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FARMERS' NEED FOR CLIMATE SERVICES AND INFORMATION FOR AGRICULTURAL DECISION-MAKING IN NORTH-CENTRAL NAMIBIA

Cecil Togarepi [1], **Radi A. Tarawneh** [2], **Moammar Dayoub** [3], **Rauna Nekongo** [1], **Joel Muzanima** [1], **Susanna Shivolo-Useb** [1], **Khaled Al-Najjar** [4*]
[1] Department of Animal Production, Agribusiness and Economics, University of Namibia, Ogongo Campus, Private Bag X5507, Oshakati, Namibia
[2] Department of Economics, Faculty of Agriculture, Jerash University, 26150 Jerash, Jordan
[3] Department of Computing, Faculty of Technology, Turku University, 20014 Turku, Finland
[4] Department of Animal Wealth, Arab Center for the Studies of Arid Zones and Dry Lands,2440 Damascus, Syria

ABSTRACT

This study aims to identify farmers' needs for climate and agricultural information, assess effectiveness of its delivery channels, and explore role of technology and mobile applications in improving access to climate services and enhancing agricultural adaptation. This is achieved through collection and analysis of quantitative and qualitative data from selected villages in Oshana and Omosati.

Results show that majority of farmers in Oshana and Omosati are women (55.5%), and most have a secondary education or higher. Their ages range from young to middle-aged. They face significant challenges, including limited financing (51.7%), high production costs (29.1%), poor weather forecasting (75.5%), and prevalence of crop diseases (79.5%). They struggle to use mobile phones due to cost, weak network coverage, and a lack of training. Farmers need information on soil preparation (87%), fertilizers (81.5%), pesticide application (78.8%), resource management, and crop selection. They request comprehensive weather and climate data, with regional variations in some indicators. They primarily use radio (84.2%) and neighbours (67.8%) for information, while reliance on mobile phones (41.8%), computers (14.4%), and television (28.1%) is increasing.

The study concludes that farmers need diverse climate services and information and communication technology tools, but they lack appropriate devices. They rely on soil and climate information to determine timing of land preparation, planting, fertilization, and pesticide management, and they often access this information via smartphones. It recommends educating farmers and providing them with timely and appropriate climate information, disseminating rainfall forecasts using accessible technologies, and supporting policies to enhance effectiveness of agricultural extension services.

Keywords: Farm Technologies, Farmer Requirements, Climate Data, Information.

INTRODUCTION

Namibia is a semi-arid country characterized by extreme climatic variability and high environmental fragility, making it vulnerable to droughts, floods, and other extreme weather events that directly impact agricultural productivity and rural livelihoods Kaundjua et al. (2012), Awala et al. (2019), Amandaria et al. (2025). These challenges are amplified in the northern regions, which experience the highest rainfall and population density, further straining agricultural ecosystems Ofoegbu and New (2021a). Climate change contributes to increased frequency and intensity of climate-related risks, reduced crop yields, and deteriorating health and

*Corresponding Author:
Email address: Khaled Al-Najjar (khnajj2011@yahoo.com)
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nutritional conditions, highlighting need to strengthen farmers' resilience to these changes Montle and Teweldemedhin (2014), Keja-Kaereho and Tjizu (2019).

Reference studies in arid environments show a growing interest in developing more sustainable agricultural practices and enhancing agricultural sector's resilience to climate change. Tarawneh et al. (2025a) emphasize importance of bioeconomics in promoting sustainability through renewable resources and international cooperation. Abu Harb et al. (2024a) point to need for education and awareness to support inclusive agricultural practices that are resilient to climate change. Studies by Delfani et al. (2024), Al-Lataifeh et al. (2024), Dayoub et al. (2024) and Tarawneh et al. (2025b) highlight the growing role of smart technologies in improving the environmental and economic performance of the livestock sector. Research by Tarawneh et al. (2022) and Tarawneh and Al-Najjar (2023) demonstrates the importance of agricultural extension and financial support in promoting water resource sustainability and empowering smallholder farmers. In context of food security, Abo Znemah et al. (2023) point to the factors influencing food income and expenditure and their role in building resilience. Besides Al-Barakeh et al. (2024), who highlight the potential of local livestock in achieving sustainable rural development. The findings of Abu Harb et al. (2024b) support the adoption of technology as a means to improve economic efficiency. This is in line with the growing research trend that focuses on integrating technology, developing agricultural knowledge, and enhancing resilience to climate change. This contributes to shaping practical research directions that address current agricultural and environmental challenges.

