farming activities, it came out that the most frequently used digital tools were phone calls, radio, WhatsApp, and the dialling of Farmerline IVR, 399. The females often used radios and phone calls while males often used all the digital tools. It was not surprising that no farmer had ever used the PlantwisePlus digital tools because the AEAs who work with them were not using it either.

The use of mobile phones, especially smartphones, was dominated by young males followed by young females, adult males, and least by adult females. The adult females disclosed that they cannot afford the cost of smartphones and data. Those who had mobile phones also found it difficult to use them for their farming operations unless their wards helped them. The youth were more digitally inclined and, therefore, could take pictures and send them to Plant Doctors or extension agents to seek solutions when they had diseases or pests on their crops.

5.1.2 Use of other digital tools by men and women agricultural service providers in addition to PlantwisePlus digital tools

The use of digital tools has become an essential part of modern agricultural practices. As the agricultural sector continues to transform digitally, it is crucial to understand the various tools used by service providers. This section of the report examines how male and female agricultural service providers are integrating other digital tools into their workflows, in addition to the CABI PlantwisePlus Digital Advisory tools. This assessment was also done at the national, regional, district, and community levels to have a holistic understanding of the usage of the other digital tools being used by service providers apart from the CABI PlantwisePlus Digital tools.

Use of other digital tools by men and women agriculture service providers in addition to PlantwisePlus digital tools at the national level

The Department of Agriculture Extension Service (DAES) delivers advisory services to farmers through several digital tools. These include radio, television (GBC and TV3), internet, mobile phones, information vans, social media platforms such as WhatsApp and Telegram, Short Message Services (SMS) and Cowtribe. These tools are used to disseminate improved technologies to farmers throughout the country. For instance, the ministry has a live program with GBC and TV3 to broadcast documentaries to farmers. In the rural areas, the district officers also go to these radio stations to teach farmers about new and improved technologies. Also, to disseminate information to a large group of farmers, MoFA procured Information Vans fitted with communication equipment and distributed them to the ten regions to enable the AEAs to produce short technological and agriculture video documentaries on Good

Agricultural practices and show them to the farmers and also share them on other platforms to more clients. With regards to WhatsApp, our staff used it for communications, while the farmers took photographs of the diseased plants in the fields for solutions. The interviewee from the MoFA Agricultural Extension Directorate also had this to say:

“We have the internet, radio, television, and social media platforms which we use to educate farmers as far as agriculture is concerned. So, we use this type of data advisory tool to inform farmers. For instance, we use the radio a lot because we believe using the radio information can be reached or conveyed to over 2000 farmers depending on the time of broadcasting. We also use television as well as social media platforms such as WhatsApp, within our offices we use it for our meetings and communication. Hence, currently, this is what we are using now. Those who can't have access to these tools, purchase information vans that are furnished with communication gadgets, the officers produce video documentaries of the agricultural good practices and then they air these videos to the communities in the evening. In doing so information will reach everyone both male, female, and the aged in that community” (Interview with an officer, MoFA-Extension, November 2023)

At national level, there is no available data on the number of male and female farmers reached by these platforms. Also, an interviewee from the extension directorate was asked to provide insights into the level of usage and access in terms of age and gender among extension agents and farmers in Ghana. He reported that the youth have access to and use more digital services than the older/aged ones. Similarly, the younger male youth have access to digital more than younger females. The findings implied that access to digital tools by older women is limited. The low access among older women farmers reduces access to digital advisory services provided through SMS and mobile internet (Chassin, 2022). Due to a lack of affordable handsets, low illiteracy, and digital skills, women farmers are less likely to own and use these digital tools than men.

Table 5. Access and Usage of Digital Tools Used by Service Providers

Organization	Digital Tools Used by Service Providers	Application of Digital Tools
Department of Agriculture Extension Service (DAES)	Radio, Television (GBC /TV3), internet, mobile phones, social media platforms eg. WhatsApp, Telegram and SMS, Cowtribe	<ul style="list-style-type: none"> • Use of weather information eg. When to plough, application of weedicides, etc. • Use of Market information eg. Prudent marketing, market prices, etc. • Information sharing eg. WhatsApp, Telegram, Twitter, etc.
Plant Protection Regularly Service Division (PPRSD)	Kobo tool, Pet risk analysis Tool, IITA Seed Tracker, Traceability System, IPPC ePhyto Solution-GeNS for Ghana, fall armyworm. monitoring, and early warning signs app.	<ul style="list-style-type: none"> • Fertilizer quality control • Plant health data collection, • Pest risk analysis, • Provide early warning system, tracking of seed production and distribution
MOFA-E-EXTENSION	CSIR Technology Portal, Syecomp – IVR, Cowtribe– Mobile (Zhulia App), SKT Aeroshutter–Web, Yision Tech hub –Web, Esoko–SMS, AFA – IVR.	<ul style="list-style-type: none"> • Weather and climate information, • Traceability, market advisory, and remote sensing, • Mapping, surveying, and crop monitoring
ESOKO	Insyt, IVR, Analytics, SMS Push, Voice Push, Weather SMS.	<ul style="list-style-type: none"> • Weather forecast and early warning information. • Extension Advice • Market price information

Organization	Digital Tools Used by Service Providers	Application of Digital Tools
FARMERLINE	399 Service-Toll free farmer line to reach farmers, mergdata software, CocoaLink	<ul style="list-style-type: none"> • Agronomic advice • Climate-smart agronomic information • Financial information • Purchase farm inputs. • Local weather information services • Call center helpline. • SMS, outbound messages, and IVR

Source: Key Informant Interviews, 2023

MOFA E-Extension Desk was established to coordinate, support, monitor, and evaluate the e-Extension System in Ghana. The e-extension unit develops and deploys training programs for e-extension personnel; research, evaluate, and integrate new digital tools into the agricultural system. An interview with the officer from the e-extension desk reported that the digital tools used include (i) CSIR Technology Portal, (ii) Syecomp–IVR, (iii) Cowtribe–mobile (zhulia App), (iv) SKT Aeroshutter–Web, (v) Yision Tech hub–Web, (vi) Esoko-SMS, and (vii) AFA–IVR. According to him, the Cowtribe is a full-stack animal vaccine distribution platform meant for manufacturers, distributors, and logistics providers to deliver animal vaccines to retailers and small-scale farmers. The SKT Aeroshutter also provides drone services for spraying agrochemicals and fertilizer applications. Asset inspection, 3D modeling, mapping, surveying, and crop monitoring. The Yision Tech hub is a comprehensive database of funding, ranging from grants, equity, debt, venture capital, and competitions to sponsorships and training for corporate bodies, churches, SMEs, women groups, farmer groups, and individuals.

According to an interviewee from the e-extension desk from MoFA, these digital advisory tools are tailored to the specific needs of various agricultural sectors, such as crop farming, livestock, agribusiness, and fisheries sectors. For instance, CowTribe provides vaccines for livestock farmers Syecomp-IVR provides weather information especially to crop farmers while Troto Tractor provides tractor services to small-scale farmers, especially in the northern parts of Ghana. Regarding access and usage of these tools, he has this to say,

“Most of the youths (both extension agents and farmers) are more literate and ICT savvy than the aged so they are more willing to use digital tools than the aged. There are more male youths in agriculture than female youths. Consequently, more male youths tend to use digital tools than their female counterpart” (Interview with officer from e-extension desk, MOFA, November 2023)

“As I said, in the north the farms are owned by the male so it is the male that will assess these solutions and when it comes to the youth, the challenge won’t be that much because they are educated; they can read and write and these solutions are in the English Language so they are not all that difficult for them to assess” (Interview with officer from e-extension desk, MOFA, November, 2023).

The findings of the study implied that the women farmers are less likely than men farmers to be literate in digital skills and be aware of and understand mobile technology. Also, the results also showed that women are less likely than men to be able to read and write and navigate interfaces using mobile phone. Consequently, this may affect the confidence of women in performing new task using mobile phone and internet and seek for new information. This affects the access and usage of digital tools for advisory services such as price information, climate and weather advisory, agronomic/livestock management, and farm management by women farmers.

The Plant Protection Regulation Service Division (PPRSD) used many digital tools to deliver advisory services to farmers in recent years. These digital tools include the Kobo tool, Pet Risk Analysis Tool, IITA Seed Tracker, Traceability System, IPPC ePhyto Solution-GeNS for Ghana, and fall armyworm monitoring and early warning signs app. These digital devices are used for different services to farmers and other clients. For instance, the **Kobo tool is used for** fertilizer quality control to develop a dashboard for fertilizer data analysis and to monitor the activities of fertilizer importers, blenders, producers, distributors, and retailers in the country. The **FAO-FAMEWS App** (Fall Armyworm (FAW) Monitoring and Early Warning System (FAMEWS)) is a mobile application for Android cell phones for the real-time global monitoring of the Fall Armyworm (FAW). The app allows farmers, communities, extension agents, and others to record standardized field data whenever they scout a field or check pheromone traps for FAW. Data from the app provides valuable insights into how fall armyworm changes over time with ecology, to improve knowledge of their behavior and guide best management practices. **IITA SeedTracker** is used for real-time tracking of seed production, including pre-planting planning, registration of seed fields, crop management, harvesting, quality assessment, and quality assertion.

The Division also developed a Traceability System to ensure that farmers and exporters can access international market requirements. This system makes it easier to track all processes involved in the production of plant and plant products. **IPPC ePhyto Solution: GeNS for Ghana:** The Generic ePhyto National System (GeNS) is a centralized system to facilitate the creation of ePhytos. It is a multi-tenant web-based system developed for countries without their system to produce ePhytos and send and receive them electronically. The app is designed purposely for exporters, out-growers, and inspectors.

Though both men and women can use these platforms, the only requirement is that one must have a mobile phone. Most of the officers are efficient in the usage of these digital tools. An officer from PPRSD summarized the usage and access of digital tools by men and women on this point:

“Anyone can access these tools. However, you may have to get a phone if the tool is a mobile app. Also, men have more access to and use more digital tools than their female counterparts. Getting a smartphone cost more than other ones with keypads. Men are known to be the head and known to be in control of the finances of the family. We may not find all the women using smartphones and that is a challenge. Also, between the youth and the elderly, the youth used more digital tools than the elderly. They are more digitally inclined. They have the digital literacy more than the elderly” (Interview with PPRSD, November 2023).

The use of these digital tools also minimized the risk women extension officers encounter in their field of work. Due to certain cultural barriers, in some locations, men don't allow their wives to interact with male extension officers and vice versa. This apps makes it easier for officers to interact with farmers from home without physical contacts. An officer said:

“The digital advisory tools have minimized some of the risks that some of the extension officers go through with their farmers. These apps make it easier for me to interact with my farmers from my house. Probably, I call you, you tell me your problems, and I give you the solution through the mobile phone instead of me walking to your place to encounter those problems. So, it has minimized those risks for women extension agents” (Interview with an officer, November 2023).

ESOKO a private sector company also provides digital advisory services to farmers through Insynt, IVR, Analytics, people, SMS Push, Voice Push, and Weather SMS and Application Programming Interface (APIs). The company delivers to farmers accurately informed and up-to-date information, at the right time, to the right group through SMS, voice SMS, IVR, and call center. With the use of these digital tools, the company provides data collection services,

biometric profiling, weather forecast and early warning information, agronomic and extension advice, custom messages, and market price information services to farmers. An interview with an officer from Esoko explained the operation of the company. He has this to say:

“Currently Esoko uses mobile phone technology, sending information through text messages, word messaging, IVR (Interactive Voice Response), Videos, etc. Most of the videos are sent to farmers who use smartphones. Another one we have as a web tool is the knowledge plus which is normally known as the A+. It is a form of educational tool that collects data from our work and deploys it on an Android device. The agent that deploys it uses it to teach some of the farmers. It takes the form of videos, pictures, etc. and it also provides an avenue for one to ask questions about the business that has gone on so far” (Interview with an officer from ESOKO, November 2023).

“We rely heavily on mobile phone technology by looking at which mobile app can provide services such as weather information, market pricing information, etc. All these services mentioned earlier either go as a text message or a voice message depending on the beneficiary. We also take into consideration the percentage of our beneficiaries being farmers that are illiterates. This is because these tools enable them to communicate with us. The weather and market price information go as text messages and the information is sent to farmers as an SMS on their mobile phones or voice notes. When they get the market information, they can make informed decisions on how to market their farm products” (Interview with an officer from ESOKO, November 2023).

