

## **Human Adaptation to Climate Change: An Anthropological Perspective**

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### **ABSTRACT**

*One of the main agents of environmental change is the climate change and its implications on human population in the world are vast. The integrative and comparative method of anthropology provides a more holistic way of comprehending the processes by which people react adaptively in response to the different climatic conditions and intergenerational environmental change. This paper discusses anthropological perspective of human adaptation to climatic change by looking at biological, cultural and socio-economic facets of adaptation. With references to the biological anthropology, the paper explains the role of evolutionary processes and physiological adaptability that has enabled human population to respond to a broad spectrum of climatic conditions over an extended period of time. The paper in terms of cultural anthropology involves adaptation mechanisms within the subsistence systems, settlement patterns, technological innovations and systems of traditional ecological knowledge. These culturally mediated responses represent a manifestation of capability of human groups to reduce environmental stress as regards social structure and symbolic practices. In addition, the paper also looks into the ways in which the contemporary technological and economic adaptations have altered the human environment interactions in the conditions of rising climate change. The unequal climate impacts are also unveiled in the discussion where the communities that are indigenous, marginalized whose adaptive capacity is limited by the structural inequality and access to resources are targeted. Through the choice of examples of ethnographies and cross-cultural adaptation, the study explains that the process of adaptation is not a homogenous and linear response, rather, it is contextual and historically related. The study is founded on the assumption that the anthropological knowledge constitutes the vital factor in formulating effective and culture sensitive climate adaptation policies. As a result of the fusion of local knowledge systems and scientific solutions, anthropology can assist in coming up with more equitable and sustainable solutions to human resilience to global climate change.*

**Keywords:** Anthropological Perspectives, Human Environment Interactions, Environmental Inequality, Biological Adaptation, Ethnographies

### **INTRODUCTION**

Human adaptation to climatic change is of particular interest within the framework of the current study taking into consideration Pakistan as a country that is among the most climate-sensitive ones in the world [1]. The varied ecological landscape of Pakistan such as glaciated mountainous areas, arid deserts, fertile river plains, and a high population density coastline exposes the citizens of this country to various climate-induced threats that include the following: floods, droughts, heat wave, lake outburst floods by the glaciers, and rise of sea level. Such are environmental pressures that have direct impact on livelihoods, food security [2], health and settlement patterns. An anthropological approach is important in

the context of how various communities within Pakistan [3] view climate change and adapt to it based on the cultural competencies of adaptive strategies that are embedded, as opposed to the idea of adaptation as a technical or policy-based process.

The relevance of this subject is further enhanced by the fact that there are unequal social effects of the climate change in Pakistan. Small scale farmers, pastoralists, fishing communities, women, landless laborers among other marginalized groups usually lack access to resources and institutional support but turn to traditional ecological knowledge in dealing with environmental uncertainty [4-5]. The anthropological studies indicate that kinship groups, sharing of resources, seasonal mobility and indigenous agriculture and water utilization are the important resilience mechanisms [6]. A study of how people in Pakistan have adapted to climate change is thus critical in establishing the overlaps of the environment, culture, and inequalities and also helps in the formulation of locally contextual and socially inclusive climate change adaptation policies that resonates with the realities of vulnerable people [7-8].

Climate change has turned out to be one of the most important problems of the modern world with tremendous effects on the natural ecosystems, as well as human communities. The environmental situation is shifting around the world with rising temperatures, changing monsoon cycles, retreating glaciers, rising sea-levels and the growing frequency of extreme weather occurrences like floods, droughts and heatwaves [9-10]. Such transformations are a great danger to food security, water supply, health, livelihood and social stability. Although climate change can be examined using the prism of environmental science and policy-based approaches, its impacts lie within the social, cultural, and historical contexts [11]. As a holistic subject that deals with the biological and cultural aspects of human life, anthropology provided profound understanding on how societies perceive, experience and adjust to the changing climatic conditions.

Anthropologically, human responses to climate change are multidimensional with biological, cultural, technological and social responses to climate change. Humans, unlike other species, use the cultural knowledge, social organization and technology to a great extent in order to overcome environmental stress [12]. Human populations have shown amazing adaptive flexibility, as the capacity to live in different and at times extreme environments, as can be seen throughout history. Anthropology focuses on the fact that adaptation is not just a biological process but a culturally mediated process that can be influenced by the local systems of knowledge, economic processes, belief systems and power relations [13]. This strategy is especially applicable in the explanation of the modern climate change, which occurs disproportionately in different areas and social classes.

