Human Nature Journal of Social Sciences
Vol.7, No.3 (September, 2026), Pp.70-81
ISSN(online): 2788-5240, ISSN(print): 2788-5232
DOI: https://doi.org/10.71016/hnjss/7ftd6t66

Original Article **https://hnpublisher.com**

Digital Climate Information and Adaptation: Rural Farmers' Experiences of Barriers to Action in Pakistan

Mohammad Kashif[1], Aatif Iftikhar[2], Syed Muhammad Hasnain Raza[3], Shazma Zareen[4], Naeem Ullah Tariq[5]

[1]Lecturer, Department of Media & Communication Studies, NUML, Islamabad, Pakistan
[2]Assistant Professor, Department of Media & Communication Studies, NUML, Islamabad, Pakistan
[3]Lecturer, Department of Media & Communication Studies, NUML, Islamabad, Pakistan
[4]Research Scholar, Department of Media & Communication Studies, NUML, Islamabad, Pakistan
[5]PhD Scholar, School of Media and Communication, Shanghai Jiao Tong University, Shanghai, China
Correspondence: naeemutariq@sjtu.edu.cn[5]

ABSTRACT

Aim of the Study: Rural farmers can often access digital climate information, but access does not equate to adaptation. This study explores farmers' experiences of barriers encountered in the transition from digital climate information to adaptation action in the context of Rajanpur district, Punjab.

Methodology: A qualitative approach was used, based on four focus group discussions with 32 purposively selected farmers. The discussions were audio-recorded, transcribed, and analyzed thematically. Five themes emerged: access to digital climate information, making sense of information, trust and credibility, social and institutional contexts, and practical constraints on adaptation.

Findings: The findings show that farmers assess digital information through their experience, local knowledge, social networks, and trusted sources. Information may be understood and accepted but still not acted upon because of weak institutional support and limited access to credit, inputs, water, labor, and machinery.

Conclusion: The study shows that the information-to-action gap is shaped by more than access to information. It also depends on how information is understood and trusted, the support available to farmers, and their practical capacity to act.

Keywords: Digital climate information; Climate adaptation; Rural farmers; Information-to-action gap; Trust; Digital inequality; Pakistan.

Article History

Received:
July 08, 2026

Revised:
August 20, 2026

Accepted:
August 24, 2026

Online:
August 28, 2026

1. INTRODUCTION

Climate change is creating growing pressures on agriculture, particularly in rural areas where farming depends on rainfall, temperature, water availability, and other climate-sensitive conditions. Pakistan is highly exposed to these changes. Farmers have reported shifts in rainfall and temperature, water shortage,

crop losses, and changes in cropping conditions. Their ability to respond is also shaped by access to credit, irrigation, agricultural extension, inputs, and other resources (Abid et al., 2015; Raza & Shah, 2024; Saddique et al., 2022).

Climate information can help farmers respond to these risks. Weather forecasts and agricultural advice can support decisions about sowing dates, irrigation, crop varieties, pest management, and other farm practices. In Pakistan, farmers obtain such information through agricultural extension services, television, mobile phones, internet-based services, fellow farmers, and other sources. Studies have found that ICT-based agricultural advisory services can influence farmers' climate adaptation decisions (Khan et al., 2023).

The availability of information, however, does not necessarily mean that farmers can use it. Climate information needs to be timely, understandable, locally relevant, and sufficiently reliable for farmers to consider it in their decisions (Madhuri, 2023). Digital access also extends beyond having a smartphone or internet connection. Differences in digital skills, patterns of use, and the ability to gain useful outcomes from digital technologies can create further inequalities (van Dijk, 2020). For farmers, a forecast or recommendation may therefore have limited value if they cannot understand it, relate it to their own conditions, or determine whether it can be trusted.

Conditions beyond information itself also shape the decision to act on climate information. Previous research in Pakistan has identified limited financial resources, lack of credit, water shortages, inadequate extension support, and other institutional and practical constraints as important barriers to climate adaptation (Elgammal et al., 2026; Abid et al., 2015; Saddique et al., 2022).

Farmers may also discuss information with family members, neighboring farmers, extension officers, input dealers, and other members of their local networks before deciding. Adaptation is therefore not always an individual response to information but can be influenced by social relationships and institutional support (Appiah et al., 2025; Javed et al., 2023).