An officer from Esoko was asked to provide insight into the level of digital literacy by sex and age among the extension agents and farmers in Ghana. He noted that most of the extension agents are literate and efficient in the usage of these digital tools. In addition, women were given a quota (more than 30%) on all platforms of the organization. This will enhance access to and usage of these tools by women farmers. He summarized his view on this point:

“For extension agents, about 98% of them are literate and know how to use the digital tools. Most of them can WhatsApp, to call and send messages. The youth also do a lot of data by using the mobile apps. The only problem we are facing is mainly the old women and men because most of the farmers are illiterate so we must get more pictorial things to enhance more understanding. Another thing we look at is the time we send the message, especially in the mornings, so that they can both listen because that time they might be on their way together to the farm but if we send it in the afternoon, we mostly do not get them both to read. This is done in such a way to meet our target. We make sure that at least in every community, we have nothing less than 30% of women on the platform” (Interview with an officer from ESOKO, November 2023).

FARMERLINE: Farmerline has developed solutions that increase farmers' access to resources and income. They do this by leveraging innovative financing, technology, and a network of partners to help farmers increase yield and make more profit. Farmerline provides climate-smart agronomic information, financial information, and local weather information services to farmers through Mergdata software, 399 Service- Toll-free call center helpline, SMS, outbound messages, and IVR. In addition, Farmerline also provides inputs for farmers through promotion and sales, conducts digital and in-person training, and offers farmers access to markets. Through these gender-sensitive services, Farmerline has supported over 400 agribusinesses with about \$17M/30k ton worth of inputs and crops financed. Also, over 123,000 smallholder farmers have been supported out of over 1 million farmers in their network.

In summary, several digital tools have been developed and used by both public and private sector organizations to deliver rural advisory services in Ghana. For instance, MOFA through

its e-Extension Services unit used electronic media platforms such as radio, TV, internet, and social media to reach farmers and agriculture value chain actors. However, the access and usage between male and female extension farmers is varied. At national levels, more male farmers are likely to use digital tools compared to females.

This is because there are more male extension officers than females. For instance, in 2022, the ministry has only 383 females (18%) compared to 1,818 males (82%) AEAs, though it targeted employment of 30 percent female workforce. However, this provides opportunities for the recruitment of more female extension agents and training them in the application of digital tools. The study also revealed that these platforms are not contributing to gender disparities among male and female officers. The platforms can easily be accessed and used by both male and female officers.

Also, the platform created by both Esoko and farmerline are accessible and can be used by both men and women farmers. However, women farmers can be targeted by these platforms and specific messages in local languages such as Twi, Hausa, Ga, and Ewe to enable them to understand the information that is been disseminated since majority of women farmers are illiterate. In addition, following the examples of Esoko, quota can be given to women on other platforms to increase access to these digital tools by women farmers.

5.2 Challenges of Accessing and Using Digital tools by Digital Service Providers

The study revealed that several challenges continued to hinder the application of these digital tools in agriculture service delivery at the national level. These include:

High digital illiteracy and skills gap among farmers. Many women farmers, especially in rural areas and older farmers (both men and women), lack the necessary digital literacy skills to effectively use digital tools and platforms. An officer noted that:

“The youth are efficient in the operation of the digital platforms but the aged are not. Mostly, if the aged find problems with their fields, they would have to wait for their children to come around to guide them even though they have the phones with them” (Interview with PPRSD Officer, November 2023).

The high digital illiteracy among farmers affects the effective utilization of these tools for advisory services in most of the country. Most youths (both male and female) are more literate than the aged (both old men and women) and are more knowledgeable in the operation of these digital tools. An officer from the e-extension desk of MOFA summarises his point on this:

“Most of the youths (both extension agents and farmers) are more literate in ICT than the aged so they are more willing to use digital tools than the aged. There are more male youths in agriculture than female youths. Consequently, more male youths tend to use digital tools than their female counterpart” (Interview with an officer from MOFA e-extension desk, November 2023).

Gender stereotypes and cultural norms. Gender stereotypes and cultural norms continue to hinder women's use of digital tools. In Ghana, culturally, men are the heads of households with the duty to control resources and make decisions, while women are usually expected to care for children, fetch water, cook and work in their male family members' fields. These norms do not allow rural women to have access to digital tools due to lack of resources. It also limits women farmers time and mobility. In addition, agriculture is still perceived as men's work, and as such most of the field work is seen as risky for women. An officer said:

“Honestly, the fieldwork is usually male-biased, because of how tedious it is when you go to the field. Sometimes you must ride motorbikes because of long distances. It isn't that the females cannot do it, but we try not to put them through those risks. So, in terrains where we know we have to go very far or ride bikes, we let the females stay

back while males go. Even though the app is here for us, we still have to go to the field. We have a GPS device that we use, so we have to go there, pick the coordinates, pick the size of the farm, and from the size, we can get the yield of the farm, so we have to be on the field, do our inspections, take samples, check the size, check the GPS coordinates where input onto the platform” (Interview with an officer, November 2023).

Also, women farmers' contributions have been relegated to farm labour, such as planting, cultivating, and harvesting farm produce. This often makes women lack a voice and decision-making power to be empowered, which render them invisible along the agrifood supply chains. In traditionally women-owned value chains, such as the shea value chain in Ghana, all sellers are women. However, cultural norms discourage them from engaging men and maintaining social network outside their families. This limits their ability to interact with formal buyer in the value chains (Shanahan, 2022).

Poor mobile network. The poor network remains a major challenge for extension service officers and farmers. However, this affects both men and women, youth and the aged. This is very severe in most rural communities where the national network has not reached them. In addition, lack of ownership of smart phone by women farmers has led to low usage and access to agricultural information using these devices. An officer said:

“Poor mobile network remains a major issue. Most of these platforms require internet connectivity. On the field, some of us don’t get access to the internet. On the field, we mostly have to work offline and come back to continue where we have proper internet connectivity. Secondly, low education. Most people in farming are not educated so they don’t understand what to do to be enrolled on digital platforms. That was our challenge with the yam farmers” (Interview with an officer, November 2023).

Use of other digital tools by men and women agriculture service providers in addition to PlantwisePlus digital tools at the regional level

Several digital tools have been used by agriculture service providers in both the Ashanti and Bono regions to deliver rural advisory services to farmers. These digital tools include radio, television, community information centers, digital billboards, documentaries, mobile phones, digital signposts, a kuafo marketplace, WhatsApp, SMS, Facebook, Skype, Interactive Voice Recording (IVR), and a mobile van.

The study revealed that, at the regional level, private sector actors such as Esoko and Farmerline platforms have played a key role in disseminating weather information and farm output prices to farmers. The radio programs are sponsored by Farm Radio International and are very popular among farmers, and agriculture extension agents, especially in Ejura. In the Ashanti region, to facilitate the dissemination of information among farmers, Jingles were developed in various languages including English, Twi, Hausa, Ga, and Ewe. These radio programmes benefit both men and female farmers in the farming communities.

An interview with the Ashanti Regional extension officer reported that in 2023, through these digital platforms, regional MOFA was able to reach all 430 extension officers and disseminate good agricultural practices to about 96,750 farmers. Though the regional MOFA is unable to disaggregate the farmers and officers reach into male and female farmers, significant portion of these are women farmers. In addition, as part of the efforts to promote access and usage to these digital advisory tools, the Ashanti Regional Department of Agriculture has also engaged in sensitization and training of farmers on these new digital tools and their application in agriculture. An officer said:

“A lot of sensitization and education has been going on in the region. We are not deploying just one digital tool to convey our messages to our dear farmers, but we use them interchangeably to enhance understanding and its usage among farmers. As I

said earlier, most of our farmers in rural areas have their favourite radio stations that they are glued to. Therefore, it is important not to sit on only one radio station but to move from one station to another to deploy information. We also have our WhatsApp platforms which include 43 districts, thus any information shared on this platform is also distributed to others in their various districts. We sometimes go to communities to have a live radio discussion where feeds are picked from there to the main stations. We also take our recordings to the interior to record some of the voices and their challenges to find solutions for them. If it is for research, we link up with the research institute, if it is for police, we try to let the Regional Coordinating Council (RCC) or whoever is in charge know about it. In the Ashanti region, we have 706 stations, the CSIR crop research institute, soil research institute, forestry research institute of Ghana, the universities as well, and all our demonstrations also have a signpost on them” (Interview with an officer, November 2023).

The aggressive and innovative approach adopted by the regions has produced several success stories from farmers in the Ashanti Region. An interview with a Regional Extension officer recounts how he used the WhatsApp video platform to educate a female farmer on pineapple production and she made a significant profit. He summarized the success story on this point:

“I had a female farmer at Krofa, where I introduced pineapple production techniques to her, and pineapple is not a native crop of the region. This female farmer heard of it and wanted to practice the same and maximize her income but here was the case I couldn’t go to her place. Most of the interactions were done on the WhatsApp platform as a digital tool to disseminate information. She could call me live and whatever information I have for her in case she is doing some applications; I will have a look at it and advise her whether it is wrong or right or whether she needs to add something or not. We use pictures to determine the state of the farm and suggest the type of agrochemicals to use. Even when she is mixing the chemicals, she sends a video, as well as a video of every stage of the growth of the pineapple. I can boldly say that the pineapple has been harvested and sold and the lady has made a lot of profit. I can share with you, her contact for her to testify that all these were done through WhatsApp” (An interview with Ashanti Regional Extension Officer, November 2023).

The challenges faced by service providers in access and use of digital tools.

At the regional level, challenges such as (i) high illiteracy among farmers (ii) language barrier making it difficult to use platforms that are in English to communicate with older farmers (iii) low network connectivity especially in rural areas (iv) high cost of data were reported by service providers interviewed as a major challenge affecting the usage of digital tools among men and women service providers at the regional level.

At the regional level, most extension officers, plant doctors, PPRSD officers, and agro-input dealers are literate and efficient in the usage of digital tools. Though both men and women officers are literate and conversant with digital tools, there is a need to further train them in how to efficiently operate these tools. However, high illiteracy among older farmers (both men and women) remains a challenge to the usage of digital tools. These regional level officers require further training in the use of these digital tools. A regional extension officer summarized his view on this point:

“The older farmers can only be reached through interpreters (third party) or by the use of Uliza which they can speak, and you can hear and can also reply” (An interview with Ashanti Regional Extension, November 2023).

“For the extension agents and farmers, we still have a little work to do. What I see for the digital tools for the extension agents is training. Most of them are conversant with them. For the PlantwisePlus and Akafo marketplace, some training needs to be done

before it can be used. Even for Uliza, how to get your message or feedback requires training otherwise, you won't be able to do that. For the farmers, if they were conversant with digital tools, I don't think the issue of marketing would be a problem" (Interview with Ashanti Regional Extension, November 2023).

Use of other digital tools by men and women agriculture service providers in addition to PlantwisePlus digital tools at the district level

The usage of digital tools accessed and used at district level are like those used at the regional level. At the district levels, the Agriculture Extension Agents (AEAs), district plant doctors, and agro-input dealers accessed information through (1) radio (Sompa FM, ark FM, and Nimde3 FM) (2) mobile phones, (3) television, (4) SMS, (5) WhatsApp, (6) YouTube videos, (7) Facebook videos, (8) Kobocollect tools, (9) Farmerline platforms, and (10) Esoko platforms.

The usage and access of these digital tools among district officers, plant doctors, and agro-input dealers are high. The district officers used these digital platforms to disseminate agriculture-related information to farmers. The study found that the use of radio, mobile phones, and WhatsApp are the most common digital tools used in most districts visited in Ashanti and Bono regions. These platforms can be easily used by both men and women district officers and do not contribute to inequalities among them. However, district extension officers need further training to significantly improve their knowledge and skills in using these digital tools more efficiently.

The use of Farmerline and Esoko services is common among farmers in most districts especially in Ejura. Farmers obtained information from these platforms on weather and climate-smart production practices through regular SMS. Similarly, farmers recount receiving calls from Farmerline 399 services regularly. Both men and women farmers benefited significantly through these platforms. An extension officer recounted how she used digital tools to deliver agriculture information to farmers.

"I use WhatsApp but, in the community, those that use digital tools are not many. With them, they can screenshot diseases and send them to me, so I work on it. For those who find it difficult to use digital tools, I call them often but sometimes if the issue is beyond me, I forward it to my office, and they will also forward it to the crop research for a solution. I also listen to the radio. They have stations like Sompa FM, Ark FM, and Nimde3 FM, they have agricultural programs" (Interview with an Extension Officer, Sunyani East, December 2023).

