JOURNAL FOR SOCIAL SCIENCE STUDIES
An International Peer-Reviewed Open Access Journal

ISSN (Online): 3006-2071 | ISSN (Print): 3006-2063
Volume 4 • Issue 6 • October 2026

INDIGENOUS KNOWLEDGE AND BOTTOM-UP CLIMATE GOVERNANCE: COMMUNITY-BASED ADAPTATION IN BALOCHISTAN, PAKISTAN

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DOI: https://doi.org/10.5281/zenodo.23341577

Keywords
Indigenous knowledge; community-based adaptation; bottom-up governance; local participation; climate adaptation; social inclusion; community resilience; Balochistan.

Article History
Received: *25 June 2026*
Accepted: *16 September 2026*
Published: *02 October 2026*

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Abstract

Climate adaptation in environmentally vulnerable regions requires more than externally designed interventions; it also depends on the knowledge, agency, and participation of communities experiencing climate-related pressures. This study examines how indigenous knowledge and community participation contribute to locally appropriate climate adaptation in Balochistan, Pakistan. Using a qualitative interpretive design, the study draws on semi-structured interviews with 28 climate-affected individuals and 30 key informants. Thematic analysis was used to examine traditional adaptation practices, local innovation, youth engagement, social inclusion, institutional relationships, and community–institution collaboration. Findings indicate that communities possess substantial experiential knowledge concerning water management, agriculture, livestock, weather conditions, and collective resource use, but changing environmental conditions have reduced the effectiveness of some traditional practices. Communities have consequently developed local innovations and collective coping mechanisms, although some responses reflect distress rather than sustainable adaptation. The findings further demonstrate that limited participation, gender and social exclusion, weak government–community linkages, and insufficient long-term support constrain locally generated adaptation. The study argues for a bottom-up and hybrid approach that connects indigenous knowledge and community agency with appropriate scientific, technological, and institutional support. Such an approach can strengthen the relevance, inclusiveness, and sustainability of climate adaptation in Balochistan.

INTRODUCTION

Climate adaptation is increasingly understood as not just a process of formal institutions and externally planned interventions but also the knowledge and practices, as well as the agency of communities in the process of adapting to environmental change. Local communities may have long-term knowledge of managing their environment, including water, agriculture, livestock, ecosystem, and climatic uncertainties,

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An International Peer-Reviewed Open Access Journal
ISSN (Online): 3006-2071 | ISSN (Print): 3006-2063
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through their adaptation practices, which may be context-specific. This type of knowledge may serve as a significant basis for local adaptation solutions in the absence of formal institutional support. The Balochistan Climate Change Policy (2024) also highlights the importance of local ownership and the need to ensure that climate action and decision-making involve communities, indigenous and traditional knowledge systems, women, youth and marginalised groups.

Balochistan represents a significant context within which to analyze this community aspect of climate governance (Rehman & Hamza, 2024). Rural and resource-dependent communities are facing growing pressure from climate-related changes, which impact existing livelihoods and traditional methods of environmental management (Rehman & Hickey, 2019). The province's recent research suggests that people living in the area see rainfall, temperature, water availability, and agricultural patterns changing and they respond to these changes depending on their experience of these shifts. Studies in coastal Balochistan also show that indigenous ecological knowledge is intertwined with community organisation, cultural practices and local resource management of the Gwadar fishing community (Rana et al., 2021). This implies that local knowledge is not just a storehouse of traditional knowledge and skills, but is embedded in wider social and environmental systems and processes through which communities know and respond to change. But, under the changed environmental and socio-economic conditions, indigenous knowledge may not be effective (Tesfahun et al., 2026). Climatic uncertainty can shift the environmental context in which traditional practices have evolved, and institutional change, resource degradation, technological change, and reduced intergenerational transfer of knowledge can further erode existing adaptive practices (Ogisi & Behho, 2023). The crux is thus not about a choice between traditional knowledge and modern approaches, but about recognising, strengthening, and appropriately integrating locally grounded knowledge with relevant scientific and institutional input.

