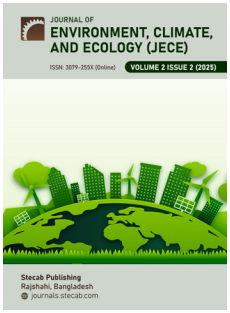

Journal of Environment, Climate, and Ecology (JECE)

ISSN: 3079-255X (Online)

Volume 2 Issue 2, (2025)

https://doi.org/10.69739/jece.v2i2.707

https://journals.stecab.com/jece

Published by
Stecab Publishing

Research Article

Climate Change Adaptation through Tacit Knowledge: Exploring the Invisible Pillars of Socioeconomic Resilience in Rural Africa

*[1]Kassim Alabani, [2]Alhassan Ziblim, [2,3]Clifford Bugli, [1]Prince Opoku

About Article

Article History

Submission: June 02, 2025
Acceptance : July 08, 2025
Publication : July 23, 2025

Keywords

Climate Change Adaptation, Community-Based Adaptation, Indigenous Knowledge, Rural Africa, Socioeconomic Resilience, Tacit Knowledge

About Author

[1] School of Economics, University of Cape Coast, Ghana

[2] SD Dombo University of Business and Integrated Development Studies, & University for Development Studies, Ghana

[3] School of Allied Health Sciences, University for Development Studies, Ghana

Contact @ Kassim Alabani
kassim.alabani001@stu.ucc.edu.gh

ABSTRACT

Climate change is still putting the lives and ecological stability of rural Africa at risk. Poor communities are dealing with more and more droughts, unpredictable rain, and lower agricultural productivity. Although formal adaptation frameworks typically prioritize scientific and technological interventions, this study investigates the often-overlooked significance of tacit knowledge; locally embedded, experiential, and orally conveyed practices enhance climate change adaptation and socioeconomic resilience. Guided by resilience theory and an interpretivist framework, the study employs a qualitative methodology, utilizing 20 in-depth interviews and four focus group discussions in rural communities of Northern Ghana and Eastern Uganda. The results indicate a diverse array of tacit strategies, encompassing ecological forecasting, conventional water harvesting, crop diversification utilizing indigenous seeds, and resilient social reciprocity frameworks. The paper backs call for recognising and including tacit knowledge in formal policy planning and program design. The study adds new empirical evidence and a strong theoretical framework to the conversation about climate change in the developing world by focussing on the "invisible pillars" of adaptation.

Citation Style:

Alabani, K., Ziblim, A., Bugli, C., & Opoku, P. (2025). Climate Change Adaptation through Tacit Knowledge: Exploring the Invisible Pillars of Socioeconomic Resilience in Rural Africa. *Journal of Environment, Climate, and Ecology, 2*(2), 9-19. https://doi.org/10.69739/jece.v2i2.707

1. INTRODUCTION

Climate change is a widespread global catastrophe that adversely affects vulnerable populations, especially those residing in rural regions of developing nations. The interplay of socio-economic vulnerability, environmental degradation, and ineffective institutions in sub-Saharan Africa exacerbates the impacts of climate shocks (Tolulope *et al.*, 2025; Muhamya *et al.*, 2024). The weather and social and economic conditions in Africa have a direct effect on the farming activities of its rural population. Farming in Africa depends a lot on rain and other weather conditions, so changes in temperature and seasons are very important for business (Ricart *et al.*, 2022). Extreme weather, like long droughts, unpredictable rain, and widespread flooding, has hurt a lot of people, property, and food systems (Asuamah Yeboah, 2024).

There have been a lot of serious efforts around the world and in the region to help people adapt to climate change, but most of the plans have been based on formal, technical, and infrastructure-based solutions. These include big irrigation systems, new weather forecasting tools, and systems that send out early warnings to everyone. Still, these efforts often don't take into account the unique situations that exist in rural areas, where traditional and culturally ingrained ways of coping are still important for everyday adaptation (Giacomelli *et al.*, 2022; Golfinopoulos & Koumparou, 2024). There is a growing academic interest in informal, experiential knowledge systems, especially tacit knowledge, that are based on local cultural practices and passed down through generations (Yao & Bell, 2022; Masenya, 2023).

In this context, tacit knowledge refers to the unspoken, intuitive, and experiential understandings that individuals and communities utilize to navigate environmental uncertainty. It includes farming calendars based on ecological indicators, oral histories of past environmental events, and socially ingrained habits that encourage sharing resources and managing risks as a group (Yan & Yu, 2021; Salama *et al.*, 2024). In rural Africa, this kind of knowledge is often the main way to protect against climate change, especially when there isn't any formal institutional support (Tschakert *et al.*, 2023).

The main goal of this study is to address the ongoing exclusion of tacit knowledge from formal climate change adaptation planning and policy frameworks. Tacit knowledge is still mostly "invisible" in national adaptation strategies, donor-funded interventions, and international climate governance dialogues, even though it has been shown to be useful (Boulle, 2023; Jackson *et al.*, 2023). This lack of visibility makes the gap between official adaptation mechanisms and the lives of communities that are most affected by climate change even bigger (German, 2022; Petit-Perrot, 2022). As a result, interventions that don't include a lot of indigenous knowledge systems often don't make sense in the context and don't last long (Enomoto & Umeya, 2022).

The purpose of this study is to look at how tacit knowledge can help rural Africans adapt to climate change and, as a result, make their economies more resilient. The study looks at communities in Ghana and Uganda, two countries where rural livelihoods are especially vulnerable to climate-related disruptions and where indigenous knowledge systems are still used (Karunarathne, 2020). This geographical focus enables a thorough examination of context-specific experiences and yields significant insights into overarching regional dynamics. This study seeks to investigate the function of tacit knowledge in facilitating adaptation to climate and socioeconomic resilience in rural Africa. The specific goals are:

i. To determine the characteristics and manifestations of tacit knowledge utilised in rural communities for climate change adaptation.

ii. To assess the contribution of this knowledge form to socioeconomic resilience.

iii. To evaluate the degree to which tacit knowledge is acknowledged or integrated within formal adaptation frameworks.