The training received by these district officers on the operations of digital tools is mixed. While plant doctors and some extension agents received training from CABI over the years on the usage of digital tools, agro-input dealers and other extension officers reported that they have not received any formal training in the operations of digital tools. A capacity-building program by the e-agriculture desk of MOFA is needed for these officers to enhance their knowledge in the usage of these digital tools especially for women extension agents.

Challenges of access and usage of other digital tools

Several challenges hinder the access and usage of digital tools at the district level. These include (1) High illiteracy especially among adult women farmers (2) Inadequate access to smartphones (especially among adult women farmers) (3) Language problems (most digital tools are in English) (4) Financial issues with the high cost of smartphones (5) Old men and women are mostly illiterate and cannot operate these digital tools effectively (6) High cost of Internet bundles/Internet bundle affordability problems (7) Availability of phone to farmers especially women farmers (8) Low participation of women in decision making especially in Muslim communities (9) Low access to mobile networks/no networks in rural areas (10) Lack

of electricity in rural/farming communities (11) Land tenure challenges affect more women than men (12) Lack of interest among adult/old farmers in digital tools (both men and women).

Among the challenges reported in various districts, low access to mobile networks/no networks in rural areas are a major challenge that hinders the usage of digital tools among farmers. Without access to reliable mobile networks, mobile phones cannot be used to access any digital information. These affect AEAs and all categories of farmers in rural areas especially women farmers.

In addition, the high cost of data, and poor electricity connection in farmers' communities were among the key challenges that hindered both male and female agriculture service providers at the district level. The extension officers, plant doctors, and input dealers at the district level expressed their frustration about the situation. An extension officer summarizes his views on this point:

“Our phone network services are not helping us. How to get a network to access certain information to give to farmers is a problem. Also in my operational area, there is a lack of electricity, to charge my devices like phones and tablets to be used frequently unless I travel to another community where there is electricity to do it. And also, data buying too is a problem and a challenge that we are encountering. Right now, things are not going well looking at the cost of transportation and other things, to get money to buy data although we could buy but not enough for us to buy more to do a lot of research to help our farmers. Therefore, data buying is a problem network is a problem and electricity is also a problem where I am at Sunsuso” (District Extension Officer, Ejisu, November 2023).

“The network problem is a major one. You have to find a stable connection and by that time, the farmer won't be available, so you have to find a suitable time for both of you to meet. Most of the farmers are illiterate so when you visit them and start talking about the internet, they think you are book long so mostly we have to use the local terms for them to understand you and the extension work will be successful” (Interview with Emmanuel, Assistant Extension Officer, November 2023).

Female farmers are not allowed to share their opinions in meetings. This is a major problem in Muslim-dominated communities. This partly hinders the dissemination of information on improved production practices to farmers. In some cases, old female farmers do not have access to mobile phones and if they do have phones, they often relied on their children to guide them to operate it. An officer said:

“Yes, there are some communities where they don't allow women to share their opinions. As an extension officer, it is sometimes a problem to stand in front of them and talk. They don't see why a woman should lead them. For example, in the Muslim communities, there are lots of restrictions. This makes the work difficult sometimes. There are circumstances where it becomes a challenge, trying to reach out to the women who don't have phones through their husbands. There may be some meetings that require the presence of female farmers, and the husbands can decide not to allow their wives to go. I remember with GROW-FOR-ME, we gave inputs to farmers, and they were expected to pay back with bags of maize. What we realized was that there was a farmer who came in anger because his wife was allowed to be part of the project without his consent as a man. So, he refused to lease the land to his wife. And that hindered the wife” (Interview with an officer, AEA, Ejisu, November 2023).

Unavailability of phones to farmers especially older women farmers

More males used phones than older women farmers in rural areas. They attributed this to financial challenges which affect women more compared to men. A smaller number of women

farmers own smartphones in most communities visited. Recent finding also showed that women are now seven per cent less likely than men to own a mobile phone (Chassin, 2022). During an interview with the district extension officer, he said:

“The males in my place use phones more than the females. There's one lady who has her husband's number in mind but when you need her number unless you call the husband, the issue is that the husband gets the phone and they were all using the husband's phone before, so she is not used to her number” (Interview with District Extension Office, Ejisu, November 2023).

Language problems prevent farmers from using digital tools.

High illiteracy level among women farmers compared to men. Most adult women farmers are not able to read and write and this affects their ability to use digital tools for their farming activities. Mohammed said:

“We have difficulty, especially with the language barriers. Some of the communities can't speak Twi at all. When you speak Twi the person won't understand, maybe the person might speak Dagomba which you also don't understand. Henceforth language is one of the disadvantages of the barriers” (Interview with an officer, AEA-EJURA, November 2023).

Use of other digital tools by men and women agriculture service providers in addition to PlantwisePlus digital tools at the community level

Farmers in the various communities visited have been using digital tools to obtain information from agriculture officers. These tools include mobile phones, television (Adom TV, Kantanka TV, and TV3), radio (Dormaa FM, Sompaa radio, radio BAR, Nsromma FM), WhatsApp, Facebook, and TikTok, information centers, mobile phones, videos (projector), SMS, farmer line services (399 services) (See Table 2). Mobile phones, radio, and television are the main digital tools used by farmers at community levels to access agriculture information.

Farmers make phone calls to AEA concerning various problems in their farms to seek redress. Farmers with smartphones also reported that they take pictures of diseased parts of crops and forward them to their officers. In addition, radio programs aimed at teaching farmers about good agricultural practices, pest and disease control, financial management and bookkeeping, and weather information.

These programs are mostly held in Dormaa FM, radio BAR, Nsromma FM, and Garden City Radio in Bono and Ashanti regions. Farmers also watch various agriculture programs on television (Adom TV, Kantanka TV, and TV3). Many farmers reported that they easily adopt and practice programs they watch on television compared to radio. According to these farmers, they can easily see and follow the processes and procedures they watch on television and replicate the same in their farms. During a focus group discussion with adult female farmers, they said:

“I used the mobile phone to call the Agric officer to seek advice concerning the rice I wanted to plant. When I burnt the field to prepare for the next growing season and get rid of pests and diseases, I called him and asked him if I was already done with the burning of the fields and if I should go ahead to plant the rice. He asked me whether it had rained, and I told him it hadn't. He then told me to let it rain before I started to plant the rice. He called me after a few days to ask if it rained, and I told him that it had rained, and he told me to grow the rice. He also made me aware that I should start spraying when I see that the rice is growing at some point or level” (Focus Group Discussion with Female Adult, Domar Gyaase, December 2023).

I use a mobile phone to call the extension officer when I have a problem with my cocoa farm. I remember I had an issue with my farm some time ago, I called the extension office with my phone to tell him about it and he told me he would bring a chemical that I would use to spray my farm to prevent the spread of pests and diseases. I also listen to radio stations on educational programs to help farmers. I watch television and get access to chemicals that can help my farm grow (Ejisu-Asosuanso–Female Adult, November 2023).

“My name is Nancy. The radio has helped us a lot in our agricultural work because we mostly listen to the agricultural programs and then we learn new things from it which has helped us in our agricultural work. With the television, some TV stations do show agricultural programs that we watch and practice in our work. There is much more understanding in watching the television than the radio because the television is much more practical which makes understanding easier. I listened to an agricultural program at Somp FM, and they were talking about the measurement and cutting of crops and how it should be done” (Youth Women Group, Gyaase, December 2023).

The challenges faced Farmers in accessing and using digital tools.

Despite the benefits of digital tools, several challenges hinder their widespread use among farmers in various communities. These challenges include; (1) Poor mobile network, (2) Lack of knowledge in using mobile phones/Inadequate knowledge in using Smartphones (3) No electricity (4) High cost of the bundle (5) High illiteracy (writing and reading) among farmers especially women (6) High cost of data (7) Language barriers (8) High price of data (9) Not having time and busy schedules among women farmers with house chores and farm activities (10) Lack of finance

Lack of knowledge in using mobile phone

There is a lack of knowledge in using smartphones among older farmers, especially women. Most adult farmers are not able to operate smartphones to access information on the internet. According to the participants of the focus group discussion, most adult farmers (Both men and women) own simple phones that can only allow them to make and receive calls. However, the use of smartphones is common among young (male and female) farmers. The participants of the focus group said this:

“We have little knowledge about how to operate mobile phones, we try our best to do what we can. Also, sometimes we make someone who understands the language to teach us or to explain to us” (FGD with adult men farmers, Gyaase, December 2023).

High Illiteracy and lack of mobile phones among adult female farmers affect access and usage of digital tools for farming activities. Though there is high illiteracy among farmers in various communities visited, however, the illiteracy rate among women adult farmers is higher compared to their male counterparts. This is a major challenge to the use of digital tools such as mobile phones and other digital platforms such as WhatsApp, Facebook, etc to access agricultural information. Mobile phones were also used to call radio programs where immediate feedback from listeners was needed. However, it was observed that the majority of those who had radio sets and mobile phones to listen to the radio programs were men and the youths; a few old women farmers had radio sets or mobile phones. This was reported by farmers during a focus group discussion at Ejisu-Asosuanso:

“I don't know how to read and write that is why I don't use the mobile phone because I cannot use it. But for the radio, since it doesn't need any reading and writing, I listen to it a lot. The agriculture officers also come to teach us how to use neem tree solutions to kill pests on our farms. Some of us do not have the money to buy a smartphone, or radio or even use it. Even with the phones we are using now, unless someone uses it to call another person for us, we cannot dial and call ourselves” (Focus group discussion with Female Adults in Ejisu-Asosuanso, November 2023).

“Most of the farmers don't have mobile phones due to financial issues, most of them too have but they can't use them because they are not educated, and most are illiterate. At times the farmer might have the phone because he/she is illiterate they can't go and search for information. I have a women farmer group and only five of the women have mobile phones. With regards to gender, the percentage of women who are illiterate is higher than that of the men in the district. Also, the young farmers (both male and female), most of them are educated as compared to the aged farmers because the old ones are only a few who are educated, most are illiterate” (Interview with an officer, AEA Ejura, November 2023).

Busy schedule with caregiving and non-productive activities by adult women farmers

Not having time and busy schedules among women farmers due to household chores and farm activities was reported as a major challenge to the usage of digital tools. This prevents them from listening to radio programs on agriculture and even operating their phones. The usage of mobile phones was mainly for making and receiving calls rather than seeking information for farming activities. A participant in the focus group discussion said this:

“Technology came in the time of the youth. We have a lot of things we think about as old women. We don't even have the time to use the phones. My daughters still use their phones while they are cooking. As an old woman, you don't have the time for that, and you will use the phone throughout the entire day. But for them, they are always on the phone, learning new things but for you, it is only for making and receiving calls. But as you have said now, we are going to try our best to learn to use the phones. As you said, it is good. You have taught us to include these tools in our farming because it will help us. We will strive for our children to teach us” (FGD with adult female farmers in Ejura, November 2023).

High cost of internet data bundles

High-cost data was reported by farmers as a challenge preventing them from using mobile phones to access information on the internet. This affects both male and female farmers. Farmers in various communities complain of a lack of finance to purchase internet bundles to operate their phones.

“The price of the data bundle is one of the barriers and, we do not have a sufficient number of agricultural officers. Also not having a smartphone is a barrier” (Focus group discussion with young male farmers in Nkrankrom, December 2023).

Lack of training among farmers about digital tools

While much training was done at national and regional levels for agricultural service providers, the same was not observed in the communities visited. Most farmers do not have formal training in digital tools and their operations. A young male focus group discussant said this:

“To be very honest, none of us have had any orientation or training. The thing is, when we encounter any problem and we inform the extension officers, they don't respond to us in the next immediate days. So, our help comes from ourselves and our shared experiences. So, over here in Ejura, when you raise subjects of digital tools, we don't have any knowledge about them. They haven't given any training it is just recently that FARMERLINE has started calling and training us so it is just this year that they have started training the farmers. Almost 90% of farmers can't use their phones to visit Google or use the CABI platforms” (Focus group discussion with young male farmers in Ejura, November 2023).

Lack of electricity in rural communities

Lack of electricity in some farming communities serves as a barrier to the usage of digital tools. Most rural communities visited do not have access to electricity. Farmers in these communities are connected to the national grid and are not able to use these digital tools

efficiently. This affect both male and female farmers. For instance, communities in Gyase near Nkrankrom lack a consistent supply of electricity and this affects the usage of mobile phones and even radio.