The Knowledge-to-Action framework also illustrates the link between knowledge and action as a process of interpretation, adaptation, application, and paying attention to factors that influence the implementation (Graham et al., 2006). In this context, obtaining climate information is just one part of the process. Farmers must be able to understand the information, evaluate its reliability, relate it to their farming conditions, and have adequate support and resources to respond. In this context, digital climate information needs to be understood not simply in terms of access but in relation to what farmers do with the information they encounter.

1.1 Research Gap

Existing research shows that digital and ICT-based agricultural information can improve farmers' access to climate advice and support adaptation decisions. Studies in Pakistan have examined farmers' use of ICT-based advisory services, climate-risk perceptions, digital access, and the institutional and resource constraints that affect adaptation (Khan et al., 2023; Saddique et al., 2022). Other research has examined the role of climate information services, including issues of trust, interpretation, timing, and usability (Madhuri, 2023; Warner et al., 2022). Research on misinformation has also begun to consider how unreliable or conflicting information can affect farmers' adaptation decisions. However, these issues have largely been examined as separate aspects of information use or adaptation rather than as parts of the same process.

Less attention has been given to what happens between receiving digital climate information and acting on it. There is limited qualitative evidence on how farmers collectively interpret information, assess its credibility, verify conflicting claims, discuss it within social and institutional networks, and weigh it against the practical resources and risks involved in adaptation (Appiah et al., 2025; Mustafa & Alotaibi, 2024). This study addresses this gap by examining these connected processes through focus group discussions (FGDs) with rural farmers in Pakistan.

1.2 Research Questions

RQ1: How do rural farmers access, encounter, and make sense of digital climate information?

RQ2: How do trust, social relationships, and institutional factors shape farmers' responses to digital climate information?

RQ3: What practical barriers affect the translation of digital climate information into climate adaptation action?

2. LITERATURE REVIEW

Digital technologies have expanded the ways farmers obtain climate and agricultural information. Alongside television, extension services and fellow farmers, mobile phones, internet platforms, WhatsApp, Facebook and digital advisory services have become part of the agricultural information environment. Research from Pakistan shows that farmers use a combination of conventional and ICT-based sources, and that ICT-based advisory can influence climate adaptation decisions (Khan et al., 2023). However, access to digital information remains uneven. Differences in connectivity, digital skills, education, and patterns of use can affect whether farmers gain meaningful benefits from digital technologies (Porciello et al., 2022; van Dijk, 2020).

Access, however, is only the first step. Climate information has to be understood and linked to local farming decisions. Forecasts may be presented in technical language, cover a wider geographical area than a farmer's village, or provide probabilities rather than clear instructions. A systematic review found that interpretation, timing, language, and local relevance can affect whether climate information becomes useful for farmers (Madhuri, 2023). It might be helpful for farmers to integrate digital information with their own observations and experience while interpreting its implications for their farms.

Credibility is another aspect of information interpretation. Similarly, farmers do not automatically believe all the information they receive from digital platforms, since they can choose not to trust something based on its origin. Credibility, trust in information providers, and experience are listed as key factors in climate information utilization (Warner et al., 2022). The proliferation of social media and informal digital communication creates additional difficulties since farmers can receive professional information, recommendations from friends, commercial offers, and even disinformation through the same medium. In Pakistan, recent research has also linked misinformation and information asymmetry with difficulties in climate adaptation (Javed et al., 2023; Kashif et al., 2026). This suggests that farmers may need to compare information with other sources, consult people they trust, or assess it against their own experience before acting on it.

Farmers' decisions are also shaped by their social and institutional environment. Family members, neighboring farmers, and community networks can influence adaptation decisions, while agricultural extension services and government institutions can provide advice and support. Research in Pakistan indicates that extension, training, and social networks can influence farmers' adaptation behavior (Khan et al., 2023). Yet information from an institution does not necessarily provide the practical assistance required to implement a recommendation. This creates a distinction between receiving advice and receiving support.

Adaptation requires resources. Studies of Pakistan consistently identify financial limitations, lack of credit, water shortages, inadequate inputs, and other practical constraints among the barriers to climate adaptation (Nawaz & Avetisyan, 2025). The reason for this may simply be that the necessary seed, machinery, water, labor, or investment is not available. And here lies the core difference between failure to act due to lack of information and failure to act due to lack of capacity. Considering the above, the link between climate information provided digitally and adaptation is not necessarily a linear one. Information must go through many processes before it translates into action.

2.1 Theoretical Framework

The study is primarily guided by the Knowledge-to-Action (KTA) framework (Graham et al., 2006). Its main value for this study is that it does not assume that knowledge automatically leads to action. The process of moving from knowledge to practice is seen as a process in which the knowledge is adapted for context, and barriers to using the knowledge are identified and resolved (Graham et al., 2006). This aligns with the focus of the study: farmers can get and interpret digital climate information but end up not using it.

