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RESEARCH ARTICLE

Effectiveness of Indigenous Knowledge and Resilience of the Kalasha Indigenous Community in Climate-induced Disasters and Water Management

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Abstract
Indigenous knowledge plays a pivotal role in climate change and disaster resilience. This research is conducted in District Chitral (Kalash Valley), Khyber Pakhtunkhwa, Pakistan, to investigate the effectiveness of indigenous knowledge in enhancing disaster and climate change resilience. This study is qualitative in nature. There were 48 respondents from three clusters of the study area (Bumburet, Rumboor, and Birir). It also explores the effectiveness of these practices in forecasting, mitigating, and adapting to climate uncertainties and disasters. Indigenous early warning systems, indigenous housing and infrastructure methods, forest and land management, and water and food security are analyzed through thematic and narrative analysis. The study focuses on objectives such as identifying and documenting the indigenous practices of the Kalasha people regarding climate change and disasters. It is revealed that there are no valid documents of the ancestral practices regarding climate change and disasters of the Kalasha indigenous community. It is revealed that the Kalasha community's indigenous knowledge plays a pivotal role in their community's disaster risk reduction strategies. This study also revealed that the Kalasha indigenous community's knowledge is transmitted, maintained, and adapted across generations. Their indigenous knowledge plays a significant role in forecasting, mitigating, and adapting in making local strategies to minimize the disaster risk. Indigenous practices should be utilized for the disaster risk reduction strategies.

Keywords: Indigenous knowledge; Disaster; Climate Change; Resilience; Kalasha Indigenous community

Introduction

Nowadays, climate change is a global concern. It is affecting every nation directly or indirectly. Climate uncertainties are posing serious threats to every aspect of life. These changes have been chronicled in a variety of recent reports, such as those by Intergovernmental Panel on Climate Change (IPCC). Climate change affects agriculture and food production in complex ways. It affects food production directly through changes in agro-ecological conditions and indirectly by affecting growth and distribution of incomes (Schmidhuber & Tubiello, 2007). Climate change is the mother of all externalities: larger, more complex, and more uncertain than any other environmental problem. Weather affects agriculture, energy use, health, and many aspects of nature, which in

turn affects everything and everyone (Tol, 2009). However, indigenous communities are more prone to climate change as compared to other societies. They have a dependency on the natural resources, and climate change directly affects their natural resources.

The current climate uncertainties affect everyone, but not equally. Developed nations tackle the issues quite easily with proper funding and planning, as they do not require assistance from outside the country (Khan, 2024). However, developing states do not contribute to the causes of climate change and disasters, yet they are being affected in numerous ways. Pakistan is one of the most climate change-affected countries. Pakistan is in the tropical region of the globe. It is the region where climate change is causing more disasters. Pakistan is more prone to climate change as compared to others (Hussain et al., 2019). According to the report of the United Nations Environment Program, the impacts of climate change on agriculture, forestry, and water resources are a greater threat to people they have dependency on the natural resources. Increase in temperature and a change in the pattern of rains will affect the agriculture of the country more badly. Pakistan is more likely to face extreme weather conditions in the coming years. Pakistan has not had enough resources to help its citizens during disasters (Akram & Hamid, 2014). The Global Climate Index has placed Pakistan in most affected countries list by climate change from 1994 to 2017. According to the reports, climate change caused 512 deaths per year and caused a loss of 3826.03 million Dollars. There were a total of 145 incidents of climate change during this period. These climate events were droughts, floods (super flood of 2010), heavy snowfalls, cyclones, severe heat waves(Eckstein, Hutfils, & Winges, 2019). Inside, Pakistan's indigenous communities are more prone to climate-induced disasters, and they have no access to climate finance. Amid growing strategies and planning to tackle climate change and disasters, indigenous knowledge and practices play a pivotal role in resilience towards these uncertainties. Indigenous knowledge reflects the dynamic way in which the residents of an area have come to understand themselves in relationship to their natural environment and how they organize that folk knowledge of flora and fauna, cultural beliefs, and history to enhance their lives (Kincheloe & Semali, 2002). In the context of disaster resilience, indigenous knowledge is embedded in the local culture (Khan, 2024). Indigenous communities in their environments have led them to develop time-tested knowledge and practices to prepare for, mitigate, respond to, and recover from the impacts of natural hazards. Collectively, these are referred to as local and indigenous knowledge (Hadlos, Opdyke, & Hadigheh, 2022). During disasters in rural areas, survival mostly depends on indigenous knowledge, because the informal means by which indigenous knowledge is disseminated provides a successful model for other knowledge on disaster risk reduction management. Benefits of community-based disaster risk reduction through indigenous knowledge are particularly admitted for addressing vulnerability issues because communities can identify and reduce risks by themselves (Wang, et al., 2019). This study explores the indigenous knowledge in disaster reduction and management. This research aims to comprehensively investigate and understand the effectiveness of indigenous knowledge in enhancing disaster resilience and fostering climate change adaptation strategies in the context of Chitral, Pakistan. This research study explores the traditional knowledge systems and practices related to climate change and disaster preparedness amongst the indigenous communities of Chitral. This also explores the effectiveness of indigenous knowledge in mitigating the impacts of climate change and disasters and enhancing community resilience.