The problem addressed by this study is the limited access of smallholder farmers in Namibia to accurate and up-to-date climate information for making agricultural decisions Cruz et al. (2021), Ofoegbu and New (2021b). While farmers rely on traditional adaptation mechanisms, the severity of current climate change and increasing climate uncertainty exceeds the capacity of these mechanisms to respond effectively Reid et al. (2008). Furthermore, weak agricultural extension services, resource scarcity, the vast geographical area under cultivation, and the emergence of new pests all contribute to reducing the effectiveness of climate and agricultural information channels for farmers.

The importance of this study lies in crucial role of climate information in improving agricultural decision-making, particularly in fragile and semi-arid environments. The literature emphasizes need to enhance access to climate services through both formal and informal channels, as providing reliable and timely climate information contributes to better agricultural risk management, supports adaptation to changing conditions, and reduces the vulnerability of rural livelihoods Vincent et al. (2017), Tall et al. (2013), Tall et al. (2014), Tall et al. (2018), Hansen et al. (2019). This role is further amplified by the increasing use of information and communication technologies, which offer new opportunities for disseminating and accessing climate data, thus supporting farmers' efforts to address escalating climate risks Mapiye et al. (2023).

The gap lies in lack of systematic studies that focus on assessing actual needs of Namibian farmers for climate services, identifying type of information required, adequacy of existing delivery channels, and their receptiveness to modern technological tools such as mobile applications Hewitt et al. (2011), Brasseur and Gallardo (2016). Furthermore, effectiveness of these tools in addressing shortcomings of traditional extension systems and their potential impact on promoting agricultural adaptation and improving decision-making processes among smallholder farmers are not adequately examined.

Based on this problem, the study aims to identify farmers' needs for climate and agricultural information. It also seeks to support agricultural decision-making. Furthermore, it assesses the effectiveness of formal and informal information delivery channels and their ability to meet the needs of smallholder farmers. In addition, the study explores the role of agricultural technology and mobile applications in improving access to and dissemination of climate services. It also estimates the demand for digital climate services and analyzes their potential to enhance agricultural adaptation. Finally, it evaluates their role in mitigating climate risks in semi-arid regions. Consequently, the study contributes to a deeper scientific understanding of climate service development in Namibia. This supports agricultural sustainability and enhances farmers' capacity to respond effectively to increasing climate challenges.

MATERIALS AND METHODS

1) Study area

The study was conducted in selected villages in two districts of north-central Namibia: Oshana and Omusati. This region is home to the Owambo ethnic group, which constitutes majority, representing 40% of Namibia's population Angula and Kaundjua (2016). In Oshana district, the study was conducted in three villages within the Ongwideva ward: Onamutai, Omatandu, and Okandji. The population of the Onisi ward in Omusati district was estimated at 13,149, distributed across three villages: Omaineni, Omakova, and Ibalila. The total population of Omusati was 243,166, while the population of the wider Onisi ward was approximately 34,065, comprising 7,717 households Namibia Statistics Agency. (2014).

2) Study design and Sampling

A mixed research design was used, collecting both quantitative and qualitative data using open-ended and closed-ended questions to understand farmers' climate service needs. A multi-stage sampling approach was employed to intentionally select the Omosati and Oshana districts as case study sites. One constituency was then selected from each district, and two villages from the Ongwedeva constituency, along with the villages of Ibalila and Omaineni, were chosen. A simple random sampling method was used to select approximately 20 households from each of the selected villages. In the Ongwedeva constituency, 79 farmers were randomly selected, with an equal number from each of the selected villages, for a total of 146 respondents. The Cochrane formula was used to determine an appropriate sample size that accurately represented the population. The sample size estimation equation was applied at a confidence level of 90%, assuming homogeneity of selected sites, using the formula ($n_0 = (Z^2pq)/e^2$), where value of (Z=1.645) was adopted, and (p=q=0.5) was adopted due to lack of a prior estimate of ratio.

3) Data collection and analysis

A survey was conducted to determine farmers' need for climate, weather, and agricultural information to make decisions regarding the production of major crops such as millet, maize, cowpeas, and sorghum. A questionnaire with open-ended and closed-ended questions was used to collect data. Data were gathered through a pre-designed questionnaire administered via face-to-face interviews with farmers. Descriptive statistics were used to summarize the data, employing measures of variance, central tendency, and the chi-square test. The analysis was performed using SPSS (2025).