The concept of human adaptation to climate change is interesting to analyze in Pakistan because of the geographical diversity and great susceptibility of the country to environmental risks [14]. The nation has a great variety of ecological landscapes which are the mountain ranges of Himalaya and Karakoram, desert and semi-desert, fertile river plains, and a long coastal strip of the Arabian Sea. All these areas are characterized by unique climatic issues and local population has evolved localized adaptation strategies over a period of generations [15]. An example is the case of the mountainous Gilgit-Baltistan and Khyber Pakhtunkhwa and the communities have long been accustomed to extreme climate conditions with terrace farming, seasonal migration, and highly developed water management systems based on glacier melting [16]. Nevertheless, faster meltdown of glaciers and unstable snowfall patterns currently put these conventional systems at risk that compel communities to adapt their agricultural activities and patterns of settlement [17].

Climate change in the Indus River plains has increased variability in monsoon which causes disastrous floods like that which affected 2010 and 2022. Anthropological literature brings out the reaction of rural communities in Punjab and Sindh to repeated flooding through the adaptation of the agricultural cycle, livelihood diversification, and by protecting one another through the kinship systems. These are the social

mechanisms that are vital in the resilience that tends to offset the inadequate state support [18]. Equally, in the dry areas of Balouchistan and Tharparkar, the extended droughts and the water scarcity have determined the adaptive mechanisms of pastoral nomadism, communal use of water and dependence on native drought-resistant crops. However, climate change has led to more intensification of droughts burdening such traditional adaptive mechanisms [19].

The Sindh communities that are coastal, especially that of the Indus Delta are confronted by the additional challenge of sea-level rise, coastal erosion and saltwater intrusion. Fishing communities have had to change fishing methods, relocate either on a seasonal or a permanent basis and adjust to the shrinking stock of fish [20]. The anthropology of these adaptations has shown that they are not only economic adaptations, there are changes in social identity, cultural traditions and cohesion within communities as well. Notably, these communities are some of the most innocent culprits of climate change but which get a disproportionate contribution towards the impacts of the same.

Anthropology is also interested in the role of social inequality in adaptive capacity. In Pakistan, minorities like small scale farmers, landless workers, women and indigenous people tend to lack resources, technology and political representation and as a result, their adaptation to their climatic stress cannot occur effectively [21]. Anthropology can provide the challenge to top-down climate policy and the need to consider the traditional ecological knowledge in the process of adaptation planning by recording the lived experiences and the local perspectives on the matter.

On this note, an anthropological analysis of the way human beings adapt to climatic change is imperative in determining the resilience and vulnerability in the Pakistani society. Anthropology offers an in-depth insight into how human beings react to environmental change in culturally significant manners by incorporating biological, cultural and socio-economic viewpoints [22]. The article thus looks at the anthropological understanding of human adaptation to climate change, especially in Pakistan and why the local knowledge, social networks, and cultural practices are important in influencing adaptive strategies to a more uncertain future of the environment.

### ***Research Objectives***

- To investigate the perception and experience of climate change by various communities in Pakistan in their daily lives.
- To examine the biological, cultural, and socio-economic coping mechanisms of Pakistani communities to changes in the environmental conditions associated with climate.
- To record native knowledge and traditional regime contributing to climate adjustment in innumerable fields in Pakistan.
- To determine the role of social factors like poverty, gender and marginalization on adaptive capacity and vulnerability to climate change.
- To address how social networks and community institutions can be used to increase resilience to risks associated with climate change.
- To make anthropological contributions that can be used to guide culturally sensitive and locally-based climate adaptation policies in Pakistan.

### ***Significance of the Study***

The study is an important one because it explores the adaptation of human beings to climate change in socio-cultural and ecological setting of Pakistan, which is a highly climate-sensitive country in the global scene. Climatic issues like floods, droughts, heat waves, melting of glaciers and rise in sea level directly impact the livelihoods, settlement and social organization. An anthropological approach brings out how

communities react to these issues using culturally entrenched adaptive measures instead of purely employing technical solutions.

The contribution to the study is also in the form of recording the traditional ecological knowledge and community-based adaptation strategies by various communities, such as farmers, pastoralists, and coastal inhabitants. Moreover, it highlights the disproportional effects of climate change on the marginalized populations and offers information that can be utilized to create locally based, culturally sensitive, and socially inclusive climate change adaptation initiatives in Pakistan.