Literature Review

Various study highlighted the vulnerability of indigenous communities to climate induced disasters (Kenney, Phibbs, Meo-Sewabu, Awatere, McCarthy, Kaiser, & Kereopa, 2023: Cervantes Benavides, Mc Dermott, Seddighi, & van den Berg, 2025). Kalasha indignious community also prone to climate induced disasters. The Kalasha indigenous community lives in the District Chitral. The Chitral district is located in the northern part of Khyber Pakhtunkhwa, Pakistan. Chitral borders Afghanistan to the North and to the West, Gilgit-Baltistan to the

East, Swat to the Southeast, China to the North and East, and the Afghan Wakhan corridor to the North and East. Afghanistan's Nuristan and Kunar provinces are to the West (Nüsser, 2001). Being a mountainous region, 13% of the district of Chitral is covered by 542 glaciers (Niggli, Allen, Frey, Huggel, Petrakov, Raimbekova & Wang, 2024) which makes Chitral vulnerable to climate uncertainties. Additionally, the climate of Chitral is getting warmer year by year, which increases the chances of GLOFs. The people of Chitral have experienced disasters (such as flash floods, drought, GLOF, landslides, and windstorms) in the last 25 years, and the discharge of major rivers in Chitral has increased (Saiqa, Tahir, Naveed, Khan, & Jamal, 2024). The geography of the study area (Kalash valley) is also highly vulnerable to these disasters.

The Kalash community also relies mainly on natural resources and agriculture for its livelihood. They are dependent on forests for various purposes, such as wood for fuel and construction, etc. Moreover, fruits and dry fruits are abundantly grown here and also exported to local markets. The last few years have crippled the livelihood resources due to continuous flooding, and GLOF has demolished large forest areas and agricultural lands (Khan, 2025). Chitral was smashed by flash floods in 2010, 2011, 2013, 2015, 2020 (Khayyam, 2020), 2022, 2023, and 2024 (Saiqa, Tahir, Naveed, Khan, & Jamal, 2024). The successive disasters hit Kalash livelihoods hard: for many years, the majority has been dependent on farming, tending to orchards, and herding as the primary sources of income. The Kalash community is considered to be the most ancient and indigenous ethnic group. The Kalasha people are the smallest minority group living in the district of Chitral, Pakistan, with an estimated population of 4000 (Rehman, Li, Tian, & Kong, 2020). A plenty of research has been done, but still there is no authentic evidence which ascertains their origins. A Global Human Rights Defence paper titled, 'Tribe of Kalash: the last kafir' describes them as the last of the people of 'Kafiristan' – an area that once encompassed the entirety of northwest Pakistan and eastern Afghanistan before being divided by the Durand line – who retain elements of their ancestral cultural identity (Skidmore, 2021). There are various views, for instance, some of the Kalasha people consider themselves as the descendants of Alexander the Great, while other oppose it. Chitral-based senior journalist Gul Hamad Farooqi, who has extensively covered all cultural festivals and other relevant aspects of the Kalasha people, says these people are 'Indian Aryans'. According to Farooqi, the provincial Archeological Department, with the assistance of international archaeology experts, had recently discovered a 5,000-year-old graveyard in the Shindor area of Chitral. "The experts in their study of the graveyard had stated that the people inhabiting the region are Indian Aryans (Farooqi, 2021).

Indigenous knowledge, unique to specific societies and cultures, serves as the basis for local decision-making in agriculture, health, natural resource management, and other activities (World Bank, 1998). This knowledge is formed through interactions with the natural and social environment, trial and error over time, and is primarily oral and unwritten. It encompasses local beliefs, values, and knowledge, resulting from centuries of practice and error in the natural environment. Despite the effectiveness of indigenous knowledge, there is limited research on this topic in Pakistan, which gradually leads to the vanishing of century's centuries-old and tested knowledge. These practices are usually practiced in remote areas of Pakistan and are often neglected when policies regarding disaster risk reduction are made.