A second layer to understanding the location of these barriers is the Social Ecological Model (SEM). Farmers' responses are influenced in both individual and family peer contexts as well as in community context, agricultural extension services, and broader institutional contexts. The model is therefore useful for connecting the individual experience of information with the social and institutional environment in which adaptation decisions are made.

Digital inequality is used to explain the first part of the process. Digital access involves more than owning a smartphone or having an internet connection. Differences in digital skills, quality of access, frequency of use and ability to obtain useful outcomes can create unequal opportunities to benefit from digital information (van Dijk, 2020). Research on farmers similarly shows that the digital divide can involve differences in ICT ownership, access, digital literacy and quality of use (Sharma et al., 2025; Upadhyaya et al., 2019). This perspective helps explain why some farmers may encounter and use digital climate information more effectively than others.

Taken together, these perspectives provide a process-based framework for the study. KTA helps explain the movement from information towards action, and SEM helps locate barriers within individual, social, institutional, and wider structural settings, and Digital inequality helps explain differences in access.

Figure 1: *Conceptual Model of the Digital Climate Information-to-Action Process*

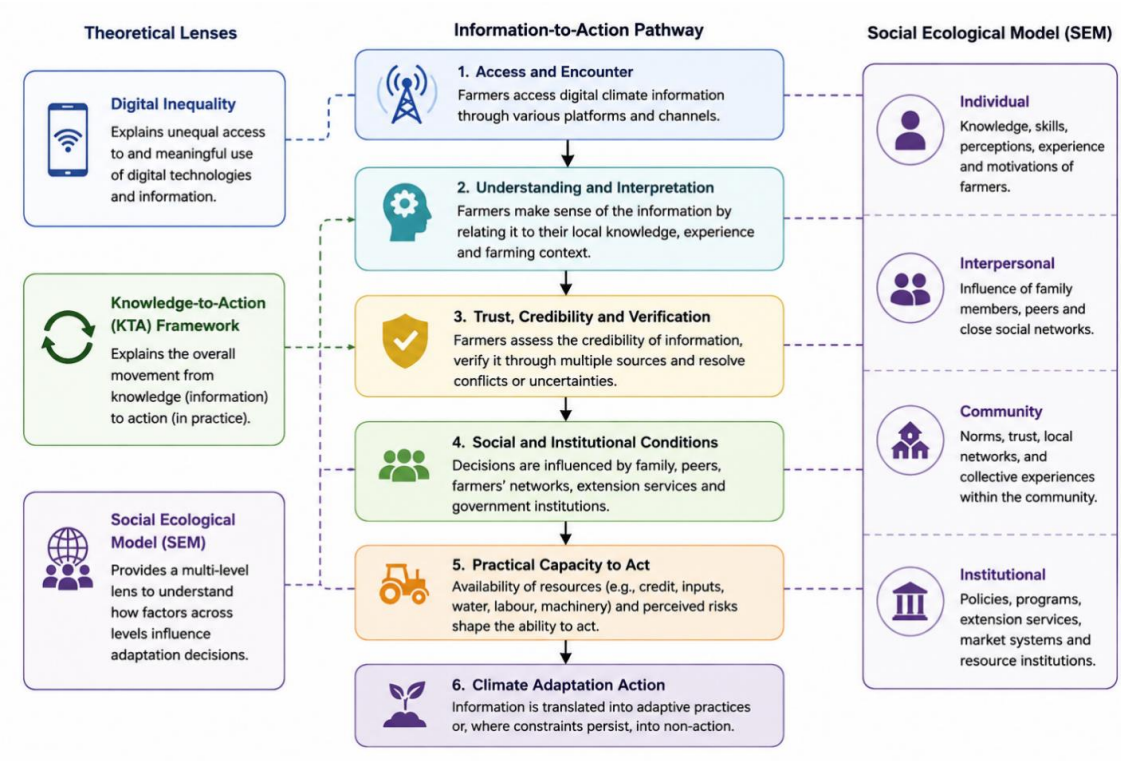

Figure 1: The model does not present the process as strictly linear. Farmers may return to other sources, seek advice, question information, or reconsider a decision at different stages. The model provides a

conceptual basis for examining where and why the movement from digital climate information to adaptation may be interrupted.