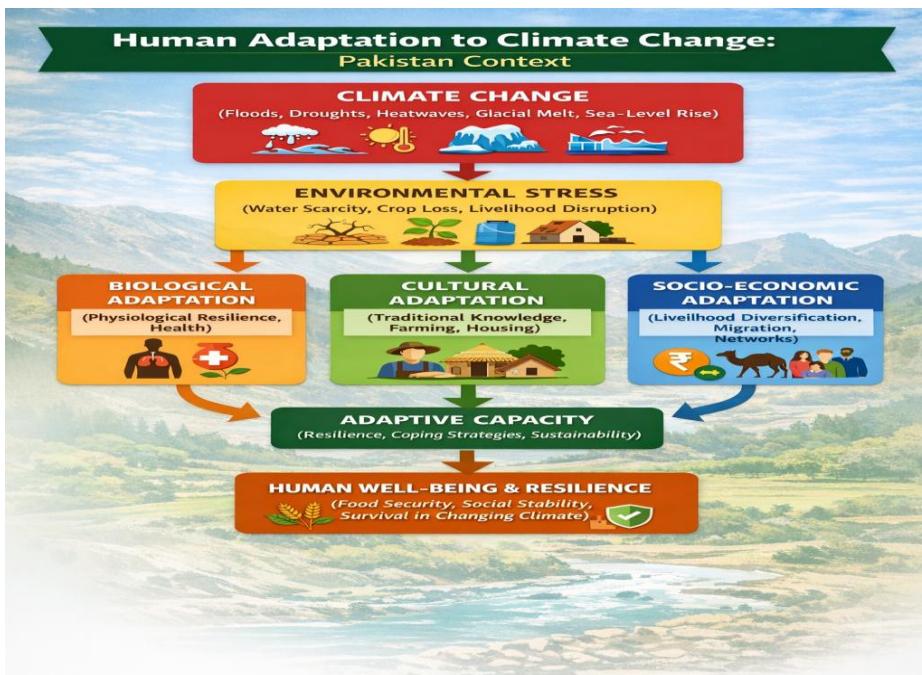
### ***Research Gaps***

Although there is an increasing body of literature on climate change and adaptation in Pakistan, there are still gaps in the integrative anthropology analysis that should integrate biological, cultural, and political views. Numerous studies target either a particular geographic area or risk and do not analyze the general social processes. Fewer local voices are also incorporated in the policy-oriented research. This paper aims to fill this gap using a comprehensive anthropological perspective in order to examine the process of human response to climate change in various ecological and social settings in Pakistan.

### ***Work Contribution***

The current research paper has contributed to the body of literature on the anthropology since it presents a culturally grounded explanation of how the human beings may adjust to climate change in the specific situation to the situation in Pakistan. As opposed to technocratic approach or sheer environmental approach, the local perceptions, the native knowledge systems, and the everyday adaptive practices in diverse ecological regions are studied as future forecasts. The integration of the biological, cultural, and socio-economic factors leads to the formation of the whole concept of adaptation, which is a dynamic and situation-dependent process, formed by the past, culture, and social inequality.

The work contribution too is empirical in the sense that they document community-based adjustment to the climate-exposed community like farmers of the Indus plains, pastoralists of the arid regions, mountain community which depends on the glacial system and the coastal fishing communities. All these findings suggest that kinship, traditional resource management and livelihood diversification are some of the factors that encourage resilience. In addition, the study is also as well as contribution to applied anthropology in the sense that it brings information which can be used in enacting policies on culturally sensitive and social inclusion climate adaptation in Pakistan thereby bridging the gap that exists between the one in research and policy practice.



**Figure 1: Anthropological Framework of Human Adaptation to Climate Change in Pakistan**

## LITERATURE REVIEW

### *Human–Environment Interaction in Anthropological Thought*

The issue of human and environmental relations has been one of the most significant ones in the development of anthropological studies. The first anthropological research stressed the importance of environmental determinism which posits that climate and geography had direct influence on human culture and behavior. This method was however later criticized as being too simplistic on complex social processes [23]. Modern anthropology has a more subtle approach and is able to see the process of human adaptation as a process of interaction and dynamism based on the cultural practices, social organization, historical context, and political-economic influences [24]. Cultural ecologists and ecological anthropologists believe that cultural mediation strategies are not merely an active response to environmental challenges but instead a culturally mediated form of adaptation by humans.