2. LITERATURE REVIEW

2.1. Empirical review

Tolulope *et al.* (2025) undertook a thorough examination of the responses of rural communities throughout Africa to climate-induced environmental changes. Through an integrative literature approach, the authors assert that community-based adaptation strategies, despite lacking technical sophistication, are often contextually relevant and effective in mitigating climate stressors. The research conducted by Tolilope *et al.* (2025) is very important because it focusses on a specific region, which allows for a wide range of experiences to be captured in different national settings. The study does, however, provide only a limited understanding of how informal knowledge systems work, instead focusing on codified institutional responses.

Madzivhandila (2024), on the other hand, looks at how local knowledge systems help South Africa deal with climate change, focussing on communities that have been left out in the past. The author used a qualitative approach that included focus groups and in-depth interviews. They found that traditional ecological knowledge helps people survive and gives them a sense of cultural identity and collective strength. This study agrees with Tolulope *et al.* (2025) that tacit knowledge is important, but it doesn't go into detail about how this knowledge interacts with formal policy frameworks. Both studies show how important indigenous adaptation mechanisms are, but they use different methods to look at how visible this knowledge is in policymaking. Alhassan and Haruna (2024) talked to farmers in rural areas of Nigeria and Ethiopia to learn how they feel about climate change and how they plan to deal with it. The results show that farmers use a lot of traditional methods, like crop rotation, planting early, and saving water, which they learnt through years of experience. One of the best things about their study is that it compares two countries, which makes it easier to analyse the context. The authors did, however, point out that these strategies are not widely recognised by national climate policy frameworks.

Ketlhoilwe (2022) underscores the significance of community knowledge in Botswana, particularly within women-led groups that exchange adaptation perspectives through informal channels. This study places greater emphasis on gendered knowledge systems and collective memory as resilience strategies in comparison to Alhassan and Haruna (2024). Both

studies emphasize the role of tacit knowledge in maintaining rural livelihoods, yet they reveal a policy deficiency that excludes such knowledge from formal adaptive frameworks. Theodory (2021) presents a case study from Tanzania's Ngono River Basin, illustrating how local farmers rely on environmental indicators, such as the flowering of particular plants or the migration of animal species, as early warning systems. This qualitative study emphasizes the accuracy and dependability of these indicators for agricultural planning. Nonetheless, it failed to provide a framework for the formal integration of these cues into national meteorological services. In a similar vein, Nyadzi *et al.* (2021), in their systematic review of indigenous knowledge and climate change adaptation across Africa, present numerous instances of local communities utilizing ecological indicators to predict weather phenomena. They contend that, notwithstanding their effectiveness, these systems are often regarded as "unscientific." In comparison with Theodory (2021), their review illustrates a prevalent issue, highlighting the marginalization of empirically based yet uncodified knowledge systems. Both studies underscore the predictive reliability of tacit knowledge while revealing the lack of institutional mechanisms for integration.

Madzivhandila (2024) illustrates the role of local knowledge systems in promoting social cohesion within South African communities. The author's findings indicate that cultural rituals and traditional leadership structures function as coordination mechanisms during climate-induced crises. This focus on community improves how people work together and help each other, especially in areas that are already at risk. Salama *et al.* (2024) investigate the cultural significance of place-based knowledge in urban settings, emphasizing that tacit knowledge is fundamental to community identity and environmental stewardship. Their insights, while concentrated on urban populations, align with Madzivhandila's (2024) findings in rural contexts. Both studies confirm that climate resilience is not merely a technical concept but is profoundly connected to cultural values and social cohesion.

Yao and Bell (2022), in their examination of water management within China's "Sponge City" initiative, demonstrate the integration of tacit knowledge into urban infrastructure planning. Their findings indicate that hybrid systems, which integrate expert and indigenous knowledge, improve both sustainability and community ownership. Although the study concentrates on a non-African context, it offers transferable insights into knowledge pluralism. In the African context, Nyadzi *et al.* (2021) and Ketlhoilwe (2022) emphasize the necessity for collaboratively developed climate information systems. Their research suggests participatory models that amalgamate indigenous and technical knowledge through workshops and community-based monitoring. These studies encounter more systemic impediments than Yao and Bell (2022), including insufficient resources and policy inertia; however, they collectively advocate for integrative knowledge practices.

Torhemen *et al.* (2024) investigated the adoption of agroforestry technology in Nigeria, revealing that although local communities possess extensive knowledge regarding land and water management, their viewpoints are rarely integrated into policy. Their research indicates a disjunction between community knowledge and institutional governance. Boulle (2023) presents a comprehensive critique by examining the nationally determined contributions (NDCs) of South Africa, Ghana, and Kenya. The author identifies a scenario in which policy knowledge systems are predominantly influenced by expert-driven narratives, thereby marginalizing local perspectives. This exclusion diminishes both legitimacy and effectiveness. In contrast to Torhemen *et al.* (2024), Boulle's work contextualizes the issue within global climate governance discourses, thereby introducing a political economy perspective to the exclusion of tacit knowledge.

Nyadzi *et al.* (2021) articulate apprehensions regarding the persistent degradation of local knowledge systems due to urbanization, globalization, and intergenerational disconnection. Their review emphasizes that younger generations are increasingly deprived of indigenous ecological knowledge, thereby compromising the sustainability of adaptation strategies. Hussein *et al.* (2024) contributes an additional layer by examining the gendered aspects of knowledge systems. Their Islamic legal analysis asserts that patriarchal norms obstruct women's engagement in climate adaptation discourse, despite women being essential custodians of local knowledge. These findings align with those of Ketlhoilwe (2022), who emphasizes the crucial function of women's informal networks in Botswana.