Method and Material

This research aims to understand the unique aspects of indigenous knowledge and how it relates to being prepared for disasters. People who genuinely represent the spirit of indigenous knowledge and community strength are included for the purpose of collecting data. A total of 48 members, including elderly community members/first responders, local/traditional practitioners, house keepers, and local leaders, are among the many community members who took part in our study. Cluster sampling strategy in a geographical context is used for

sampling. In order to select the entire study area, the population is divided into clusters. This strategy was chosen due to its usefulness and compatibility with the particular context of this research. In addition, these three valleys share similar culture and traditions. To ensure the accuracy and quality of the data, all these locales are included because of the similarities in local practices regarding disaster and climate change resilience. Data of this study is collected by using two data collection tools: In-depth interviews and Focus group discussion. After collecting data, we used thematic analysis to explore the relation between indigenous knowledge and resilience towards climate change and disasters in the locales of the Kalash valley. The themes included the Indigenous early warning system, indigenous housing and infrastructure methods, Forest and land management, and water and food security in the study area. Indigenous knowledge related to every theme has been analyzed according to the objectives of the research. Moreover, the ethical considerations are strictly followed. Prior consent was taking from all participants of the study.

According to the hazard ranking table, floods and landslide carry significant damages to the community with total risk number of 36 and 24, respectively. These are followed by earthquake with risk number 16. To cope with these hazards, the indigenous practices play a significant role in forecasting, dealing, and response.

Theoretical Framework

This study explores the role of indigenous knowledge in disaster risk reduction. The indigenous stand point theory provides theoretical insight to study the role of indigenous knowledge and its role in disaster risk management. This theory allows us to understand the indigenous in the context of indigenous communities. The Two-Eyed Seeing approach utilizes Western and Indigenous knowledge to develop a climate change policy (Macfarlane, Charles-Norris, Warren, Mahendra, Butler, Hayes and Armstrong, 2022). This approach gives insight into understanding and utilizing both indigenous and Western knowledge. It allows a diverse group of people to use all their understandings to improve the world.

Analysis of the Kalasha Community's Indigenous Knowledge Role in Disaster Reduction

Indigenous Early Warning System of the Kalasha Indigenous Community

Before the introduction of modern technologies, the Kalasha community developed unique and highly localized early warning systems (EWS) based on observational knowledge and communal communication. Nearly all respondents emphasized the effectiveness of these traditional methods, particularly for anticipating flood events and Glacial Lake Outburst Floods (GLOFs). A widely cited indicator is the “particular smell” detected before a flood, which elders quickly recognize due to their experience. One respondent stated that

> “Some signs can signal an imminent natural disaster-before a Glacier Lake Outburst Flood (GLOF) we could observe small lumps of mud in torrents. Similarly, before a flood strikes, a specific wind and smell lead it”. (Individual Interview, 07 July 2023)

This natural sign remains a trusted element of the community's early warning. Community members also described the role of hunters and herders as key observers. They would patrol mountain areas and glaciers, reporting dangerous cracks or shifts. They learn these from their ancestor (Khan, Khan, & Kamal, 2024). (One of the respondents stated that

> “Like the hunters and herders used to visit the glacier sites and then they used to inform the community in case of any crack... The herders had another way, which was through playing a horn called ‘Booq’ to inform the community in case of emergency”. (Individual Interview, 09 July 2023)

These methods formed a social system of early detection, transmitting messages quickly to villages below. Traditional communication also included fire signals, strategically placed at visible high points near glaciers. A chain of volunteers or herders would ignite fires to signal potential danger. These indigenous systems did not rely on electricity or modern tools, making them simple yet practical. As noted by Dekens (2007), "The traditional early warning system was perfectly fine, and it was very efficient. These systems were not originally designed as flood warnings but evolved from military, pastoral, or religious practices. Techniques such as lighting fires, sounding horns, or using the call to prayer served multiple roles but became reliable tools for alerting communities about natural hazards." These indigenous methods are highly effective in the Kalasha indigenous community. The effectiveness of this indigenous warning system has also been validated and also with local interpretation of stream behavior and timely evacuation (Dekens, 2007). One of the respondents stated that;

> "We use our indigenous system for warning. For instance, we monitor rising water levels and warn vulnerable households through shouts and door knocks, and these practices are still widely used in our Kalash Valley"(Individual Interview, 09 July 2023)

These findings illustrate that indigenous early warning systems, though informal, remain vital for disaster preparedness in Chitral's high-risk areas. Their simplicity, community-based approach, and effectiveness highlight their relevance, especially in remote regions where technological systems may fail or be unavailable (Ali, Buergelt, Paton, Smith, Maypilama, Yuŋgirrŋa, & Gundjarranbuy, 2021). Indigenous communities have a dependency on their culturally based indigenous mechanism to reduce disaster risk.