RESULTS

Socioeconomic characteristics of the respondents

Figure 1 summarizes the demographic, social, and economic characteristics of survey participants from selected villages in Omosati and Oshana. The results indicate increased female participation in agriculture. Most participants have at least a secondary education, and a significant proportion hold university degrees. Age groups range from young to elderly, with the majority being early to middle-aged. Marital status varies, with a higher proportion of single participants. Employment status is categorized as employed, self-employed, and unemployed, highlighting the diversity of economic circumstances.

Figure 1

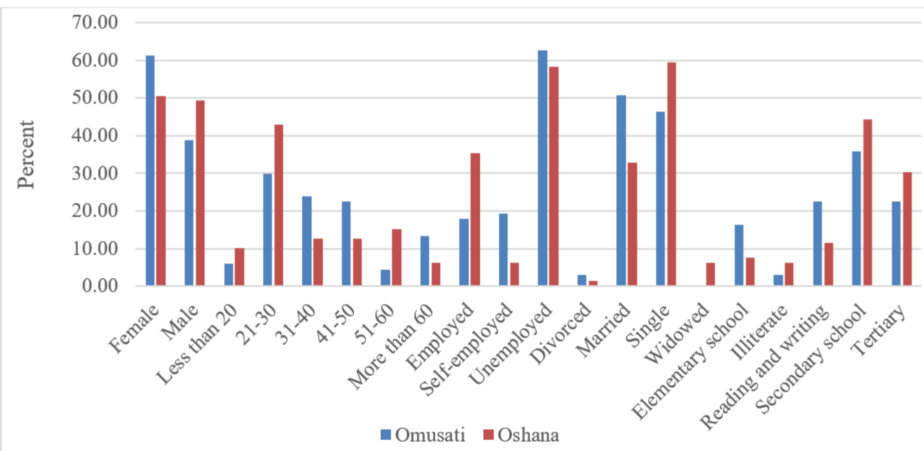

Figure 1 Distribution of Sociodemographic Characteristics Across Regions

CHALLENGES FACED IN CARRYING OUT AGRICULTURAL ACTIVITIES

Farmers report facing a variety of challenges, most notably limited access to finance and capital, particularly in Oshana Table 1. Other common difficulties, such as high input costs, lack of weather forecasting information, crop diseases, and inadequate agricultural extension services, affect farming activities across different regions. The findings suggest that farmers face broadly similar constraints regardless of their location.

Table 1

Table 1 Challenges Faced by Respondents in Carrying Out Agricultural Activities

Challenges faced in agricultural activities	Response	Omusati region	Oshana region	Total	Chi-Square Value
Obtain inputs (seeds, fertilisers, pesticides, etc.)	No	12(17.4)	12(14.6)	24(15.9)	0.21
	Yes	57(82.6)	70(85.4)	127(84.1)	
Weather forecasting to start the planting season or timely activities	No	13(18.8)	23(28.0)	36(23.8)	2.82
	Yes	55(79.7)	59(72.0)	114(75.5)	

High production costs	No	46(66.7)	61(74.4)	107(70.9)	1.08
	Yes	23(33.3)	21(25.6)	44(29.1)	
Lack of market information	No	49(71.0)	50(61.0)	99(65.6)	3.23
	Yes	19(27.5)	32(39.0)	51(33.8)	
lack of finance and capital (No access to credit)	No	40(58.0)	32(39.0)	72(47.7)	7.03**
	Yes	28(40.6)	50(61.0)	78(51.7)	
Crop diseases	No	12(17.4)	16(19.5)	28(18.5)	0.62
	Yes	55(79.7)	65(79.3)	120(79.5)	
lack of extension services	No	21(30.4)	29(35.4)	50(33.1)	2.68
	Yes	46(66.7)	53(64.6)	99(65.6)	

Chi-square value with no star means p>0.05, **p<0.01, and the percentages are placed in parentheses.

CHALLENGES ASSOCIATED WITH ICT (MOBILE) USAGE IN AGRICULTURAL ACTIVITIES

Table 2 shows the main barriers faced by farmers in the Omosati and Oshana regions when adopting mobile phone technology for agricultural decision-making. The financial costs of phones and data are the most significant obstacles, while electricity supply issues, weak communication networks, and a lack of training are substantial limitations on technology use. In contrast, barriers related to technical knowledge and language do not vary significantly between regions, suggesting that the main constraints stem more from economic and infrastructural factors than from farmers' knowledge and skills.