These studies collectively validate the importance of tacit knowledge in enhancing socioeconomic resilience to climate change. They highlight a plethora of experiential, culturally ingrained practices pertinent to the unique contexts of African rural communities. However, a persistent disjunction exists in the literature; despite tacit knowledge being acknowledged as effective, it is consistently overlooked in policy frameworks and adaptation strategies. Limited research has comprehensively examined the role of this type of knowledge in enhancing resilience or its integration into formal governance frameworks. This study aims to address the existing gap by examining the specific roles and dynamics of tacit knowledge in enhancing resilience within rural African communities, particularly in Ghana and Uganda. In this way, it hopes to add to the conversation about climate adaptation and pluralistic knowledge systems in both theoretical and practical ways.

2.2. Theoretical framework

This research is grounded in resilience theory, which offers a conceptual framework for comprehending the responses of social-ecological systems to external shocks, including climate change, and their subsequent recovery. Emerging from the ecological sciences via the contributions of C.S. In the 1970s, Holling defined resilience as the ability of ecosystems to withstand disturbances while maintaining essential functions (Holling, 1973). Over time, scholars like Neil Adger, Carl Folke, and Brian Walker have expanded this idea to include socio-ecological aspects, emphasizing how human and natural systems evolve and adapt together (Folke, 2006; Adger, 2000; Walker *et al.*, 2004).

Resilience theory is especially important for rural African communities because climate change, poverty, and weak institutional support systems are making things harder

for them. These communities often face severe weather events, unpredictable rainfall, and declining agricultural productivity, all of which jeopardize livelihoods and food security. Resilience theory offers frameworks for analyzing how these communities adapt via both absorptive and transformative strategies (Tschakert *et al.*, 2023). The principal concept in resilience theory is adaptive capacity, referring to the ability of individuals and communities to modify their behaviors, practices, and institutions in reaction to climatic stressors. Indigenous practices, social networks, and cultural norms all contain tacit knowledge that is very important for building this adaptive capacity. It represents the repository of experiential perspectives that guide decision-making in the absence of formal scientific data or institutional interventions (Madzivhandila, 2024).

Resilience theory also recognizes the possibility of transformation, wherein institutions and concepts that can no longer maintain themselves through gradual change may coalesce into more stable frameworks. In rural Africa, such transformation may encompass the expansion of livelihoods, the reconfiguration of land use practices, or the integration of indigenous knowledge with scientific methodologies. This study employs resilience theory to examine not only how communities adapt to the impacts of climate change but also how they reconfigure and reimagine their social-ecological systems to flourish amid uncertainty. Thus, resilience theory offers a comprehensive framework for examining the intricate interactions among climate change, tacit knowledge, and socioeconomic adaptation within the context of rural Africa. It emphasizes the importance of bolstering community-based knowledge systems as vital elements of climate resilience strategies.

In rural Africa, tacit knowledge is an important resource for dealing with climate change, but it is often ignored. Policymakers and practitioners can use this information to make people more resilient by understanding how important traditional practices, early warning systems, and cultural cohesion are. But to really reach its full potential, we need to look at issues like the loss of local knowledge, less recognition by policymakers, and gender inequality. It is very important to promote tacit knowledge through codification, community empowerment, policy harmonisation, and collaboration across sectors in order to find good and long-lasting ways to deal with climate change.

Table 1. key insights on tacit knowledge and climate change adaptation in africa

Region/Country	Key Strategies/Practices	Challenges/Barriers	Citation
Nigeria	Growing a variety of crops, planting early, and getting knowledge about the climate	Not fully included in national policies, disparities among men and women	(Torhemen *et al.*, 2024)
Botswana	Social learning, women's groups, shared experiences	Reliance on informal communication and susceptibility to modernisation	(Ketlhoilwe, 2022)
Tanzania	Soil and water conservation, traditional weather forecasting	Decline in traditional knowledge transmission, cultural shifts	(Theodory, 2021)
South Africa	Indigenous knowledge systems, community-based initiatives	Marginalisation by scientific approaches, policy oversight	(Madzivhandila, 2024)
Eastern Africa	Diversification of pasture fodder species, access to technology	Lack of timely weather forecasts, gender influence on decision-making	(Hussein *et al.*, 2024)

3. METHODOLOGY

This study applies a qualitative research design based on interpretivist epistemology. This method lets you look closely at how people and communities who use tacit knowledge to deal with the bad effects of climate change live and what they think about it. Researchers have found that qualitative research designs are particularly good at looking at complex social phenomena in specific situations because they focus on depth rather than breadth and allow for more detailed understanding of social processes and localised worldviews (Tisdell *et al.*, 2025; Bercht, 2021). The study took place in rural parts of Northern Ghana and Eastern Uganda. We chose these places because climate change has had a big effect on them. For example, they have had a lot of droughts, strange rain patterns, and food insecurity that is getting worse. They also have a lot of indigenous and tacit knowledge that has been passed down through the years.

We used purposive sampling to choose people who had a lot of experience with indigenous climate adaptation practices. There were 40 people in the sample, including subsistence farmers, traditional leaders, women's group leaders, and local agricultural extension officers. This method was chosen to make sure that people with different types of knowledge in the communities were included. It also follows best practices in qualitative research for finding key informants (Tisdell *et al.*, 2025). We got our data by using two qualitative methods: in-depth interviews and focus group discussions. We did 20 semi-structured interviews to learn about people's personal stories and deep thoughts on how to adapt and cope with things in their own communities. There were also four focus group discussions (FGDs), each with 5 to 8 people. These FGDs were a place for people to talk to each other, share information, and come up with shared values and beliefs about how to deal with climate change. We made interview guides based on themes found in the literature, such as how people learn, how they deal with problems, how they see risks, and how they feel about

formal climate interventions (Bercht, 2021).

The thematic analysis was used to look at the qualitative data. The first step was to code the transcripts of interviews and notes from focus group discussions. Then, overarching themes were created to summarise the main patterns in the data. We coded by hand so we could really understand the text, and we used different methods and people to make sure the data was correct. Also, member checking was done by showing the first results to a few chosen participants and asking for their feedback and approval. This is a way to make qualitative research more credible (Tisdell *et al.*, 2021; Borgstede & Scholz, 2021).