This process is carried out with strong community involvement. Adaptation measures that are developed without community engagement may not align with the community's needs, priorities, or even cultural norms and coping mechanisms (Ombogoh et al., 2022). On the other hand, greater participation can help communities to share their lived experience and to suggest solutions that are viable for their local context, as well as contribute to decisions that impact their environmental security (Nazir et al., 2025). The existing provincial climate-policy framework makes a clear case for community participation and locally led adaptation, with a special focus on the participation of women, youth and marginalised groups.

However, the interaction between communities and formal institutions (Khawaja, 2022) is also important in determining participation. If the government agencies have not been in contact with local communities, there may be limited recognition of community knowledge as well as limited support for local community responses. This separation can limit scope for collaboration, knowledge sharing and adaptation at the local level. This is especially pertinent for bottom-up approaches to climate governance, whereby communities are not just the beneficiaries of adaptation strategies but also the designers and implementers of climate action (Raheem et al., 2025).

While community-based adaptation (CBA) has become increasingly recognised, there has been limited empirical consideration of how indigenous knowledge, local innovation, participation, and institutional relationships are intertwined in the context of Balochistan. Climate vulnerability and adaptation needs have been documented in existing literature and new provincial policy has formally recognised local ownership and community participation. But there is a need for more attention to the experiences that are shaping how communities are responding to changing

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environmental conditions, as well as the institutional factors that enable or limit community adaptive capacities.

This study fills this gap by studying community-based adaptation in Balochistan from the perspective of climate-impacted people and relevant institutional actors. Based on the Sustainable Livelihoods Framework and Community-Based Adaptation perspective, traditional environmental knowledge, local innovation, community participation, social inclusion, institutional relationships and the potential of combining indigenous knowledge with suitable modern approaches are the focus. It asks:

How can indigenous knowledge and community participation contribute to locally appropriate climate adaptation in Balochistan, Pakistan?

2. Literature Review

2.1 Indigenous Knowledge and Climate Adaptation

In communities that have developed strategies to cope with climatic variations through experiential knowledge, indigenous and local knowledge (ILK) is an integral component and important source of environmental knowledge (Khwaja, 2022). This can encompass understanding weather patterns, managing water resources, selecting appropriate crops, handling animals, and collaborative utilization of resources (Khan & Nasker, 2026). However, climate variability, extended periods of drought, water constraints, and environmental degradation in the region of Balochistan are changing the context in which many of the traditional practices have evolved. In Balochistan, recent studies have demonstrated that local experience and culturally shared knowledge and understanding of environmental change have a strong effect on farmers' perceptions of climate change and water scarcity (Yousuf & Barrech, 2022).

The persistence of indigenous knowledge should not therefore be interpreted as all traditional practices are still equally effective (Yousaf et al. 2025). Environmental conditions can change quickly and impact the effectiveness of practices that were established by a relatively stable environment. Instead, this research investigates this conflict between the importance of inherited knowledge and the loss of its efficacy, specifically, as it pertains to contemporary adaptation needs.

2.2 Community-Based Adaptation and Local Innovation

Community-based adaptation (CBA) involves centering adaptation action on the communities who are most affected by a hazard or disaster. A core idea is that communities have context-specific knowledge and social networks that can enhance the relevance of adaptation interventions. A recent study in Pakistan also reveals that local institutions are important in facilitating context-specific adaptation, and that lack of resources and coordination can limit their effectiveness (Yousaf et al., 2025).

Local adaptation is not limited to traditional practices. Where sufficient response is lacking, communities can form new ways of collective organization, mutual support, informal resource sharing, and livelihood responses (Nazir et al., 2025). In the current study, however, adaptive innovation and distress-induced survival strategies are separated. Adopted responses in severe resource constraints can help relieve the symptoms and do not necessarily enhance resilience. This distinction is significant in comprehending the boundaries and the agency of community-based adaptation.