Table 2

Table 2 Barriers to Mobile Technology Adoption in Agricultural Decision-Making: Insights from Namibian Farmers

Challenges associated with mobile use in agricultural activities	Characteristic	Omusati region	Oshana region	Total	Chi-Square Value
Price of smart mobile phone	No	16(23.2)	24(29.3)	40(26.5)	0.71
	Yes	53(76.8)	58(70.7)	111(73.5)	
Cost of data	No	28(40.6)	42(51.2)	70(73.5)	1.71
	Yes	41(59.4)	40(48.8)	81(53.6)	
Electricity supply	No	21(30.4)	54(65.9)	75(49.7)	18.80***
	Yes	48(69.6)	28(34.1)	76(50.3)	
Inadequate technical knowhow	No	48(69.6)	57(69.5)	105(69.5)	0.01
	Yes	21(30.4)	25(30.5)	46(30.5)	
High cost of acquiring and maintenance	No	69(69.6)	65(79.3)	113(74.8)	2.7
	Yes	20(29.0)	17(20.7)	37(24.5)	
Language barrier	No	56(81.2)	68(82.9)	124(82.1)	1.05
	Yes	13(18.8)	13(15.9)	26(17.2)	
Telecommunications network problems	No	29(42.0)	52(63.4)	81(53.6)	8.42**
	Yes	40(58.0)	30(36.6)	70(46.3)	
Lack of training on mobile phone	No	65(58.0)	65(79.3)	130(86.1)	7.13**
	Yes	4(5.8)	17(20.7)	21(13.9)	
Prefer use of radio/television broadcasting for agricultural information	No	58(84.1)	58(70.7)	116(76.8)	3.74*
	Yes	11(15.9)	24(29.3)	35(23.2)	
Other	No	66(95.7)	82(100.0)	148(98.0)	3.64*
	Yes	3(4.3)	0(0.0)	3(2.0)	

Chi-square value with no star means p>0.05, *p<0.05, **p<0.01, ***p<0.001, and the percentage are placed in parentheses.

CLIMATE SERVICES INFORMATION REQUIRED BY FARMERS TO SUPPORT AGRICULTURAL DECISION-MAKING

Although not statistically significant, most participants sought information on soil preparation timing, fertilizer application rates, and pesticide timing Table 3. The primary needs for climate services were for resource allocation related to labor, finance, and pesticide application timing. Farmers identified several reasons for requesting weather information, including soil preparation, weed control, crop selection, irrigation management, and resource allocation. Many farmers rely on manual methods and local knowledge to assess soil moisture and sometimes consult their neighbors for advice on fertilizer use. This information is crucial for cost management and efficient irrigation, making soil moisture data vital for making daily decisions in agricultural activities.

Table 3

Table 3 Types of Agricultural-Related Information Needed by Farmers for Agricultural Decision-Making

Variable	Characteristic	Omusati region	Oshana region	Total	Chi-Square Value
Timing of preparation for the soil	Yes	57(85.1)	70(88.6)	127(87.0)	0.4
	No	10(14.9)	9(11.4)	19(13.0)	
Timing of weeding	Yes	37(55.2)	36(45.6)	73(50.0)	1.35
	No	30(44.8)	43(54.4)	73(50.0)	
Choosing of crops/crop variety (depend on season dry/wet)	Yes	42(62.7)	51(64.6)	93(63.7)	0.06
	No	25(37.3)	28(35.4)	53(36.3)	
Irrigation management in terms of timing of irrigation and quantity of water to be applied	Yes	24(35.8)	22(27.8)	46(31.5)	1.07
	No	43(64.2)	57(72.2)	100(68.5)	
Resource use allocation both labour and finances]	Yes	14(20.9)	27(34.2)	41(28.1)	3.17*
	No	53(79.1)	52(65.8)	105(71.9)	
Fertiliser application the quantity and type of fertiliser as well as the timing of application of fertilisers on crops	Yes	52(77.6)	67(84.8)	119(81.5)	1.25
	No	15(22.4)	12(15.2)	27(18.5)	
Timing of pesticide application	Yes	46(68.7)	69(87.3)	115(78.8)	7.57***
	No	21(31.3)	10(12.7)	31(21.2)	

Chi-square value with no star means p>0.05, *p<0.05, ***p<0.001, and the percentage are placed in parentheses.

