CLIMATE INFORMATION AND KENYA'S WOMEN SMALLHOLDER FARMERS: A NEEDS ASSESSMENT

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Sauti.

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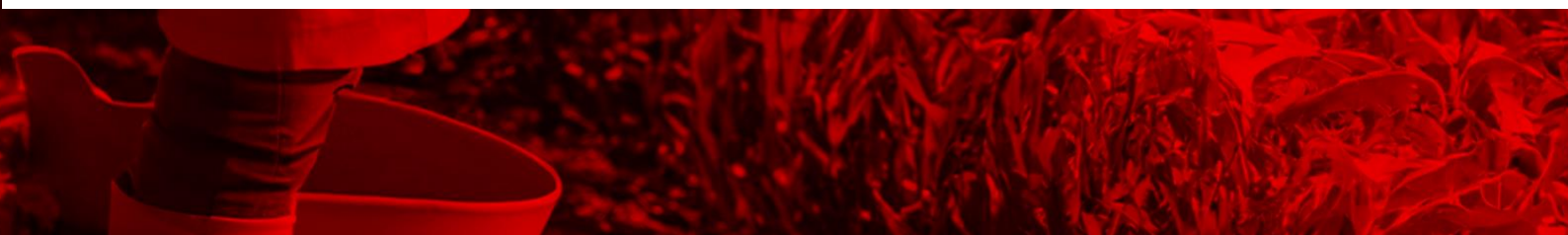

EXECUTIVE SUMMARY

Climate change poses significant challenges for development programmes that target gender inequalities in areas of agricultural productivity, farm incomes, and food security. Considering that four out of five women in developing countries report agriculture as their primary economic activity, the consequential effects of increasing climate volatility is likely to have a disproportionate impact on women.

One proposed solution strategy to mitigate the impact of climate change volatility is to improve the planning and decision-making process of farmers by supplying ICT-enabled weather and climate information resources. Meaningfully implementing these ICT-based solutions for women farmers in developing countries, however, requires solution designers to pay careful attention to the gender dynamics of information accessibility, digital literacy, and capacity.

This report assesses the climate-related information needs of Kenya's women smallholder farmers with the objective to inform meaningfully relevant and accessible information solutions in the region. The primary target sample was women small-scale farmers in Kenya who were identified from Sauti East Africa's agriculture and climate information platform. Data was collected with three data collection tools (sample size in brackets):

- USSD Mobile Survey (~ 177 women small-scale farmers)
- IDI Telephone Survey (~ 40 women small-scale farmers)
- KII Telephone Survey (~ 8 agricultural professionals and experts)

The findings of this assessment indicate a significant demand among respondents for information and guidance on various climate-related themes essential for both long-term planning and immediate farming decisions. Smallholder farmers emphasized the profound impact of climate and weather information on their decision-making processes in farm planning and execution. However, the study identified a disparity between the climate adaptation information and services available and what smallholder women farmers currently access. A notable portion of respondents highlighted the lack of crucial information on farming techniques, technologies, and weather and early warning systems among smallholder women farmers.

The report finally concludes with five practicable recommendations that can guide solution designers in making strategic decisions in the effective delivery of climate information services:

- Increasing Smallholder Farmers' Capacity and Awareness of Climate Information
- Enhancing the Relevance and Quality of Climate Information
- Simplifying and Tailoring Climate Information to Women Farmer's Needs
- Increasing Smallholder Women Farmers' Access to Agricultural Extension and Advisory Services
- Complementing Traditional Weather and Climate Information Channels with ICT-based Digital Information

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LIST OF ACRONYMS

ASAL	Arid and Semi-arid Lands
ATDC	Agricultural Technology Development Centers
FAO	Food and Agriculture Organization
ICT	Information and Communications Technology
ICCASA	Inclusive Climate Change Adaptation for a Sustainable Africa
ICIPE	International Centre of Insect Physiology and Ecology
IDI	In-depth Interviews
IKI	Die Internationale Klimaschutzinitiative
KALRO	Kenya Agricultural and Livestock Research Organization
KII	Key Informant Interviews
MSME	Micro, Small and Medium Enterprises
PELUM	Participatory Ecological Land Use Management
UNDP	United Nations Development Programme
USSD	Unstructured Supplementary Service Data

1. INTRODUCTION

Climate change poses significant challenges for development programmes that target gender inequalities in areas of agricultural productivity, farm incomes, and food security (UNDP 2017, Ofori et al. 2021). Considering that four out of five women in developing countries report agriculture as their primary economic activity (Doss 2011), the consequential effects of increasing climate volatility is likely to have a disproportionate impact on women.

One proposed solution strategy to mitigate the impact of climate change volatility is to improve the planning and decision-making process of farmers by supplying ICT-enabled accessible, reliable, and relevant weather and climate information (Abiodun 2022; Born 2021; Hansen et al. 2019 & Chandni et al. 2018). Meaningfully implementing these ICT-based solutions for women farmers in developing countries, however, requires solution designers to pay careful attention to the gender dynamics of information accessibility, digital literacy, and capacity.

In Kenya, agriculture is a key contributor to the country's economic growth, accounting for 21.2% of the country's gross domestic product (World Bank 2022). Most of Kenya's agricultural production, however, occurs on arid and semi-arid lands where more than 7 million farmers do not reliably receive rainfall to sustain year-round crop production (Kalele et al. 2021, Adimo n.d.). Moreover, the overwhelming majority of Kenya's agricultural activity is conducted without additional irrigation technologies and relies on rainfed (98%) irrigation. With smallholder farmers dependent on the climate for their livelihoods, the agricultural geography of Kenya is vulnerable to abnormal changes in rainfall and temperature, and increasingly extreme climatic events like droughts and floods (Bryan et al. 2013; Makong 2021 & Ratner 2022).

Information and Communication Technology (ICT) can play a pivotal role in mitigation and adaptation of climate change challenges. Integrating ICT tools into farming activities can improve efficiency and effectiveness in climate change mitigation and adaptation efforts by smallholder farmers (Ayim et al. 2022). ICTs also play an important role in promoting climate smart agriculture, as they can facilitate access to information, which reduces smallholder women farmer's exposure to short-term risks, while building capacity to adapt to and be resilient in the face of shocks and longer-term stresses (CCARDESA 2020).

Research in Kenya's agricultural value chains finds that women-led MSMEs are likely to have different information requirements and information accessibility dynamics compared to men (Sauti Trade Insights 2023; Hadley and Aoko 2022; Hadley et al. 2018; Hadley and Lipoweicka 2017). In particular, the gender digital divide, which describes the gendered inequities in digital literacy and technology adoption, is a significant barrier to providing women farmers with timely climate information (Partey et al. 2020). Pathways to resilience that include the adoption of agricultural climate information, therefore need to consider women farmers' preferred information channels and gender-specific needs.

Towards this consideration, this report presents an assessment of the information environment of smallholder women farmers to inform the digital solutions for ideal impact. The intended audience for this report is similarly minded solution designers and development program practitioners who are implementing or planning new agricultural initiatives that seek to improve smallholder farmers' information for climate-smart decisions. Findings are structured to steer program implementation of technological development that can effectively shape smallholder women farmers' effective use of climate information for climate-resilient farm operations.

2. OBJECTIVES

The objective of this report is to assess smallholder women farmers' information requirements in Kenya, including identifying the ways in which climate-related information is most useful to them and the information channels that are best suited to their needs. Five counties in Kenya across Western and Rift Valley regions which are part of the main food basket region in Kenya are selected for this study owing to their major contribution to agricultural production in the country. The counties include Homabay, Trans Nzoia, Uasin Gishu, Nakuru, and Vihiga.

This report is part of a series, which includes a stakeholder mapping and a baseline report, conducted by Sauti in fulfillment of an assignment for the International Climate Initiative's (IKI) Small Grants Programme. This assessment will guide the development of a meaningfully accessible information platform solution that will promote climate-related information to Kenya's smallholder women's farming activities. After testing and launching an agro-climatology information platform, marketing and capacity building activities are planned. Additionally, direct training is planned for community leaders in the five counties. The resulting platform is intended to operate for two years until 2026. This report documents Sauti's initial needs

assessment and provides a learning resource for other solution designers with similar strategic objectives.

3. METHODOLOGY

The findings in this report are drawn from an analysis of mobile USSD surveys, key informant interviews (KII), and in-depth interviews (IDI) conducted in Kenya among smallholder women farmers. A purposive selection consisting of 225 individuals formed the sample frame for data collection. All telephone interviews were conducted in the participant's preferred language: English or Swahili.

For this report, data was compiled using three different data collection tools:

1. **USSD Mobile Survey:** 177 participants in the mobile survey were identified from a wider pool of users that access Sauti's information platform. Selection was based on user's self-identification as farmers and the completeness of their existing profile data (e.g. gender, age, education). The identified participants were invited to complete a survey on Sauti's information platform, which included 20 questions related to demographic information, farming location, and information need areas. The surveys were conducted between September 21, 2023 and November 15, 2023.
2. **IDI Telephone Survey:** The 40 respondents that participated in the IDI telephone interview were identified through desktop research and scoping of the relevant actors in climate, agriculture, and women's participation in agricultural value-chains throughout Kenya. We then interviewed all that responded to our email request for an interview. The IDI telephone survey comprised 18 questions related to how climate change has affected farming activities, desired climate adaptation and mitigation information for farming resilience, current source of climate-related information, and preferred information channels/sources.
3. **KII Telephone Survey:** To get more insight into information gaps and needs of smallholder farmers in Kenya, 8 professionals and experts working in Kenyan agricultural agencies were included in the study by way of structured KIIs over the telephone. Like the IDI participant selection, the KII participants were identified through desktop research of the relevant actors in climate, agriculture, and women. The identification of the KII sample was based on the unique role that each organization plays in relation to climate and agriculture. The KII telephone survey consisted of 16 questions which focused on

assessing the impact of climate change on women's farming activities, services provided by the agency to women farmers, useful climate change information to women farmers, and preferred sources of information.

Table 1 presents the organizational participants of the KIIs in this study and their presence in different Kenyan counties:

Table 1: Summary of Key Informant Interviews

Organization	County presence
Women Farmers Association of Kenya	Nakuru, Uasin Gishu
The Inclusive Climate Change Adaptation for a Sustainable Africa (ICCASA)	Nakuru, Vihiga, Uasin Gishu, Homa Bay, Trans Nzoia
Participatory Ecological Land Use Management (PELUM)	All the 47 counties through partners. Also Regionally-based through representative members
Agricultural Technology Development Centers (ATDC)	All the 47 counties through the Ministry of Agriculture's Climate Smart Agriculture Department
Ministry of Agriculture (MOA)	All the 47 counties
Chiromo fertilizers	Rift Valley: North and South Rift

3.1 Data Collection Demographics

Complete statistical results for each data collection tool are available in Annex 1. All mobile survey respondents identified as women. We summarize the mobile survey results for primary source of income, age and education, and farming location results below to inform further discussion.

3.1.1 Primary Source of Income

The mobile survey found that farming, fishing, and livestock is the main source of income for 58% of the respondents of this study. A smaller proportion of the respondents indicated that they engage in trade (23%), other income-generating activities (13%), services (4%) and transport (2%).