Indigenous Knowledge Role in Building Disaster Resilient Infrastructure

Despite the proximity of many settlements and agricultural lands to torrents and GLOF-prone areas, the Kalasha community has historically used locally informed construction techniques to reduce the impact of disasters and climate uncertainties. A key strategy has been the construction of retaining walls, built using traditional materials such as stones and wood. These structures, many of which date back decades, are still functioning and continue to protect lives and livelihoods. Indigenous communities emphasized the effectiveness and durability of these traditional walls in contrast to modern interventions introduced by external agencies (Prasad & Nigam, 2023). One of the respondents stated that

> "We do have a retaining wall still standing in our village. It was built in 2005. It still supports the retaining walls installed by NGOs, which are made of stone and wire. The modern walls are not that effective during floods because they fall when the earth underneath is eroded by water. What we have constructed is the best because the science behind the building is much accepted. The branches of specific trees are gripped with the standing, and the other sides of the branches are covered with large stones to stabilize the sawed wood and the branches (Individual Interview, 21 July 2023)

These structures not only serve as flood barriers but also help prevent soil erosion, making them multifunctional and sustainable. The local community collectively made these walls, and they spent the least amount on building these safety walls. The local population of the Kalasha indigenous community collectively supports these local strategies based on their indigenous knowledge (Khan, 2024). Indigenous knowledge is used as strategies to protect their houses and livelihood during the monsoon seasons. One respondent stated that

> "To stop the erosion of land due to floods, we built retaining walls in the traditional ways using large willow wood and stones. Traditionally made retaining walls are much more durable than modern ones." (Individual Interview, 25 July 2023)

These structures are typically constructed by community members themselves, using local resources. Their low cost, reliability, and adaptability to environmental conditions make them an important example of indigenous innovation. They used the local resources, and they can manage resources by themselves without support of the government. During the focus group discussion, one of the participants stated that.

> "The new projects should also include traditional knowledge and should use the local resources, as it is easy and reliable with our environmental conditions, and the people will show interest in taking part in its maintenance." (BT/FGD

Moreover, Kalasha housing techniques reflect generations of adaptive knowledge aimed at reducing earthquake vulnerability. The respondents consistently expressed confidence in their traditional homes, which have withstood multiple significant earthquakes. Built on slope terraces to avoid flood damage, these structures are also highly resilient to seismic activity. They strongly prefer their house structure built in light of their indigenous knowledge about building houses. This is a powerful expression of trust in indigenous construction methods. The key structural element is the "Gren daar", strong wooden beams inserted between walls at regular intervals, typically every one foot. These beams are locked together at the corners using wooden pegs instead of nails, which helps the walls flex and absorb shocks during an earthquake. One respondent stated that

> "The constructions here are more resilient towards earthquakes. The 'Gren' used between walls is the best knowledge our ancestors have taught us. We have witnessed many earthquakes but never saw a major impact on us or our settlements" (Individual Interview, 25 July).

These houses often consist of single-room layouts known as *"baipash,"* featuring flat stone-and-mud roofs supported by five wooden pillars. The combination of wood, stone, and clay ensures both strength and flexibility. These construction methods have long been used in Kalash, Chitral, and the broader Khyber Pakhtunkhwa region, making them inherently earthquake-resistant. Moreover, households situated on terraced slopes incorporate protective measures against rockfalls, which can be triggered by earthquakes or heavy rains. Many have built rear-facing retaining walls to shield their homes from falling debris. One of the respondents in the focus group discussion stated that

> "To prevent damage to our houses from rock falls (caused by rainfall or earthquake), we have constructed extra walls at the back of our houses, as we live in terraced houses on slopes. The house sites are not prone to huge rock falls, but to small pebbles. The walls stand and prevent the damage." (Focus group Discussion, 2023)

Households construct terraces behind their homes to reduce the impact of falling rocks. These local techniques are not only economical and environmentally compatible, but they also demonstrate the community's deep knowledge of the landscape and their capacity to coexist with environmental risks. These indigenous methods are acceptable to the local people.

Natural Resource Management

Forests have long been considered one of the most vital natural resources in the Kalash Valley. However, due to increasing population pressures and ongoing deforestation, forest coverage is steadily declining (Bari, Dowlatchahi, & Iweins, 2022). In response, the community has historically employed a range of indigenous

forest management practices, most notably the "Dayn" system, which predates the establishment of the governmental Forest Department. The Dayn system was a traditional community-based governance structure responsible for overseeing all aspects of forest use, including tree cutting, grazing, fuelwood collection, and fire prevention. One respondent stated that

> "The forests were preserved through 'Dayn', where the community used to forbid the use of a part of the forests for 5 years and only use another part.. In this way, the jungle was preserved".(Individual Interview, 25 July 2023).

Under this rotational use system, one section of the forest was completely closed to all forms of use, no tree felling or grazing, for a fixed period (typically five to ten years), allowing natural regeneration to take place. Once matured, this section would reopen while another section entered the restricted phase. This sustainable cycle allowed the forest to replenish while continuing to meet community needs. In addition to rotational bans, the Dayn committee prohibited destructive practices such as dragging tree branches. The dayn committee used to ban the dragging of tree bushes and brunches as it results in gullies during rainfall. One of the most routine and impactful activities practiced by community members, including women and children, was the collection of dry leaves and branches. These materials were used as fuel, roofing insulation, and bedding for livestock. Over time, the decomposed material was repurposed as organic fertilizer: One respondent stated in the focus group discussion that