To make sure the study follows ethical standards, it got ethical approval from well-respected institutional review boards in Ghana and Uganda. Everyone agreed to take part after being told what the research was for, what their rights were, and how the data would be used. Confidentiality and anonymity were strictly followed throughout the entire research process. It was clear that working with vulnerable communities on climate issues was an ethical issue, and it was handled with care (Ghadge *et al.*, 2020). This method is meant to look into the parts of tacit knowledge that are often ignored in climate change adaptation. It is also in line with calls in the literature for more use of qualitative methods to understand the social aspects of environmental change (Bercht, 2021; Tisdell *et al.*, 2025). Table 2 summarizes the methodology employed.

Table 2. Summary of methodology

Participant Role	Location	Data Collection Method	Number of Participants
Subsistence Farmers	Northern Ghana & Eastern Uganda	Semi-structured Interviews & FGDs	18
Traditional Leaders	Northern Ghana & Eastern Uganda	Semi-structured Interviews	6
Women's Group Leaders	Northern Ghana & Eastern Uganda	Semi-structured Interviews & FGDs	8
Agricultural Extension Officers	Northern Ghana & Eastern Uganda	Semi-structured Interviews	8
Total			**40**

4. RESULTS AND DISCUSSION

This section shows what the study found based on three specific goals: (1) figuring out what kinds of tacit knowledge rural communities use to deal with climate change, (2) figuring out how these kinds of knowledge help socioeconomic resilience, and (3) figuring out how much tacit knowledge is acknowledged or included in formal adaptation frameworks.

4.1. Forms of tacit knowledge used in climate change adaptation

The study noticed a wide range of tacit knowledge forms that are used in the daily lives of people in rural areas of Ghana and Uganda. This kind of knowledge comes from the culture of the area, is passed down orally, and is very old. One important way to use this information is to use biological and ecological indicators to guess how the weather will change, especially when it rains. Farmers and older people in both countries are very close to their environment, which helps them notice small changes that mean bad weather is coming. A farmer in Northern Ghana said, "When the Shea-nut trees start to bud early and the baobab leaves grow thick, we know the rains will be good that year." These kinds of observations aren't just one-time things; they're part of a bigger body of knowledge. People in the area guess what the weather will be like by watching how animals move, how trees bloom, and how insects act. Someone from Eastern Uganda said something like this: "If the wild mushrooms grow early and the termites come out in large numbers, it means we need to get our farms ready for heavy rain."

People have passed down these signs for a long time, and they are good ways to guess what will happen. Kids learn from their elders by watching them, hearing stories, and working on the farm with them. "Reading the land" is a useful skill that takes years of living in the area and paying close attention to how things change in nature. Along with talking about the weather, the people also talked about traditional ways to manage water. This showed that they knew a lot about how water is available at different times of the year and how it moves through the landscape. In some low-lying areas of Northern Ghana that are known to collect runoff, people build traditional dugouts. These are shallow water reservoirs that people dug by hand. "My grandfather taught me how to dig rain traps where water naturally collects," one person said. "We find water there even when it's dry." People have learnt how rain falls and how quickly soil absorbs it, and these ways of storing water are based on that knowledge. They also use old-fashioned engineering methods, like putting stones around the edges of water pits to keep them from eroding and losing water through seepage.

Long-standing customs guide how people in Uganda share water and water their crops. People in the community stressed how important it is for elders to lead informal irrigation rotations to make sure everyone has fair access to the limited water resources. "We follow the schedule set by elders; everyone knows when it's their turn to channel water to their fields." People trust each other and follow social norms and moral expectations instead of formal rules, which is why these systems work. This shows how important it is to trust others, give back, and follow the rules of your community. If you don't follow these rules, you might have problems with other people, which shows how deeply ingrained they are in society. People who took part said they planted crops and made other decisions that were in line with the lunar and traditional calendars. Farmers often look at the moon's phases and the planting schedules of their ancestors to decide when to plant or

harvest. A Ghanaian elder said, "The full moon tells us when to plant maize; it always brings strong roots." Formal science often ignores these kinds of beliefs, but they show that people have been watching the environment for a long time and can help with planning when to plant crops.

In essence, these results show that tacit knowledge is more than just stories or superstitions; it is a well-organised, useful, and scientifically sound body of knowledge. It helps manage resources, protect the environment, and keep farming strong in rural Africa. It is very important because it shows how important lived experience and talking between generations are for coming up with ways to deal with climate change that work in some places.

4.2. The role of tacit knowledge in socioeconomic resilience

The study showed that tacit knowledge is very important for making rural communities stronger in both their economy and their society. It has an effect on how people adjust to changes in their surroundings and how they work together to keep their economy going. Participants repeatedly stressed agroecological practices as important ways to lower risk and ensure that there is enough food. These practices are based on generations of experience. Intercropping was one common thing that came up. It helps spread risk during times of year when things aren't always clear. Farmers in Northern Ghana and Eastern Uganda talked about planting crops that help each other grow and keep them safe in case something goes wrong. "We plant groundnuts with maize," said one farmer from Ghana. One will survive if the other fails. This way, everyone in the house has enough to eat. This method not only helps with soil health and a variety of foods, but it also keeps crops from dying completely, which is especially important in places where the weather changes a lot. You don't learn these kinds of things in a formal agronomy class. You learn them by trying things out in a certain area and then slowly sharing what you learn.

A lot of people also talked about using native seed types. People who took part in the study said over and over that they liked traditional seeds better than commercial hybrids because they can adapt to local conditions and are less likely to be affected by pests and drought. "The seeds we use have been with us for generations," said a Ugandan. "They last longer than the ones you can buy in town." Families usually trade these native seeds and keep them safe in community seed banks or other informal ways. People care about these seeds because they are important for farming and have a lot of meaning in history and culture. Tacit knowledge also strengthens social safety nets by using informal systems of mutual aid and reciprocity. People in both countries deal with shocks like floods, droughts, or bad harvests by relying on family, sharing work, and giving food to those in need. "I got food from my neighbours when my family lost crops to floods," one person said. We do the same thing when someone else needs help. When people think this way, they really believe in helping others and being responsible for what they do. Those who have more than they need should help those who don't. This will make the group stronger and fairer. There are unspoken rules that govern these social behaviours, and social pressure and group expectations keep them going.