### *Adaptation and Climate Change in Anthropology*

The concept of adaptation in anthropological literature is considered as a multi-dimensional process that is biological, cultural, and socio-economic. Long-term physiological adaptations to climatic conditions (thermoregulation and adaptation to altitude) have been reported by biological anthropologists. Nevertheless, a greater part of the current literature focuses on cultural adaptation as the major mechanism of human reaction to the rapid climate change [25]. Cultural adjustment is encompassed by subsistence adjustment, technology, settlement and social organization. According to the argument of the anthropologists, the flexibility in culture enables human societies to adapt to environmental stress faster as compared to evolution of the biology on its own.

Climate change has brought novel complexities to the examination of adaptation because of its faster speed and international nature. In contrast to the climatic changes of the past, the modern climate change is strongly associated with industrialization, globalization, and unequal distribution of resources [26]. Consequently, anthropological studies are starting to pay more attention to the vulnerability, resilience,

and adaptive capacity, articulating the role of social inequality and power relations in climate stress reaction.

#### ***Traditional Ecological Knowledge and Local Adaptation***

There is a large collection of anthropological literature focusing on the importance of traditional ecological knowledge (TEK) in adapting to climate. TEK is a local body of knowledge that determines how resources are managed, how agricultural activities are operated and how the environment is managed. Research in indigenous and rural communities has found that TEK increases the resilience of the indigenous people through sustainable land use, biodiversity preservation, and management of risks [27]. According to anthropologists, the problem with disregarding of local knowledge in favor of top-down technological solutions is that it commonly results in either ineffective or unsustainable outcomes of adaptation.

Research in the context of Pakistan demonstrates the significance of the localized practices like the water-sharing systems, crop diversification, pastoral movement, and the shared resources. These are cultural practices that are entrenched in culture and social relations [28], and thus they are very important in explaining the adaptive behavior at community level.

#### ***Climate Change, Vulnerability, and Social Inequality***

The anthropological literature has never failed to show that the impact of the climate change has not been evenly spread, but it has been more on the marginalized groups. Political ecology is a critical practice to examine the vulnerability which is constructed by historical marginalization and land tenure system as well as unequal resource access. Scientists argue that climate change is not contributing to the feeling of social imbalances but it intensifies it [29]. The climate risks in South Asia are exacerbated by weak institutional support, population increase, and poverty.

The literature documents how the small-scale farmers, pastoralists, women and the landless laborers in Pakistan have been exposed to greater levels of vulnerability against floods, droughts, and heat stress. According to gender-related studies, women tend to be the most impacted by climatic change due to the fact that they are the ones who fetch water, engage in agriculture, and be the ones who handle households yet they make very poor decisions [30]. The reason behind this is that these findings promote the significance of socially inclusive adaptation strategies.

#### ***Anthropological Studies on Climate Change in Pakistan***

New anthropological and interdisciplinary research in Pakistan is concerned with region-specific climate issues. Researchers have recorded community response to glacial retreat and glacial lake outburst floods in north mountainous regions with the majority of studies focusing on adaptive responses to these floods, like changed cropping-calendar, seasonal-migration, and early-warning systems used by locals [31-32]. Within the Indus Basin, research indicates how frequent flooding has caused some shifts in the farming activities, migration of settlement and the dependence on kinship ties in recovering.

Anthropological studies in arid lands, like Balochistan and Tharparkar, lay stress on pastoralism, drought-tolerant resistant crop as well as communal management of water as the main adaptive mechanisms. Sindhi-based studies of the coast uncover adaptation strategies of the fishing community to rising sea-level and depleted marine resources, namely diversification of livelihood and migration [33]. All these studies demonstrate that the adaptation in Pakistan is very localized and is embedded in the culture.

### ***Resilience and Adaptive Capacity***

Resilience has become a prominent concept in anthropology literature of climate change. Resilience is a property which implies that individuals and communities take in environmental shocks without disrupting social and cultural continuity [34]. Instead of focusing on the technical capacity, anthropologists warn against the consideration of resilience as only a technical capability, which implies its social and cultural aspects [35]. The social networks, kinship networks and community institutions are important in enhancing adaptive capacity especially in the resource limited environments such as Pakistan [36-37].