> "We used to collect dry leaves and wood from forests for fuel purposes and to cover our house's roofs. The leaves were also used to pour in cattle sheds to keep them warm during winters. At last, these leaves would be converted into fertilizer after being mixed with cow dung." (Focus group discussion, 2023)

While the primary motivation was household use, this practice significantly reduced forest fire risk by removing flammable debris, and this concept can also play a significant role in global forest management strategies. For example, the Finnish Forestry Program (2013) reported similar firebreak techniques used in Tanzania, where vegetation is cleared in 2.5–3 meter strips to prevent fires from spreading to farms or homes. Kalash Valley has never escalated to large-scale catastrophes, largely due to strong community mobilization and preventive action. In case of a fire, villagers work collectively to remove dry wood, cut down burning trees, and contain the spread. One respondent stated that

> "We all have observed forest fires in our region, and we have responded to it and succeeded. We removed dry woods as much as we can. We cut down trees that caught fire and pushed them into the fire so that after burning, it would not fall over the unburned trees." (Focus group discussion, 2023)

Even human-induced fire risks, such as cooking or tea-making during forest visits, were addressed through culturally ingrained safety measures. Before leaving the forest, visitors would ensure that any open flame was fully extinguished. These examples reflect a multi-dimensional forest preservation ethic within the Kalash community, which blends rotational resource use, community-led enforcement, and hazard mitigation, rooted in practical experience and intergenerational learning. These indigenous methods reduce hazards and disasters that occur in indigenous communities.

Water and Food Security

In the Kalash Valley, access to clean water, particularly during disasters and harsh winters, has historically posed significant challenges. However, the community has developed several indigenous strategies for water sourcing,

storage, and filtration, based on their environment and traditional knowledge. One of the most reliable water sources in the region is the fountain or spring, locally called “Uch”. These are naturally occurring underground springs that flow from the earth and remain unfrozen during the coldest seasons. One respondent stated that

> “In the winter season, all the nearby available water sources freeze, and we have to arrange water for us from specific water sources called ‘Uch’. Uch is the place where the underground water comes out and flows over the land. It does not freeze because it is warm as it comes from under the ground. This is/was our water source during the winters”.(Individual Interview, 25 July 2023).

Another indigenous method is the use of artificial water reservoirs, known locally as “Chhat”. These structures, although not widespread in all valleys, are designed to collect rainwater or water from torrents for household and agricultural use. Observed particularly in Rumboor Valley, these water harvesting systems are similar to those found elsewhere in Chitral. As noted by Nadeem, Elahi, Hadi, & Uddin (2009), ″Chat" reservoirs are common across Chitral and are constructed by individuals or communities to address water scarcity. A smaller-scale but historically significant method of water storage is the “Sardawai” system. This is a covered reservoir built near homes, filled via channels carrying water from fountains or torrents. The covering helps maintain cleanliness and prevents freezing in the winter months. Although largely obsolete due to piped water projects, its past relevance remains notable: The degradation of water quality over time was another theme raised during fieldwork. Modern influences, especially untreated sewage from homes and hotels, have contributed to the pollution of natural sources. One respondent stated that

> Previously, we used to drink clean running water, but now it has become polluted due to waste and sewage disposal from homes and hotels. The watercourses are contaminated, and people perform various unclean activities in these water sources, further adding to the pollution.”(Individual Interview, 25 July 2023).

In winter, when neither Uch nor reservoirs are accessible due to snow accumulation, families resort to melting ice and snow for water. For those depending on torrents throughout the year, filtration and sedimentation methods are employed. During heavy summer rains, torrents often become muddy and contaminated. People fetch the water, let sediments settle for hours, and filter it using transparent cloths before consumption: The socio-cultural factors of indigenous communities play a pivotal role in their water reservoir management. One respondent stated that

> “We used to bring muddy water from the stream and keep it for hours to settle the mud down at the bottom. Water from above was then filtered through some cloth and used.” (Individual interview)

A less common but historically intriguing practice is glacier grafting or artificial glacier formation, used to secure long-term water supplies in remote areas. It was approximately 1905 or earlier when the Mehtar (Ruler) of Chitral, Shuja Ul Mulk, had used the method of glacier grafting. At that time, the water was scary for most of the regions. The ruler chose a place named ‘Birmogh Lasht’ and dug a huge area and deepened it to a certain level, and in winter, he ordered to fill that trench with snow. After filling it with snow, they poured huge amounts of salt on the snow and buried it with soil. The people who have witnessed that process used to say that till midsummer, the water was used for agricultural purpose.

Although these stories suggest glacier grafting was often used for strategic defense or symbolic power, they demonstrate an advanced understanding of snowpack stability and seasonal melt. Supporting this, Nadeem,

Elahi, Hadi, & Uddin (2009) reported that attempts at glacier grafting in Warijun village failed due to poor site selection and insufficient snowfall. In summary, the Kalash Valley's indigenous water and sanitation practices show remarkable ingenuity and adaptability. From spring utilization and water harvesting to traditional filtration techniques and winter snow melting, these methods have helped communities survive in extreme environments long before modern infrastructure arrived.