2.3 Participation, Inclusion and Bottom-Up Governance

The role of participation in bottom-up climate governance is crucial as it enables the inclusion of local knowledge and priorities in adaptation decision-making processes. Meaningful participation also encompasses addressing the needs and concerns of communities, including groups whose voices are not well represented in the community decision-making process,

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especially women, youth and the economically marginalised (Tesfahun et al., 2026). Community participation, gender responsiveness, youth engagement and social inclusion are clearly mentioned as part of the climate action in the current Balochistan climate-policy framework (Government of Balochistan, 2024).

But formal recognition of participation does not guarantee meaningful participation. The extent to which knowledge is recognized and who has a say in decisions about resource use and adaptation can depend on social and political inequalities. This means more than consultation and involves establishing institutional avenues for communities to shape adaptation priorities and implementation.

2.4 Institutional Support and Hybrid Adaptation

Community agency does not imply institutional independence. With limited financial, technical, infrastructure, or access to government programmes, communities may continue to be limited in their ability to implement local initiatives. The evidence from the current adaptation efforts in Balochistan shows that there is a growing trend of inter-sectoral coordination between different government departments, development partners, research institutes and local communities; this includes the inclusion of indigenous knowledge in climate-resilient planning (GoB, 2024).

This facilitates a hybrid adaptation process that integrates indigenous knowledge and locally developed practices with suitable scientific, technological and institutional support (Rehman et al., 2026). In such a strategy, neither traditional knowledge alone nor external, technologically designed solutions are the only options, thereby avoiding two extremes: the first being that traditional knowledge is enough, and the second that it is replaced entirely by an external, technologically designed solution (Syed et al., 2024). The important issue is thus how to achieve interaction among various knowledge systems and institutional actors in a way that does not compromise the sense of community ownership.

2.5 Research Gap

The significance of climate vulnerability, adaptation and local knowledge in Balochistan has been highlighted in existing literature and recent policy action has started to acknowledge the role of community participation and indigenous knowledge (GBC). Less focus, however, has been placed on the interplay of knowledge erosion, local innovation, participation, social inclusion, and government–community relationships in the adaptation of communities. This study fills this gap by focusing the analysis on the experience of those affected by climate change, in order to understand how communities respond to new environmental conditions, negotiate their own adaptation strategies, and interact – or not – with existing formal adaptation processes. The analysis is informed by the Sustainable Livelihoods Framework (SLF) and the Community Based Adaptation (CBA) perspective.

3. Theoretical Framework

3.1 Sustainable Livelihoods Framework

The Sustainable Livelihoods Framework (SLF) offers a helpful lens through which to view how the climate-affected communities mobilize the assets and social relationships they have at their disposal to cope with environmental shifts. The framework looks at livelihoods as interdependent types of capital (human, social, natural, physical and financial resources) and it acknowledges that vulnerability and institutional processes influence access to and use of these resources to generate livelihood outcomes.

The SLF is especially relevant to the present study as community adaptation can involve responses beyond technical responses to climate hazards. People's response to changes in conditions can be affected by a variety of factors including traditional environmental knowledge, social networks, collective organisation, access to natural resources and household capabilities. The framework thus

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offers some insight into why communities might respond to similar environmental pressures through different adaptive responses. It also offers a foundation for the understanding that resource constraints might turn adaptation into short-term or distress coping.

3.2 Community-Based Adaptation

The Community-Based Adaptation (CBA) approach is an addition to the SLF, which puts communities affected by the impact at the heart of adaptation processes. CBA highlights the importance of local knowledge, participation, community ownership, and local solutions over just 'outside-in' interventions. It is relevant to Balochistan because of the significance of locally created knowledge and collective practices to engage with environmental changes.

This study is employing CBA to assess the extent to which communities can be involved in identifying adaptation priorities, provide knowledge for decision-making, create local solutions and communicate with government and other supportive institutions. It also highlights issues of inclusion, especially for women, young people and socially excluded people.

3.3 Conceptual Framework

This framework also allows the study to examine the limits of community-based responses.