“When we had no light in this town, we had a strong network but when we had light connected in this town the network is no more stable here. Hence if we want to make a call, we have to move from here to another town to be able to call or have access to the internet” (Focus group discussion with adult Men farmers at Gyaase, December 2023).

Major Findings

- The main other digital tools used by regional agriculture service providers include phone calls, WhatsApp platforms, radio (Garden City Radio), and ESOKO platforms. SMS, mobile phones, audio-visual vans, and videos.
- At district levels, the main digital tools used include radio, mobile phones, television, SMS, WhatsApp, YouTube videos, Facebook videos, Kobo collect tools, farmer line platforms, and Esoko platforms.
- Mobile phones, radio, and television are the main digital tools used by farmers to access agricultural information.
- High awareness and usage of digital tools among regional and district agriculture officers and agro-input dealers. However, usage levels among farmers are very low.
- Several digital tools in extension delivery space are available but they are used by farmers to access different kinds of information with no training support.
- High illiteracy and poor internet infrastructure especially among rural dwellers (weak network connection) continue to be a major challenge for all stakeholders.
- Access to mobile phones among adult women farmers is low compared to their male counterparts. Coupled with high illiteracy among adult female farmers, these challenges limit access and usage of digital tools among farmers in various rural communities.

The category of men and women farmers who directly access digital advisory services.

In examining the status of access and use of digital tools by men and women farmers in Ghana, it is crucial to delve into the specific dynamics of their engagement with digital advisory services. The assessment reveals similar and distinct patterns in the categories of men and women farmers who directly access these services, providing insights into the reach and effectiveness of digital tools in different segments of the agricultural community.

Table 6: The summary of the status of access and use of digital tools by men and women farmers in Ghana.

Category of Farmer Groups/Community	Digital Tools Used by Farmers	Challenges hindering access and usage of Digital Tools
BONO REGION		
DORMA GYAASE Female Adults	Radios and Mobile phones, whatsapp.	1. Network Challenges 2. Lack of knowledge in using mobile phone 3. High Illiteracy among adult women farmers
Dorma Gyaase Youth Women	Mobile phones, radios, and television (Adom TV and TV3)	1. Inadequate knowledge in using Smart phones 2. Bad network in the community 3. No electricity 4. High cost of bundle

Category of Farmer Groups/Community	Digital Tools Used by Farmers	Challenges hindering access and usage of Digital Tools
Dormaa Gyaase Male Adult	Radio (Dormaa Fm, Nsromma Fm), Mobile phones, television	<ul style="list-style-type: none"> • Network issues • High Illiteracy High cost of data
Dormaa West, Gyaase Male Youth	Radio (Nsoroma radio), mobile phones	<ul style="list-style-type: none"> • Networks problems • Language barriers • Inadequate finance
Sunyani East, Nkrankrom - Male Adult	Radio (Radio BAR), mobile phone	<ol style="list-style-type: none"> 1. Lack of education, 2. Poor mobile network in farming communities
Sunyani East, Nkrankrom – Young Male	Radio, mobile phones, WhatsApp, Facebook, and TikTok to learn about farming.	<ol style="list-style-type: none"> 1. Poor connection for data networks, 2. Language challenges, 3. High price of data
Sunyani East, Nkrankrom - Female Adult	Mobile phones, radio, information centres.	<ol style="list-style-type: none"> 1. Inadequate time, and busy schedules of older women due to house chores and farm activities 2. Poor network connectivity 3. The data finish early and its expensive. 4. High illiteracy among older women farmers
ASHANTI REGION		
Ejisu Male Youth	Radio, mobile phones.	<ol style="list-style-type: none"> 1. Lack of finance 2. No access to mobile network. 3. No electricity in communities 4. High Illiteracy among farmers
Ejisu-Asosuanso Male Adult	Mobile phones and radio	<ol style="list-style-type: none"> 1. High Illiteracy/not able to operate the digital tools such as mobile phones. 2. No electricity in communities' hinder usage of digital tools
Ejisu-Asosuanso– Female Adult	Mobile phone, radio, and television	<ol style="list-style-type: none"> 1. High illiteracy, 2. Poor Road network and 3. No electricity in rural areas
Ejura–Young Female	Mobile phones, radio, television	<ol style="list-style-type: none"> 1. Busy schedule with house chores and farm activities 2. High illiteracy rate among young female farmers 3. Bad network for services
Ejura - Female Adult	Mobile phones, radio	<ol style="list-style-type: none"> 1. High illiteracy rate 2. Not able to read and write
Ejura - Male Adult	Videos (projector), radio, SMS, farmerline services	<ul style="list-style-type: none"> • Languages challenges (illiteracy)
Ejura – Young Male	Mobile phones, farmerline services (399 services), radio, WhatsApp, videos	<ul style="list-style-type: none"> • High Illiteracy rate among famers

Source: Community Focus Group Discussion, 2023

From the table above there are similar digital tools that are accessible to both women and men farmers from the focus group discussions in respective of whether they are adults or young. These consist of the following in the table below;

Radio and Television (TV) Platforms	Particularly in places with low literacy rates, audio-based advice services such as radio broadcasts and audio-visual services such as TV can be quite effective. Language obstacles can be solved using local voice and visual-based services.
Mobile Phones	In rural locations, feature mobile phones are often easier to reach than smartphones. Most of these farmers can make calls to reach out to extension officers or their colleague farmers for assistance in their agricultural activities. On the other hand, farmers with smartphones can communicate and share visuals such as images and videos of their agricultural activities via social media platforms such as WhatsApp, Facebook, and TikTok among others.
Community Information Center	Other digital tools have been utilized mostly by adult women this includes Community Information Center. Access to important agricultural information is frequently facilitated by the community information center. For women who work in agriculture, these center's can be a convenient and trustworthy way to get information on market prices, weather forecasts, agricultural techniques, and crop management. This is because women spend most of their time at home and listen to the information center when it disseminates information to the local community.
Interactive Voice Response (IVR) Systems	IVR systems make information accessible to those with weak literacy and digital skills by enabling farmers to retrieve and create SMS services that efficiently reach farmers with simple voice commands.
Information Van Videos (Projector)	Mobile extension services can be provided via information vans that are outfitted with projectors and movies. They can visit various farming areas and present instructive films on crop management, pest control, current farming methods, and other pertinent subjects. This assists in providing farmers in remote places with important information.

Nevertheless, in many communities, women farmers are not able to access the information van. This is because they frequently balance a variety of duties, such as caring for others and doing housework. Women's time is limited by the time restraints that come with these duties.

Meanwhile, due to their limited access to formal education, which can lead to poorer levels of computer literacy, women in the communities also struggle to adjust to the IVR system.

5.3 The drivers and barriers to women farmers' access to digital advisory services

The study furthermore examined the drivers and barriers to women's access to digital advisory tools. Identifying and analysing these factors shed light on the challenges and opportunities that influence women farmers' utilization of digital tools. By assessing the drivers, such as technological literacy, socioeconomic factors, and the perceived benefits of digital advisory services, we gain a comprehensive understanding of the motivators that encourage women farmers to embrace digital solutions.

The implementation of digital agriculture technologies has the potential to create more inclusive, environmentally sustainable, and productive agri-food systems, which will help to achieve the Sustainable Development Goals. The swift uptake of mobile phones and other digital devices in most African nations has expedited the implementation of agricultural

services for farmers and other stakeholders in the value chain, culminating in improved accessibility to data, expertise, financial services, marketplaces, and farming equipment (Mabaya and Porciello, 2022).

On the other hand, diverse factors impact the availability of digital advising services for female farmers. To effectively build methods to increase the involvement of female farmers using digital tools, it is imperative to comprehend these characteristics.

5.3.1 The barriers to women farmers' access to digital advisory services

Digital Illiteracy

From the discussions that were held with the women, most of the women cannot either read or write therefore navigating through the phone becomes a hurdle to overcome. This is a result of no formal education or low formal education among them. This has rendered the women illiterate in their respective communities. Whether young or adult, are expressing difficulties with their literacy and education levels when it comes to utilizing mobile phones. Females, both young and old, point to illiteracy as a major deterrent to using mobile phones. This includes difficulties with writing, reading, and comprehending communication. On the other hand, adult females admit to depending on others to use their phones for specific tasks, including placing calls. They rely on other people to make phone calls for them. A female adult expressed her challenge in this way:

"I don't know how to read and write that is why I don't use the mobile phone because I cannot use it. (Focus Group Discussion, Ejisu-Asosuanso – Female Adult, November 2023)"

Another female adult had this to say:

"Even with the phones we are using now, unless someone uses them to call another person for us, we cannot dial and call ourselves (Focus Group Discussion, Ejisu-Asosuanso – Female Adult, November 2023)."

These narratives above, show that a prevalent problem among adult and adolescent ladies is their inadequate proficiency with phone usage. Beyond just making calls, many also describe issues with typing and using smartphones. One young woman also said:

"I am not educated henceforth I'm not able to use a smartphone and I don't have any knowledge about using it. Another problem we also face is the issue of typing. Since most of us are illiterate we find it difficult to type (Focus Group Discussion, Gyaase – Young Female, December 2023)"

The lack of formal education for adult and young females is proven to be a crucial factor impacting their capacity to use mobile phones efficiently. This lack of education contributes to the incapacity to use the devices' functionalities appropriately as some participants indicated as follows:

"The thing is we are illiterate so even if they send us a message, we won't see it (Focus Group Discussion, Ejisu-Asosuanso – Young Female, November 2023)."

"The reason why we can't use them fully is that most of us did not go to school. So, if we were able to go to school, we could do everything on the phone. There are some of us who even if we want to call someone unless they give their phones to someone to look for the number before we want to call (Focus Group Discussion, Ejura - Female Adult, November 2023)."

All these quotes reveal high illiteracy rate among adults and young females and their inability to use mobile phones efficiently. Studies have shown that one of the most important measures of a nation's standard of living is its literacy rate (Aggarwal *et al.*, 2022). According to Mapiye *et al* (2023), considerable potential exists for enhancing farmers' productivity and livelihoods through the efficient use of Information Communication Technologies (ICT) to increase accessibility to relevant agricultural information and services.

However, women farmers may find it more difficult to access and use digital platforms efficiently if they have low levels of digital literacy. The ability to effectively use information and communications technology (ICT) and engage with digital information ecosystems is referred to as digital literacy (Machin-Mastromatteo, 2021). From the findings, a greater number of women, both adults and young female farmers mentioned digital illiteracy as a hindrance during the focus group discussions.

These insights from the focus group discussions demonstrate the connections between reading, education, and the usage of mobile phones by adults and young females. Implementing educational campaigns, training programs, or technology solutions that are user-friendly and intended for individuals such as women farmers (both young and adult) with poor reading levels could be one strategy to overcome these challenges.

Cultural and Social Constraints

Women's independence and autonomy may be restricted by societal norms. Sometimes constraints placed by communities or family members prevent women from obtaining and using digital technologies. For example, young and adult females drew attention to cultural conventions that can limit their access to information, such as the idea that ladies should not listen to the radio at someone else's house as explained by a female participant in a quote below:

"We are females, and you can't go and sit in someone's house to listen to the radio. (Focus Group Discussion, Ejisu-Asosuano – Female Adult, November 2023)."

Also, one of the obstacles to obtaining information is time constraints. In rural areas, social duties like household chores or activities such as cooking, cleaning, washing, and taking care of children among others also add to the time limitations. A lack of time to interact with traditional media, such as radio or television, is expressed by a female in the quote below:

"Busy schedules are the barriers preventing me from using digital advisory tools to help myself. Please I don't have time to listen to the radio or watch Television. (Focus Group Discussion, Ejura – Young Female, November 2023)"

Additionally, young women farmers stated that agricultural extension organizations assist their husbands' or elder family members' farming endeavours rather than those of the young female farmers. This could have an impact on the drive or necessity for young female farmers to independently look for agricultural information as expressed in the quote below:

"As for my area when they come it is the old age people they meet and not us the youth. But I have seen some before it was my father who attended that training on farming and told me about it when he returned. (Focus Group Discussion, Ejura – Young Female, 30th November 2023)"

Furthermore, safety issues such as snake bites about taking radio sets to farms were brought up. This is because the sound from the radio sets attracts snakes which poses a great danger to the women. Even though it would have been a good opportunity for women to listen to some agricultural information while on the farm because of their busy schedules at home. This highlights the real difficulties that women encounter when trying to obtain agricultural information. A female adult expressed her concern in this way:

“We the women can take radio sets to our farms because when we do that, we end up putting ourselves in danger because the sounds from the radio attract the call of snakes. (Focus Group Discussion, Sunyani East, Nkrankrom - Female Adult, December 2023).”