Another important thing that tacit knowledge does is help keep social capital strong. A lot of people who answered said that trust, remembering things together, and making decisions together are very important. Traditional leaders and elders are very important when people disagree, need to figure out how to use land, or need to take care of shared resources. A Ghanaian elder said, "People listen when the elders talk." We don't do the same things wrong again because we remember what happened during the last drought. People really respect these informal leadership structures and think they are better at responding to people's needs than outside authorities. Participants often doubted formal institutions, saying that government actions were slow, corrupt, and not sensitive to other cultures.

The results show that tacit knowledge is what makes rural economies strong in general. It helps families and communities deal with uncertainty by giving them different ways to make money, encouraging them to work together, and letting them learn from their mistakes. These communities don't just use official support systems. Instead, they stay healthy by using what they know and the strength of many people working together, even when the weather changes and the economy gets bad.

4.3. Recognition and integration in formal adaptation frameworks

Even though tacit knowledge is very important for adapting to climate change, research from Ghana and Uganda shows that it is often not included in official plans and policies. People from different parts of the study said that even though traditional practices are well-known and have been shown to work, people from outside the area don't talk about or use them very much in development programs.

A farmer from Northern Ghana said, "The people from the district office come with plans, but they don't ask us how we get through the dry seasons." People in Eastern Uganda said this too. They thought that formal adaptation strategies often come from higher up and don't take into account what rural people have been through and what they know about their environment. Most of the time, government extension workers and development agents were taught how to use new farming methods, but they didn't learn much about how traditional ways of knowing work.

One extension officer said, "We know the elders have wisdom we don't always understand or use," even though they are trained in modern methods. Some people said that their traditional knowledge was sometimes recognised, like during pilot projects for agroforestry or workshops on saving water. But a lot of the time, these programs didn't last long and there was no way to make them bigger or add to them over time. "They were interested in how we planted things once, but the project ended before anything could be built on," said a community leader from Uganda. The way that adaptation programs were set up made it hard for people to really learn from each other. People said that even though local people, like elders and leaders of women's groups, have important knowledge about climate issues, they are not often included in consultation processes or stakeholder dialogues.

This disconnection has a far reaching effects on how well

adaptation works. Policies that don't take into account local knowledge might lead to interventions that don't work, aren't culturally appropriate, or don't last. Indigenous practices can also become weaker when tacit knowledge is not included because younger people see them being pushed aside in favour of solutions that outsiders support. But there were still a few signs that things were getting better. In some places, NGOs and civil society groups have started to build places where scientists, policymakers, and people who have traditional knowledge can work together to share what they know. Even though these efforts are small, they show that adaptation planning could be more open and include more people. The results show that there is still a disagreement between formal adaptation systems and community-based ways of knowing. Even though tacit knowledge is still an important part of climate resilience, its lack of visibility in policies and institutions keeps it from reaching its full potential. To close this gap, we need to work hard to give local voices more power in conversations and actions about adaptation. This will make sure that policies are in line with and help the people who are most affected by climate change.

4.4. Discussion of results

In Ghana and Uganda, rural communities depend on a variety of tacit knowledge systems that come from cultural heritage, long-term observation of the environment, and passing down knowledge from one generation to the next. Most of these types of knowledge are oral, experiential, and specific to a certain situation, which makes them very well suited to local ecosystems (Madzivhandila, 2024; Nyadzi *et al*., 2021). Using biological and ecological indicators to predict rain and weather changes is a common example. Farmers in both countries said they used animal behaviour, tree flowering, and insect activity as signs. "When the Shea-nut trees start to bud early and the baobab leaves grow thick, we know the rains will be good that year," said a farmer in Northern Ghana. In the same way, a participant from Eastern Uganda said, "If the wild mushrooms grow early and the termites come out in large numbers, it means we need to get our farms ready for heavy rain." Theodory (2021) and Nyadzi *et al.* (2021) found similar ecological forecasting systems in other parts of Africa, which is what these practices show.

Water knowledge and landscape management were two other important topics that came up in addition to climate forecasting. People in Northern Ghana, for example, build traditional dugouts in places where water naturally collects, based on what they have heard about how water moves through the ground. "My grandfather taught me how to dig rain traps where water naturally collects," one person said. We can still find water there even when it's dry. These findings are in line with research like Alhassan and Haruna (2024), which shows how indigenous farming systems have a deep understanding of water. The way people organise water sharing shows how deeply ingrained unspoken rules are in adaptation. Elders in Ugandan communities set up informal irrigation schedules: "We follow the schedule set by elders; everyone knows when it's their turn to channel water to their fields." This finding is in line with Ketlhoilwe's (2022) work, which emphasises how customary governance and social norms affect how resources are distributed during times of stress.

Other examples, like planting calendars based on the moon, show how traditional cosmologies affect farming choices. A Ghanaian elder said, "The full moon tells us when to plant maize; it always brings strong roots." This backs up Salama *et al.*'s (2024) claim that adaptation is not just physical but also cultural and symbolic, strengthening identity and continuity. These examples show that tacit knowledge is more than just stories or symbols; it is organised in a way that makes sense, based on real-world evidence, and works in practice. These systems are valid, context-specific responses to environmental uncertainty, as shown in the larger body of literature (Nyadzi *et al*., 2021; Tolulope *et al*., 2025). They deserve to be recognised not only as heritage but also as useful parts of modern adaptation strategies.