Food security has long been a concern for the indigenous people of the study area. Historically reliant on the land, these communities now face increasing challenges due to climate change, including unpredictable weather, erratic precipitation, and disasters that disrupt agricultural routines (Faraz, Khan & Khan, 2025). Climate change has had mixed impacts; on the one hand, warmer temperatures have improved yields and allowed for *double cropping*. On the other hand, it has caused faster glacier melting and the extinction of several traditional crops. One respondent stated in the group discussion.

> "Over the past fifty years, I have noticed a significant change in our agricultural practices. Previously, we could only get one crop from our fields due to weather conditions. Now, with changing climates, we can successfully sow corn after harvesting wheat and get good yields. So, in this regard, the changes have been beneficial for agriculture, but due to the warmer climate, we have lost many other crops that we used in our early days." (Focus group discussion, 2023)

Sowing periods have shifted due to temperature increases; what used to be planted in late May now begins in February or March, and autumn crops like wheat and maize are now sown in November instead of September. The lower valleys commonly practice *double cropping*, while the upper valleys still rely on single crops. Before sowing, fields are fertilized with cattle dung, and traditional tools are used for burying seeds, protecting them from birds and frost. This process, called *Nirwazu*, remains widespread. Nirwazu is a process through which the newly sown seeds of maize, wheat, etc are buried. A huge branch of a tree (with thorns) is dragged over the field to cover the seeds with soil. To deal with snow-covered fields during spring, ashes, soil, or sand were applied to speed melting. This process is still being practiced throughout Chitral. Furthermore, some crops were left unprocessed for later use, as processed or wet maize or wheat flour may get ruined if stored directly. For that purpose, Maize and wheat grains were dried in the sun or by fire to prevent bitterness. One respondent stated that

> "We used to dry the maize before grinding because it used to be very bitter after months in storage." (Individual interview, 2023)

For preservation, food was stored in *'Gonj'*, a wooden or soil-based room with thick walls, maintaining a stable temperature. Another storage method involved *'Kash'*, a sealed underground chamber, now often replaced by *'Chom'*, a wooden box with a similar function. One respondent stated that

> "To store the foods, we used 'Kash', a store made up of soil and sealed after storing the foods inside. People preserved their food in a large box made of clay or wood." (Individual interview, 2023)

As the winters in the study area are harsh and cold, local people often faced difficulties in finding sources of food in ancient times. To handle the situation, fruits like apricots, mulberries, and apples were sun-dried for winter use. The indigenous methods based on indigenous knowledge play a pivotal role in infrastructure, food and water management, and also in disaster management.

Conclusion

This research highlights the significant connection between indigenous knowledge and disaster preparedness in Kalash Valley, Chitral, Pakistan. The Kalash community, which has strong ties to its traditions, has demonstrated the potential of centuries-old methods in addressing the constantly changing problems caused by climate change and disasters. Their wisdom has provided protection against a variety of hazards, including earthquakes, landslides, and floods. Through this study, the relationship between indigenous practices and climate change resilience has also been highlighted. In addition, the local knowledge and modern adaptations are interlinked and easy to put on the ground in developing areas like Chitral. This study revealed that indigenous standpoint theory addresses the cultural context of indigenous methods and their influence on the Kalasha indigenous community. This research shows that the wisdom of indigenous people is important in helping communities deal with disasters better. It reminds us that even though climate change is complicated, indigenous knowledge can still be used and it can help. The story of the Kalash people shows that old traditions and new ways can work together to help prepare and mitigate the impacts of climate change and other disasters. The integration and empowerment of indigenous knowledge is important and may be helpful in coping with disasters and enhancing resilience towards climate change and disasters. The Two eyed seeing approach we need for any policy for disaster preparedness to understand the important role of indigenous methods in disaster preparedness.

Recommendations

On the basis of this study's findings, there are some recommendations which may result in betterment of the community as the indigenous knowledge plays a pivotal role in climate change and disaster resilience in developing regions like Chitral. Some of the recommendations are as follows:

1. Mainstreaming indigenous knowledge and practices in Disaster Risk Reduction interventions: This will allow the projects and policies to be more successful as the community will feel engaged and belong with the intervention. In addition, the maintenance of projects also depends on the community's behavior. Giving some room to community decision-making and including their experiences in projects will ensure quality and success. For instance, a community-based early warning system
2. Documentation of indigenous practices and wisdom: Community members are the first responders to any disaster. Their experiences are valuable as they have witnessed the consequences and facing aftermath of disasters. They have practical knowledge regarding their environment and they follow their ancestral and tested practices, which would never be followed if this knowledge and practices had no effectiveness. These practices should properly be documented by investing in research and studies which ensure the safeguard of local knowledge.
3. Bridge between indigenous knowledge and scientific/modern knowledge: This idea is suggested because the scientific interventions for disaster risk reduction are sometimes costly, irrelevant to an ecosystem, whereas the indigenous knowledge play its role from centuries. By combining these practices, the outcomes will give more output, as depending upon scientific knowledge is never enough for a country like Pakistan because of limited resources and diverse environments.