3. METHODOLOGY

3.1 Research Design

This study used a qualitative thematic research approach based on Focus Group Discussions (FGDs). The method was selected because the study is concerned not only with what farmers know or believe, but also with how they discuss, compare, question, and make sense of digital climate information in relation to their farming decisions. Shared perceptions and discrepancies can be identified, as well as areas of consensus and conflict, in group interaction but not necessarily in individual interviews (Morgan, 1997; Onwuegbuzie et al., 2009).

This was especially important at a time when farmers' decision-making processes regarding how to react to climate information were guided by family, fellow farmers, community experience, and institutional relationships.

3.2 Study Area and Participants

The study was conducted in Rajanpur District, Punjab, Pakistan. Participants were selected through purposive sampling to ensure that they had direct experience relevant to the research questions. Participants were adults aged 18 years or above who were currently engaged in farming and had experience receiving climate, weather, or climate-related agricultural information through digital platforms such as WhatsApp, YouTube, TikTok, and Facebook.

The participants varied in age, education, farming experience, and level of digital media engagement. This variation allowed the discussions to include different experiences of accessing and using digital climate information. People who were not engaged in farming, had no experience with relevant digital information, were under 18, or did not provide consent were excluded.

Table 1: *Demographic Characteristics of Focus Group Discussion Participants (N = 32)*

Characteristic	Category	*n*	*%*
Gender	Male	20	62.5
	Female	12	37.5
Age Group	18–34 years	11	34.4
	35–50 years	14	43.8
	> 50 years	7	21.8
Farming Experience	< 10 years	8	25.0
	10–20 years	15	46.9
	> 20 years	9	28.1
Socioeconomic Status / Landholding	Smallholder (< 5 acres)	19	59.4
	Medium-scale (5–12 acres)	9	28.1
	Large-scale (> 12 acres)	4	12.5
Digital Media Engagement Level	Direct User (Smartphones, self-search)	18	56.2
	Indirect User (Relies on family/peers)	14	43.8

Table 1 explains the demographic features of the sample. 62.5 percent of the sample was male, while the remaining 37.5 percent were female. Farmers in the 18- 34 age group were 34.4 percent; 35-50 were 43.8 percent, and above 50 were 21.8 percent

3.3 Focus Group Discussions

Four FGDs were conducted with a total of 32 farmers, with 8 to 10 participants in each group. The groups were guided by open-ended questions related to farmers' access to digital climate information, their

understanding and assessment of such information, trust and verification, social and institutional influences, and barriers to adaptation.

The use of several groups allowed recurring views as well as differences between participants to be considered. This is important in FGD research because interaction among participants is itself a source of data rather than simply a way of collecting several individual responses (Grønkjær et al., 2011; Morgan, 1997).

All discussions were audio-recorded with participants' consent. The researcher also noted important discussion points, areas of agreement and disagreement, and issues that appeared relevant during each session. The recordings were transcribed, and the transcripts were reviewed alongside the discussion notes.

3.4 Data Analysis

The data were analysed using thematic analysis. The researcher first became familiar with the transcripts and then identified relevant segments of the discussions and developed initial codes. Related codes were compared across the four FGDs and grouped into broader patterns. These patterns were discussed and developed with the questions of the research and the general information-to-action process. This analysis focused on the common and divergent perspectives and experiences within and between groups. This is a similar approach applied in qualitative FGD analysis, in which agreement, disagreement, and interaction may provide a means of understanding the way the group forms and constructs meaning as a collective group (Onwuegbuzie et al., 2009)

The data collection process continued until there was a beginning of recurring patterns in the discussions and more discussions appeared not to contribute new information to the patterns that were emerging. This point was discussed as theme saturation and not just based on the number of participants. The Social Ecological Model (SEM) served as a framework for analyzing the barriers at each level, such as individual, interpersonal, community, and institutional. It was not applied as a structure to impose themes onto the data, but as a vehicle to traverse the Knowledge-to-Action framework in conjunction with the data.

3.5 Ethical Considerations

Participation was voluntary, and participants gave their consent before joining the discussions and audio recording. The aims of the study, confidentiality, and informed consent were explained to the participants. The findings are reported using the participatory group approach and not by identifying information.

4. FINDINGS

The four focus group discussions were analyzed, and five interrelated themes were identified. Farmers reported successful use of digital climate information, though this was dependent on the ease of access, ease of understanding, trust in the information, and support from social and institutional frameworks. Frequently, however, there were constraints that influenced the decision to implement when information was received. The findings are presented below in a sequence that follows this process.