The study found that tacit knowledge is a key part of how rural communities make themselves more resilient to climate change. This knowledge helps not only with adapting to the environment, but also with keeping jobs, making sure everyone has enough food, and improving everyone's well-being. These are all important ideas in resilience theory (Adger, 2000; Folke, 2006) and have been shown in recent research (Madzivhandila, 2024; Ketlhoilwe, 2022). Agroecological diversification is a big strategy that is based on tacit knowledge. Many of the people who took part said that intercropping is a way to spread risk that is based on observation and tradition. "We plant groundnuts with maize," said a farmer in Northern Ghana. One will live even if the other fails. This way, everyone in the house has enough food. This method is similar to what Alhassan and Haruna (2024) found when they looked at how to keep food production going in places that are vulnerable to climate change. Using and keeping native seeds is another important area. Participants always preferred local varieties to commercial hybrids. "The seeds we use have been with us for generations," said one Ugandan farmer. They last longer than the ones you can get in town. This agrees with what Nyadzi *et al.* (2021) and Torhemen *et al.* (2024) found: traditional seed systems were both ecologically strong and culturally important, even though they were left out of agricultural policies.

Tacit knowledge's ability to help people bounce back also applies to informal social safety nets. Participants stressed the importance of helping each other out and following the rules of reciprocity when things are tough. "My neighbours gave me food when my family lost crops to floods." One person said, "We do the same when someone else needs help." These acts of kindness aren't random; they follow long-standing, unspoken rules of behaviour in the community. Both Madzivhandila (2024) and Salama *et al.* (2024) talk about how social cohesion, collective memory, and informal networks can help people get through tough times. Also, traditional ways of leading help keep social capital and settle disagreements. In both Ghana and Uganda, elders were seen as important people who made decisions about how to use land, settle disputes, and share resources. "People pay attention when the elders speak. One elder said, "We don't make the same mistakes again because we remember what happened during the last drought." This backs up Ketlhoilwe's (2022) work, which connects traditional

leadership to community coordination and adaptation in Botswana, and Boulle's (2023) work, which criticises how formal policy often leaves out these voices.

The study's findings show that tacit knowledge is very important for rural African communities that are dealing with climate change to be able to adapt and be strong. These ideas are in line with resilience theory, especially the idea that communities adapt through context-specific, systemic responses that bring together environmental awareness, cultural cohesion, and social organisation (Folke *et al.*, 2010; Walker *et al.*, 2004). The documented community practices, which include biological forecasting and traditional water management, show that rural people can handle changes and keep things running smoothly, which is a key idea in resilience theory.

The kinds of tacit knowledge that this study found are the same as those that earlier studies found. Nyadzi *et al.* (2021) and Theodory (2021) both said that farmers in Tanzania use natural signs to guess what the weather will be like. This backs up the idea that localised environmental cues are a useful tool for making decisions that can change. The water management plans that the participants talked about are also like what Golfinopoulos and Koumparou (2024) said about how to run communal irrigation systems as a way to share environmental knowledge. These similarities show that tacit knowledge is not random or based on stories, but is built up over time through learning by doing.

Using native seeds and agroecological methods not only keeps the environment healthy, but it also makes sure that families have enough food. The findings are in line with Alhassan and Haruna's (2024) research, which showed that rural farmers in Nigeria and Ethiopia strongly prefer traditional farming methods because they are reliable and flexible. This shows that tacit knowledge helps communities deal with resource shortages and keep their jobs, as well as adapt to new environments.

This study found that social cohesion and helping each other out are like informal safety nets that keep communities safe from climate-related problems. Ketlhoilwe's (2022) study from Botswana backs this up by showing how women's groups used sharing knowledge in their communities to make themselves stronger. These networks are a type of social capital that is very important during crises, even though outside observers may not always notice them. This supports the large body of research on how social and ecological resilience are connected (Tschakert *et al.*, 2023).

Still, there is a big difference between these traditional ways of knowing and formal adaptation frameworks. The study found that people in both Ghana and Uganda always thought that their ideas were not taken seriously by government agencies or international development projects. Madzivhandila (2024) and Torhemen *et al.* (2024) said something similar: that climate adaptation policies in Africa often ignore or push aside indigenous knowledge systems in favour of standardised, top-down solutions. Without institutional frameworks for including tacit knowledge in formal planning, adaptation interventions lose their legitimacy and effectiveness.

Some extension officers knew how important it was to know about the community, but they didn't have the training or support from their organisations to use that knowledge in a useful way. This shows a disconnect in the structure that is similar to Boulle's (2023) view of policy knowledge systems in Africa, which tend to value technical knowledge more than local experience. Without systemic changes that promote knowledge co-production, efforts to improve adaptation will not be enough and may not last.

Resilience theory says that these results suggest that current adaptation efforts may not build long-lasting transformative capacity if they don't include the important knowledge systems that help communities deal with problems. Holling and other researchers have said that resilience isn't just about keeping things the same; it's also about letting communities change when their current systems stop working. Tacit knowledge is an important way for change to happen because it can adapt and fit into local situations.

The study shows how important tacit knowledge is for adapting to climate change and making communities more resilient. It also shows how it is still being pushed to the edges of formal structures. To close this gap, future policies need to be changed so that they recognise, record, and use community-based knowledge in both planning and carrying out. This will not only make adaptation strategies more useful, but it will also give the communities that are most affected by climate change the power to lead their own paths to resilience.

5. CONCLUSION

The goal of this study was to look into the importance of tacit knowledge in adapting to climate change and how it affects the socioeconomic resilience of rural African communities. Using qualitative data from Ghana and Uganda, the study has shown how important traditional, experiential, and culturally ingrained knowledge is for helping rural communities predict weather patterns, make the most of limited resources, and set up social safety nets in times of climate uncertainty.

The results showed that tacit knowledge is present in local agroecological practices, indigenous forecasting systems, and social norms of giving and receiving. These systems of knowledge are not only adaptable, but they are also very important for keeping food safe at home, dealing with water stress, and helping communities deal with extreme weather. The study also found that this knowledge base didn't fit with the formal adaptation frameworks that governments and development agencies had put in place. Formal adaptation planning often ignores tacit knowledge, which is important for rural resilience. This could lead to community perspectives being ignored and culturally ingrained ways of coping getting worse.