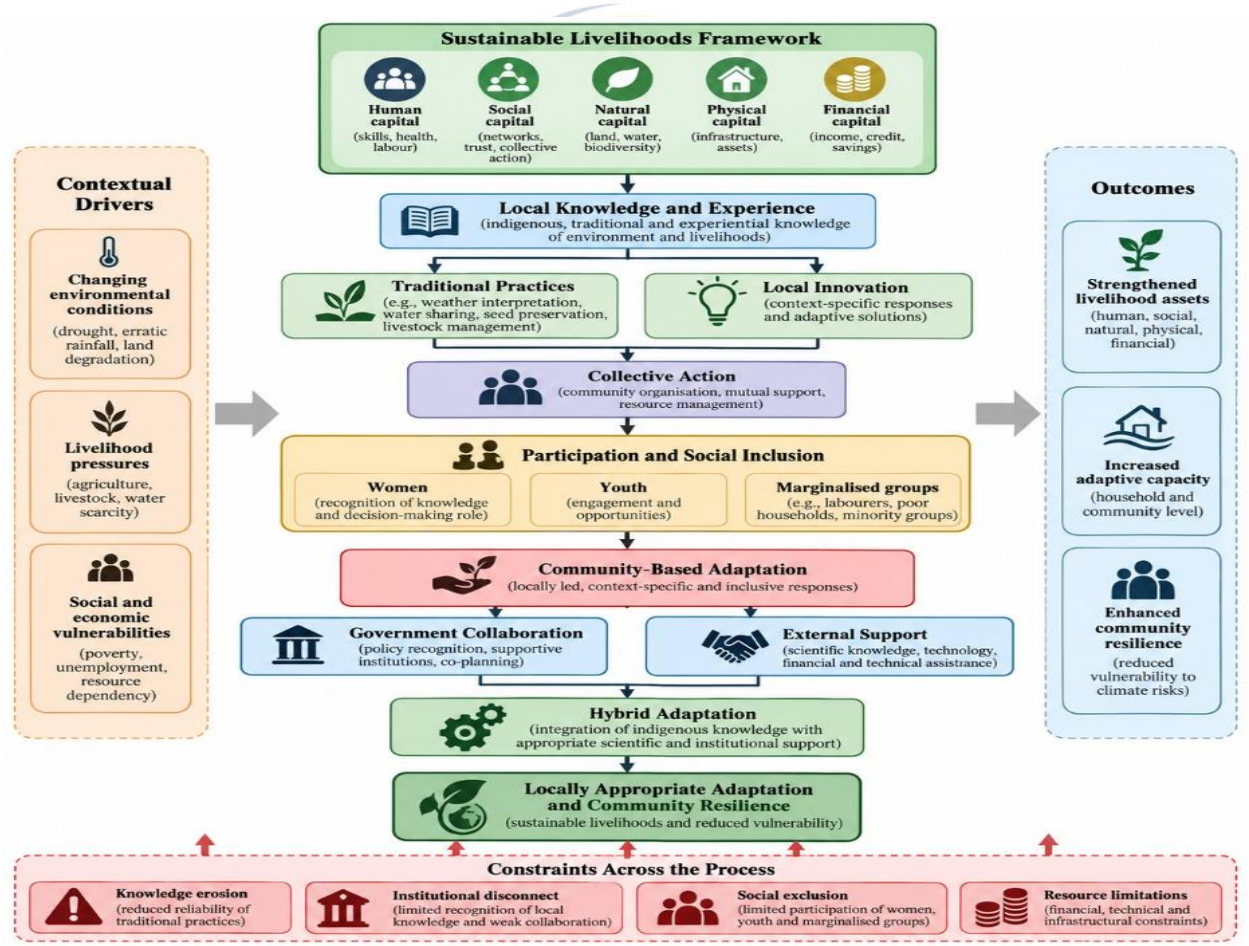


Figure 1: Analytical framework

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Methodology

4.1 Research Design

The research was conducted as a qualitative, interpretive study to explore the ways communities impacted by climate change conceive of the changing environment, rely on local knowledge, develop climate adaptation strategies, and engage with formal institutions. The study aimed to gain insights into lived experiences, meanings, perceptions and locally developed practices, therefore, a qualitative approach was appropriate.