### **METHODOLOGY**

#### ***Research Design***

In this research, qualitative research design will be used to examine the anthropological explanation of human adaptation to climate change. The qualitative research is the most suitable study design in this study since it allows a detailed study of the social sense, cultural behavior, and lived experience which form adaptive behavioral responses to environmental change. Anthropology pays attention to the interpretation of human behavior in terms of culture and history, and a qualitative approach gives the opportunity to explore the issue of adaptation as a socially created and dynamic process, rather than a technical and measurable phenomenon. The research is exploratory and interpretive in both nature where the researcher seeks to develop subtle understandings of how various communities in Pakistan react to climate related issues.

#### ***Study Area***

The geographical area of interest in this research is Pakistan, which is a country with high level of ecological diversity and increased exposure to climate change. The physical landscape of Pakistan comprises the Himalayan, Karakoram and Hindu Kush Mountain ranges in the North; the Indus River plains of Punjab and Sindh; arid and semi-arid areas of Balochistan and Tharparkar and a long coastline on the Arabian Sea. All of these areas are uniquely vulnerable to climate-related uncertainty (like the melting of glaciers, floods, droughts, heat rays, and the increase in sea levels). The ecological variation offers a perfect environment where one can study different types of human adaptation. Through the analysis of adaptation within various environmental zones, the paper is able to understand the complexity and context of adaptive strategies in Pakistan.

#### ***Data Sources***

The study is premised on secondary qualitative data, which comprises of a broad body of scholarly and institutional literature. They consist of peer-reviewed anthropological and interdisciplinary journal articles, ethnographic research, scholarly books and publications by the international organizations that are interested in climate change and development in Pakistan. Special consideration is made to those studies which record community-based adaptation measures, indigenous knowledge system and socio-cultural reactions to environmental stress. Secondary data are used to enable a comparative analysis of the various regions being studied in a limited region as well as ensuring methodological feasibility.

#### ***Data Collection Strategy***

The data collection was performed through the systematic review of the available literature pertaining to climate change, human adaptation and anthropology in Pakistan. Academic databases, institutional repositories, and official publications were searched to find the relevant sources. The case studies in various ecological locations were chosen according to their topicality to the issues connected with climate as well as their having of qualitative descriptions. This approach was necessary to make sure that the

information was representative of a variety of social, cultural, and environmental settings, which would allow considering the entirety of adaptation processes.

### ***Data Analysis***

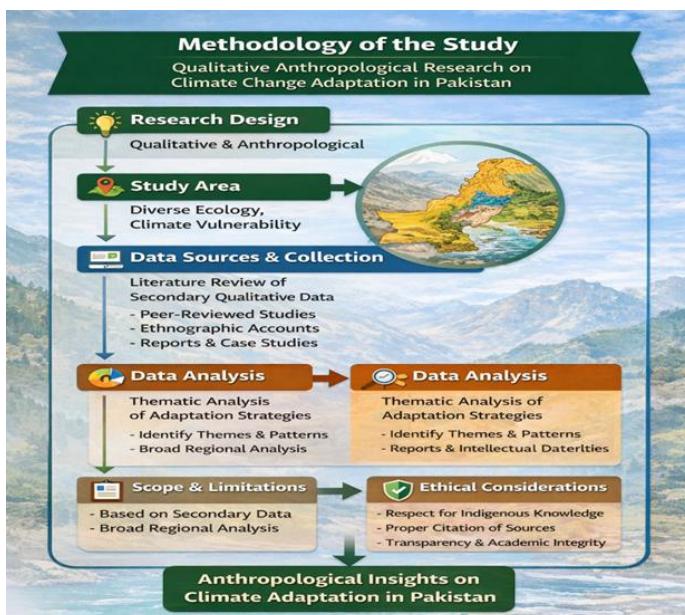
Thematic analysis which is a well-used qualitative analytical method was used to analyze the collected data. The analysis was conducted through several steps such as getting accustomed to the data, coding of the primary concepts, the recognition of the main themes, and interpretation of the patterns in terms of adaptation, vulnerability, and resilience. Traditional ecological knowledge, livelihood diversification, social networks, migration and inequality were the themes addressed in relation to environmental stressors. Anthropological theoretical perspectives, specifically, cultural ecology and political ecology were used to interpret the findings and bring to the fore the interplay between culture, the environment, and power structures.

### ***Scope and Limitations***

Although this paper presents a qualitative research process in detail, there is a limitation in the fact that it utilizes secondary data. The lack of initial ethnography missions might limit the richness of personal community outlooks. This is, however, overcome by relying on a broad variety of quality ethnographic and empirical research. The research is not a statistical generalization but a study with a purpose of formulating context-specific interpretations applicable to the anthropological research and policy-making.