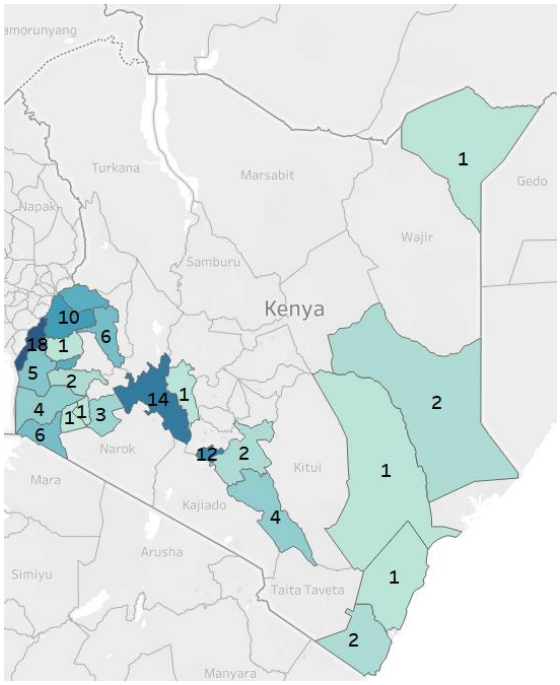
3.1.2 Age and Education

Most of the respondents (54%) are aged between 20-39 years. The data suggests that the majority of women survey respondents engaging in smallholder farming are considered youths (<35). Considering educational attainment, 43% indicated that they held secondary education as their highest level of education - compared to 29% who held a primary education, 26% who have university/college degrees, and 2% with no formal education. Altogether, young women were typically better educated than older women.

3.1.3 Respondent's Location

The mobile survey respondents were geographically spread across Kenya. Most respondents were located in either Western Kenya (33%) or the Rift Valley (27%). Nyanza (17%) and Nairobi (11%) were the next most represented. The Coast (4%), North Eastern (3%), and Central (1%) regions are less well represented in this study.

Figure 1.0: Geographic Location of Mobile Survey Respondents



4. DISCUSSION AND FINDINGS

We divide our discussion and findings into three sections: Farming Environment, Climate and Agricultural Information Needs and Access; and Access to Agricultural Services and Support Programs.

4.1 Farming Environment

This section analyzes the climate environment in which smallholder women farmers conduct their daily farming activities in relation to climate change.

4.1.1 Type of Farming Activities

The results point to women's agricultural production being largely oriented toward crop production, with few survey participants involved in livestock value-chains. The mobile survey shows that farming activities varied from crop farming (44%), mixed crop-livestock farming (43%) and livestock farming (9%). A few respondents were engaged in agricultural activities that were not related to crop or livestock farming (5%), indicating that they were involved in other agricultural activities such as fish farming or poultry farming.

Similar research shows that while many men grow drought-resistant crop varieties, women farmers engage in the planting of traditional crops and mixed cropping (Wrigley-Asante et al., 2017). Men have also been found to be better equipped to respond to climate shocks and have more technical resources compared to women on how to adopt climate smart strategies like improved seed varieties, soil fertility conservation practices, and soil and water conservation practices (Assan et al., 2018). These empirical findings are consistent with the data collected for this report and highlight that climate adaptation strategies relevant to men may be different from those relevant to women farmers.

4.1.2 Land Ownership

Women's land ownership provides economic security and enables women farmers to participate in decision-making processes related to agricultural land management, resource usage, and climate adaptation strategies. IDI responses reveal that most respondents are co-owners of their land (57%), while the rest own their land (23.8%) or lease it (19%) to do their farming activities.

Women who co-own land are more likely to work with their husbands or in partnerships with fellow farmers through cooperatives, and collaboratively make decisions on the use of farming land. Although farmland co-ownership enables women to play

an active role in land use and management, they rarely have direct contact with essential extension services needed for managing the farm land or receive agricultural information from their husbands or other male family members, especially if farm work is divided by gender.

Despite ownership, or co-ownership, the literature points to gender disparities and inequalities in decision-making power for women farmers. Ngigi et al. (2016) found that men have greater decision-making power over land and are the sole decision-makers on land use in most of the households sampled in the eastern and western regions of Kenya. In cases where joint decisions are made, women often have little input compared to their husbands (Osanya et al. 2020).

Findings by Muriithi (2015) also showed that women were discriminated against when accessing extension services in central Kenya. Ragasa (2012) showed that women are less likely than men to participate in agricultural training and extension activities due to the greater demands on their time as well as to cultural factors. As a result, women miss out on acquiring and applying information and skills that could be used to improve their agricultural productivity on their farming land. Ragasa et al. (2013) also found that men are more likely to be visited by extension officers compared to women, pointing to the need for climate information service delivery to consider the gender dynamics in information traction and uptake.

4.1.3 Prevalence and Impact of Climate-related Shocks on Farming Activities

Floods, high temperatures, and drought have extensive socio-economic effects especially for vulnerable groups, such as women. Survey participants report the following challenges associated with the weather and climate conditions:

- ***Drought:*** 31.8% of the respondents reported that drought reduces their crop or food production which also negatively impacts their farming income levels. Some mentioned that they constantly must buy power to irrigate land which depletes their income. Others shared that they face harvesting challenges, food and water shortage, and deaths of livestock due to food and water shortages. Low production and low quality of napier grass leading to low milk production during drought was also highlighted by some respondents.
- ***High temperatures:*** For 27.3% of the respondents, high temperatures were the major reason why they experienced an increase in crop and livestock pests and diseases. Crop damage, soil erosion, weakening of plants and the reduction in the ability to produce fruits in their farms were mentioned as consequences of high temperatures by some respondents. Other respondents mentioned that increased temperatures cause the pesticides that they use on crops to evaporate quickly while the rest of the respondents stated that they experience prolonged honey production from their bees due to high temperatures.
- ***Excess rainfall:*** 27.3% shared that excess rainfall was the main reason why their crop yields and farming income were reducing. Respondents associated a number of specific effects from excess rainfall, including damaged crops, stunted growth of crops, soil erosion, pests and diseases, and prolonged honey production for bees in some farms.
- ***Land degradation:*** A smaller proportion of respondents (13.6%) identified land degradation as the biggest issue affecting them. Some respondents stated that activities like cutting down trees cause them to experience landslides. Other respondents shared that the blue gum trees planted in their areas require a lot of water, so it causes water scarcity and loss of soil nutrients, which are essential for crop development.

4.2 Climate and Agricultural Information Needs and Access

This section analyzes farmers' climate and agricultural information needs in terms of current levels of relevance and accessibility to smallholder women farmers.

4.2.1 Essential Information Needs and Preferences

Understanding women's vulnerabilities and climate information needs is critical to designing and implementing meaningful and effective climate services that can increase their knowledge and adoption of climate-smart practices and increase their adaptive capacity. When asked about essential information for their business, women farmers responded that information on weather and early warning systems featured prominently (39%), followed by market prices (35%), and where to find buyers and sellers (25%). The preference for weather and early warning systems suggests that there is a more urgent need for proactive ways of handling the impact of disasters like floods and drought and a need to improve their adverse effects on farming for better income prospects.

IDI results reflected similar responses, where respondents indicated a need for information on sustainable farming methods (27.7%), environmental conservation (19.1%) and training opportunities (17.0%), to cope with the effects of climate change.

Evidence from a gender-based analysis of access to climate information services and climate-smart agriculture in Kenya reveals that there are gender differences in access to climate information services, with women farmers having significantly less access to early warning systems and advisory services on adaptation than their husbands (Ngigi and Muange 2022). Another study in Senegal identified a need among women farmers for a combination of information on weather and climate advisories with seed price and availability and market price advisories (Carr, Fleming, Kalala 2016). Therefore, program design could consider improving availability of a blend of weather and early warning systems and market price advisory services to women farmers to enable them to make climate-smart and market-smart decisions that improve their farming incomes.

4.2.2 Information Gaps

Identifying and understanding gender-specific weather and climate information gaps of smallholder women is an important step towards addressing their climate adaptation and mitigation needs and helping them make climate-smart decisions. In this study, the information gaps for smallholder women farmers were

identified by evaluating the information that was most important, but least accessible to them. Most respondents indicated that smallholder women farmers lacked and were most in need of information on sustainable farming techniques (37%), farming technologies (20%) and weather and early warning systems (14%).

The identified information gaps among smallholder women farmers have profound implications for their overall resilience and success in agriculture. The lack of access to sustainable farming techniques underscores the need for targeted educational interventions. By addressing this gap, agricultural extension services and training programs can empower women with the skills needed to adopt environmentally friendly and economically sustainable farming practices. Moreover, the deficit in access to information regarding sustainable farming technologies suggests a potential hindrance to the adoption of innovative and efficient agricultural methods. The desire for weather and early warning systems reflects a critical need for timely and context-specific climate information, crucial for making informed decisions and adapting to climate uncertainties.

4.2.3 Current Climate Information Channels

Provision of accurate and timely climate information such as weather forecasts and severe weather warnings is important in assisting smallholder women farmers to improve agricultural productivity and mitigate the negative effects of climate change. The results in this study found that women had widely distributed preferences for information dissemination pathways. The top three preferred sources to obtain climate and agricultural information by smallholder women farmers was through government and nongovernmental organizations' sources (19.7%), subject matter experts (16.0%), and the radio (11.8%). Subject matter experts include agricultural extension officers, agriculture officers and agronomists. A few respondents mentioned that they source information from conferences and seminars, television, the internet, and peers.

The results are largely in line with evidence from research conducted in Senegal discovered that women usually prefer receiving climate information services through producers' organizations or social gatherings. However, another study done in Rarieda constituency in Kenya showed that approximately 92% of farmers (majority of them being women) receive weather and climate

information mainly through radios and local administration, yet only 14% find the information useful in their operational decisions. (Onyango, Ochieng and Awiti 2012). This could be indicative that program designers may need to consider tailoring weather and climate information to be helpful for women farmer's ability to successfully manage climate risks and variability.

4.2.4 Trusted Information Channels

Trust in climate adaptation information acquired through different channels is critically related to whether farmers act on the information they receive. Our results suggest that the top three trusted information channels for smallholder women farmers are subject matter experts (47.6%), the internet (14.3%), and the Ministry of Agriculture (9.5%). Only a few respondents indicated that they trusted public media channels, such as television or radio for climate and agricultural information. Other channels such as seminars, peers and field visits are considered less trusted avenues for accessing reliable and relevant climate and agricultural information.

According to IDI respondents, subject matter experts include agricultural extension officers, agricultural officers, and agronomists. Smallholder women farmers' preference for experts could be attributed to experts being well-educated on the best crop varieties to plant and being in a better position to educate farmers on more accurate, reliable climate change information. Another possible reason for smallholder women farmers' trust in experts is that they are competent enough to guide farmers' choices on climate-smart farming based on the latest research and current practices as certified advisors.

These results resonate with a study which found that women had a higher trust on extension officers and social group dissemination pathways and found them more reliable than their husbands. As a result, this significantly influenced their decision to adopt climate-smart technologies such as drought-tolerant crop types and cultivars, soil and water management strategies, agroforestry, and other agricultural innovations (Ngigi and Muange 2022). This implies that reliability and relevance of climate information channels are important factors to consider in the design of climate information dissemination services since they influence women farmer's level of confidence in adopting climate-smart strategies.

4.3. Access to Agricultural Services and Support Programs

This section analyzes the current services and support programs offered

to smallholder women farmers, their relevance, accessibility, and efficacy.

4.3.1 Limits and Barriers to Climate Adaptation Information Dissemination via Technology Solutions

In Kenya, the major innovative channels of climate information dissemination include radio, mobile phone applications, internet, and SMS. Respondents in this study highlighted that some solutions could present challenges for the less literate who desire that there be a response mechanism where a farmer can send a follow-up enquiry on information they receive through the tech-enabled solution. Other respondents highlighted that digital literacy among some women farmers, especially older farmers, can be a challenge when interacting with tech-enabled solutions. Evidence from Ethiopia corresponds with this finding, showing that farmers face challenges in adopting SMS for obtaining information due to the low digital literacy rate in rural Ethiopia (Tamru et al. 2023).

The results suggest that the current tech solutions that disseminate climate information moderately meet their needs. Despite technological advancements in climate predictions and their potential benefits to farmers, a study found that only 40% of smallholder farmers in Kenya use climate information to make climate variability adaptation decisions, with lack of trust being the main constraint (Muema et al. 2018). Addressing this trust barrier is crucial to unlocking the full potential of climate information technologies and ensuring that a larger proportion of smallholder farmers in Kenya can benefit from informed decision-making in the face of climate variability.