Table 4 shows that farmers in the Omosati and Oshana regions have a high demand for various types of climate information to support agricultural decision-making. This includes weather forecasts, rainfall data, temperature readings, and predictions related to climate change and flooding. These findings highlight the importance of providing accurate and comprehensive climate information to facilitate agricultural planning and climate-risk-based decision-making.

Table 4

Table 4 Types of Climate-Related Information Demanded by Farmers to Support Agricultural Decision-Making

Variable	Characteristic	Omusati region	Oshana region	Total	Chi-Square Value
Weather forecasting	No	2(3.0)	8(10.1)	10(6.8)	2.89*
	Yes	65(97.0)	71(89.9)	136(93.2)	
Soil temperature at different depths	No	18(26.9)	17(21.5)	35(24.0)	0.56
	Yes	49(73.1)	62(78.5)	111(76.0)	
Rainfall	No	9(13.4	4(5.1)	13(8.9)	3.13*
	Yes	58(86.6)	75(94.9)	133(91.1)	
Climate change projections	No	2(3.0)	2(2.5)	4(2.7)	0.03
	Yes	65(97.0)	77(97.5)	142(97.3)	

Flood projections	No	3(4.5)	1(1.3)	4(2.7)	1.4
	Yes	64(95.5)	78(98.7)	142(97.3)	
Temperature projections	No	2(3.0)	1(1.3)	3(2.1)	0.53
	Yes	65(97.0)	78(98.7)	143(97.9)	

Chi-square value with no star means p>0.05, *p<0.05, and the percentage are placed in parentheses.

Figure 2 illustrates regional differences in farmers' needs for specific weather information. Therefore, general weather forecasts are recommended. Statistically significant differences were found between Omosati and Oshana regions regarding the importance of temperature, soil temperature, radiation, humidity, evaporation, and precipitation. Other weather parameters, including different types of forecasts and projections, did not show any statistically significant regional differences.

Figure 2

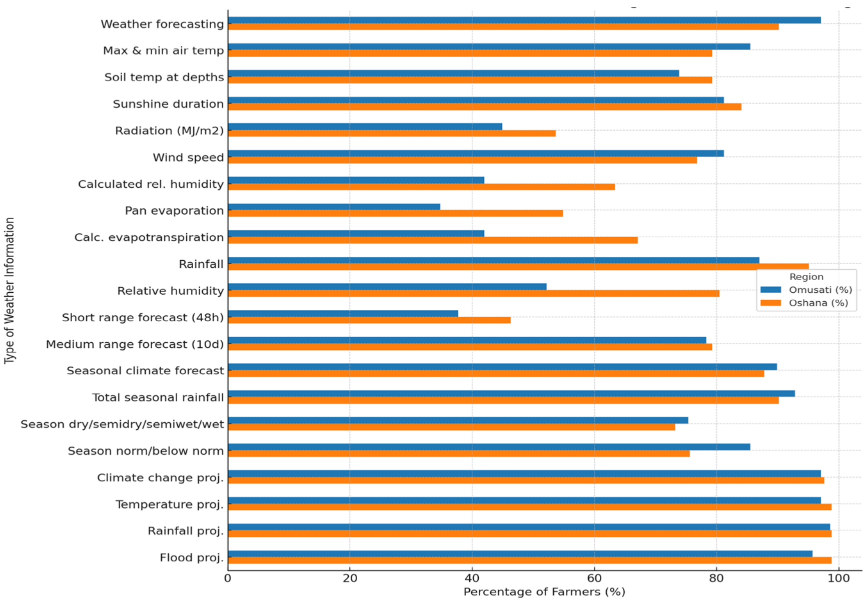

Figure 2 Comparison of Weather-Related Information Needs for Agricultural Decision-Making in Omusati and Oshana Regions, Namibia

Figure 3 illustrates why farmers need weather information, considering the global importance of soil preparation. Resource allocation and the timing of pesticide application showed significant regional variations. Other factors, such as sowing and irrigation, also vary, but not as drastically.