Declarations

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Conflict of Interest: The author declares that there are no competing or conflict of interests related to this study.

Ethics Approval / Declaration: This study involved human participants and was conducted in accordance with ethical research principles, including voluntary participation, informed consent, confidentiality, and respect for participants. Formal institutional review board (IRB) approval was not obtained, as the author was not affiliated with any institution at the time of the study.

Consent to Participate: Informed verbal consent was obtained from all individual participants prior to data collection. Participation was entirely voluntary, and participants were informed of their right to withdraw at any stage.

Consent for Publication: Consent for publication was obtained from all participants. No identifying personal information has been included in this manuscript.

Data Availability: The qualitative data generated during this study are not publicly available due to ethical considerations and the need to protect participant confidentiality. However, anonymized data may be made available from the corresponding author upon reasonable request.

Authors' Contribution: The authors solely conceptualized the study, conducted data collection and analysis, and prepared the manuscript.

AI Generative Text Statement: No generative artificial intelligence (AI) tools were used to generate the research content, data, analysis, or conclusions of this manuscript. AI-based tools were used only for language refinement and clarity, without altering the scholarly content or interpretation.

References

Akram, N., & Hamid, A. (2014). Climate change: A threat to the economic growth of Pakistan. Progress in Development Studies, 73-83. doi:10.1177/1464993414546976

Bari, F., Dowlatchahi, M., & Iweins, M. (2022). Empowering local communities to protect forestry resources and reverse deforestation and forest degradation in high-value Chilgoza forests in the Kalash valley of Pakistan. Technical documents & project reports. Retrieved from Food and Agriculture Organization of the United Nations: http://www.fao.org/3/cc1792en/cc1792en.pdf

Cervantes Benavides, C., Mc Dermott, R., Seddighi, H., & van den Berg, C. (2025). Perceptions of limate-Related Risk by Indigenous Communities: A Systematic Review. Wiley Interdisciplinary Reviews: Climate Change, 16(6), e70033.

Dekens, J. (2007). Herders of Chitral, The lost messengers? International Centre for Integrated Mountain Development (ICIMOD).

Eckstein, D., Hutfils, M.-L., & Winges, M. (2019). GLOBAL CLIMATE RISK INDEX. (J. C.-R. Daniela Baum, Ed.) Who suffers most from extreme weather events? Retrieved from www.germanwatch.org/en/cri

Farooqi, G. H. (2021, April 25). Shrouded in myth and mystery: the origins of the Kalasha. (H. Hussain, Interviewer) The Express Tribune. Retrieved from https://tribune.com.pk/story/2296631/shrouded-in-myth-and-mystery-the-origins-of-the-kalasha

Faraz, A., Khan, Z., & Khan, I. (2025). Beyond the Framework: Assessing the Integration of Indigenous Views in Khyber Pakhtunkhwa's Climate Change Policy. Global Sustainability Research, 4(1), 180–189. https://doi.org/10.56556/gssr.v4i1.1218

Hadlos, A., Opdyke, A., & Hadigheh, S. A. (2022). Where does local and indigenous knowledge in disaster risk reduction go from here? A systematic literature review. International Journal of Disaster Risk Reduction, 79. doi:https://doi.org/10.1016/j.ijdrr.2022.103160

Hussain, M., Butt, A. R., Uzma, F., Ahmad, R., Irshad, S., Rehman, A., & Yousaf, B. (2019). A comprehensive review of climate change impacts, adaptation, and mitigation on environmental and natural calamities in Pakistan. Environmental Monitoring and Assessment, 192. doi:https://doi.org/10.1007/s10661-019-7956-4

Indigenous Knowledge, practices and customary norms of fire management in Tanzania study in nine villages. (2013). Sustainable Forest Management in a Changing Climate. Retrieved from https://www.fao.org/3/cb6609en/cb6609en.pdf, region of Pakistan. Natural Hazards, 1033-1056. doi:10.1007/s11069-020-03944-7

Kincheloe, J. L., & Semali, L. (2002). What is indigenous knowledge? Voices from the academy. London: Routledge.

Khan, Z (2025). The Socio-economic Status of Pashtun Children After Migration Due to Climate Change", Migrant Children and Youth: Wellbeing and Integration Around the World, Loretta E. Bass https://doi.org/10.1108/S1537-466120250000036005

Khan, Z. (2024). Indigenous Knowledge and Community Institutions' Role in Pashtun Pastoral Community Resilience to Climate Change. Global Sustainability Research, 3(2), 17–26. https://doi.org/10.56556/gssr.v3i2.925

Khan, Z. (2024). Pashtun Indigenous knowledge and resilience: Mitigating climate change in Northern Pakistan. Fourth World Journal, 24(2), 77-90.