4.3.2 Awareness of Availability of Climate and Agricultural Services and Support Programs

Agricultural extension and climate information services delivered by government, NGO, and farmer facing organizations are essential for sustainable agricultural development and food security amidst variable climates (Tall et al. 2014). Respondents that participated in the KIIs demonstrated how their organizations offer women farmers support on:

- Training and capacity building;
- Advocacy and policy influencing on gender and inclusion;
- Linking farmers to stakeholders;
- Agricultural extension services; and,
- Follow ups to evaluate progress with implementation of technologies and coping with climate change.

However, the survey responses reveal that most respondents (76%) have never been involved in, or are not aware of, any climate and agricultural services and support programs in their areas. A few others knew about existing programs offered by their county governments, agricultural officers, cooperative societies, or organizations, such as International Centre of Insect Physiology and Ecology (ICIPE) and Kenya Agricultural and Livestock Research Organization (KALRO).

Considering the link between women farmers' vulnerability to climate change and insufficient access to agricultural extension and training services (Adeoti, Coster & Akanni 2016), these results suggest a communication and reach problem for agroclimatic support services that needs to be addressed among smallholder women farmers in rural areas.

4.3.3 Climate Adaptation Training Needs

Societal dynamics, limited resources, and domestic responsibilities can limit women farmers' participation in climate adaptation training. During interviews, women farmers were asked whether they had ever participated in any training programs related to climate-smart agriculture or climate adaptation and mitigation. Half of the respondents shared that they had never received any training.

The results suggest that a fair number of women farmers do not have access to opportunities to gain skills and knowledge on climate adaptation strategies and/or do not have any access to training opportunities. Due to societal dynamics, services on climate adaptation are not accessible to women, possibly because of limited resources and domestic and household management responsibilities which keep them from traveling to training locations.

Evidence from proximate literature highlights additional factors that can influence climate-smart adoption for women farmers. A study by Kondylis et al. (2016) found that extension information about sustainable land management practices in Mozambique does not reach female farmers as effectively as male farmers, and a positive effect on adoption among female farmers is only observed when more female extension workers were involved. A DR Congo study found that climate adaptation adoption increased when there was joint participation of male and female co-heads in extension information training in their households (Lambrecht et al. 2016). Therefore, effective program design should be gender-responsive by making climate adaptation information involve

targeted training which accommodates their needs and domestic responsibilities.

4.3.4 Preferred Training Methods for Learning About Climate Adaptation and Climate-Smart Agriculture

Capacity building that focuses on climate adaptation and climate smart agriculture can give women farmers the skills to adopt the best strategies for successful climate mitigation. Participant responses reveal that face-to-face (76%) engagements were the most preferred training method for learning climate adaptation strategies among smallholder women farmers. This includes field visits, workshops, visual displays of work and experiments. A minority of farmers shared that they were more comfortable with receiving information through indirect means such as group training (16%), radio programs (4%) and text or voice messages (4%).

Face-to-face training may be the preferred training method among smallholder women farmers because it allows farmers to practically participate in learning how to apply strategies on the farm. A CCAFS study in Kaffrine, Senegal supports this finding as it found that although weather forecasts on the radio are popular, women farmers prefer to receive weather forecast information through more personal contact, so agricultural extension officers also bring this information from meteorologists directly to local women farmers. As a result, women farmers who took forecasts from the radio or from a personal contact were more capable of planning for the season ahead and increasing their productivity (CCFAS, 2014).

Despite their preferences, women's domestic and household responsibilities may constrain them from being able to reliably access training on climate adaptation in other ways. Research exploring factors that impact agricultural extension training programs for smallholder women farmers in Njombe District, Tanzania highlights that few women farmers participated in training mainly because they had less resources to access those services (Gwivaha, 2015).

Therefore, effective training programs successfully impact and best support women farmers by providing practical training sessions on climate adaptation and climate-smart agriculture while considering women's different responsibilities, needs, interests and constraints.

5. RECOMMENDATIONS FOR PROGRAM DESIGN

5.1 Increasing Smallholder Farmers' Capacity and Awareness of Climate Information

Creating awareness among women farmers about the availability and significance of such information are pivotal steps for promoting informed and climate-smart farming decisions. For example, forecast information such as seasonal and daily forecasts can empower women farmers to plan and make better decisions about crop selection, time to drill, fertilizers, and yield projections. Critical weather alerts can be especially critical for animal husbandry during specific seasons, such as moving livestock to higher ground before forecasted flooding events.

Despite the benefits of climate information to farmers, many women indicated limited knowledge of communication channels for this information. Moreover, during extreme climate events, traditional climate advisory services can become overloaded or break down. To increase resilience during significant climate shocks, development efforts should also be directed toward increasing farmers' awareness of alternative channels for accessing climate adaptation and agricultural information beyond traditional agricultural organizations.

Comprehensive training on sustainable farming techniques and climate-adaptive technologies can contribute to bridging the climate information gaps for women farmers in Kenya. This training should be grounded in evidence and showcase the practical costs and benefits of climate services. Previous evidence has shown that this training can also enhance farmers' ability to implement and adopt practices essential for coping with climatic risks (Aryal et al., 2021; Ochieng et al., 2017). Moreover, when digital ag-tech is involved, farmer training becomes more important, as the benefits of digital solutions are not always self-evident.

5.2 Enhancing the Relevance and Quality of Climate Information

Enhancing the relevance and quality of climate information is pivotal in addressing the specific needs of women farmers. Disparities in access to climate information services for women farmers highlight the importance of relevant program design addressing these gaps. The preference for weather advisories, seed information, and market prices, sustainable farming methods, environmental conservation, and available training opportunities emphasizes the need for more

comprehensive services in climate-related programming.

It is also imperative to continually enhance the quality of information service delivery, ensuring alignment with the evolving climate and agricultural needs of women smallholder farmers. Given the increasing volatility of weather events, not just temporarily, but also spatially, climate services should consider increasing the relevance of their information by prioritizing localization, precision, and timeliness. For example, studies have shown that when smallholder farmers have access to weather and climate information relevant to their area, particularly seasonal and sub-seasonal scale forecasts, they are more likely to implement climate adaptation strategies such as late or early planting, using early maturing crops, agroforestry practices, and soil and water conservation measures (Belay et al 2017; Dewi and Whitbread 2017). Climate information service delivery, which focuses on maximizing reach, should also consider disaggregating their information to maximize the relevance to specific farm areas.

5.3 Simplifying and Tailoring Climate Information to Women Farmer's Needs

Current and existing climate change and climate-smart agriculture information may be too complex for the average woman smallholder farmer. Our report's findings indicate that there is a need to make the information simpler and easier to understand. Program developers may need to simplify communication on very technical concepts about climate adaptation strategies and descriptions of different climate-smart technologies used in agricultural activities. Programs should also provide better quality and comprehensible information in relation to crops which are predominantly grown by smallholder women farmers.

Given the specific needs of women smallholder farmers, agricultural extension and climate information services need to proactively integrate gender-based approaches into their service delivery. Most women farmers, for instance, engage in rural farming activities where climate change affects their farming differently from urban areas. Therefore, to ensure that smallholder women farmers' resilience is built equitably, solution design should proactively target rural smallholder women farmers. Specifically, the information provided to these smallholder women crop farmers should be able to improve their ability to cope with, withstand and adapt to droughts, floods and high temperatures experienced in rural towns. New programs, especially, must be able to fill the gap between the

information that is already being provided and the issues that rural women farmers prioritize, such as time demands on women's farming activities.

5.4 Increasing Smallholder Women Farmers' Access to Agricultural Extension and Advisory Services

Engaging smallholder women farmers with climate information services requires a range of different approaches. Respondents access information in different ways and from different sources, however, agricultural extension staff were highlighted to be the most trusted and commonly requested advisory source for women farmers. Respondents highlight the benefits of active interactions and exchange between extension staff and farmers. They also highlighted the need for specialized expertise when farmers are integrating the advice of climate information.

Despite the role that agricultural extension workers can play in direct training and information dissemination to women smallholder farmers, the ratio of official agriculture extension officers to farmers in Kenya stands at 1:1800, which is far below the Food and Agriculture Organization (FAO) recommendation of 1:400 (Mwaniki 2019). Here, development practitioners can work to increase the effectiveness or coverage of agriculture extension workers, especially in rural areas where their demand is highest.

5.5 Complementing Traditional Weather and Climate Information Channels with ICT-based Digital Information

Lack of, or inadequate access to, climate and weather information poses a significant obstacle to the adoption of climate-smart technologies by smallholder farmers (Autio et al. 2021). ICT-based digital tools hold considerable potential to complement traditional weather information dissemination methods, enhancing the reach and accessibility of climate and weather information for smallholder women farmers.

The findings point to the availability of traditional channels like radio and agricultural extension services for women farmers for climate and weather, however, there is an opportunity to leverage ICT to provide supplementary out-of-hours information and additional materials. By integrating ICT-based communication channels such as USSD and SMS, this approach can address gender sociocultural barriers, empowering women farmers to manage climate-related risks and adopt appropriate adaptation strategies independently and on their own time.

6. CONCLUSION

The findings of this assessment indicate a significant demand among respondents for information and guidance on various climate-related themes essential for both long-term planning and immediate farming decisions. Smallholder farmers emphasized the profound impact of climate and weather information on their decision-making processes in farm planning and execution. However, the study identified a disparity between the climate adaptation information and services available and what smallholder women farmers currently access. A notable portion of respondents highlighted the lack of crucial information on farming techniques, technologies, and weather and early warning systems among smallholder women farmers. This underscores the need for solution designers to address these specific information gaps to enhance the resilience of smallholder women farmers to climate change and improve overall agricultural productivity.

To do this, this report presented five practicable recommendations that can guide solution designers in making strategic decisions in the effective delivery of climate information services:

- Increasing Smallholder Farmers' Capacity and Awareness of Climate Information
- Enhancing the Relevance and Quality of Climate Information
- Simplifying and Tailoring Climate Information to Women Farmer's Needs
- Increasing Smallholder Women Farmers' Access to Agricultural Extension And Advisory Services
- Complementing Traditional Weather and Climate Information Channels with ICT-based Digital Information

This study serves as a crucial foundation for the development of tailored agricultural programs, ensuring the provision of key decision-making information and advisory services that align with the livelihood activities of women smallholder farmers. The five recommendations presented in this report provide actionable guidance for solution designers to strategically enhance the delivery of climate information services, ultimately aiming to bolster the resilience of smallholder women farmers to climate change and improve overall agricultural productivity in Kenya.