4.2 Participants and Sampling

There were two groups of participants, namely 28 climate-affected individuals and 30 key informants. The 28 community participants were the experiential part of the study and were identified based on their having direct experience of environmental stresses including drought, water shortages, land degradation and related livelihood disruptions. Key informants were relevant government officials, NGO representatives, academics and professionals, and those with experience of environmental governance and adaptation.

A purposive sampling method was applied for the climate-affected participants and snowball sampling was the main method applied to identify the key informants. The community sample was saturated when further interviews resulted in little new information or themes.

4.3 Data Collection

Data were gathered by semi-structured, face-to-face interviews. The interview format enabled the participants to provide rich descriptions of their experiences and gave the researcher the flexibility to explore the issues related to traditional knowledge, changing adaptation practices, local innovation, participation, involvement of youth and women, institutional support and collaboration.

Participants were told about the study prior to the interviews, signed informed consent forms, and were told that there would be no confidentiality issues and that participation was voluntary. Audio recording of the interviews was used with the participants' permission and field notes were kept to record observations and context.

4.4 Data Analysis

Interview data was transcribed and analyzed thematically using NVivo. Analysis was achieved by re-reading and re-familiarisation, grouping related codes into categories and constructing more general themes. NVivo was also utilized to make comparisons between participant groups and to explore relationships between categories that emerged.

The community-focused aspects that emerged from the data were used as a framework to organise the analysis for this article: traditional adaptation practices, local innovation, youth engagement, adaptation obstacles, and assistance and collaboration. These themes were analysed using the Sustainable Livelihoods Framework and Community Based Adaptation perspective.

4.5 Trustworthiness and Scope

To ensure credibility, the data from the interviews were systematically coded, repeated engagement with the data was done, perspective checks were made between community participants and key informants, and contextual field notes were kept. The study was cross sectional and qualitative and therefore aimed to give contextual and interpretive insight, rather than statistical generalisation.

5. Findings

Six interrelated dimensions of climate adaptation in communities emerged through thematic analysis of in-depth interviews with 28 climate-affected individuals and 30 key informants in Balochistan: erosion of and change to TK, local innovation and collective action, youth engagement, participation and social inclusion, institutional relationships and sustainable support and collaboration. These themes taken together suggest that communities have significant experiential knowledge and adaptive capacity, yet

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their capacity to translate this into ongoing adaptation is hampered by environmental change, limited participation, social exclusion, and poor institutional connections.

5.1 Erosion and Changing Effectiveness of Traditional Knowledge

Traditional knowledge was identified as a key element of community adaptation, especially in terms of weather forecasting, moving livestock, sharing water, seed storage and farming. But participants repeatedly reported that some traditional practices are not as reliable as before due to changes in environmental conditions. One of them said, "*My grandfather taught me to read the clouds carefully, but these days the clouds lie to us, they speak a new, chaotic dialect that we don't understand.*" Yet another mentioned that what used to be good grazing land was now bare, and good grazing practices were now no use. What these accounts seem to indicate is that knowledge itself is not lost, but something has altered in the environment in which knowledge is developed.

This proved to be especially true during long dry spells. One participant commented that traditional seed saving techniques were no longer working because the seeds were no longer able to withstand multiple years of drought conditions. Likewise, the shared practice of water management based on seasonal rainfall was reported as being less and less suited to the growing irregularity of rainfall. In this way, TK was always a source for the community, and participants argued for the necessity to update, adapt and integrate it with methods that could address new environmental conditions.

5.2 Local Innovation and Collective Action

Nevertheless, communities showed a high capacity of local response. Informal credit arrangements, collective water management, mutual assistance and other social organisations were reported as important adaptation mechanisms. One participant noted that the social rather than technical innovations were the most effective and that collective organisation was central when formal resources were scarce. Water-user associations were also said to be developing in the absence of adequate provision of water in the formal sector.