Figure 3

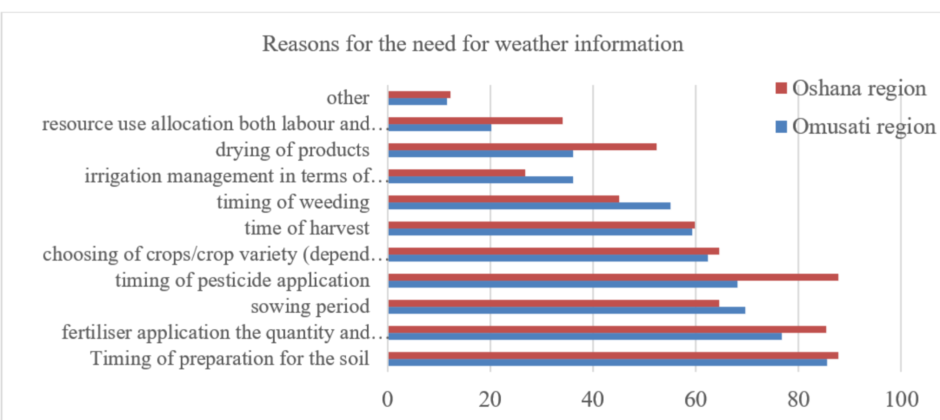

Figure 3 Reasons Farmers Need Weather Related Information

The results in Figure 4 show that the majority of respondents received their weather and climate information via radio, totaling 84.2%. An additional 67.8% of participants reported receiving weather information from their neighbors. Only a small percentage received information from extension workers.

Figure 4

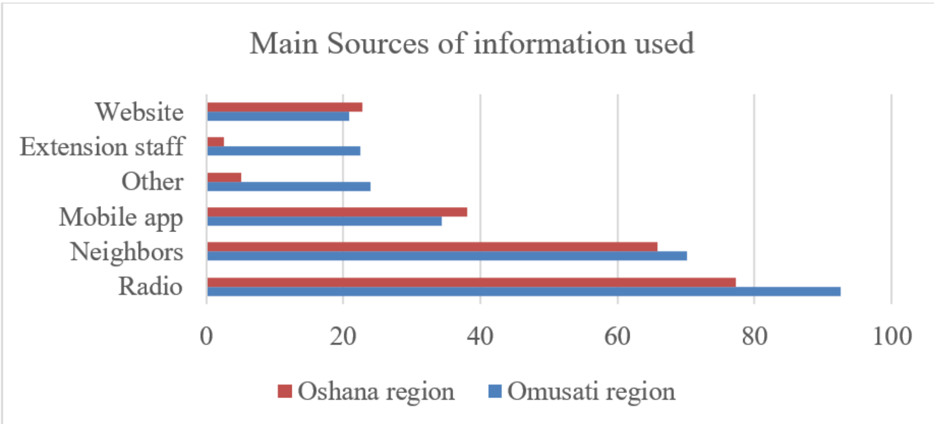

Figure 4 Farmers' Main Sources of Climate Related Information

Radio broadcasting remains a central channel for agricultural information in Namibia, as shown in Figure 4 However, this dominance faces clear challenges, as illustrated in Figure 5 The weak telecommunications infrastructure highlights the need for effective alternatives, and the accuracy of information gathered from farmers raises several concerns. Consequently, participants are now turning to mobile phones and the internet, with a significant increase in computer usage, indicating a strategic shift towards more diverse information sources.