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ANNEX 1: MOBILE SURVEY, KII AND IDI QUESTIONNAIRES

I. MOBILE SURVEY QUESTIONNAIRE:

General Questionnaire – Mobile Survey Questionnaire		
Category	**Sub category**	**Questions**
Key attributes	General	1. What is your gender? a. Male b. Female c. Choose not to answer 2. What is your age? a. <19 b. 20-39 c. 40-49 d. 50-59 e. 60-69 f. 70+ 3. What is your highest level of education? a. No formal education b. Primary c. Secondary d. University/College 4. What is your primary source of income? a. Trade b. Farming, Fishing, or Livestock c. Transport d. Services e. Other 5. What is your County? a. Homabay b. Uasin Gishu c. Vihiga d. Nakuru e. Trans Nzoia

		f. Other 6. Select your region: a. Nyanza b. Western c. Riftvalley d. Coast e. Eastern f. North Eastern g. Nairobi h. Central 7. Specify County (if Nyanza) a. Kisii b. Kisumu c. Migori d. Nyamira e. Siaya 8. Specify County (if Western) a. Kakamega b. Bungoma c. Busia 9. Specify County (if Rift Valley) a. Baringo b. Bomet c. Elgeyo Marakwet d. Kajiado e. Kericho f. Laikipia g. Nandi h. Other 10. Specify County (if Coast) a. Kilifi b. Kwale c. Lamu d. Mombasa e. Taita Taveta f. Tana River 11. Specify County (if Eastern)

		a. Kitui b. Machakos c. Makueni d. Marsabit e. Meru f. Tharaka Nithi g. Embu h. Isiolo 12. Specify County (if North Eastern) a. Wajir b. Garissa c. Mandera 13. Specify County (if Central) a. Kiambu b. Kirinyaga c. Muranga d. Nyandarua e. Nyeri
	Nature of farming	14. What kind of farming do you practice? a. Livestock b. Crop c. Both
Access to and Value of Information	Information needs	15. What info is more useful to you as a farmer? a. Market and Weather info b. Crop and Animal Handling c. Resource Conservation d. Finance and Insurance 16. What information is more essential for your farming? a. Market prices b. Where to find buyers and sellers c. Weather forecasts and early warning systems

		17. How often would you like to receive weather/early warning systems information? (If weather/early warning systems) a. Daily b. Weekly c. Monthly d. Seasonally 18. Which crop growing and handling information is most important to you? a. Pest and disease control b. Seeds and crop varieties c. Crop storage and post-harvest handling 19. Which resource conservation information is more important for your farming? a. Soil Testing, Treeplanting, and Conservation b. Water Harvesting and Conservation 20. Which of the below two do you require most for your farming? a. Financing/Loans b. Input subsidies c. Crop & Livestock Insurance d. Farming training opportunities

i. KII Questionnaire

General Questionnaire – Key Informant Interview		
Category	**Sub category**	**Questions**
Key attributes	General	1. Name: 2. Phone number: 3. Position/Role: 4. Contact information(for follow ups):

		5. Which of the project counties do you have a presence in? (Nakuru, Vihiga, Uasin Gishu, Homa Bay, Trans Nzoia) 6. Would you be able to introduce us with your representatives at each of the mentioned counties?
	Type of organization/ Nature of Support	7. What kind of support or programs does your organization provide to women farmers? 8. a. What kind of agriculture related information do you provide to farmers? b. What type of climate and sustainable agriculture information do you incorporate into your interactions with farmers? 9. In which languages do you deliver your content to farmers and what channels do you use? What informed your choice of language?
	Key climate-related challenges faced in farming	10. a) How has climate change affected women in agriculture?e.g. Climate Change Impact: Shifts in rainfall patterns have affected planting seasons and reduced crop yields. b) What are some of the major challenges or vulnerabilities that women farmers face due to climate change impacts? e.g. Challenges/Vulnerabilities: Crop losses have affected income stability, leading to difficulties in purchasing inputs for the next planting season. 11. a) In your experience, what kind of information would be most useful for women farmers to

		cope with climate changes and protect their farms? eg. weather forecasting and early warning systems, community-based adaptation strategies, agroforestry practices, reduced tillage, renewable energy use, cover cropping, improved manure management. b) Why is information about farming and climate important to women farmers? c) How do farmers use this information to make better decisions about their farming activities?
Access to and Value of Information	Information needs	12. a) What climate and agriculture related information resources do women farmers need for their work that they currently can't find or don't have access to? eg.localized weather forecasts, soil health and fertility, access to finance/funding, access to improved seeds, government policies and regulations b) What do they have good access to (is it working/not working)?
	Access to information / channels	13. a) What are the sources of agricultural and climate-related information that women farmers currently rely on?e.g. radio programs, community meetings, IVR(Interactive Voice Response), SMS/USSD, extension officers, tv shows, word of mouth, printed materials b) Which information channels and sources do the women farmers trust the most for the agricultural and climate related information they need? 14.

		a) Are SMS/USSD services commonly used by the women farmers you engage with to access information? b) Could you please tell us the disadvantages of using SMS/USSD to disseminate climate related information c) Could you please tell us the advantages of using SMS/USSD to disseminate climate related information d) When considering WhatsApp and SMS/USSD, which platform do you believe would be more effective in meeting the information requirements of women farmers? e) How do you perceive each platform's strengths in this regard? (SMS/USSD) f) How do you perceive each platform's strengths in this regard? (WhatsApp)
Farmer Support Initiatives		15. Do you know of any training initiatives focusing on climate-smart agriculture and building resilience to climate change among women farmers in the project/other counties? If yes, could you please share the names of the organizations that offer such training within the local community? 16. Could you kindly suggest another organization(s) that is actively engaged with women farmers in addressing climate change, and that we could reach out to for better understanding their information needs within the project/other counties?

ii. IDI Questionnaire

General Questionnaire – In Depth Interview		
Category	**Sub category**	**Questions**
Key attributes	General	1. What is your gender? a. Male b. Female 2. What is your age? a. 21-30 b. 31-40 c. 41-50 d. 51-60 e. 61+ 3. What is your primary source of income? a. Farming b. Business 4. What is your County? a. Homabay b. Uasin Gishu c. Vihiga d. Nakuru e. Trans Nzoia f. Other
	Size and nature of business and level of formality	5. a) What kind of agriculture do you practice? b) What livestock do you keep or crops that you cultivate? 6. Could you describe the kind of land ownership by women farmers in your region? 7. Which language are you proficient in (reading and writing) and which one do you prefer to access information?

	Key climate change-related challenges faced in farming	8. How has climate change affected your farming activities in your county? Please describe any specific challenges you've faced due to changing weather patterns. e.g. changes in rainfall patterns, temperature, pest and disease prevalence
Access to and Value of Information	Information needs	9. What specific information do you need to cope with the effects of climate change and improve your farming practices? e.g. adaptation strategies, weather forecasts, climate patterns, irrigation techniques, soil health and fertilities, government policies and support. 10. Apart from climate-related information, what other types of agricultural information are essential for your farming activities? (e.g., market prices, crop storage techniques, pest and disease management)
	Access to information / channels	11. a) Where do you currently obtain agricultural and climate-related information? b) Which information sources/organizations do you trust the most for reliable and relevant agricultural and climate related information you need? 12. Do you listen to radio stations for information? If so, which ones? 13. What time(s) of day do you generally listen to the radio?
Farmer Support Initiatives		14. Are there any particular climate change adaptation and mitigation measures you would like to learn more about to enhance your farm's resilience? e.g. Drought-resistant Crop Varieties, Rainwater Harvesting Techniques, Soil Conservation Practices

		15. Have you participated in any training programs related to climate-smart agriculture or climate change adaptation and mitigation? If yes, how effective were they? 16. Are there any climate change support services or programs provided by the government or organizations in your region? If yes, have you utilized these services, and how helpful have they been in addressing your information needs? If yes, please elaborate on how these services have helped address your information needs, or if you found them not particularly useful, kindly explain why. 17. Which training methods would you be interested in to understand how to access agricultural and climate related information? e.g. workshops, field visits, webinars, online forums, sms/ussd training program. If a new information service were to be introduced, how would you prefer to receive training on using this service?