The study backs up the importance of resilience theory, especially its focus on how people can adapt and change when things go wrong. It shows that resilience in these communities means more than just bouncing back from shocks. It also means keeping up culturally appropriate ways of life that are closely tied to local ecological knowledge and learning from older generations. Climate policies and adaptation programs need to formally recognise and include tacit knowledge right away so that local and formal knowledge systems can be linked. This could mean planning processes that include everyone, training that respects how indigenous people learn,

and ways for institutions to keep track of and protect these kinds of knowledge systems. Future research should look more closely at how hybrid models that combine tacit and scientific knowledge can improve adaptive abilities on a large scale while still allowing people to make their own choices. Tacit knowledge isn't just a cultural artefact; it's a flexible and strategic tool for building resilience. We need to stop talking about adapting to climate change in a top-down, technocratic way and start talking about it in a way that includes everyone and is based on where they live and what they know.

RECOMMENDATIONS

The results of this study have important implications for climate adaptation policy, especially in rural Africa, where tacit knowledge is a useful but often overlooked resource. To make sure that responses to climate change are fair, effective, and long-lasting, adaptation strategies need to go beyond technocratic, one-size-fits-all solutions and take into account the importance of community-based knowledge systems.

i. Institutional acknowledgment of implicit knowledge: National and regional climate adaptation policies should recognise tacit knowledge as a valid and important source of adaptation expertise. This should be included in national adaptation plans (NAPs), climate-smart agriculture policies, and the curricula for extension services. This would give indigenous people a stronger voice and make sure they are part of the decision-making process.

ii. Climate governance with participation: Policymakers should create participatory frameworks that include local communities, especially traditional leaders, elders, women, and youth, in the planning, execution, and oversight of adaptation initiatives. This kind of involvement not only makes interventions more effective, but it also helps people feel like they own them and makes them more likely to succeed in the long term.

iii. Digital preservation and documentation: It is important to act quickly to document, digitise, and store tacit knowledge systems before globalisation, urbanisation, and changes in generations make them less useful. Governments, NGOs, and research institutions should work together to set up community-led knowledge repositories and oral history projects that protect traditional ways of adapting.

iv. Linking up with scientific systems: Whenever possible, we should encourage hybrid approaches that mix tacit and scientific knowledge. For example, people might be more likely to trust and use climate information services if they were combined with local weather signs. This means that researchers and extension agents need to learn how to talk to people from other cultures and work together to make things.

v. Adaptation planning that includes all genders: Policies need to deal with the fact that women often have important ecological and farming knowledge, and that men and women have different levels of access to resources and decision-making platforms. It is important to make safe, welcoming places for women to share and pass on their knowledge so that the whole community is strong.

vi. Collaboration across sectors and borders: To adapt to climate change, people in different fields, like agriculture, water, education, and disaster management, as well as across borders, need to work together. Regional groups like ECOWAS and IGAD should help make places where people can share information. This way, communities that live in similar places can learn from each other's successful ways of adapting.

vii. Put money into building local capacity: Finally, climate financing should focus on building capacity at the local level first. This includes showing people how to farm in a way that doesn't hurt the environment, how to take care of their local resources, and how to talk to people so they can tell outside groups and policymakers what they need and know.

STATEMENTS AND DECLARATIONS

This study obtained ethical approval from the pertinent institutional review boards in Ghana and Uganda, ensuring that all procedures adhered to the Helsinki Declaration and institutional ethical standards. All participants provided informed consent, with assurances of confidentiality, anonymity, and the right to withdraw at any time without penalty. The researchers paid for the study themselves as part of an academic investigation into how communities can adapt to climate change and become more resilient. The authors assert the absence of competing interests or conflicts of interest. All authors examined and sanctioned the final manuscript. Data that backs up the findings can be given to anyone who asks for it, as long as they don't want to know who the participants are.

REFERENCES

Adger, W. N., Barnett, J., Brown, K., Marshall, N., & O'Brien, K. (2011). Cultural dimensions of climate change impacts and adaptation. *Nature Climate Change, 1*(2), 112–117.

Alhassan, U., & Haruna, E. U. (2024). Rural farmers' perceptions of and adaptations to climate change in Sub-Saharan Africa: Does climate-smart agriculture (CSA) matter in Nigeria and Ethiopia?. *Environmental Economics and Policy Studies, 26*(3), 613-652.

Asuamah Yeboah, S. (2024). Assessing Climate Change Impacts on Food Security in Africa: *Regional Variations and Socio-Economic Perspectives.*

Bercht, A. L. (2021). How qualitative approaches matter in climate and ocean change research: Uncovering contradictions about climate concern. *Global Environmental Change, 70*, 102326.

Borgstede, M., & Scholz, M. (2021). Quantitative and qualitative approaches to generalization and replication–A representationalist view. *Frontiers in psychology, 12*, 605191.

Boulle, M. (2023). *Knowledge for change, or more of the same? The roles of policy knowledge systems in the nationally determined contributions of South Africa, Ghana and Kenya.*

Enomoto, T., & Umeya, K. (Eds.). (2022). *Bouncing Back: Critical Reflections on the Resilience Concept in Japan and South Africa.* African Books Collective.

Ford, J. D., Cameron, L., Rubis, J., Maillet, M., Nakashima, D., Willox, A. C., & Pearce, T. (2016). Including indigenous knowledge and experience in IPCC assessment reports. *Nature Climate Change, 6*(4), 349–353.

German, L. (2022). *Power/knowledge/land: Contested ontologies of land and its governance in Africa*. University of Michigan Press.

Ghadge, A., Wurtmann, H., & Seuring, S. (2020). Managing climate change risks in global supply chains: a review and research agenda. *International Journal of Production Research, 58*(1), 44-64.

Giacomelli, E., Iori, E., Villani, S., Walker, S., Musarò, P., Vittuari, M., ... & Magnani, E. (2022). Beyond Panic? Exploring climate mobilities in Senegal, Guatemala, Cambodia and Kenya-Case study report. *CRIS Current Research Information System, 13*(7).

Golfinopoulos, S. K., & Koumparou, D. (2024). Rural Environmental Governance: A Communal Irrigation System in Greece through the Social–Ecological System Framework. *Sustainability, 16*(15).