Figure 5

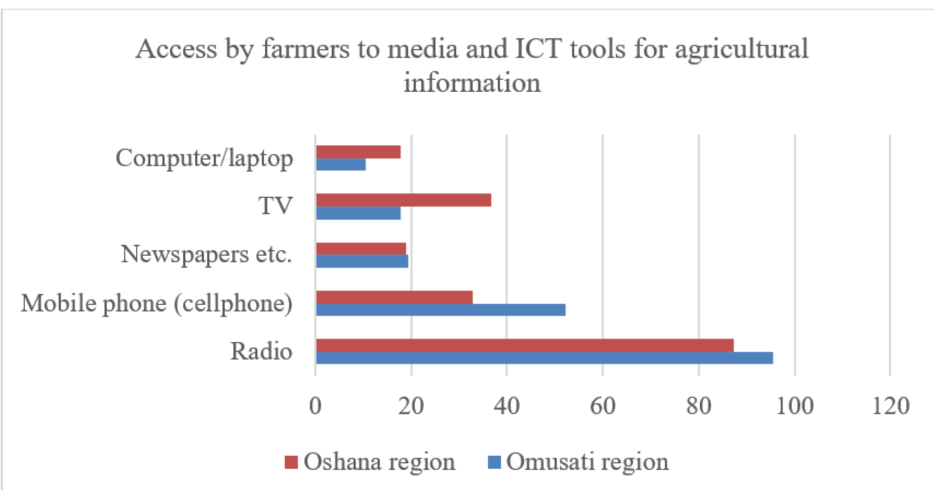

Figure 5 Access to Media and ICT Tools for Agricultural Information

DISCUSSIONS

Demographic, social and economic characteristics

The demographic and socioeconomic characteristics of the respondents revealed gender dynamics, education levels, and employment status in Omusati and Oshana. Women outnumbered men, highlighting their central role in agriculture and rural livelihoods. This is consistent with broader findings on women's contributions to agriculture and food production under climate variability. Education influences access to agricultural and climate information, with most respondents having at least a secondary education. Employment opportunities varied, with a significant proportion unemployed. Gumucio et al. (2020) underscore the roles of gender in accessing resources and making climate-related decisions, reinforcing the need for gender-sensitive climate services. Vo et al. (2023) emphasized the importance of considering sociodemographic differences to avoid bias, while Fel et al. (2022) highlighted the links between demographics, dietary patterns, and social support needs.

PRODUCTION CHALLENGES AND NEED FOR INSTITUTIONAL SUPPORT

Farmers in both regions face significant challenges, with limited access to finance being the most pressing, particularly in Oshana. High input costs, unreliable weather forecasting, crop diseases, and inadequate agricultural extension services also hinder productivity. These widespread problems highlight the need for improved financial support, climate information, and agricultural extension services. Nyarko and Kozári (2021) emphasize the importance of incentives, ICT integration, and stronger extension services for achieving agricultural sustainability Rahman and Huq (2023), Anteneh and Melak (2024).

OBSTACLES TO ADOPTION OF INFORMATION AND COMMUNICATION TECHNOLOGIES

The adoption of information and communication technologies (ICTs) in the agricultural sector faces significant regional challenges. These include weak infrastructure, low mobile phone literacy, and continued preference for traditional media such as radio. The high cost of smartphones and data services is a major barrier to adoption, highlighting the need for policies that promote affordability. Krell et al. (2021) indicate that mobile services have promising potential to support agricultural development, but their use remains limited due to high costs and weak farmers' networks. Quandt et al. (2020) link mobile phone use to improved maize productivity in Tanzania. Kabirigi et al. (2023) demonstrate that usage patterns vary according to farm type, education level, and age group.

FARMERS' PRIORITIES AND INFORMATION GAPS

Farmers prioritize practical climate services information. They focus on soil preparation, fertilizer use, and pest control. However, resource management and the timing of pesticide application have a greater impact on climate services utilization. Farmers rely on manual soil moisture assessment and consult neighbors for fertilizer advice. This reflects gaps in access to reliable scientific data and local guidance. Sutanto et al. (2022) emphasize the role of soil moisture in improving irrigation and weed control at a reasonable cost. Zhai et al. (2020) highlight the challenges in agricultural decision support systems. Borrero and Mariscal (2022) focus on the importance of governance and collaboration in digital platforms. Ara et al. (2021) advocate for participatory design to promote the adoption of decision support services.

DEMAND FOR AND ACCESS TO CLIMATE INFORMATION

Over 90% of farmers seek climate-related information. This reflects their concern about increasing droughts, rising extreme temperatures, and erratic rainfall patterns in Namibia Spear and Chappel (2018), Keja-Kaereho and Tjizu (2019); Van and Biradar (2021). Despite the availability of data, several barriers hinder its use. These include format, language, and accessibility. This aligns with Ncoyini et al. (2022), who emphasize the importance of tailoring climate information to the needs of end users. Myeni et al. (2024) highlight the need for accessible climate services to enhance resilience. Ritu and Kaur (2024) underscore the role of attitudes, benefits, and support systems in adoption. Hasan and Kumar (2019) and Kumar et al. (2020) advocate for participatory approaches to improve decision-making.

REGIONAL VARIATIONS AND IMPORTANCE OF DEDICATED DATA

Regional variations in weather information reflect local agricultural practices. General forecasts are evaluated on a global scale. However, temperature, soil temperature, radiation, humidity, evaporation, and rainfall show clear regional differences between Omosati and Ochana. This finding highlights the need for climate services tailored to each region. Yegbemey et al. (2023) and Yegbemey and Egah (2020) confirm that appropriate weather data improves agricultural decisions. Mabhaudhi et al. (2025) also emphasize the role of such data in supporting climate-smart agriculture. Yegbemey et al. (2023) report that SMS-based rainfall forecasting in Benin increases productivity and reduces costs.