ANNEX 2: SURVEY AND QUESTIONNAIRE RESPONSES

Mobile Survey Responses

Figure 1. Age

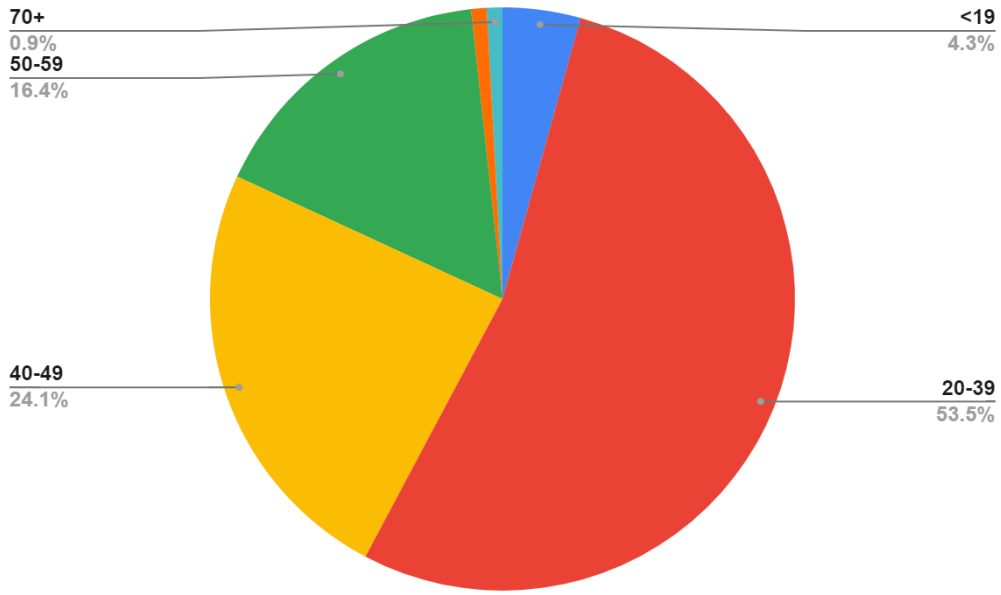

Figure 2. Education

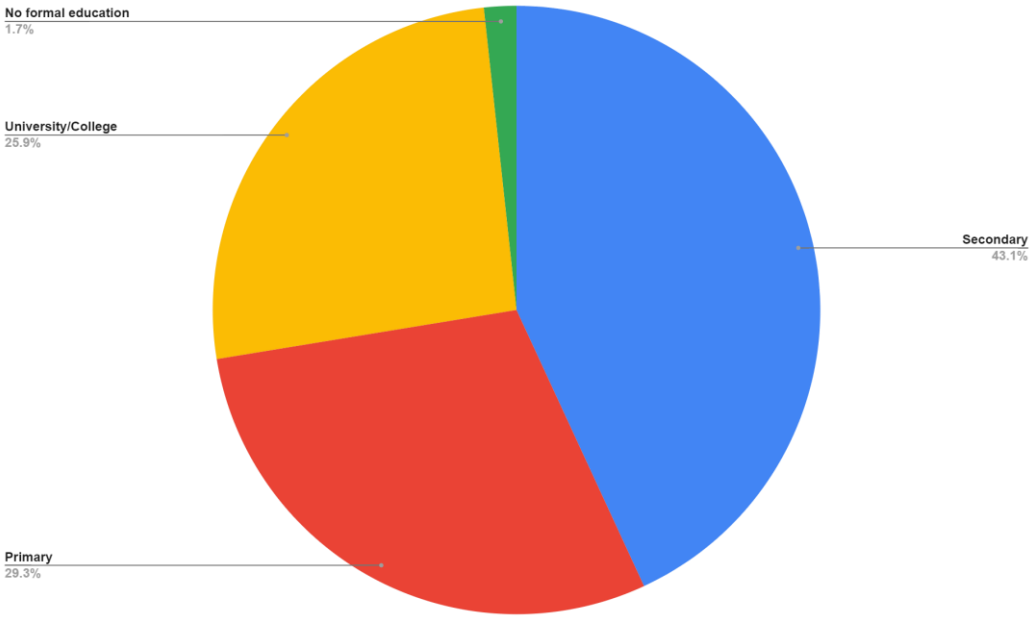

Figure 3. County

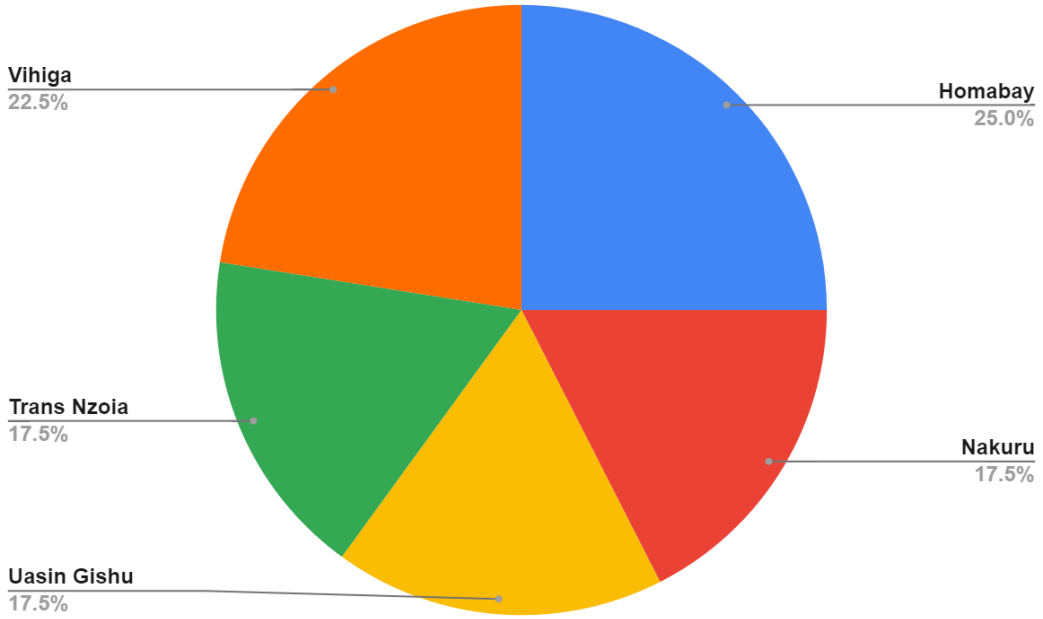

Figure 4. Farming Location

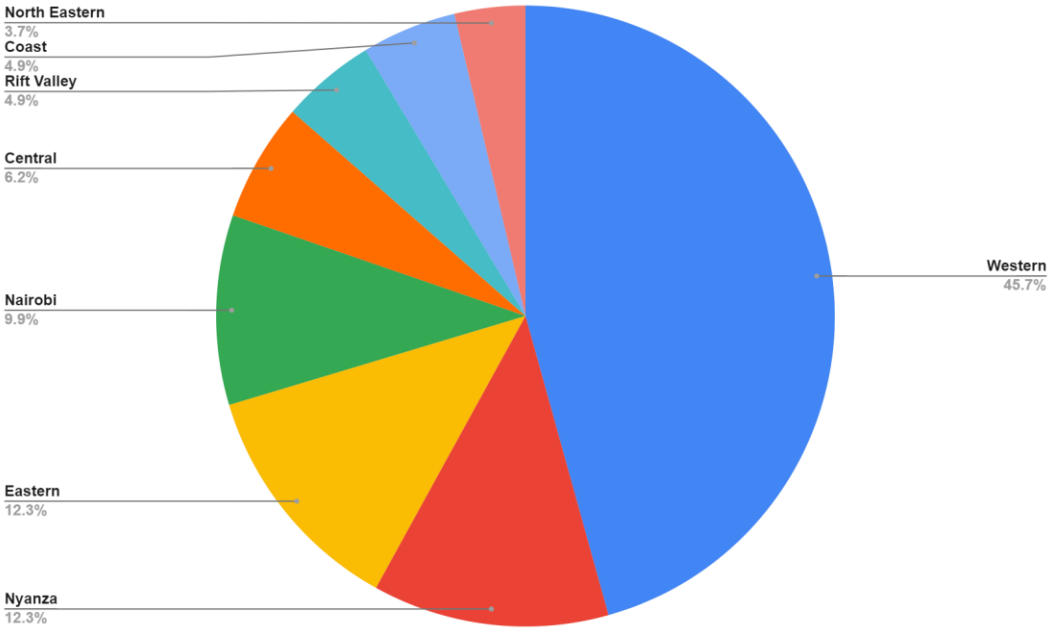

Figure 5. Source of Income

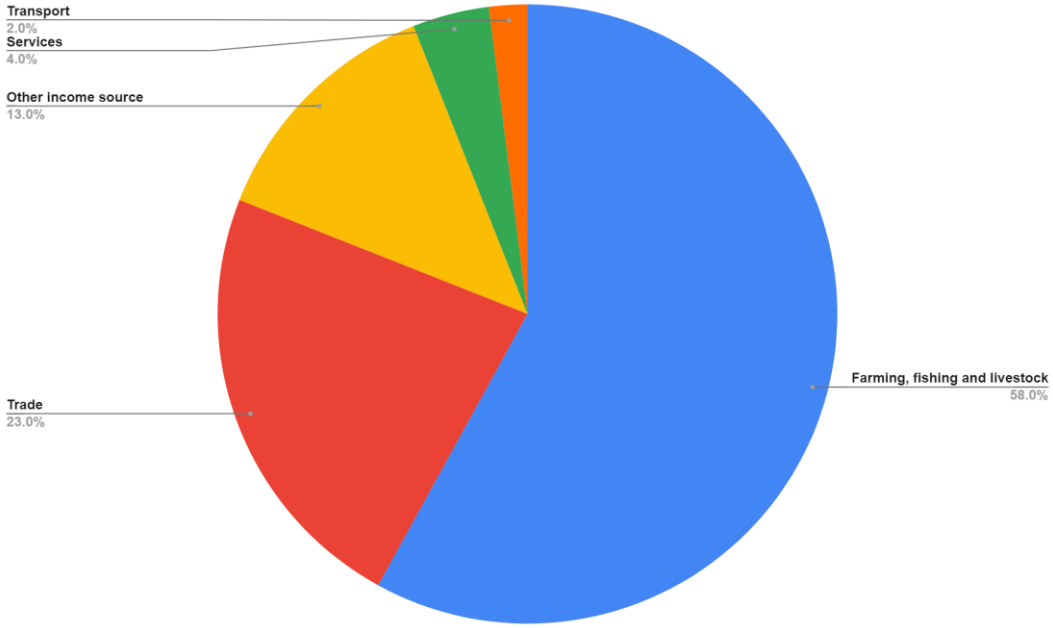

Figure 6: Preference for frequency in receiving weather/early warning systems information