The narratives highlight the many obstacles that women encounter while trying to obtain information. Their information access environment is difficult due to social norms, time restrictions, limited agency in farming decisions, and safety considerations. Targeted interventions, like community-based information sharing, flexible scheduling for educational programs, and taking safety concerns into account when farming techniques are implemented, may be necessary to address these difficulties.

Language and content relevance

Engagement with digital advisory services may be hampered by a lack of content in local languages and relevance to the unique context of women farmers using digital technologies. During the focus group discussions, the women mentioned several difficulties with language and content relevance. The findings show that when it comes to using digital tools to communicate with agricultural extension agents or utilizing digital technologies, language presents a substantial barrier for female participants, regardless of age. English is challenging to understand both when spoken and written, making it tough to follow directions, send messages, or get information as one participant indicated in this way:

“I do not understand the English language, so it sometimes becomes difficult to understand when using these digital tools. (Focus Group Discussion, Dormaa West, Gyaase - Female Adult, December 2023)”

The study findings show that the language barrier and the problem of illiteracy are linked. Females, whether young or old, emphasize that not being literate in English makes it more difficult for them to understand communications and make efficient use of digital technologies. The quotes below buttress this point:

“Sometimes, I call them, but I do not hear what they say and some of them also speak English, and I don’t understand. (Focus Group Discussion, Ejisu-Asosuano – Female Adult, November 2023).”

“The messages they send to us are also a barrier due to the language of the message because some of us are illiterates. (Focus Group Discussion, Ejura – Young Female, November 2023)”

More adult females are turning to non-verbal means of communication to get past language difficulties, like displaying actual images of crop problems. It would seem from this that nonverbal or visual communication is preferred as indicated by a female adult participant:

“The English language is a barrier for us. We may not be able to send a message or even a picture because we don’t understand the language. We walk all the way to show them pictures of the problems with our crops. The language hinders us (Focus Group Discussion, Ejura - Female Adult, November 2023)”

The findings show that both young and adult females find it extremely difficult to obtain information and make use of digital tools due to the language barrier, especially when it comes to English. Developing technologies that accommodate people with different levels of literacy and language skills, offering translation services, or putting language-appropriate communication practices into practice are some possible solutions to this problem.

Infrastructure Challenges

The young and adult female farmers in various places mentioned poor network coverage as a major challenge. This has an impact on their capacity to communicate, send images, and retrieve information from mobile phones. Their communication with agricultural officers and other parts of their agricultural activity is impacted by the absence of a dependable network as indicated in the quote below:

“The network service is very poor and makes it difficult to send pictures of the farm and other kinds of messages to the agricultural officer. (Focus Group Discussion, Dormaa West, Gyaase - Female Adult, 5th December 2023).”

The young female farmers also mentioned difficulties they were having finding the equipment they needed for farming and training. The introduction of a moisture thermometer draws attention to the fact that agriculture requires specialized tools, and it is problematic when those tools are lacking. Furthermore, a major difficulty is the absence of reliable access to energy. It is difficult for both young and adult female farmers to charge their phones and other devices, which affects how well they use technology as mentioned by a young female below:

“Also using a mobile phone here is difficult because we don’t have electricity to charge the phone and usage of the mobile phone is difficult due to poor network service (Focus Group Discussion, Ejisu-Asosuaso – Young Female, 28th November 2023).”

The findings draw attention to a variety of intricate issues about technology infrastructure, such as network performance, scarcity of necessary instruments, and irregular power supply. Resolving these issues might necessitate expanding tool accessibility, upgrading the technological infrastructure, and finding ways for the communities under discussion to have a consistent source of electricity.

Financial exclusion

The focus group discussions show that access to and usage of technology, particularly radios and cell phones, is severely hampered by budgetary limitations. For younger and older women, money becomes a major obstacle that keeps them from purchasing and utilizing smartphones. For a lot of people in these communities, the price of getting a smartphone and associated costs like data become prohibitive.

Also, the inability to listen to radio broadcasts is attributed to limited access to radios. The absence of a rudimentary means of communication implies challenges in acquiring essential tools for receiving information as expressed in the quotes below.

“Most of us don’t have a radio so we don’t listen to the radio (Focus Group Discussion, Sunyani East, Nkrankrom - Female Adult, December 2023).”

We do not have most of the radio in our homes which is why we do not listen to it (Focus Group Discussion, Ejisu-Asosuaso – Female Adult, November 2023).

Additionally, it appears that young female farmers prefer text-based communication over phone conversations, maybe because of financial concerns. This emphasizes how crucial it is to take communication preferences into account when creating treatments or disseminating information as seen in the quote below:

“Sometimes when you call, you might not reach the person. But if you send it, it will be faster than using the phone calls. So, smartphones are good and if you don’t have money to buy, then you have problems (Focus Group Discussion, Sunyani East, Nkrankrom – Young Female, 4th December 2023).”

The findings show that financial limitations are a major problem that limits people in these areas' ability to acquire and utilize technology for communication and information access. To overcome these obstacles, efforts to lower the cost and increase accessibility of technology may be put in place. Examples of these activities include community programs, subsidies, and partnerships with companies that offer technology solutions to marginalized communities.

5.3.2 The drivers to women farmers' access to digital advisory services

Increased Connectivity and Improved Infrastructure

The women who participated in the focus groups disclosed that having more access to mobile phones and the internet improves connection, which gives women farmers access to digital advising services.

The importance of mobile phones in agricultural operations is emphasized by female farmers, especially when it comes to handling financial transactions and customer interactions. Receiving payments straight to mobile phones is seen to be a useful and effective approach to managing transactions and taking care of urgent financial demands. One woman said this:

“If we get phones, it will help us. As we are here, we are all farmers and marketers. On Mondays, your clients can ask you to send them the products and they will send you the money. If you don't have a phone and you direct your client to send it on someone's phone, maybe you would need money urgently for something. Because for us as farmers, it is the same money we use for the farm that we use for the market as well. If we get the phones, it will help us. You can receive your money on your phone and use it as you desire. We would be glad if we get this help (Focus Group Discussion, Ejura - Female Adult, November 2023).”

Furthermore, female farmers indicated that their communities needed better mobile network services. They think that improved connectivity will make it possible to communicate with agricultural officers more effectively, which will promote the expansion of the agriculture industry. This demonstrates how infrastructure aids in the development of agriculture.

“If the government can help us get service in most of our communities, it will help us to get more in touch with the Agric- officers which will help facilitate the growth of our farms and the agricultural sectors at large. (Focus Group Discussion, Dormaa West, Gyaase - Female Adult, December 2023)”

Moreover, agricultural tools were requested by female farmers. This shows that they need assistance with tools and resources to improve their farming methods. It is believed that having access to tools is essential to making agricultural tasks easier.

“The agriculture officers should make available tools that will help us in farming. (Focus Group Discussion, Ejura – Young Female, November 2023).”

To sum up, the discussions highlight the role that mobile phones play in agricultural operations, the need for better connectivity, and the demand for access to the tools that farmers require. With an emphasis on the contribution of infrastructure and technology to the improvement of agricultural productivity and financial transactions, these insights can guide policy and intervention measures meant to assist female farmers in these communities.

Information Empowerment

According to the women, through the use of digital tools, female farmers are empowered and have access to vital agricultural data, enabling them to make informed decisions on crop management and farming techniques.

According to some of the female farmers, the ability to operate a smartphone is not only dependent on formal education. They give instances of people who have finished secondary school but have trouble using their phones, contrasting this with younger people who are less educated but can use their phones well. This calls into question the notion that digital literacy and higher education are inextricably linked.

“Even with the phone issue, it is not about going to school or not going at all. I know people who went to school, but it is very difficult for them to even call someone on their contact list or send a text message. My mother didn’t go to school, but she can call someone on her own. So, for me, using the phones is not about going to school or not. Many people completed the secondary school level, but they can’t use the phones. Even the little ones in class 2 can use the phones very well and even teach you how to do some things but they have not reached anywhere far on the academic ladder. My child in class 4 taught me some basic stuff when I got my phone. So, for me, it is not about going to school or not. As it was said earlier, some people study the numbers, and they check the numbers well before they call. (Focus Group Discussion, Ejura - Female Adult, November 2023)”

Additionally, the female farmers' individual learning and desire comments imply that drive and personal interest are important factors in developing digital literacy abilities. People can overcome educational barriers if they demonstrate a desire to use smartphones and to learn.

“I didn’t even go to nursery, but I can call anyone I want to call on my phone. It is a desire I have and I use it always. If you write your number for me, even after 10 years, I can look for your number and call you. But I didn’t step foot in a class. (Focus Group Discussion, Ejura - Female Adult, 30th November 2023).”

Furthermore, the female farmers argue in the quote below that government-led focused training programs could be an effective way to reduce the digital literacy gaps. It is believed that training community members in person is a more successful strategy than depending on outside educators.

“The government should train people for some time and send them out there to teach those who are illiterate about using smartphones. With that, I think it will help (Focus Group Discussion, Gyaasi – Young Female, December 2023).”

The discussions provide a complex viewpoint on how formal education and digital literacy relate to one another. Along with highlighting the value of personal drive, the females propose that locally driven training programs would be a better way to close the digital divide.

Financial Inclusion

The women believe that financial inclusion facilitated by digital technologies, such as mobile banking and payment platforms, helps women farmers handle their money more effectively.

“As we are a group, the government can help us financially so that even if you don’t have the money, you can use some to buy a phone for your work and pay later. So, if there’s going to be any help from the government to enhance the use of digital tools, it should be in terms of money (Focus Group Discussion, Ejura - Female Adult, November 2023).”

The women suggested that the government should offer financial support to enable them to afford cell phones or other digital tools. The objective of this strategy is to mitigate the financial obstacle that could impede individuals from independently obtaining these technologies. One of the suggestions is a deferred payment option, which lets people use the products right away and pay for them later.

Tailored Content

The women farmers from the focus group discussions require digital consulting services that offer tailored and culturally aware material that can better connect with female farmers and meet their unique needs and difficulties. These focus group discussion narratives offer insightful information about the influence of radio and television shows, particularly when it comes to agricultural education. Below are some salient points from the quotes. It is emphasized that the radio is an essential information source, especially for those who might not be literate. It is an accessible medium for sharing agricultural knowledge because it does not involve reading or writing.

“But for the radio, since it doesn’t need any reading and writing, I listen to it a lot. (Focus Group Discussion, Ejisu-Asosuanso – Female Adult, November 2023)”

Also, there are TV and radio show programs which is known as "Farmers Time". These programs provide agricultural information about crops, types of insecticides to use, and solving problems farmers encounter with pests. This demonstrates how radio and TV may help by offering helpful guidance on agricultural techniques.

“There is this radio station that has a program called Farmers Time (Akuafuor mer3), they educate on the crops and types of medicines for spraying each crop because they said sometimes there are certain pests that normally affect the farms of many people in the country. (Focus Group Discussion, Ejura – Young Female, November 2023).”

In addition, some of the women related stories of how they used the guidance they heard on the radio or saw on TV to address actual issues on their farms. This real-world application of knowledge demonstrates the concrete influence of agricultural information broadcast on radio and TV.

“XTV station has an agricultural program on Saturdays, and they speak in the Dagomba language which is a local dialect that I do understand (Focus Group Discussion, Ejura – Young Female, November 2023).”

In one story, the effective use of Nim tree extracts for pest management in maize cultivation is mentioned. This reflects the doable fixes provided by radio shows and the successful results farmers who follow their recommendations get.

“We grow maize and one day we tuned our radio to Nyhira FM where they were giving information on how to use Nim tree extracts to kill the pest that destroys the maize crops on the farmland. After hearing it we tried it and it worked, so through the radio we were able to find a solution to the problem (Focus Group Discussion, Ejisu-Asosuanso – Young Female, November 2023)”

It is also acknowledged that the radio helped spread knowledge about cocoa cultivation practices, such as the right ways to dry and brood cocoa seeds. The rectification of a previously utilized technique (plantain leaves and mosquito nets) highlights the radio's importance in spreading new and improved practices.