4.1 Theme 1: Accessing and Encountering Digital Climate Information

Farmers described a mixed information environment rather than dependence on one digital source. They mentioned WhatsApp groups, Facebook, YouTube, TikTok, mobile phones, and weather services alongside television, agricultural officers, input dealers, other farmers, and their own farming experience. Digital platforms provided information about rainfall, temperature, crop diseases, sowing times, irrigation, and pest management.

> *"Whenever we want to know about the weather or any problem in the crop, the first thing we do is check our mobile phone. Sometimes we see information on WhatsApp groups, sometimes on Facebook or YouTube. We also receive videos from other farmers about diseases, spraying and irrigation. If there is a chance of rain, someone usually shares the weather forecast in the group." (R: 01)*

Access, however, was not the same for all participants. Farmers with smartphones, internet access, and greater familiarity with digital platforms were more likely to search for information themselves. Others mainly received information through friends and relatives. Differences between younger and older farmers were also discussed.

> *"Not everyone uses these applications in the same way. Some people know how to search on YouTube or check the weather forecast, but many farmers only receive information when someone sends it to them. Usually, the younger people in the family have smartphones, and they tell the older farmers what they have seen on the internet." (R: 02)*

Participants further distinguished between simply receiving information and receiving information that was timely, understandable, and relevant to their crop and local conditions. Thus, having access to a digital platform did not necessarily mean having useful climate information.

> *"Information is available on the mobile, but that does not mean it is always useful for us. Sometimes the forecast is for the whole area, while conditions in our village are different. We need information at the right time and according to our own crop and locality." (R: 03)*

4.2 Theme 2: Making Sense of Digital Climate Information

Farmers did not treat digital climate information as ready-made advice. They interpreted forecasts and recommendations in relation to their own farming experience, observations and local knowledge. Participants discussed whether a forecast matched conditions in their village and whether it was relevant to their crop and sowing period.

> *"We can read the forecast on the mobile but cannot be blind. First, the conditions in our own neighborhood. Sometimes, we see the forecast of rain, but we don't see it in our village. We've been farming for a while now, so we take what we are seeing on the mobile and relate that to what we're seeing."(R: 04)*

Understanding was also affected by the way information was presented. Technical terms, unfamiliar language, and general forecasts could make information difficult to apply. Some participants said they could understand the information but were less certain about what action it required on their own farms. Education and digital literacy also created differences in how information was understood. Farmers therefore gave meaning to digital climate information by comparing it with what they already knew and observed.

> *"Weather information may be accurate overall but depends on the crop and its stage. Rain could be beneficial for one farmer, but disadvantageous for another, who may have just sprayed or may be ready to harvest. So, it is necessary to know the information in the context of their situation."(R: 05)*

Understanding was also affected by the way information was presented. Technical terms, unfamiliar language, and general forecasts could make information difficult to apply. Some participants said they could understand the information but were less certain about what action it required on their own farms. Education and digital literacy also created differences in how information was understood. Farmers therefore gave meaning to digital climate information by comparing it with what they already knew and observed.

"We can understand it if the information is not complicated. However, certain words and phrases used in the technical field are not known to ordinary farmers. If the message is understood by an educated person, but not by others, it may be difficult to know how the information applies to their fields." (R: 06)

4.3 Theme 3: Establishing Trust and Credibility in Digital Climate Information

Farmers did not automatically associate trust with digital information. They were more hesitant about accounts they were not familiar with on social media and about forwarded messages with an unclear source.

"There are lots of messages we receive on WhatsApp and Facebook, which we can't believe because at times we do not know who the sender is or where the information came from originally. If we are not aware of the source, we get doubts." (R: 07)

Doubt was a major factor in conflicting forecasts and differences between digital information and farmers' own observations. Information was deemed unreliable when forecasts were wrong, information was outdated, claims were exaggerated, or commercial information was provided without a clear source.

"We'll sometimes hear that it's going to rain, and sometimes that it's not going to rain," he says, "then we get confused about which one to take the word of. We also check the conditions here, as sometimes the forecast doesn't match up with what we're seeing here." (R: 08)

Meanwhile, farmers were not passive recipients of information that they were unsure about. They mentioned a few methods to verify it, such as consulting other farmers, calling input suppliers or agricultural officers, comparing them with other websites, and waiting to see if the forecast weather conditions were met. Trust was thus established by 'close comparison' and 'experience', and not by assumption from the digital platform itself.