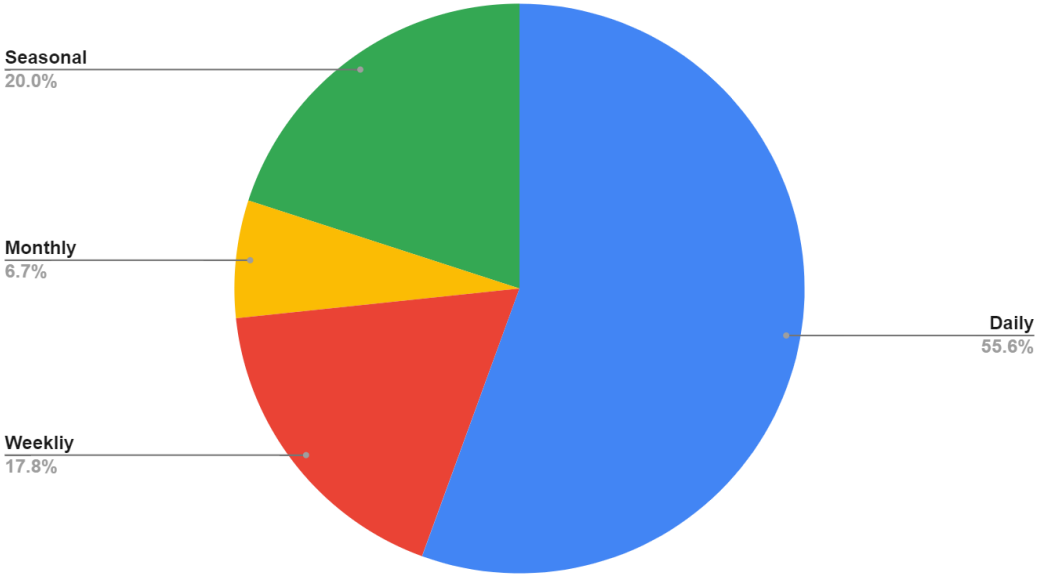

Figure 7: Most important conservation information

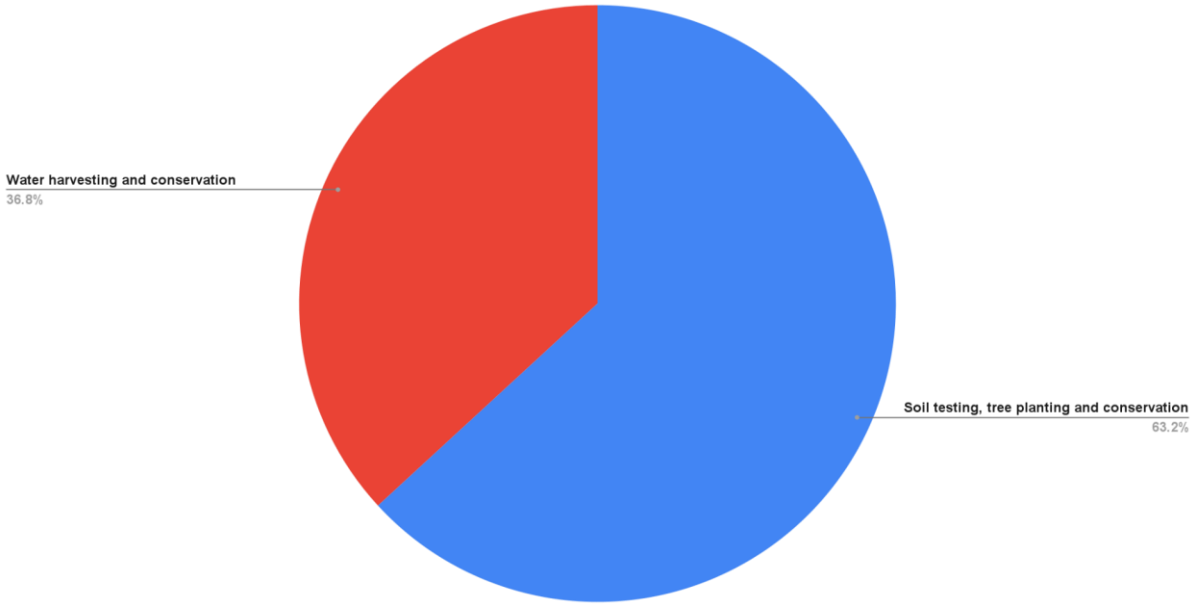

Figure 8: What is most required for farming

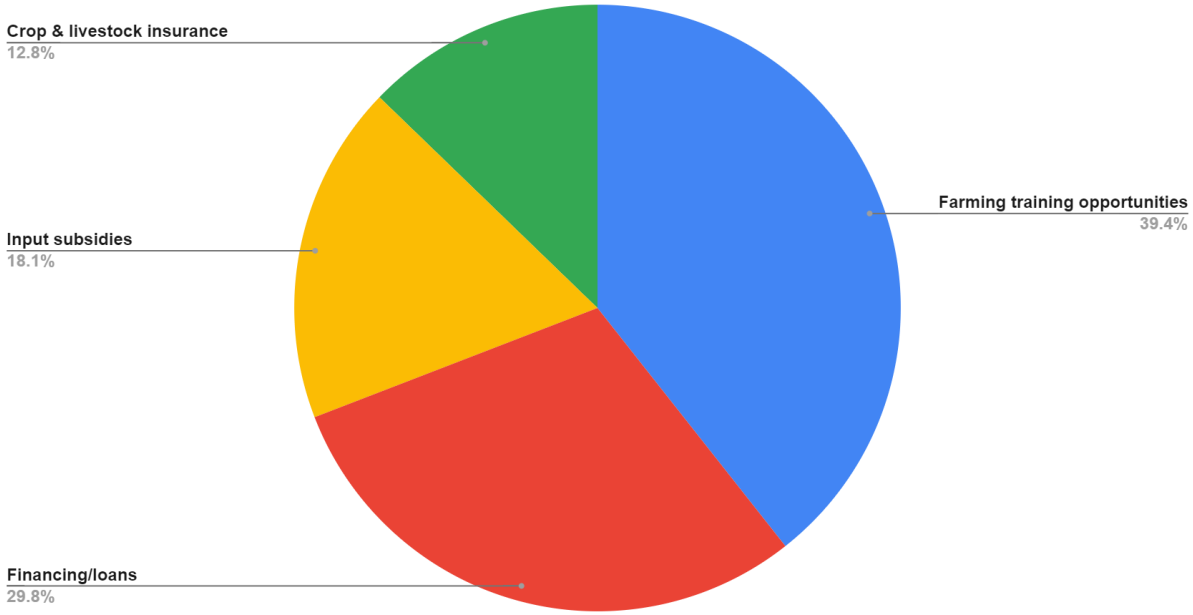

Figure 9. Most important crop growing and handling information

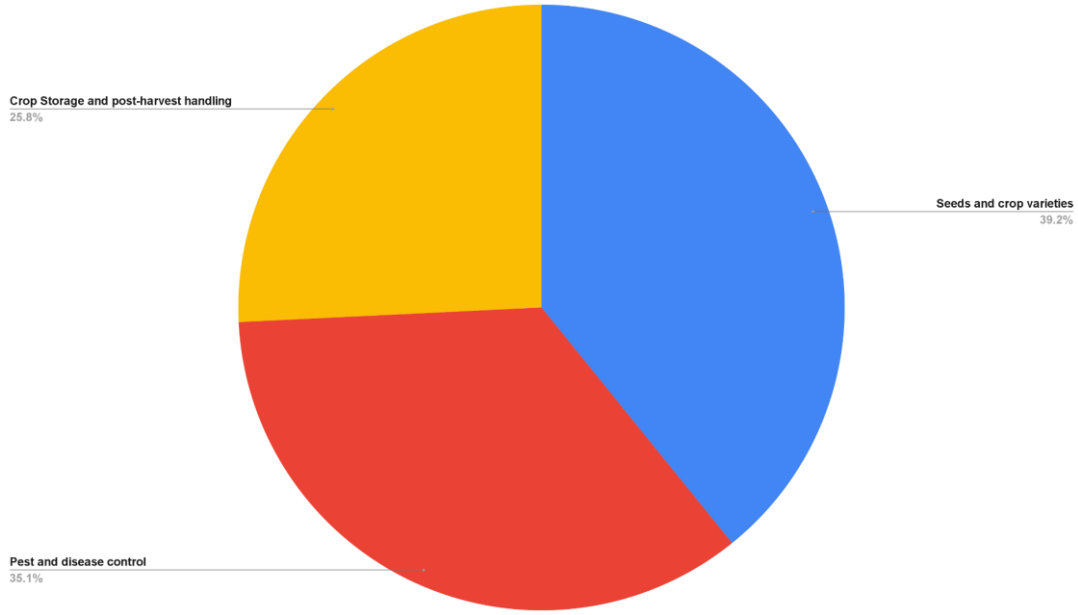

Figure 10: Most useful information

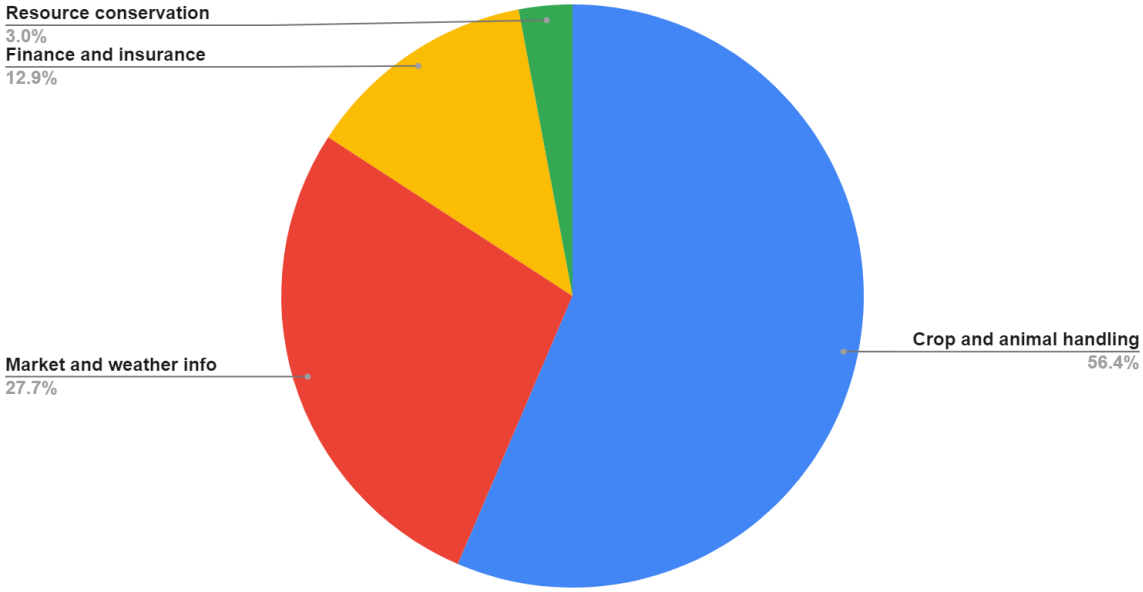

Table 1. The type of information that would be most useful for women farmers to cope with climate changes and protect their farms:

Variable	Description	Response rate
Farming techniques	*Sustainable planting techniques:* using drought tolerant crops like pigeon peas and cassava and when to plant them, using crop residues instead of throwing them, adopting biodiversity by using different species of crops, security crops that mature early, plant anytime to reduce market prices *Sustainable farming techniques:* encouraging organic farming, urban farming which consumes less water, bringing experts to help farmers understand better farming techniques, water harvesting, how to use locally available resources to manage climate issues, learning when and how to harvest, when to apply fertilizer, learning types of irrigation and amount of water needed	37%
Farming technologies	*Access to technology:* how to access farming technology accessibility, where to find technology for soil testing, who should be contacted when seeking certain technologies *Type of technology:* technologies for testing soil health, awareness of organizations that use technologies for soil tests and their benefits, technologies that do not depend on natural climate like irrigation technologies, the use of modern technologies, post-harvest technologies	20%
Weather and early warning	*Seasonal planting:* provision of seasonal forecasts to inform planting. Weekly forecasts to inform harvest and fertilizer application days. Daily forecasts to inform farm planning for the day.	14%

	Weekly and monthly weather forecast to inform preparation of farmers and enabling them to plan their short-term farming activities	
Land rights and ownership	*Land rights education*: learning about and exercising womens' rights to own land. *Land ownership:* awareness development on land resources ownership e.g. that the government allows women to own land through chamas/ saccos /VSLAS) *Land use:* how women can make decisions about the land they want to use for farming e.g. what to plant and when to apply fertilizer (most decisions are made by their spouses), and how to continue farming on those lands	8.6%
Diversification of livelihoods	How other types of crops can be introduced for planting based on the resources women farmers already have like land, climate condition, water availability etc.	8.6%
Tree planting	Encouraging the planting of fruit trees and other exotic plants. Also, how fruit trees can be planted and their benefits.	5.7%
Pest and disease management	Information on control measures and the management of pests and diseases affecting crops and livestock	5.7%

Table 2. The kind of support or programs the organization provides to women farmers

Variable	Description	Response rate

Training and capacity building	The organization capacitates smallholder farmers with education on areas such as soil nutrition, climate-smart agriculture, value addition, sustainable agricultural technologies, health risks and disasters.	43%
Advocacy and policy influencing	The organization is involved in advocacy and policy influencing for smallholder farmers on gender and inclusion	14%
Linking farmers to stakeholders	The organization creates linkages between farmers and stakeholders operating in the farmer's county	14%
Agricultural extension services	The organization provides agricultural officers who do door to door visits to farmers and provide them with practical demonstrations on sustainable farming practices.	14%
Follow up services	The organization does follow ups with farmers to ensure they implement new technologies to cope with climate change	14%

Fig 11. Agriculture related information that they provide to farmers:

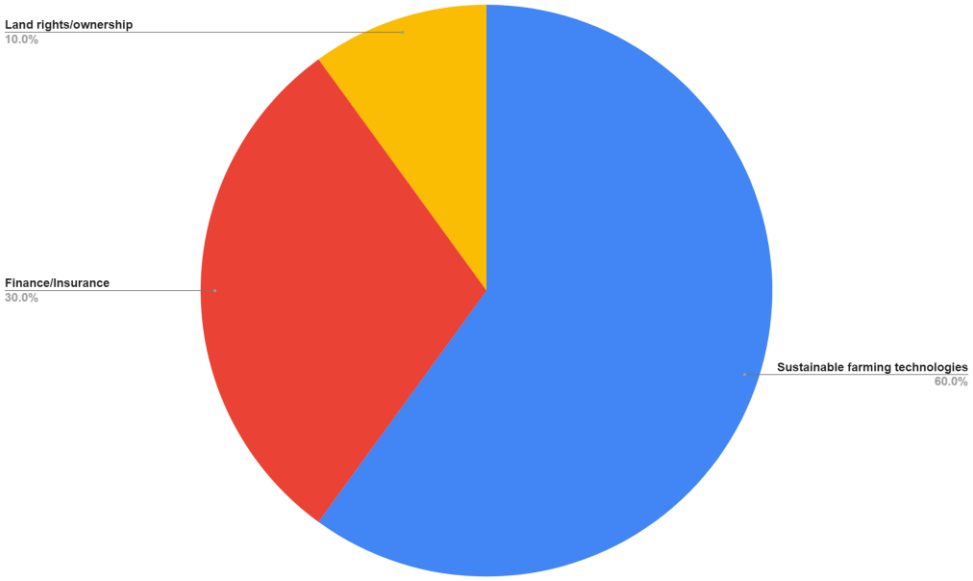

Table 3. How climate change has affected women in agriculture:

Variable	Description	Response rate
Crop damage	Increase in heat has led to livestock destroying crops while they are in search of water. Drought has also led to the reduction in crop yield. Fires caused by increased heat also contribute to crop damage. Lightning and thunder have also been reported to cause crop damage.	33%
Livelihood disruption	It has become difficult for women to manage livelihoods with the current unpredictable weather. Women farmers are struggling to get water to harvest. There is also conflict when the women are the only ones in the household providing for the whole family when the men lose their income. Extreme heat forces farmers to wake up early or work late in the evening. Farmers end up not going to the farm at all due to strong winds. They also spend a lot of time looking for firewood due to unavailability of wood caused by a lot of tree-cutting.	27%

Food insecurity	Climate change reduces food production levels and crop yields. Climate change has also affected food prices since food is now more expensive due to unpredictable weather changes.	20%
Livestock and crop diseases/death	Occurrences like lightning and thunder cause livestock death. change in weather patterns like extreme heat, humidity and cold increase the chances for livestock to get diseases and crops to be infested with pests. Crop yield also reduces when diseases caused by extreme weather patterns occur on farmlands.	20%

Fig 12. Sources of agricultural and climate-related information that women farmers currently rely on:

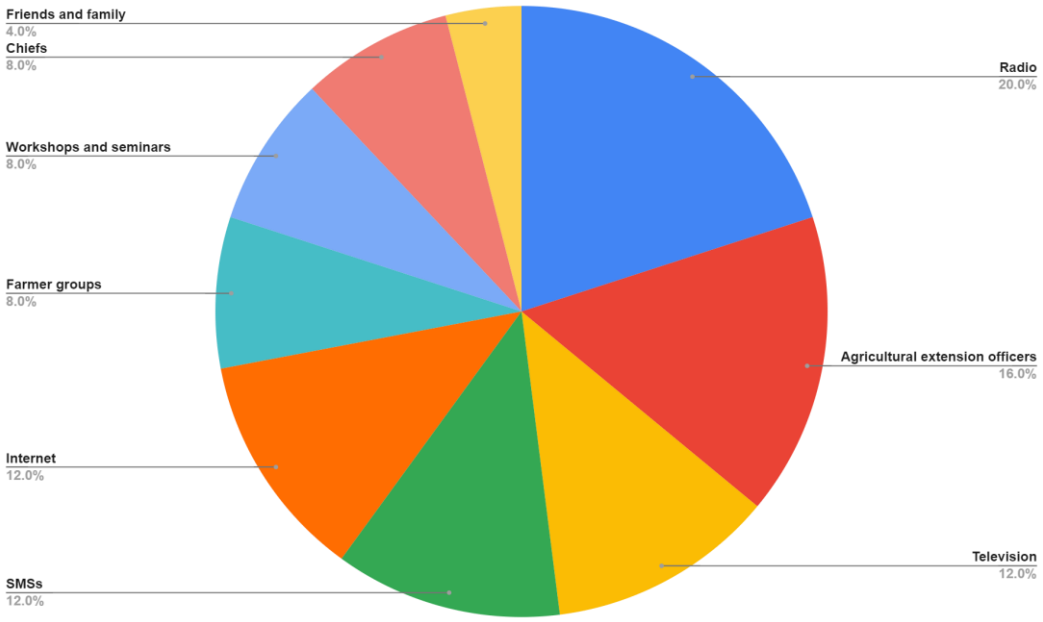

Table 4. Advantages and disadvantages of using SMS/USSD to disseminate climate related information

Advantages	Disadvantages

SMS ensures that messages are being sent in a timely manner	USSD does not have a reply feature incase a farmer needs to follow up on something
USSD is good for fast weather updates	Most farmers are not able to read and understand messages on SMSs, especially the older farmers. Only young farmers are the ones that read SMSs
SMS enables someone to preserve the messages they receive for future reference	SMS will need one to follow up with calls if farmers need to speak to someone in real time

Table 5. Recommended organization(s) that are actively engaged with women farmers in addressing climate change

Government organizations/initiatives	Non governmental organizations/initiatives
Ministry of Agriculture, Livestock, Fisheries and Co-operatives	Kenya National Farmers' Federation (KENAFF)
Agriculture Sector Development Support Programme (ASDSP)	Aquaculture Business Development Programme (ABDP)
Small Scale Irrigation and Value Addition Project (SIVAP)	Pan African Climate Justice Alliance (PACJA)
Agricultural and Rural Inclusive Growth Project (NARIGP)	Kenya Climate Change Working Group Association
Ministry of Co-operatives and Micro, Small and Medium Enterprises (MSME) Development	International Livestock Research Institute (ILRI)
Ministry of Public Service and Gender (State Department for Gender)	ICOW

Kenya Agricultural and Livestock Research Organization (KALRO)	Self Help Africa
	Practical Action
	Cereal Growers Association
	Build Africa
	World Vision
	Farmer Cooperatives

IDI Responses

Table 6. Information that smallholder women farmers need to cope with climate change

Variable	Description	Response rate
Sustainable farming methods	Information on: poultry farming methods, fertilizer application, water storage/harvesting techniques, pesticide and herbicide application methods, waste management practices, livestock farming, irrigation methods, management of pests and diseases for crops and livestock, crop rotation, post harvesting practices, artificial insemination for livestock, crop storage techniques, fruit tree planting	27.7%
Environmental conservation	Information on: agroforestry practices, Tree planting methods, using clean energy instead of firewood, soil conservation, land management, water pan construction and management, how to plant blue gum trees in an environmentally friendly way,	19.1%

	construction of terraces and gabions to prevent soil erosion, production and use of biogas	
Training	Information on: available training opportunities educating farmers about adaptation strategies, tree planting, measures to take when harvesting water, farmers exchange programme to know how they have excelled, agriculture stakeholder network to act as linkage, link to a group of farmers who plant same crops to learn from them, outreaches to other farmers/capacity building, Climate change training	17.0%
Farming technologies	Information on: soil testing and management, solar energy sources, marketing technologies, access to generator and pipes for irrigation, technology for drying vegetables, solar-powered technology for irrigation	12.8%
Sourcing of input	Information on: subsidized and certified fertilizer and seeds, water pumps, pesticides, drought and flood resistant seeds	8.5%
Weather forecast and early warning	Information on: when to expect long and short rains, temperature levels, early warnings to avoid false predictions, El Nino preparedness	8.5%
Financing	Information on: access to finance through financial institutions, finance for seeds and pesticides, finance for getting water pumps)	6.4%

Table 7. The current source for agriculture and climate-related information

Variable	Description	Response rate
Climate and agriculture organizations	Information is sourced from non governmental organizations, farmer groups and associations that represent the interests of Kenyan farmers such as One	19.7%

	Acre Fund, Kenya National Farmers' Federation (KENAFF), and Cereal growers association.	
Subject matter experts	Information is sourced from agronomists, agricultural extension officers and agriculture officers who provide specialist advice.	16%
Radio	Information is sourced from agricultural programs broadcasted on radio channels.	11.8%
Government agencies	Information is sourced from the government through organizations such as Kenya Agricultural and Livestock Research Organization (KALRO), and Ministry of Agriculture, Livestock, Fisheries and Co-operatives.	10.5%
Television	Information is sourced from agricultural shows broadcasted on televisions.	10.5%
Conferences and seminars	Information is sourced from trainings done in conferences and seminars organized by NGOs.	10.5%
Internet	Information is sourced from the internet especially Google and WhatsApp.	10.5%
Peer farmers	Information is sourced from fellow women farmers	5.3%
Print media	Information is sourced from books and newspapers with agricultural content	2.6%
Phone (SMS)	Information is sourced from text message services involving the transmission of targeted notifications and alerts	1.3%
Agrovets	Information is sourced from agrovets who supply farm inputs	1.3%

Figure 13. Information source that is trusted the most for reliable and relevant agriculture and climate-related information