“The radio helped me to know how to brood and dry the cocoa seeds very well and how to make them look neat I also got to know that they do buy them and export them the European countries to sell them. I used to ferment the cocoa bod with mosquito nets but through the radio, I was taught that using mosquito nets and plantain leaves is not the right way to ferment the cocoa bod but the use of sacks (Focus Group Discussion, Ejisu-Asosuanso – Young Female, November 2023).”

On the other hand, the fact that an agriculture show on XTV was mentioned in Dagomba emphasizes how crucial language is to communication. Programs with regional accents are valued for their capacity to accommodate the audience's linguistic preferences.

“XTV station has an agricultural program on Saturdays, and they speak in the Dagomba language which is a local dialect that I do understand (Focus Group Discussion, Ejura – Young Female, November 2023)”

Moreover, female farmers advocated for agricultural initiatives to be provided in a language that women could understand such as speaking Twi or another local language instead of English. This underscores the significance of linguistic accessibility in facilitating successful communication in their agricultural activities.

“For me the best way I would understand it simply is that they should change the English language to the language I understand whether Twi or any other local language. With that it would be simpler for me to understand and use it. (Focus Group Discussion, Gyaasi – Young Female, December 2023)”

Together, these discussions highlight how important radio and television are for disseminating agricultural knowledge, offering workable answers to real-world farming problems, and utilizing local languages to improve accessibility and comprehension among the intended audience.

Community Networks

Encouragement of involvement and group membership through incentives and support for farmer associations and groups is crucial in rural areas. (Abdulai *et al.*, 2023). By using these platforms, female farmers indicated that it would help them collaborate and connect to create a friendly community that promotes knowledge exchange and group learning.

The discussions derived from the focus group talks shed light on significant issues including education, financial responsibility, youth development, community support, and the function of information centre. Firstly, the importance of women helping one another by honestly addressing issues and asking for assistance is emphasized. The goal is to establish a network of support where women may help one another continuously via honesty.

“I think as women, we shouldn’t be shy to inform our friends when we have problems and seek their help as well. And when we get helped, we should be honest as well so that we can keep helping ourselves. I think we can do this to help ourselves as women (Focus Group Discussion, Ejura - Female Adult, November 2023).”

Emphasizing the importance of individual accountability and self-determination is the second discussion. Here a woman who has never attended college, emphasizes the value of education and self-motivation in gaining new abilities, such autonomous contact management.

“One thing too is that, if you have the desire to learn something, you must be taught how to do it. Because it is your work. Whatever possible way you can use to learn, you must learn. For me, I didn’t also go to school, but there is no name on my contact list that I don’t know. After they store the name, I study the number very well so, I don’t need anyone to bring it up for me in the future. The thing is mine, I must force myself to learn how to do it. There is no need to make yourself an illiterate (Focus Group Discussion, Ejura - Female Adult, November 2023).”

The third narrative discusses how crucial financial integrity is to the community. While it is recommended to borrow money for necessities, it is stressed that being truthful and repaying debts on time are key to preserving goodwill and avoiding monetary difficulties.

“In terms of money, you can go to a colleague and borrow GH¢10 to buy credit if you don’t have money at that time. When you get the money then you pay back. That is why I said there should be honesty among us. There are people that as soon as you give it to them, they take it as a gift and decide not to pay it back. It is the lack of

honesty that has made us suffer in most cases as Africans (Focus Group Discussion, Ejura - Female Adult, November 2023)."

The fourth narrative makes the case that for young people to actively contribute to community development, they must receive thorough training. The idea is to help people who might not have access to formal education by using the knowledge that has been acquired.

"I also think that they should train the youth well so that they can also use the knowledge they have gotten to help the people in this town, especially the uneducated people (Focus Group Discussion, Gyaasi – Young Female, December 2023)."

The importance of information centre is emphasized in the fifth narrative, particularly about agricultural guidance. Agricultural officers should be consulted before applying pesticides, as suggested; this emphasizes the importance of specialists in guaranteeing appropriate farm management.

"It is the information centre we listen to most at times, the information centre always says that when you find out that pest and disease are worrying your farm, call the agricultural officer to come and check before using medicine to spray it (Focus Group Discussion, Ejisu-Asosuano – Female Adult, November 2023)."

In conclusion, these narratives, taken as a whole, exhibit a community-centric perspective that emphasizes cooperation, accountability, integrity, and the value of education and training for the collective benefit of both individuals and the community. It emphasizes how intertwined the community is when people focus on helping one other and making the most of resources, whether that be through financial support or information exchange.

6. Conclusion

In conclusion, the study highlights significant gender disparities in access and utilization of digital tools, particularly the PlantwisePlus digital tools, at different levels of agricultural governance in Ghana. While there is relatively high adoption of digital tools among extension service leadership at the national level, challenges persist at the community level, particularly for women farmers.

The findings emphasize the need for a gender-sensitive approach in the design and implementation of digital tools. Addressing smartphone constraints, promoting digital literacy, and tailoring applications to the specific needs of both men and women farmers are crucial steps to bridge the existing gender gap in access and use of these technologies. Moreover, the study underscores the importance of raising awareness at the community level, particularly among women, to promote the advantages of smart mobile phones for enhancing access to extension and advisory services.

The age and literacy divide, with younger and more literate individuals being more receptive to digital tools, suggests the importance of targeted capacity-building efforts. Special attention should be given to female farmers, ensuring they have the skills and knowledge to leverage digital tools effectively. Additionally, the study underscores the potential role of women-led information network platforms and the integration of financial support mechanisms, such as Village Savings and Loans schemes, to facilitate women's access to smartphones and internet data.

In summary, the recommendations drawn from the study offer practical strategies to enhance the inclusivity of digital tools in Ghana's agricultural sector, promoting gender-responsive extension and advisory services and ultimately contributing to the overall development of the agricultural value chains. Addressing these challenges at the community level is crucial to ensuring that the benefits of digital tools reach all farmers, irrespective of gender, age, or socioeconomic status.

7. Limitations and Challenges

The research team encountered some limitations and challenges during the fieldwork and the research work.

The ethical application process and approval delayed the field work, the data collection process, and the research cycle in general. To reduce the impact of the delay, expedited ethics application process was requested. In addition, the research teamwork had to deliver without compromising the quality of the research. Some participants proved challenging initially but with time they understood the study and were relaxed and provided additional information for the study. However, there were instances where some respondents refused to be interviewed on the grounds of being tired of researchers and their interviews. Even though the respondents were not forced to participate, the researcher tried to explain to such respondents the nature and importance of the research.

The researcher faced some technical difficulties with the recording equipment, especially during interviews. For instance, the digital voice recorder failed to record one interview. The researcher relied on the field notes. Also, some of the recordings were not very clear due to the noisy nature of the study area. This made transcription difficult. The researcher had to listen to the interviews repeatedly before the information was accurately transcribed.

Interviews in the ministries and some organisations who collaborate or work with the producers were difficult. It was difficult getting respondents at their workplaces for interviews at any time the researcher visited, they were either in a meeting or had gone out for official assignment. This was difficult as it involved a lot of driving to interview participants. Some officials also requested for the interview guide but misplaced them and made excuses. Several visits were made to follow up on the officials and to provide them with new interview guide.

Some officials were moved to other departments and were not available during the follow-up visits this delayed the process as the researcher had to start most of the processes again. However, in the end with persistent efforts, the researcher was able to interview them. Regardless of the problems encountered during the fieldwork, it is worth mentioning that due diligence was taken to ensure that quality was not compromised.

Ethical Considerations

The researcher strictly adhered to the ethics of research by seeking ethical clearance from the Ethics Committee of the CSIR-Institutional Review Board – Council for Scientific and Industrial Research (CSIR). The researcher assured participants of the confidentiality and anonymity of their responses. Besides, the researcher did not compel or lure participants to participate in the study, as consent was sought voluntarily. Their participation in the study will not in any way present any harm to them as the protocols of this study are subject to an institutional ethical review board of the CSIR. The researcher also declared her background and purpose of the study to clear any conflict of interest.

8. Recommendations

The study recommends the following to ensure that more extension agents and farmers use the PlantwisePlus digital tools:

- 1) Development of new apps or improvement on the existing apps that can be used offline and that are tailored to the specific needs of women and men to improve access to gender-responsive extension and advisory services.

- 2) Targeted or intentional Capacity building and training of AEAs and agro-input dealers at the district levels on access and use of PlantwisePlus digital tools with a special focus on females. This will also help reach out to more women farmers, help them manage their farms independently, and close the gender gap.
- 3) Use women-led information network platforms designed to link women farmers groups to extension and advisory services delivery to reach out to more farmers at the community level and link-up with other digital agro-innovation hubs to reach out to more women.
- 4) Financial Support - Women farmers will be inclined towards digital tools with substantial support in terms of training and financial assistance to acquire smart mobiles phones and internet data– For instance the use of Village Savings and Loans scheme for women groups.
- 5) CABI and other stakeholders implementing educational campaigns, training programs, or technology solutions that are user-friendly and intended for individuals such as women farmers (both young and adult) with poor reading levels could be one strategy to overcome these challenges.
- 6) Targeted interventions, like community-based information sharing, flexible scheduling for educational programs, and taking safety concerns into account when farming techniques are implemented, may be necessary to address some of the socio-cultural challenges.
- 7) Developing technologies that accommodate people with different levels of literacy and language skills, offering translation services, or putting language-appropriate communication practices into practice are some possible solutions to extreme difficulties in obtaining information and making use of digital tools due to the language barrier, especially when it comes to English.
- 8) To overcome financial limitations that limit people's ability to acquire and utilize technology for communication and information access. Efforts to lower the cost and increase accessibility of technology may be put in place. Examples of these activities include community programs, subsidies, and partnerships with companies that offer technology solutions to marginalized communities.

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10. Annexes

10.1 Ethical Clearance Documents



COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH HEAD OFFICE

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Our Ref: **CSIR/IRB/AL/23/VOL 1-025**

Date: **5th December 2023**

ETHICAL CLEARANCE

RPN022/CSIR-IRB/2023

The Council for Scientific and Industrial Research (CSIR) Institutional Review Board (IRB) has reviewed and approved your protocol.

**TITLE OF PROTOCOL: GENDER AND DIGITAL ADVISORY SERVICES ASSESSMENT
IN GHANA**

PRINCIPAL INVESTIGATOR: DR. AKUFFOBEA-ESSILFIE MAVIS

CO-PRINCIPAL INVESTIGATORS: DR. VICTOR ATTUQUAYE CLOTTEY

**SPONSOR: CENTRE FOR AGRICULTURE AND BIOSCIENCE INTERNATIONAL
(CABI)**

Please note that a final review report must be submitted to the Board at the completion of the study. Your research records may be audited at any time during or after the implementation.

Any modification of this research project must be submitted to the IRB for review and approval prior to implementation.

Please report all serious adverse events related to this study to CSIR-IRB within seven days verbally and fourteen days in writing.

This certificate is valid till **4TH DECEMBER, 2024**.

**Mr. Okyere Boateng
(CSIR-IRB, Chairman)**

Cc: Director General, CSIR



**COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH
CSIR-IRB CONSENT FORM TEMPLATE**

Key Informant Interviews

Title: Gender and digital advisory services assessment in Ghana

Principal Investigator: Dr. Mavis Akuffobe-Essilfie

Address: Council for Scientific and Industrial Research-Science and Technology Policy Research Institute, P. O. Box CT 519 Cantonments, Accra, Ghana.

General Information about Research:

You are invited to participate in the study titled "Gender and digital advisory services assessment in Ghana" sponsored by the Centre for Agriculture and Bioscience International (CABI) and conducted in Ghana. An integral part of our study aims at bridging the gender gap in accessing and using digital tools for agriculture in Ghana.

Your participation in the study is voluntary but you are encouraged to participate to help achieve the study objectives. If you are willing to participate then Researchers and Research Assistants from CSIR-STEPRI will conduct key informant interview with you. The duration for the interview will be approximately 1 hour. The location for the interview will be chosen according to your preferences. You will be asked various questions to assess the gender and digital agriculture extension and advisory services in Ghana. To ensure that most details of the interview are captured, the Researchers will seek your permission to record the interviews, which will be later transcribed.

Possible Risks and Discomforts

There are no anticipated risks to your participation. When you are uncomfortable when responding to any question, you should feel free to communicate this to your interviewer and may ask to skip the question.