But the results differentiate between constructive local innovation and distress coping. Some responses were out of necessity, and not planned adaptation. Participants mentioned selling productive assets, cutting back on necessary consumption, and abandoning existing livelihoods as a response to extreme difficulty, not innovations. As a result, community agency cannot be seen solely as a testament to resilience; there are coping mechanisms that can be harmful in the long term, yet supportive in the short term, for households.

5.3 Youth Engagement and Social Inclusion

Youth were a key but under-tapped adaptive capability. The majority of participants did not perceive young people to be very active in climate initiatives. Economic insecurity, unemployment, and limited opportunities, instead, were seen as forcing young people's focus on the need to survive. A child or young person who does not have a secure base of income is not likely to spend time on activities that may not have great benefits or may not happen for a while, as one of the participants said.

The results also show that there was differential participation among the social groups. There was a recurring theme of women and economically disadvantaged populations being described as having valuable environmental knowledge, but limited influence on adaptation decisions. One participant said, "*No one asks the women... What we have as knowledge is not really regarded as knowledge.*" Others stated that the knowledge and skills of working people about the land were also ignored. These accounts make it clear that community participation is not just about the presence of community members in projects, it is about who is included and who is listening.

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5.4 Government–Community Disconnect

A key recurring issue was the gap between interventions designed elsewhere and what is happening in the community. Participants felt adaptation planning was not adequately responsive to their experiential knowledge, or to the particular environmental situation. One participant referred to the plans that the government has in its offices far away, while ancestral knowledge is rejected as irrelevant. Another one said that the uniform solutions, which were offered for other geographical zones, could not be mechanically applied to Balochistan's situation.

This disconnect brought down trust and restricted opportunities for co-produced adaptation. Often the process was characterized by communities being informed about interventions instead of being engaged in problem solving and intervention design. The results indicate that adaptation from the bottom-up is more than asking for consultation after decisions have been taken. It must have mechanisms for incorporating local knowledge and community priorities early in adaptation planning.

5.5 Institutional Collaboration and Sustainable Support

The participants also highlighted the lack of collaboration among government, private organisations and communities. Multiple institutional priorities and unclear responsibilities were seen as resulting in partial interventions that do not address the need. One respondent said, "*I haven't seen any collaboration that helps us... I've seen companies coming, digging and going*". These suggest that even with more actors, the involvement of community needs, institutional responsibilities, and longer-term outcomes does not necessarily result in collaborative adaptation.

The focus of the participants was therefore on ongoing, empowering support, instead of short-term assistance. A common request was for interventions that would bring jobs, productive assets, enhance local capacity, and allow communities to take control of their livelihoods. Public works was one of the activities suggested by one participant, including activities like constructing check dams, planting trees and cleaning canals. This approach moves adaptation from a quick fix to investments that build community capacity.

5.6 Toward Hybrid and Locally Appropriate Adaptation

In all themes, external knowledge, technology and institutional support were not denigrated. Instead, the results suggest that these resources are preferred along with local knowledge. Where environmental conditions allow, traditional practices are still important; scientific and technological approaches can overcome problems that would otherwise be beyond the capabilities of traditional practices. The analytical implication thus is not so much a shift from traditional knowledge to modern interventions, but a process of hybrid adaptation in which indigenous knowledge, local experimentation, scientific information and institutional support reinforce each other.

This interpretation aligns with the existing Balochistan Climate Change Policy, which makes local ownership and engagement of indigenous and traditional knowledge holders as principles of climate action. Provincial climate programmes also highlight the need for community involvement, decentralized adaptation planning, and the incorporation of traditional knowledge into adapting farming to climate change.

The overall findings indicate that community-based adaptation in Balochistan is a result of an ongoing process of relationship-building between knowledge, agency, participation, institutional relationships, and evolving environmental circumstances. Communities are not merely the passive recipients of adaptation interventions, but they actively interpret the environmental changes, develop collective responses and seek solutions. However, the success and sustainability of these responses greatly rely on whether these institutions

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acknowledge local knowledge, facilitate inclusive participation and offer long-term support.