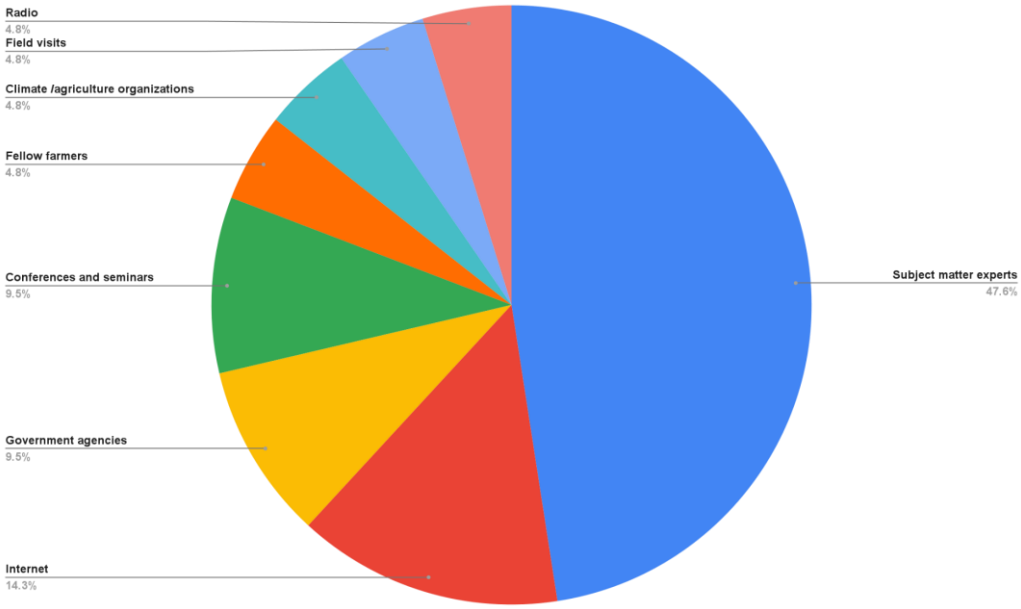

Figure 14. The effect of climate change on farming activities

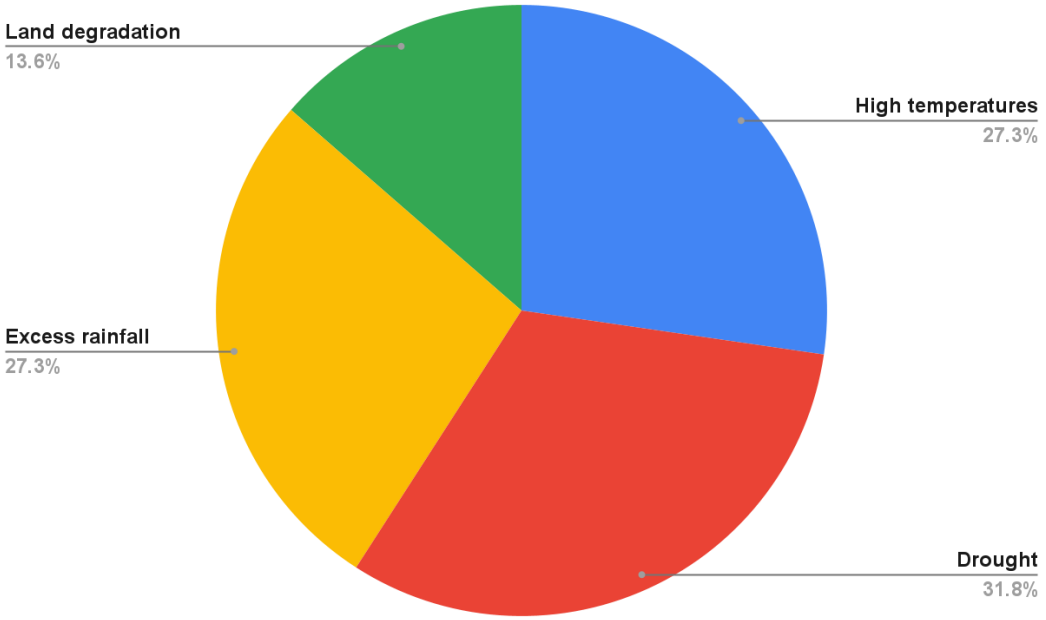

Figure 15. Type of farming activities

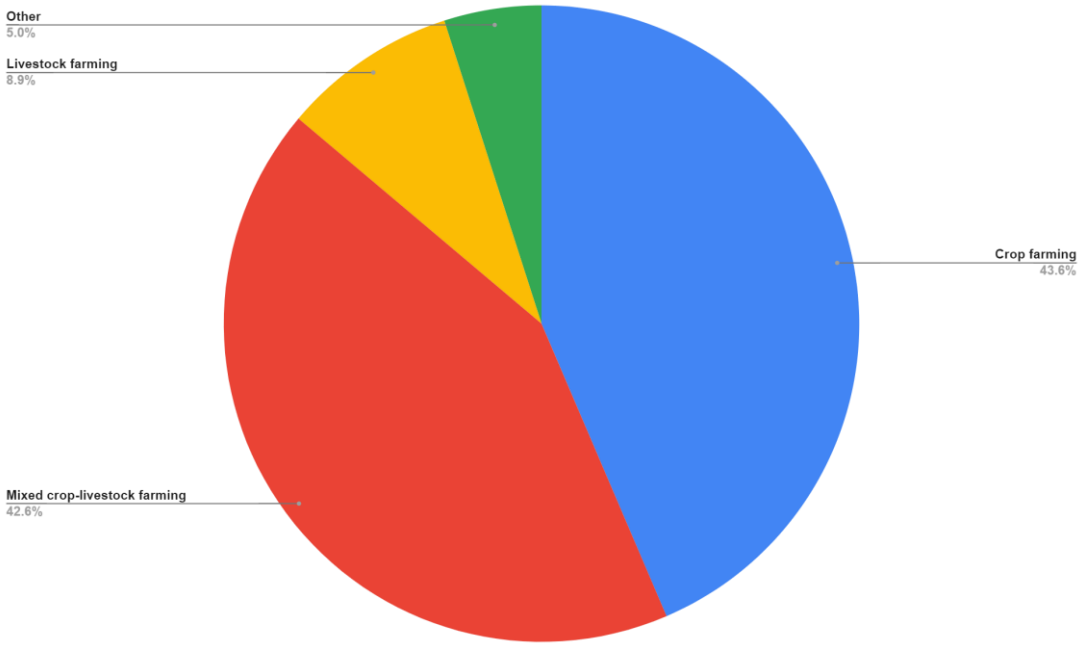

Figure 16. Land ownership

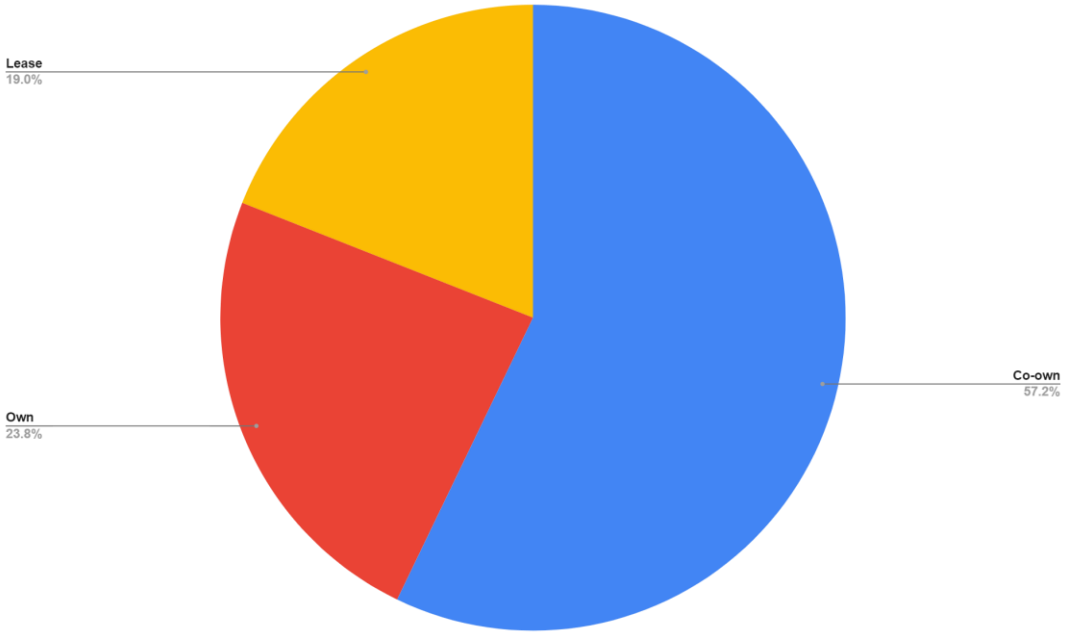

Figure 17. Most listened to radio station

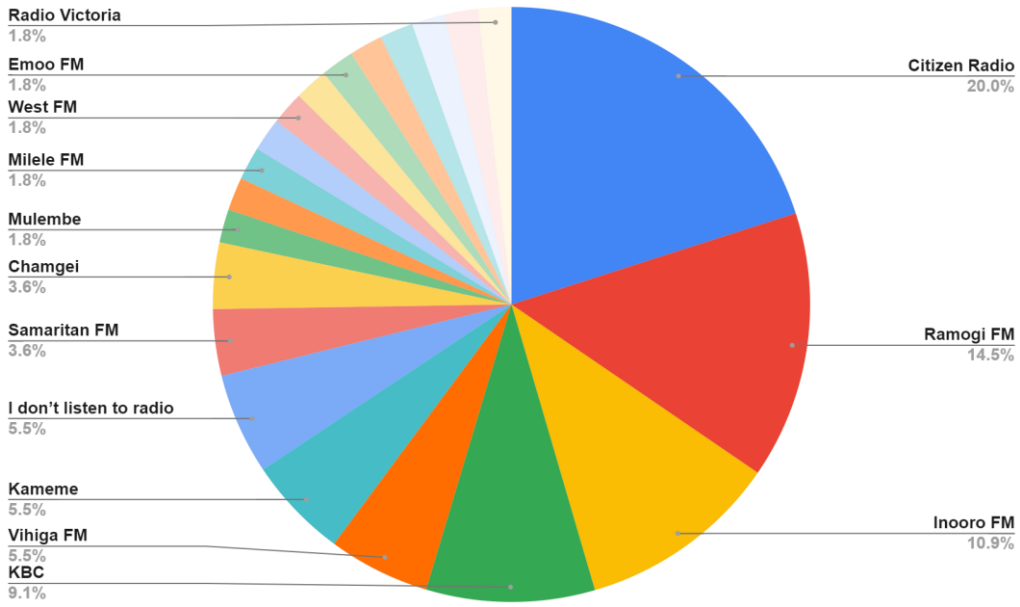

Figure 18. Most preferred time to listen to the radio

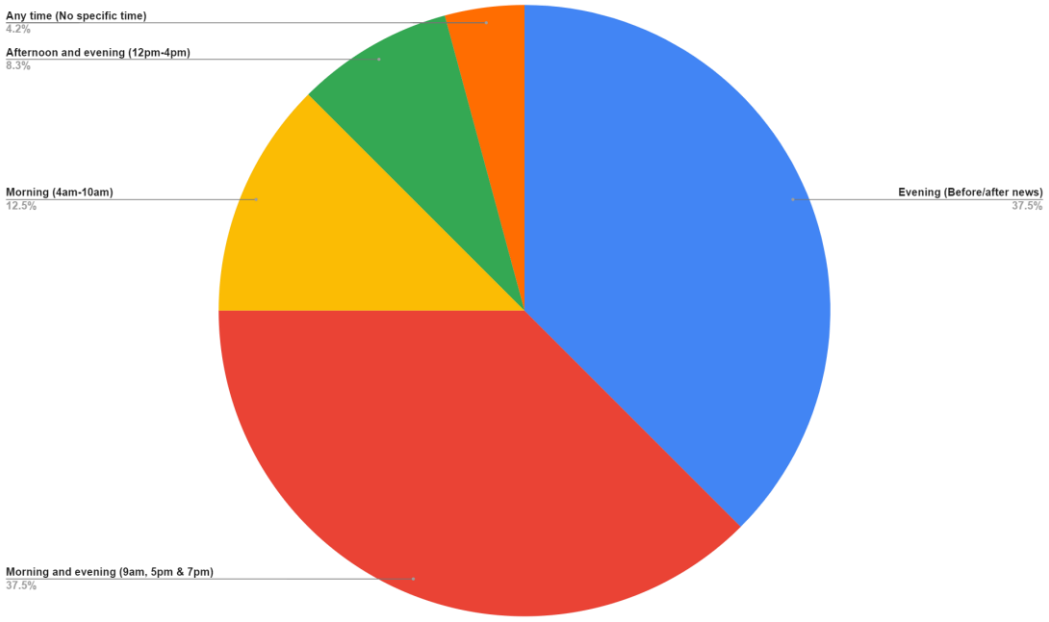

Figure 19. Availability of climate and agricultural services and support programs

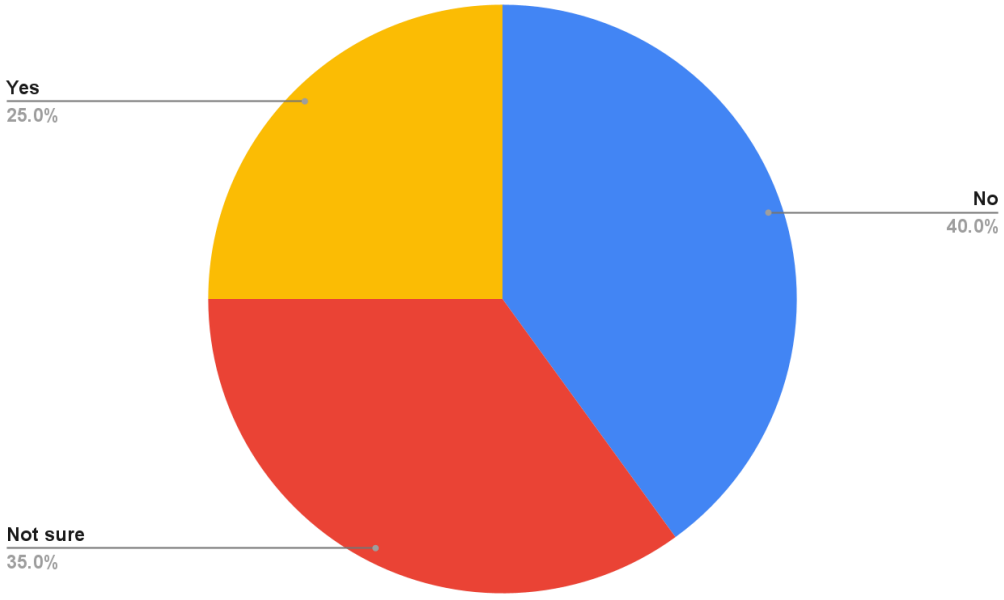

Figure 20. Preferred training methods for learning about climate adaptation strategies

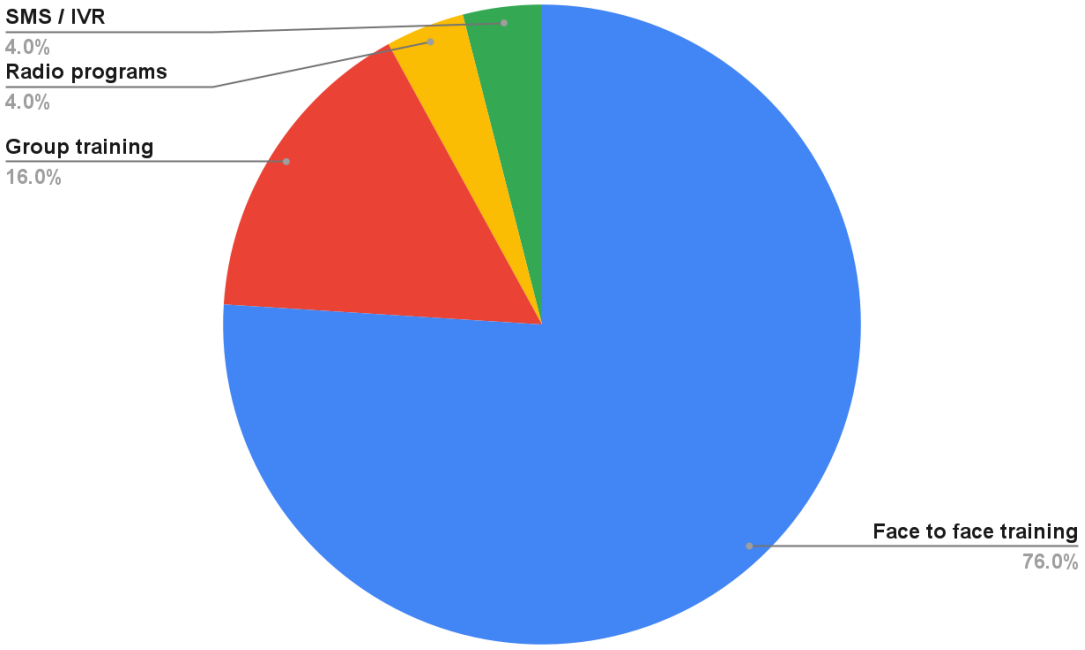

Figure 21. Awareness of availability of climate and agricultural services and support programs