Possible Benefits

The information collected through this interview will contribute significantly to our collective understanding and inform future efforts to make digital tools more accessible and beneficial to farmers in Ghana.

We will communicate our findings back to you and your community as well as to national and international policy makers so that all farmers can benefit from this study. To this end, we will follow the United Nations' Educational, Scientific and Cultural Organization "Recommendation on science and scientific researchers"

Confidentiality

Any information obtained from you in this study will remain confidential and will be available only to researchers who have completed necessary training on how to manage and analyze personal data. When the results of the study are presented, all information will be anonymized to avoid revealing your identity.

Compensation

You will receive a token GHS200 as compensation for taken time off your economic activities to participate in the study.

Voluntary Participation and Right to Leave the Research

Your participation is voluntary, and you are respectfully encouraged to participate because your answer is fundamental to achieving the study objectives and making a meaningful contribution. You are free to ask to skip the question or withdraw from the study without any consequences to you or your family. You can withdraw consent at any time.

**CSIR - IRB
APPROVED CONSENT FORM**

Date.....30/11/23.....



**COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH
CSIR-IRB CONSENT FORM TEMPLATE**

Focus Group Discussion Guide:

Title: Gender and digital advisory services assessment in Ghana

Principal Investigator: Dr. Mavis Akuffobe-Essilfie

Address: Council for Scientific and Industrial Research-Science and Technology Policy Research Institute, P. O. Box CT 519 Cantonments, Accra, Ghana.

General Information about Research:

You are invited to participate in the study titled "Gender and digital advisory services assessment in Ghana" sponsored by the Centre for Agriculture and Bioscience International (CABI) and conducted in Ghana. An integral part of our study aims at bridging the gender gap in accessing and using digital tools for agriculture in Ghana.

Your participation in the study is voluntary but you are encouraged to participate to help achieve the study objectives. If you are willing to participate then Researchers and Research Assistants from CSIR-STEPRI will conduct focus group discussion with you and about 10 other stakeholders of the same sex. All of you (about 10 people) will be interviewed together by 2 or 3 Researchers from CSIR-STEPRI. The discussions will be moderated by one of the Researchers and the duration will be approximately 1 hour. The location for the focus group discussion will be chosen according to your preferences. You will be asked various questions to assess the gender and digital agriculture extension and advisory services in Ghana. To ensure that most details of the interview are captured, the Researchers will seek your permission to record the interviews, which will be later transcribed.

Possible Risks and Discomforts

There are no anticipated risks to your participation. When you are uncomfortable when responding to any question, you should feel free to communicate this to your interviewer and may ask to skip the question.

Possible Benefits

The information collected through this Focus Group Discussion will contribute significantly to our collective understanding and inform future efforts to make digital tools more accessible and beneficial to farmers in Ghana.

We will communicate our findings back to you and your community as well as to national and international policy makers so that all farmers can benefit from this study. To this end, we will follow the United Nations' Educational, Scientific and Cultural Organization "Recommendation on science and scientific researchers"

Confidentiality

Any information obtained from you in this study will remain confidential and will be available only to researchers who have completed the necessary training on how to manage and analyze personal data. When the results of the study are presented, all information will be anonymized to avoid revealing your identity.

Compensation

You will receive a token of GHS 50.00 as compensation for taking time off your economic activities to participate in the study.

**CSIR - IRB
APPROVED CONSENT FORM**

Date.....30/11/23.....
10/1



**COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH
CSIR-IRB CONSENT FORM TEMPLATE**

In-depth Interviews with Extension agents, plant doctors, and agro-dealers working in CABI program sites (at regional and district levels):

Title: Gender and digital advisory services assessment in Ghana

Principal Investigator: Dr. Mavis Akuffobe-Essilfie

Address: Council for Scientific and Industrial Research-Science and Technology Policy Research Institute, P. O. Box CT 519 Cantonments, Accra, Ghana.

General Information about Research:

You are invited to participate in the study titled "Gender and digital advisory services assessment in Ghana" sponsored by the Centre for Agriculture and Bioscience International (CABI) and conducted in Ghana. An integral part of our study aims at bridging the gender gap in accessing and using digital tools for agriculture in Ghana.

Your participation in the study is voluntary but you are encouraged to participate to help achieve the study objectives. If you are willing to participate then Researchers and Research Assistants from CSIR-STEPRI will conduct an in-depth Interview with you. The duration for the interview will be approximately 1 hour. The location for the interview will be chosen according to your preferences. You will be asked various questions to assess the gender and digital agriculture extension and advisory services in Ghana. To ensure that most details of the interview are captured, the Researchers will seek your permission to record the interviews, which will be later transcribed.

Possible Risks and Discomforts

There are no anticipated risks to your participation. When you are uncomfortable when responding to any question, you should feel free to communicate this to your interviewer and may ask to skip the question.

Possible Benefits

The information collected through this interview will contribute significantly to our collective understanding and inform future efforts to make digital tools more accessible and beneficial to farmers in Ghana.

We will communicate our findings back to you and your community as well as to national and international policymakers so that all farmers can benefit from this study. To this end, we will follow the United Nations' Educational, Scientific and Cultural Organization "Recommendation on Science and scientific researchers"

Confidentiality

Any information obtained from you in this study will remain confidential and will be available only to researchers who have completed the necessary training on how to manage and analyze personal data. When the results of the study are presented, all information will be anonymized to avoid revealing your identity.

Compensation

You will receive a token of GHS 50.00 as compensation for taking time off your economic activities to participate in the study.

Voluntary Participation and Right to Leave the Research

10.2 Field Instruments

GENDER AND DIGITAL ADVISORY SERVICES ASSESSMENT IN GHANA

Focus Group Discussion with Men and women farmers living in CABI program areas and program areas of other organizations promoting digital tools

Introduction

An integral part of our study aims at bridging the gender gap in accessing and using digital tools for agriculture in Ghana. We value your presence as we explore the practical experiences, challenges, and insights of men and women farmers in utilizing digital advisory tools.

Our study seeks to understand how digital tools impact the lives of farmers and how these tools can better align with the needs of both genders. We are particularly interested in your experiences using these tools, the obstacles you've encountered, and the factors that have facilitated or hindered your access and use of digital resources.

In total, we will conduct 16 Focus Group Discussions, including separate sessions for both women and men farmers in each district. Your perspectives and feedback will play a crucial role in identifying opportunities to enhance the utility of digital tools in agriculture.

We genuinely appreciate your participation in these discussions, as your voices will contribute significantly to our collective understanding and inform future efforts to make digital tools more accessible and beneficial to farmers in Ghana.

Profile of Group

Date

Region..... District..... Community..... Group Name

.....

Total Number No. Females No. Males

Age range.....

Name of Leader Tel

Discussion Points

Section A: Practice using digital advisory tools among farmers:

11. How do farmers in your community currently engage with digital advisory tools for agriculture, and what types of tools are most commonly used?
12. Could you provide examples of successful adoption and utilization of digital advisory tools by farmers? What specific benefits have they experienced?
13. Are there specific agricultural practices or challenges where digital advisory tools have proven to be particularly effective, and can you share these instances?
14. How do farmers receive training or guidance on effectively using these digital advisory tools, and what role do agricultural extension services play in this process?
15. Can you describe any innovative or unique ways in which farmers have integrated digital advisory tools into their daily farming routines to improve their practices?
16. How do digital tools contribute to women's/men's decision-making processes in farming, such as crop selection, pest management, or market access?
17. In your opinion which digital advisory tools can serve women/men farmers better in the community as related to your agricultural practices? Mention any government-initiated programmes offering similar services to smallholder farmers in the community that you know?
18. Mention any NGO-initiated programmes offering similar services to smallholder farmers in the community that you know?
19. SECTION B: Barriers and facilitators for access and use of digital tools
20. What are the primary barriers that farmers encounter when accessing and using digital advisory tools for agriculture, such as issues related to technology, connectivity, or digital literacy?
21. Have there been notable initiatives to address these barriers and make digital tools more accessible to a wider range of farmers, particularly those in remote or underserved areas?

22. How do you assess the role of affordability and cost as barriers to accessing and using digital advisory tools, and what strategies are in place to mitigate these challenges?
23. Are there any cultural or language-related barriers that hinder the adoption of digital tools among farmers in your community, and how are these addressed?
24. Are there any age or gender related challenges?
25. Can you share examples of successful facilitators or strategies that have increased the use of digital tools among farmers, such as awareness campaigns, community-based training, or partnerships with local organizations?
26. How do agricultural extension services collaborate with farmers to understand their specific needs and preferences in using digital tools, and how are these insights integrated into tool development?
27. Are there any emerging technologies or trends that are expected to further facilitate the use of digital advisory tools among farmers, and how is your community preparing for these changes?
28. How do you measure the impact and effectiveness of digital advisory tools in terms of improving farming practices and outcomes, and what key performance indicators are used?
29. Can you provide insights into how the barriers and facilitators differ for specific subgroups of farmers, such as smallholders, women farmers, youth or those engaged in specific agricultural sectors?
30. In what ways do you ensure data privacy and security for farmers using digital tools, and how do you address concerns related to the sharing of personal information?
31. What are your recommendations or suggestions for making digital tools more user-friendly and accessible better align with agricultural practices for both male and female farmers in your community?

GENDER AND DIGITAL ADVISORY SERVICES ASSESSMENT IN GHANA
In-depth Interviews with Extension agents, plant doctors, and agro-dealers working in CABI program sites (at regional and district levels).

Introduction

Our study is dedicated to comprehending the gender gap in accessing and using digital tools for agriculture in Ghana, with a particular focus on PlantwisePlus and other digital resources. Our research is guided by several key objectives, including exploring the practices of agriculture service providers in utilizing these digital tools, identifying barriers they face, understanding how information from these tools is integrated into their advisory work, and assessing how well the tools align with the information needs of women farmers.

In line with this, we engage in insightful conversations with extension agents, plant doctors, and agrodealers who operate within the CABI program sites at regional and district levels. In each of the four selected districts, we will conduct interviews with both men and women agriculture service providers. These interviews will help us gain a comprehensive understanding of the experiences, challenges, and successes in using digital tools for agriculture.

We greatly appreciate your participation, as your contributions will be instrumental in shaping the outcomes of this study and in ultimately facilitating more equitable access and use of digital tools in agriculture.

Profile of Interviewee

Date

Region..... District..... Community.....

Name

Sex.....Age.....

Position.....

Tel

Discussion points:

SECTION A: Practice in using PlantwisePlus and other digital tools for agriculture:

1. Could you share your experiences with using PlantwisePlus and other digital tools for agriculture? What specific features or functions have you found most useful in your work?
2. Are there any notable success stories or case studies that demonstrate the impact of using digital tools, like PlantwisePlus, on agricultural practices and outcomes?
3. What training and capacity-building programs are in place to support agriculture service providers in effectively using these digital tools?
4. How do you ensure that agriculture service providers are kept up-to-date with the latest advancements and updates in digital tools for agriculture?
5. What are some best practices in integrating digital tools into agricultural extension services, and how have they improved the services you provide?
6. How do digital tools support your decision-making processes in activities such as pest diagnosis, crop recommendations, or product selection?
7. In what ways do you ensure data privacy and security for farmers using digital tools, and how do you address concerns related to the sharing of personal information?

SECTION B: Barriers to access and use of digital tools for agriculture:

6. What are the primary barriers that you have encountered when it comes to accessing and using digital tools for agriculture in your region?
7. How do issues like internet connectivity, device availability, and affordability affect the adoption of digital tools among farmers and service providers?
8. Are there any cultural or language-related barriers that hinder the widespread use of digital tools in your area? Are there gender/age related barriers?
9. What strategies have been implemented to overcome these barriers and promote more inclusive access to digital agricultural tools?
10. Can you share insights into the challenges faced by women agriculture service providers and farmers in accessing and using digital tools, and how these challenges are being addressed?

SECTION C: Use of information from digital tools to advise farmers:

11. How do you collect and utilize information from digital tools, such as weather forecasts, pest and disease alerts, or market data, to provide better advice to farmers?
12. Are there any data analytics or decision-support features within the digital tools that enhance your ability to offer tailored recommendations to farmers?

13. Could you share examples of instances where data from digital tools has directly led to improved farming practices or increased yields among the farmers you serve?

14. What methods are in place to ensure that the information derived from digital tools is accurately interpreted and effectively communicated to farmers, considering potential language or literacy barriers?