6. Discussion

The results show that adaptation to climate change in Balochistan is not as straightforward as introducing technologies or transferring interventions that have been designed outside the community to vulnerable communities. Instead, adaptation is determined by the interplay of local knowledge, livelihood assets, collective agency, social inclusion and institutional support. This aligns with the Sustainable Livelihoods Framework, which frames adaptation capacity as the dynamics between human, social, natural, physical and financial assets and draws attention to local knowledge and community agency (Sumari et al., 2025).

A key conclusion is that indigenous knowledge is still a valuable adaptive resource, albeit one that is dependent on the changing environmental context. Participants mentioned traditional activities such as weather forecasting, livestock migration, seed storage, water sharing, and land management and also indicated that some of these traditional activities have become unreliable due to extended dryness, changing precipitation patterns and ecological degradation. This aligns with the wider literature that demonstrates how Indigenous and local knowledge can play a role in livelihood resilience, but is not a standalone or necessarily adequate adaptation system (Yousaf et al., 2025). A recent study from Pakistan also showed that traditional coping mechanisms and local institutions are being used by local people in relation to climate risks, but they are limited by resources and institutions (Shah et al., 2025).

The results also reveal a strong association between local innovation and social capital and collective organisation. In the absence of formal support structures, community members reported informal support networks, community-based water management, and other social responses (Khan & Nasker, 2026). This is in line with the SLF perspective that social capital can bolster households' coping mechanisms to shocks and livelihood strategies. Social and natural livelihood capital are also found to be significant in climate adaptation outcomes in Pakistan (Nazir et al., 2025). The current results, however, provide an important context, in that not all coping responses are necessarily successful adaptations. Certain of the strategies were observed to be distress responses that resulted from chronic deprivation. This distinction is significant as adaptation is meant to enhance longer-term adaptive capacity rather than merely help people survive in the short term (Raheem et al., 2025).

The findings also uphold the need for participatory, bottom-up adaptation. Subjects felt interventions that didn't involve community knowledge in planning were less effective if the intervention was designed outside the community. This aligns with studies highlighting the importance of local engagement in enabling adaptation interventions to be attuned to the place-specific environmental context, livelihood goals, and local expertise (Tesfahun et al., 2026). It is also in line with the ongoing provincial climate planning in Balochistan, where community involvement, community-led adaptation, and incorporation of local knowledge into climate-resilient agriculture are explicitly stated (GoB & UNDP, 2024).

Social inclusion was also identified as a key factor for bottom-up adaptation. Women and economically marginalised groups were characterised as having valuable environmental knowledge but limited influence on adaptation decision-making. This discovery aligns with the literature that shows there is a correlation between inclusive participation and recognition of indigenous knowledge and more sustainable community adaptation (Ombogoh et al., 2022). The provincial climate agenda also lists women, youth and marginalised groups as groups that need to be included in climate planning and implementation. Thus, the results indicate that if only the community's powerful actors are involved in the process and women, youth, labourers or

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other marginalised groups are not included in decision-making, then the process cannot be claimed to be participatory.

The low participation of young people also needs to be considered. Participants linked low youth participation to joblessness, economic insecurity and short-term livelihood concerns. This indicates that youth climate engagement can't be divorced from the wider livelihood situation. Access to human, social and financial assets in SLF terms can be a limitation for young people's participation in longer-term environmental action (Ogisi & Begho, 2023). This interpretation also aligns with the focus in the province on youth participation, capacity building, and green livelihoods as measures of climate resilience.

Another key discovery relates to the link between community and formal institutions. Government interventions, scientific knowledge or modern technologies were not necessarily rejected, but those that were fashioned without meaningful engagement with local realities were questioned. This separation is significant. It is important to note that community-based adaptation does not mean the substitution of formal institutions with informal ones (Rehman & Hamza, 2024). Rather, effective adaptation must be an interplay between local institutions, community knowledge, scientific know-how, and external resources. Recent Indigenous and community-led adaptation work also calls for integration of local knowledge and community leadership in broader governance and resource systems.