DEMAND DRIVERS AND INFLUENCE OF LOCAL CONTEXT

The reasons farmers seek weather information reflect both global and regional needs. Soil preparation is critical globally, but resource allocation and the timing of pesticide application vary by region and are influenced by local practices and pest pressures. Differences in the importance of sowing and irrigation were not statistically significant. Kumar et al. (2021) noted that trust and context influence the use of hydro-climatic information. Ncoyini et al. (2022) attribute weak participation to training gaps and language barriers. Foguesatto et al. (2020) highlight that extreme weather events, rather than data, shape farmers' perceptions of climate.

COMMUNICATION CHANNELS BETWEEN TRADITIONAL AND DIGITAL

Farmers primarily rely on traditional channels for weather information. Radio is the main source, followed by information sharing among neighbors. Formal agricultural extension services play a limited role. This situation highlights a clear gap in the dissemination of official information. Popoola et al. (2020) emphasize the effectiveness of media compared to extension services. Paparrizos et al. (2023) highlight the role of farmer support applications in building trust through shared climate services. Rust et al. (2022) emphasize the increasing influence of social media and farmer networks in knowledge sharing.

INFRASTRUCTURE AND E-READINESS

Limited ICT infrastructure hinders farmers' access to agricultural information. Radio dominates communication channels, while newer technologies are gaining popularity. Weak networks limit mobile phone usage, despite the increasing reliance on computers and mobile devices. Balancing traditional and digital channels remains crucial for effective information dissemination. Mansour et al. (2024) notes that ICT provides market and technical knowledge, although barriers related to literacy, costs, and awareness persist. Assessing e-readiness using frameworks such as the Network Readiness Index can promote digital integration and support agricultural sustainability.

THE GAP IN OWNERSHIP AND USE OF TECHNOLOGICAL TOOLS

Access to information and communication technologies (ICTs) is crucial for climate adaptation, yet many farmers face barriers, such as limited access to mobile phones, computers, and radios Vaughan and Dessai (2014), Vincent et al. (2017). These limitations affect farmers' ability to access climate services. The study indicates that farmers with limited resources have limited access to media, although some use smartphones to access climate information. Of the 133 participants, 91% use mobile phones, but only 60% own them, highlighting a mobile phone ownership gap Asa and Uwem (2017). The researchers demonstrate that mobile phones are effective in providing agricultural information in Nigeria, suggesting the need to strengthen mobile extension services Duncombe et al. (2016).

IMPLICATIONS FOR POLICIES, RESEARCH, AND PRACTICES

The findings indicate the need for policy support in disseminating climate, weather, and agricultural information, along with appropriate digital support to bridge the digital divide. This access accelerates decision-making and reduces the time and cost required for sound agricultural decisions. Research is needed to determine farmers' willingness to accept and pay for climate services, and the factors influencing this willingness. It is needed to identify barriers to providing climate services to farmers, enabling the design of effective policy interventions. In practice, farmers should be clear about their needs, advocate for them, and organize themselves to reduce transaction costs and increase their bargaining power. The exchange of climate and agricultural information must be tailored to farmers' needs. It must also be easily understandable, interpretable, and usable for agricultural decision-making and planning. This approach strengthens farmers' resilience and empowers them to make informed and timely decisions.

CONCLUSIONS AND RECOMMENDATIONS

It can be concluded that farmers need a variety of climate services, including information and communication technology (ICT) tools and diverse climate information, and the results show that they are aware of the existence of these services. However, they lack access to appropriate ICT tools, such as televisions and computers. Therefore, the government should develop programs to provide ICT facilities to farmers to enhance food security in the country.

Farmers place great importance on soil moisture and climate information to help them make decisions related to their farms. This information can be used to determine the timing of land preparation, seed planting, fertilizer application, weeding, and pesticide application. Farmers can easily access climate information through devices such as smartphones. Extension services can also organize field days, distribute brochures, and make information available through physical or digital methods.

Some farmers have a limited understanding of weather information or are not well aware of it. Therefore, agricultural extension services recommend educating farmers about weather information and climate services. The study also recommends that extension staff provide farmers with appropriate and timely climate knowledge and information to use in reducing climate-related losses and maximizing benefits, such as protecting lives and livelihoods.

Farmers want access to short- and long-term rainfall forecasts. Therefore, disseminating this information requires the use of appropriate and accessible technologies that enable people to obtain climate information and agricultural services. This must be coupled with appropriate policy interventions and strategies to enhance the effectiveness of agricultural extension services.

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