"If we are not certain, then we do not take any action. We ask other farmers, sometimes we call the dealer or an agricultural officer, we may even go to another website or application to see if the same information is being provided." (R: 09)

4.4 Theme 4: Social and Institutional Contexts of Adaptation

The Social Ecological Model can also be used to facilitate understanding of this theme, which focuses on individual behavior within broader interpersonal, community, and institutional contexts. Social context appeared to influence farmers' adaptation decisions to some degree. Encouragement or discouragement of the adaptation could be done by family members, neighboring farmers, experienced farmers, and wider village networks.

"Before making a major change, we usually discuss it with people around us. We talk to other farmers and sometimes with our family because any decision can affect the income of the household. If people around us have tried something successfully, we feel more confident about doing it ourselves." (R: 10)

Also, institutional support played a role. Agricultural extension officers, government departments, and local agricultural advisory services were mentioned as sources of information for farmers; however, gaps between advice and assistance were also described. Some reported difficulty in communicating with officers, limited follow-up, and recommendations that were not appropriate for local conditions.

"Sometimes the officer tells us what we should do, but after giving the advice there is no follow-up. We may still face problems when trying to apply it. Giving information is not always enough because farmers may need further guidance and support." (R: 11)

Lack of consistency in government programs and underdeveloped coordination also hampered their confidence. The discussions therefore showed that receiving advice was different from receiving the support needed to act on it.

> *"Sometimes a program starts and farmers are encouraged to adopt something, but after some time the support is no longer available. Then we are left to manage on our own. This makes it difficult to depend on such programs when making important decisions." (R: 12)*

4.5 Theme 5: From Information to Action: Practical Constraints on Adaptation

The final theme showed most clearly why information did not always result in adaptation. Farmers were aware of practices such as changing sowing dates, modifying irrigation, using suitable crop varieties, and adopting water-saving methods. In several cases, the problem was not a lack of awareness or acceptance of these practices.

> *"There are times when we know what we should do, but we don't know what we can do. Sometimes we understand that we need to change the sowing time or that we need to use a different variety, but we have to decide whether we can afford the seed, and whether we can afford the risk." (R: 13)*

Implementation was constrained by the cost of inputs, limited credit, machinery, water availability, and additional labor. Small landholdings also increased the perceived risk of trying unfamiliar practices because a failed change could result in financial loss. Some farmers considered recommended practices useful but economically difficult to adopt.

> *"Many of the recommendations are useful, but everything requires capital. If you're told to use a different seed, change the irrigation system or use another method, you must first ask yourself if you have the resources to try it. Farmers who have a small amount of money put at risk can't simply take such risks." (R: 14)*

The discussions therefore pointed to a difference between knowing what to do and being able to do it. Digital climate information could improve understanding and even gain farmers' trust, but adaptation still depended on social support, institutional responsiveness and the resources available to the farmer. Therefore, several connected barriers rather than information availability alone played their part in shaping the information-to-action gap.

> *"The information can be correct and useful, and we can agree that the practice recommended is better, but when labor is costly or unavailable it may prove difficult to implement even if we believe it is better, as it will remain information." (R: 15)*

5. DISCUSSION

Regarding RQ1, the findings show that access to digital climate information does not necessarily mean that farmers can make effective use of it. The findings indicate that digital climate information does not lead to adaptation through a simple information-to-action process. This supports earlier research showing that the usefulness of climate information depends on how farmers understand, assess, and apply it in their local circumstances (Warner et al., 2022). The present findings add that farmers actively compare digital information with personal experience and local knowledge. Thus, meaningful access involves more than having a smartphone or receiving a forecast.

The findings related to RQ2 show that trust, social relationships, and institutional conditions play an important role in farmers' responses to digital climate information. Trust also emerged as an important part of this process. Farmers compared different sources and checked information through other farmers, agricultural officers, and their own observations. This supports research that identifies trust, credibility, and previous experience as important conditions for the use of climate information. At the same time, the

findings suggest that uncertainty is not limited to misinformation. Conflicting, outdated, or poorly sourced information can also make farmers hesitant to act. The findings also highlighted that adaptation is multidimensional, shaped by social and institutional conditions. Adaptation decisions can be influenced by family members, fellow farmers, and extension officers, but information alone is not enough when institutional follow-up is weak. This is consistent with research in Pakistan linking extension and ICT-based advisory services with adaptation (Anteneh & Melak, 2024). The gap between receiving advice and receiving practical support is particularly important in understanding farmers' decisions.