Khan, Z., Khan, I., & Kamal, U. (2024). Climate Change Intersecting Socio-economic Vulnerabilities of Kalash Indigenous Community in Northern Pakistan. Journal of Environmental Science and Economics, 3(3), 10-56556.

Khan, Z. (2024). Understanding Indigenous disabilities: A cultural perspective of Indigenous Pashtun community. In Indigenous Disability Studies (pp. 256-266). Routledge.

Kenney, C., Phibbs, S., Meo-Sewabu, L., Awatere, S., McCarthy, M., Kaiser, L., ... & Kereopa,

L. (2023). Indigenous approaches to disaster risk reduction, community sustainability, and climate change resilience. In Disaster risk reduction for resilience: Climate change and disaster risk adaptation (pp. 37-59). Cham: Springer International Publishing.

Macfarlane, R., Charles-Norris, K. A., Warren, S. K., Mahendra, A., Butler, A. J., Hayes, K., ...& rmstrong, B. (2022). Two-Eyed Seeing: Seeking Indigenous Knowledge to Strengthen Climate Change Adaptation Planning in Public Health.EnvironmentalHealthReview,65(3), 77-82.DOI: 10.5864/d2022-017

Nadeem, S., Elahi, I., Hadi, A., & Uddin, I. (2009). Traditional Knowledge and Local Institutions Support Adaptation to Water-induced Hazards in Chitral, Pakistan. Retrieved fromhttp://books.icimod.org/demo/uploads/tmp/icimodtraditional_knowledge_and_local_institutions_support_adaptation_to_water-induced_hazards_in_chitral,.pdf

Nüsser, M. (2001). Understanding cultural landscape transformation: a re-photographic survey in Chitral, eastern Hindukush, Pakistan. Landscape and Urban Planning, 57(3-4), 241-255. doi:https://doi.org/10.1016/S0169-2046(01)00207-9

Niggli, L., Allen, S., Frey, H., Huggel, C., Petrakov, D., Raimbekova, Z., ... & Wang, W. (2024).

GLOF Risk management experiences and options: a global overview. Oxford Research Encyclopedia of Natural Hazard Science.

Prasad, V., & Nigam, B. (2023). Role of traditional and indigenous knowledge in disaster management. In Indigenous knowledge and disaster risk reduction: Insight towards perception, response, adaptation and sustainability (pp. 19-34). Cham: Springer International Publishing.

Rehman, Z. U., Li, Y.-C., Tian, J.-Y., & Kong, Q.-P. (2020, September 18). Exploring European ancestry among the Kalash population: a mitogenomic perspective. Zoological Research,552-556. doi:10.24272/j.issn.2095-8137.2020.052

Saiqa, J., Tahir, S., Naveed, U., Khan, K. S., & Jamal, K. M. (2024). Climate Change and its Impact on Water Resources of Selected Areas in District Chitral with High Climatic Vulnerabilities. Sarhad Journal of Agriculture, 40(4), 14-24. doi:10.17582/journal.sja/2024/40.4.1424.1435

Schmidhuber, J., & Tubiello, F. N. (2007). Global food security under climate change. Biological Science, 104. doi:https://doi.org/10.1073/pnas.0701976104

Skidmore, Z. (2021, April 18). Tribe of Kalash: The Last Kafir. Peace for Asia. Retrieved from https://peaceforasia.ch/tribe-of-kalash-the-last-kafir/

Tol, R. S. (2009). The economic effects of climate change. Journal of Economic Perspectives, 23, 29-51. doi:DOI: 10.1257/jep.23.2.29

US Global Change Research Program. (2009). Global climate change impacts in the United States. United States: Cambridge University Press. Retrieved from https://books.google.com.pk/books?hl=en&lr=&id=UCg7inA-HksC&oi=fnd&pg=PA13&dq=global+impacts+of+climate+change&ots=u-c9DjYP2I&sig=igEho4z_95s6Whsam9zOnkBerlw&redir_esc=y#v=onepage&q=global%20impacts%20of%20climate%20change&f=false

Wang, Z., Liu, J., Xu, N., Fan, C., Fan, Y., He, S., . . . Ma, N. (2019). The role of indigenous knowledge in integrating scientific and indigenous knowledge for community-based disaster risk reduction: A case of Haikou Village in Ningxia, China. International Journal of Disaster Risk Reduction, 41. doi:https://doi.org/10.1016/j.ijdrr.2019.101309

World Bank. (1998). Indigenous knowledge for development: a framework for action. Africa:The world Bank. Retrieved from https://documents.worldbank.org/en/publication/documents-reports/documentdetail/388381468741607213/indigenous-knowledge-for-development-a-framework-for-action