15. How do you measure the impact and effectiveness of the advice given to farmers based on information sourced from digital tools, and what key performance indicators are used?

SECTION D: Information needs of women farmers and the extent to which available digital tools respond to these needs:

16. What are the specific information needs and challenges faced by young or old farmers in your area, and how do these differ from those of male farmers?

17. Are there age differences in the specific information needs? Young/old.

18. In what ways do the available digital tools address the unique information needs of women farmers in terms of age, and where are there gaps in this support?

19. Have there been any targeted or customised initiatives or features within digital tools designed to empower and cater to the needs of women (young/old) farmers?

20. Can you share success stories or examples where women farmers have benefited from using digital tools to access tailored information and advice?

21. How do you collaborate with women farmers and women agriculture service providers to gather feedback and insights that can inform the development and improvement of digital tools to better meet their specific needs?

22. What are your recommendations or suggestions for making digital tools more user-friendly and accessible for professionals in terms of gender and age in your field?

GENDER AND DIGITAL ADVISORY SERVICES ASSESSMENT IN GHANA

Key Informant Interview

Private Agriculture Service Providers

Introduction

This study focuses on CABI's PlantwisePlus program, which aims to promote climate-smart agriculture through digital advisory tools. The importance of gender-sensitive approaches to

foster inclusivity and address the barriers faced by women is critical in this initiative. By building upon previous research, the study aims to explore gender-related obstacles experienced by agriculture service providers and farmers when accessing and utilizing digital tools. The ultimate goal is to develop strategies that ensure equitable access and utilization of these tools, thus contributing to more inclusive and efficient agricultural practices.

Our study is guided by a set of key research questions. In our pursuit to address these critical questions, we recognize the significance of engaging key informants like you, who possess valuable insights and expertise. We will explore aspects such as the number and types of digital advisory tools available in Ghana, how these tools are promoted, and the existing barriers to access and use.

We are grateful for the cooperation of our key informant interviewees, who include representatives from national and organisational agriculture extension departments, plant protection agencies, ICT wings, as well as experts from private sector organizations and non-governmental organizations actively promoting digital tools for agriculture. Moreover, we will review assessment and evaluation reports to further enrich our understanding.

Profile of Organisation

Date

Region..... District..... Community.....

Name of Organisation.....

Name of Respondent

Sex.....Age.....

.....

Position.....

Tel

Discussion points:

1. What is the current inventory of digital advisory tools available in your organisation, and can you provide a breakdown of the types and categories of these tools, such as mobile apps, web platforms, or SMS-based services?
2. Could you share specific examples of digital advisory tools being used in your organisation, highlighting their features and functionalities?
3. How does the availability and diversity of digital advisory tools in your organisation compare to previous years? Have there been any notable additions or advancements in this field?
4. Are there any notable partnerships or collaborations between governmental, non-governmental organizations, and private sector entities in your organisation to develop and provide these digital advisory tools to extension agents and farmers?
5. What is the reach and coverage of these digital advisory tools? How many extension agents and farmers have access to them, and in which areas of Ghana are they most widely used?
6. What efforts have been made to target underrepresented populations?
7. Could you provide information on the key features or content of these digital advisory tools, and how they address the specific needs and challenges faced by farmers and extension agents in Ghana?
8. Are there different digital advisory tools tailored to the specific needs of various agricultural sectors, such as crop farming, livestock, fisheries, or agribusiness, in Ghana?
9. What strategies and channels are employed to promote and popularize these digital advisory tools among extension agents and farmers in Ghana? Are there training programs or awareness campaigns in place?
10. How are extension agents and farmers educated about the benefits and usage of these tools? Are there any user guides, workshops, or community engagement activities to facilitate their adoption?
11. Are there any successful case studies or user testimonials that highlight the positive impact of these digital advisory tools on farming practices and outcomes in Ghana?
12. Are there gender/age related barriers? How is your organization addressing these issues to ensure wider adoption?

13. Can you provide insights into the level of digital literacy by sex and age among extension agents and farmers in Ghana, and how it affects the effective utilization of these tools?
14. What are the ongoing research and development efforts to enhance and expand the functionality of existing digital advisory tools or to create new tools that can better serve the agricultural community in Ghana?
15. How do you plan to continually monitor and evaluate the effectiveness and relevance of these digital advisory tools to meet the evolving needs of Ghana's farming and extension communities?
16. How do you ensure data security and privacy while using digital tools in agriculture in your services?
17. Are there any regulatory or policy considerations that affect your use of digital tools in agriculture services, and how can these be improved?
18. What is your vision for the future of digital agriculture services in your operational area, and how do you see your role evolving in this context?
19. Do you have any recommendations for technology developers or providers to improve digital tools for agriculture service providers based on your experiences?
20. Please, are there any question or comments from you concerning this study?

GENDER AND DIGITAL ADVISORY SERVICES ASSESSMENT IN GHANA

Key Informant Interview

Directorate of Agriculture Extension Services, Plant Protection and ICT wing in MoFA- National level

Introduction

This study focuses on CABI's PlantwisePlus program, which aims to promote climate-smart agriculture through digital advisory tools. The importance of gender-sensitive approaches to foster inclusivity and address the barriers faced by women is critical in this initiative. By

building upon previous research, the study aims to explore gender-related obstacles experienced by agriculture service providers and farmers when accessing and utilizing digital tools. The ultimate goal is to develop strategies that ensure equitable access and utilization of these tools, thus contributing to more inclusive and efficient agricultural practices.

Our study is guided by a set of key research questions. In our pursuit to address these critical questions, we recognize the significance of engaging key informants like you, who possess valuable insights and expertise. We will explore aspects such as the number and types of digital advisory tools available in Ghana, how these tools are promoted, and the existing barriers to access and use.

We are grateful for the cooperation of our key informant interviewees, who include representatives from national and regional agriculture extension departments, plant protection agencies, ICT wings, as well as experts from private sector organizations and non-governmental organizations actively promoting digital tools for agriculture. Moreover, we will review assessment and evaluation reports to further enrich our understanding.

Profile of participants

Date

Region..... District..... Community.....

Name of Organisation.....

Name of Respondent

Age.....Sex.....

Position.....

Tel

Discussion points:

1. What is the current inventory of digital advisory tools available in Ghana, and can you provide a breakdown of the types and categories of these tools, such as mobile apps, web platforms, or SMS-based services?
2. Could you share specific examples of digital advisory tools being used in Ghana, highlighting their features and functionalities?
3. How does the availability and diversity of digital advisory tools in Ghana compare to previous years? Have there been any notable additions or advancements in this field?
4. Are there any notable partnerships or collaborations between governmental, nongovernmental organizations, and private sector entities in Ghana to develop and provide these digital advisory tools to extension agents and farmers?
5. What is the reach and coverage of these digital advisory tools? How many extension agents and farmers have access to them, and in which regions or areas of Ghana are they most widely used?
6. What efforts have been made to increase access to underserved farmers women/youth
7. Could you provide information on the key features or content of these digital advisory tools, and how they address the specific needs and challenges faced by farmers and extension agents in Ghana?
8. Are there different digital advisory tools tailored to the specific needs of various agricultural sectors, such as crop farming, livestock, fisheries, or agribusiness, in Ghana?
9. What strategies and channels are employed to promote and popularize these digital advisory tools among extension agents and farmers in Ghana? Are there training programs or awareness campaigns in place?
10. How are extension agents and farmers educated about the benefits and usage of these tools? Are there any user guides, workshops, or community engagement activities to facilitate their adoption?
11. Are there any successful case studies or user testimonials that highlight the positive impact of these digital advisory tools on farming practices and outcomes in Ghana?
12. What are the gender and age related challenges or barriers encountered in promoting these tools, and how is your organization addressing these issues to ensure wider adoption?

13. Can you provide insights into the level of digital literacy in terms of age and gender among extension agents and farmers in Ghana, and how it affects the effective utilization of these tools?
14. What are the ongoing research and development efforts to enhance and expand the functionality of existing digital advisory tools or to create new tools that can better serve the agricultural community in Ghana?
15. How do you plan to continually monitor and evaluate the effectiveness and relevance of these digital advisory tools to meet the evolving needs of Ghana's farming and extension communities?
16. How do you ensure data security and privacy while using digital tools in agriculture in your services?
17. Are there any regulatory or policy considerations that affect your use of digital tools in agriculture services, and how can these be improved?
18. What is your vision for the future of digital agriculture services in your operational area, and how do you see your role evolving in this context?
19. Do you have any recommendations for technology developers or providers to improve digital tools for agriculture service providers based on your experiences?
- 20.
21. Please, are there any question or comments from you concerning this study?

GENDER AND DIGITAL ADVISORY SERVICES ASSESSMENT IN GHANA

Key Informant Interview

Regional Agriculture Extension Directorate and plant protection departments

Introduction

This study focuses on CABI's PlantwisePlus program, which aims to promote climate-smart agriculture through digital advisory tools. The importance of gender-sensitive approaches to foster inclusivity and address the barriers faced by women is critical in this initiative. By building upon previous research, the study aims to explore gender-related obstacles experienced by agriculture service providers and farmers when accessing and utilizing digital tools. The ultimate goal is to develop strategies that ensure equitable access and utilization of these tools, thus contributing to more inclusive and efficient agricultural practices.

Our study is guided by a set of key research questions. In our pursuit to address these critical questions, we recognize the significance of engaging key informants like you, who possess valuable insights and expertise. We will explore aspects such as the number and types of digital advisory tools available in Ghana, how these tools are promoted, and the existing barriers to access and use.

We are grateful for the cooperation of our key informant interviewees, who include representatives from national and regional agriculture extension departments, plant protection agencies, ICT wings, as well as experts from private sector organizations and non-governmental organizations actively promoting digital tools for agriculture. Moreover, we will review assessment and evaluation reports to further enrich our understanding.

Profile of participants

Date

Region..... District..... Community.....

Name of Organisation.....

Name of Respondent

Age.....

Sex.....

Position.....

Tel

Discussion points:

1. What is the current inventory of digital advisory tools available in your region, and can you provide a breakdown of the types and categories of these tools, such as mobile apps, web platforms, or SMS-based services?
2. Could you share specific examples of digital advisory tools being used in your region, highlighting their features and functionalities?
3. How does the availability and diversity of digital advisory tools in your region compare to previous years? Have there been any notable additions or advancements in this field?
4. Are there any notable partnerships or collaborations between governmental, non-governmental organizations, and private sector entities in your region to develop and provide these digital advisory tools to extension agents and farmers?
5. What is the reach and coverage of these digital advisory tools? How many extension agents and farmers have access to them, and in which areas of your region are they most widely used?
6. What efforts are made to improve access for underserved populations (women, youth etc)?
7. Could you provide information on the key features or content of these digital advisory tools, and how they address the specific needs and challenges faced by farmers and extension agents in your region?
8. Are there different digital advisory tools tailored to the specific needs of various agricultural sectors, such as crop farming, livestock, fisheries, or agribusiness, in your region?
9. What strategies and channels are employed to promote and popularize these digital advisory tools among extension agents and farmers in Ghana? Are there training programs or awareness campaigns in place?
10. How are extension agents and farmers educated about the benefits and usage of these tools? Are there any user guides, workshops, or community engagement activities to facilitate their adoption?
11. Are there any successful case studies or user testimonials that highlight the positive impact of these digital advisory tools on farming practices and outcomes in your region?
12. What are the specific gender or age related barriers in promoting these tools, and how is your organization addressing these issues to ensure wider adoption?

13. Can you provide insights into the level of digital literacy in terms of age and sex among extension agents and farmers in Ghana, and how it affects the effective utilization of these tools?
14. What are the ongoing research and development efforts to enhance and expand the functionality of existing digital advisory tools or to create new tools that can better serve the agricultural community in your region?
15. How do you plan to continually monitor and evaluate the effectiveness and relevance of these digital advisory tools to meet the evolving needs of Ghana's farming and extension communities?
16. How do you ensure data security and privacy while using digital tools in agriculture in your services?
17. Are there any regulatory or policy considerations that affect your use of digital tools in agriculture services, and how can these be improved?
18. What is your vision for the future of digital agriculture services in your operational area, and how do you see your role evolving in this context?
19. Do you have any recommendations for technology developers or providers to improve digital tools for agriculture service providers based on your experiences?
20. Please, are there any question or comments from you concerning this study?

10.3 Photos from the field work- <https://photos.app.goo.gl/wCkiBJTMwNzs6NWF9>

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