RQ3 focuses on the practical barriers that affect the translation of information into adaptation action. The findings show that knowledge and capacity are not the same thing. Farmers may know about adaptive practices and still not adopt them because of limited credit, water, inputs, machinery, labor, or fear of financial loss. This closely fits the Knowledge-to-Action framework, which recognizes that moving knowledge into practice depends on the conditions that support implementation (Graham et al., 2006). Overall, the study suggests that the information-to-action gap develops through the combined effects of access, interpretation, trust, social and institutional support, and practical capacity.

5.1 Theoretical Contribution

This study makes a theoretical contribution by extending the Knowledge-to-Action (KTA) framework to the context of digital climate information and rural climate adaptation. The findings show that the movement from information to action is not a simple or linear process. Farmers may receive climate information, understand it, and even consider it useful, but this does not necessarily lead to adaptation. The process can be interrupted at different points by problems of interpretation, trust, social influence, institutional support, and practical capacity. In this way, the study adds a more detailed understanding of the information-to-action gap within the KTA framework.

The study also brings the Social Ecological Model (SEM) into this process to show that barriers do not exist only at the individual level. Farmers' responses to digital climate information are influenced by family members, fellow farmers, community networks, extension services, and wider institutional conditions. The findings therefore suggest that the movement from knowledge to action should be understood as a process shaped by both individual decisions and the social and institutional environment.

A further contribution comes from linking Digital Inequality with the KTA process. Digital inequality is usually discussed in terms of access to devices, connectivity, skills, and meaningful use. The findings suggest that these differences can influence the process from its very beginning. Farmers do not have equal opportunities to find, understand, evaluate, and benefit from digital climate information. Thus, digital inequality can shape not only who receives information, but also who is able to turn that information into useful action.

6. CONCLUSION

This study shows that access to digital climate information does not automatically lead to adaptation among rural farmers in Pakistan. Farmers first need to understand and assess the information, decide whether it is trustworthy, and consider it within their social and institutional settings. Even when information is accepted, limited money, input, water, labor, credit, and other resources can prevent action.

The findings therefore illustrate that the information-to-action gap is not simply an information problem. It reflects the combined effects of access, understanding, trust, social and institutional support, and practical capacity. Improving digital climate services therefore requires not only better information, but also greater support for farmers to use that information in practice.

6.1 Limitations

This study was limited to 32 farmers from Rajanpur District of Punjab and therefore does not represent all rural farmers in Pakistan. The findings are based on four FGDs, which reflect the common discussions and experiences of the participants and not a generalization of statistics. The study was also limited to

farmers who had a certain level of experience using digital climate and/or agricultural information; therefore, those who did not have representation in the study.

Self-reported experiences and perceptions were used as the basis for the study and may be subject to personal perspectives and memory. Because the research was on digital information, it did not explore farmers depending only on non-digital information. To further explore this, more locations and farmers with varying levels of digital access could be included in future studies.

Acknowledgements

None.

Conflict of Interest

Authors declared NO conflict of interest.

Funding Source

The authors received NO funding to conduct this study.

ORCID iDs

Mohammad Kashif [1] https://orcid.org/0009-0008-2108-2793
Aatif Iftikhar [2] https://orcid.org/0000-0003-3132-369X
Syed Muhammad Hasnain Raza [3] https://orcid.org/0009-0007-9744-1863
Shazma Zareen [4] https://orcid.org/0009-0001-5240-1485
Naeem Ullah Tariq [5] https://orcid.org/0009-0002-7713-3971

REFERENCES

Abid, M., Scheffran, J., Schneider, U. A., & Ashfaq, M. (2015). Farmers' perceptions of and adaptation strategies to climate change and their determinants: The case of Punjab province, Pakistan. *Earth System Dynamics*, *6*(1), 225–243. https://doi.org/10.5194/esd-6-225-2015

Anteneh, A., & Melak, A. (2024). ICT-based agricultural extension and advisory service in Ethiopia: A review. *Cogent Food & Agriculture*, *10*(1), 2391121. https://doi.org/10.1080/23311932.2024.2391121

Appiah, C. E., Quarmine, W., Osei-Amponsah, C., Okem, A. E., & Sarpong, D. B. (2025). Improving smallholder farmers' access to and utilization of climate information services in sub-Saharan Africa through social networks: A systematic review. *Climate Services*, *37*, 100528. https://doi.org/10.1016/j.cliser.2024.100528

Elgammal, N., Safdar, G., Raza, S.M.H., Abdelhalim, S., Iftikhar, A., Okasha, H. (2026). Environmental documentaries and the climate crisis: a multidimensional thematic analysis. *Frontiers in Communication, 11*, 1864985. https://doi.org/10.3389/fcomm.2026.1864985