Holling, C.S. 1973. Resilience and Stability of Ecological Systems. *Annual Review of Ecology and Systematics, 4*, 1-23.

Hussein, J. M., Abdullah, S. K., Dahash, Z. M., Zuhair, M., & Maksutalievna, A. M. (2024). Islamic legal perspectives on climate change and global policy frameworks. *Al-Istinbath: Jurnal Hukum Islam, 9*(2), 723-742.

Ijjasz-Vasquez, E., Karp, P., & Weber-Fahr, M. (Eds.). (2024). *Communities of Practice at the World Bank: Breaking Knowledge Silos to Catalyze Culture Change and Organizational Transformation*. Taylor & Francis.

Jackson, G., N'Guetta, A., De Rosa, S. P., Scown, M., Dorkenoo, K., Chaffin, B., & Boyd, E. (2023). An emerging governmentality of climate change loss and damage. *Progress in Environmental Geography*, 275396872211487.

Karunarathne, Y. A. (2020). *The Spatio-temporal Dynamics of Socio-economic Networks and Social Vulnerability Assessment for a Natural Disaster* (Dissertation).

Ketlhoilwe, M. J. (2022). Building community resilience through environmental education: a local response to climate change. In *Research Anthology on Environmental and Societal Impacts of Climate Change* (pp. 1-16). IGI Global Scientific Publishing.

Leach, M., Scoones, I., & Stirling, A. (2010). *Dynamic sustainabilities: Technology, environment, social justice*. Routledge.

Low, S., Baum, C. M., & Sovacool, B. K. (2022). Taking it outside: exploring social opposition to 21 early-stage experiments in radical climate interventions. *Energy Research & Social Science, 90*, 102594.

Madzivhandila, T. S. (2024). Integrating Indigenous Knowledge Systems (IKS) to Climate Change Adaptation in South Africa: Lessons from the "Past". *South African Journal of Higher Education, 38*(5), 159-168.

Masenya, T. M. (2023). Revitalization and digital preservation of Indigenous Knowledge Systems for sustainable development of Indigenous communities in South Africa. *The Serials Librarian, 84*(5-8), 86-102.

Mbedzi, A. I. N. (2021). *Going Circular: Uncovering the Spatial Potential of Circular Economic Theories Inspired by Urban Vernacular Environments* (Master's thesis, University of Pretoria (South Africa).

Mthethwa, L. C. (2024). Enhancing the resilience and adaptation of the education sector through intention awareness. In *Circular and Transformative Economy* (pp. 260-271). CRC Press.

Muhamya, H., Ocan, J., & Adyanga, A. F. (2024). Climate Change: An Obvious Phenomenon or Myth, in the African Context. *African Journal of Climate Change and Resource Sustainability, 3*(1), 183-195.

Nyadzi, E., Ajayi, O. C., & Ludwig, F. (2021). Indigenous knowledge and climate change adaptation in Africa: a systematic review. *CABI Reviews*, (2021).

Nyong, A., Adesina, F., & Osman Elasha, B. (2007). The value of indigenous knowledge in climate change mitigation and adaptation strategies in the African Sahel. *Mitigation and Adaptation Strategies for Global Change, 12*(5), 787–797.

Petit-Perrot, C. (2022). *Radio Power: An exploration of agency for the participants of a climate change communication campaign in South Africa*.

Polanyi, M. (1966). *The tacit dimension*. University of Chicago Press.

Ricart, S., Castelletti, A., & Gandolfi, C. (2022). On farmers' perceptions of climate change and its nexus with climate data and adaptive capacity. A comprehensive review. *Environmental Research Letters, 17*(8), 083002.

Salama, A. M., Patil, M. P., Elsemellawy, A. N., Abudib, H. H., Almansor, N. A., MacLean, L., & Van Riel, K. (2024). People–place narratives as knowledge typologies for social sustainability: cases from urban contexts in the Global South. *Buildings, 14*(4), 1001.

Sillitoe, P. (2010). Trust in development: Some implications of knowing in indigenous knowledge. *Journal of the Royal Anthropological Institute, 16*(1), 12–30.

Theodory, T. F. (2021). Understanding the relevance of indigenous knowledge on climate change adaptation among mixed farmers in the Ngono River Basin, Tanzania. *African Journal of Science, Technology, Innovation and Development, 13*(1), 51-59.

Tisdell, E. J., Merriam, S. B., & Stuckey-Peyrot, H. L. (2025). *Qualitative research: A guide to design and implementation.* John Wiley & Sons.

Tolulope, O. Y., Bamidele, J., Eleke, U. P., Joel, O. J., Joel, A. F., & Sennuga, S. O. (2025). Adapting to environmental changes and climate impacts in rural communities: A comprehensive review. *Global Journal of Earth and Environmental Science, 10*(1), 1-7.

Tolilope A. Mosses N. John G. (2025). *The complete guide to climate change in rural Africa* (pp. 45-58). Lagos City: Alkalem.

Torhemen, T. T., Verinumbe, I., Ikyaagba, E. T., Ancha, P. U., Ahungwa, G. A., Jande, J. A., ... & Musa, Z. (2024). Assessment of Leucaena leucocephala (Lam) de Wit agroforestry technology adoption among smallholder farmers in Benue State Nigeria. *Journal of Research in Forestry, Wildlife and Environment, 16*(1), 164-174.

Tschakert, P., Parsons, M., Atkins, E., Garcia, A., Godden, N., Gonda, N., ... & Ziervogel, G. (2023). Methodological lessons for negotiating power, political capabilities, and resilience in research on climate change responses. *World Development, 167*, 106247.

Yan, H. D., & Yu, F. L. T. (2021). Longevity, Gender Gap, and Tacit Knowledge Innovation. In *The Routledge Companion to Asian Family Business* (pp. 82-150). Routledge.

Yao, Z., & Bell, S. (2022). Tacit knowledge in water management: a case study of Sponge City. *UCL Open Environment, 4*, e031.