The results thus suggest the use of a hybrid adaptation strategy. Traditional knowledge can offer locally embedded knowledge on ecosystems and livelihoods, and scientific knowledge, technology, infrastructure and institutional resources can help to address environmental changes beyond the scope of traditional practices (Shahzad et al., 2024). The Agriculture and Livestock initiative of the Government of Balochistan is an example of this orientation, where locally driven adaptation, indigenous knowledge, and government departments, research institutions, development partners, and local communities have all been integrated (GoB & UNDP, 2024).

Lastly, the findings show that in order to achieve sustainable community adaptation, more than just a short-term hand is needed. There was a strong focus by the participants on employment, rehabilitation of productive assets and infrastructure, and ongoing institutional support, rather than simply temporary relief. This is consistent with the livelihoods perspective, as it is about increasing the assets and capacities that households can use to deal with future shocks, not just providing compensation for the impact of each shock (Rana & Gill, 2025). Community-based adaptation should be seen as a process of capacity and institutional strengthening, not a series of individual projects, the implication is that the community-based approach to adaptation should be understood as a process of strengthening local capacities and institutions.

7. Recommendations and Future Research

The results indicate several priorities for strengthening community-based adaptation to climate change in Balochistan. One, mechanisms for documenting and integrating indigenous and local knowledge, including pastoral people's, farmers', women's and others with first-hand experience of the environment, should be institutionalized in adaptation planning. This integration is in line with the current emphasis on locally led adaptation and indigenous knowledge within the province.

Secondly, community engagement should progress from consultation to co-design and co-decision-making. Local communities should participate in the process of defining adaptation priorities, choosing interventions, monitoring interventions, and assessing outcomes. Particular attention should be paid to women's and youth participation, to avoid the reaffirmation of social exclusion within community based approaches.

Third, adaptation programmes should facilitate hybrid knowledge systems, from local practices

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that have been tested and proven to scientific knowledge, technologies and extension services. This builds on the recognition of the benefits and limitations of traditional practices, and can assist communities to adapt to environmental conditions that are beyond their existing coping abilities.

Lastly, the external help should focus on capacity building for long-term livelihoods, not on short-term relief. Adaptive capacity is dependent on livelihood assets, which can be bolstered by investments in water management, livelihood diversification, community institutions, skills, and locally managed infrastructure. An exploration of the role of particular knowledge systems and community institutions in adaptation outcomes in the various ecological zones of Balochistan could be addressed in future research. Potential differences between women's participation, youth engagement, and effectiveness of hybrid adaptation approaches across districts can be explored in comparative studies.

8. Conclusion

The study demonstrates that there is a need for community-based climate adaptation in Balochistan, and that it requires the capacity to link indigenous knowledge and local experience with inclusive participation and suitable institutional support. Whilst traditional practices are still an important source of environmental knowledge, there is a chance of reduced effectiveness of traditional practices due to the changing climatic and ecological context, where adaptation is a matter of learning and adjusting and not only preserving. However, communities show agency in the ways they are organised collectively, innovate locally, and respond to threats through livelihoods, albeit some coping practices happen due to a high level of necessity. The findings also suggest that the adaptive potential of communities is constrained by the omission of women, youth and other marginalised groups, and that poor government–community relationships can hamper the local uptake of knowledge to inform adaptations. A more suitable pathway is thus a combination of local knowledge and scientific and institutional resources, using participatory and locally-led processes. The provincial climate planning process currently underway further reinforces the community engagement, local knowledge, social justice, and community-led adaptation approach. In a nutshell, the study puts community agency and recognition of knowledge at the heart of locally appropriate climate adaptation in Balochistan.

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ISSN (Online): 3006-2071 | ISSN (Print): 3006-2063
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