Graham, I. D., Logan, J., Harrison, M. B., Straus, S. E., Tetroe, J., Caswell, W., & Robinson, N. (2006). Lost in knowledge translation: time for a map? *The Journal of Continuing Education in the Health Professions*, *26*(1), 13–24. https://doi.org/10.1002/chp.47

Grønkjær, M., Curtis, T., De Crespigny, C., & Delmar, C. (2011). Analysing group interaction in focus group research: Impact on content and the role of the moderator. *Qualitative Studies*, *2*(1), 16–30. https://doi.org/10.7146/qs.v2i1.4273

Javed, M. N., Adnan, H. M., Hanan, M. A., Sarmiti, N. Z., Adeeb, H., Khan, A., & Iftikhar, A. (2023). Social media reporting on agricultural adaptation to climate change in Pakistan: Measures and implications for sustainability. *Heliyon*, *9*(11), e21579. https://doi.org/10.1016/j.heliyon.2023.e21579

Kashif, M., Raza, S. M. H., & Zareen, S. (2026). Gendered dimensions of crisis communication: Women's lived experiences during the 2025 floods in Pakistan. *Human Nature Journal of Social Sciences*, *7*(1), 10–22. https://doi.org/10.71016/hnjss/bmkk7h36

Khan, N. A., Ma, W., Owusu, V., & Shah, A. A. (2023). Does ICT-based farm advisory improve farmers' adaptation to climate change? Evidence from Pakistan. *Climate and Development*, *15*(8), 639–654. https://doi.org/10.1080/17565529.2022.2143232

Madhuri. (2023). How do climate information services (CIS) affect farmers' adaptation strategies? A systematic review. *Climate Services*, *32*, 100416. https://doi.org/10.1016/j.cliser.2023.100416

Morgan, D. L. (1997). *Focus groups as qualitative research* (2nd ed.). Sage.

Mustafa, G., & Alotaibi, B. A. (2024). Fostering adaptation to climate change among farmers in Pakistan: the influential role of farmers' climate change knowledge and adaptive capacity. *Frontiers in Sustainable Food Systems*, *8*. https://doi.org/10.3389/fsufs.2024.1471238

Nawaz, M., & Avetisyan, M. (2025). Rural credit market imperfection in financing climate change adaptation: Evidence from Pakistan. *Journal of Climate Finance*, *10*, 100062. https://doi.org/10.1016/j.jclimf.2025.100062

Onwuegbuzie, A. J., Dickinson, W. B., Leech, N. L., & Zoran, A. G. (2009). A qualitative framework for collecting and analyzing data in focus group research. *International Journal of Qualitative Methods*, *8*(3), 1–21. https://doi.org/10.1177/160940690900800301

Porciello, J., Coggins, S., Mabaya, E., & Otunba-Payne, G. (2022). Digital agriculture services in low- and middle-income countries: A systematic scoping review. *Global Food Security*, *34*, 100640. https://doi.org/https://doi.org/10.1016/j.gfs.2022.100640

Raza, S. M. H., & Shah, B. H. (2024). Global news coverage of climate change: A comparative analysis of South Asian press. *Human Nature Journal of Social Sciences*, *5*(3), 275–287. https://doi.org/10.71016/HNJSS/DE0TP681

Saddique, N., Jehanzaib, M., Sarwar, A., Ahmed, E., Muzammil, M., Khan, M. I., Faheem, M., Buttar, N. A., Ali, S., & Bernhofer, C. (2022). A systematic review on farmers' adaptation strategies in Pakistan toward climate change. *Atmosphere*, *13*(8), 1280. https://doi.org/10.3390/atmos13081280

Sharma, K., Katoch, S., Mohapatra, S., Kaur, M., & Kumar, A. (2025). Access to digital services and its impact on farm income: Empirical evidence from Eastern India. *Agricultural Economics Research Review*, *38*(2), 184–193. https://doi.org/10.1177/09713441251395494

Upadhyaya, L., Burman, R. R., Sangeetha, V., Lenin, V., Sharma, P. J., & Dash, S. (2019). Assessment of level of digitization of farmers and extent of digital divide in farm information delivery. *Indian Journal of Extension Education*, *55*(1), 115–118.

van Dijk, J. A. G. M. (2020). *The digital divide*. Polity Press.

Warner, D., Moonsammy, S., & Joseph, J. (2022). Factors that influence the use of climate information services for agriculture: A systematic review. *Climate Services*, *28*, 100336. https://doi.org/https://doi.org/10.1016/j.cliser.2022.100336