### ***Ethical Considerations***

During the study, the ethical factors were put into consideration. Since the study is designed using secondary data, it did not imply any contact with human subjects. The research, however, does not disrespect communities represented in the literature through depicting the experience of communities accurately and without misrepresenting their cultures. The local practices and indigenous knowledge systems are viewed as important contributions to intellectual knowledge instead of informal or anecdotal. All the sources are referenced, which guarantees academic integrity, transparency, and intellectual property respect.



**Figure 2: Methodological Framework of the Study**

## **ANALYSIS AND DISCUSSION**

### ***Climate Change as a Lived Social Reality in Pakistan***

Through anthropological analysis, the climate change in Pakistan has not only been an environmental phenomenon but living social reality, changing the everyday life, livelihoods and social relations in Pakistan. Pakistan is witnessing a shift in climatic conditions in the communities in the form of physical destabilization of rainfall patterns, extended droughts, frequent floods, receding glaciers and high temperature. It is the experiences that affect the way in which individuals view environmental threat and influence the adaptive response based on both cultural knowledge and experience. The key point made by anthropology is that the issue of adaptation has to be interpreted within these local meanings, not only with the help of abstract climate models.

### ***Adaptation to Culture and Indigenous Knowledge Systems.***

The most important process by which Pakistani communities have reacted to climate stress has continued to be cultural adaptation. In the agrarian regions of Punjab and Sindh, farmers have changed the cropping calendar, crop diversification, mixed farming to manage the uncertain monsoon cycle and monsoon floods. The anthropological studies point at the importance of indigenous knowledge in the selection of seeds, management of the soil, and the use of water that leads to resilience despite the lack of access to modern technologies.

In dry areas like Tharparkar and Balouchistan pastoral and agro-pastoral societies use mobility, diversification in herders and collective sharing of water as adaptations. The practices are deeply rooted in the society and kinship systems that they prove how culture intermediates environmental response. These adaptations do not support the claim that traditional practices are outdated but rather highlight the fact that they are important in the current climate resilience.

### ***Adaptation in Mountain and Coastal Communities***

Mountain communities of Gilgit-Baltistan and the Northern Khyber Pakhtunkhwa offer good examples of adaptive flexibility. Such populations traditionally have been relying on glacial melting to irrigate their lands using localized systems. As glaciers melt faster and there are more chances of glacial lake outburst floods (GLOFs), agricultural routines have been adapted, local early-warning systems have been enhanced, and seasonal labor migration has been resorted to. Anthropology demonstrates that those reactions are not single steps but general plans worked out by community collaboration and opting together ecological experience.

Equally, Sindh, along the Indus Delta, encounters rise in sea level, intrusion of salt water and dwindling fish stocks among coastal fishing populations. Some of the adaptation measures encompassed modification in fishing methods, the diversification of livelihood and migration to cities. Such adaptations, though, also lead to loss of culture and social dislocation as emphasized on the tradeoffs in adaptations. The anthropological approach attracts attention to the impact of environmental change on economic survival as well as identity and community cohesion.

### ***Social Inequality, Vulnerability, and Adaptive Capacity***

Anthropology holds a critical contribution in terms of unequal vulnerability to climate change. Adaptive capacity is also not evenly shared in Pakistan because of the poverty, landlessness, gender inequity and political marginalization. Small-scale farmers, ladies and informal workers are also likely to be more exposed to climate risks but have limited resources to adjust. The separation of genders in terms of water collection, agriculture and household management makes women more vulnerable but their experience and labor are still undervalued in the adaptation planning.

Through political ecology, it is evident that climate effects tend to increase the level of inequalities that already exist and not to be stressors in their own right. As an example, during flood recovery in rural Pakistan kinship ties and informal support systems are very often relied upon because institutional response was inadequate. Anthropology therefore brings out resilience as a social process that is based on relationship, power, and availability of resources.

### **Resilience, Community Institutions, and Social Networks.**

The Pakistani communities have a high degree of resilience that is connected with social networks, kinship ties, and local institutions. The informal source of support, mutual labor exchange and collaborative determination is crucial in the management of environmental shocks. According to anthropological studies, the adaptive capacity of communities under resource constrained environments seems to be higher because of highly sociably coherent communities. This poses a challenge to the policy approaches that only address the technological solutions leaving the social capital unaddressed.

### ***Anthropological Implications for Climate Adaptation***

This analysis has shown that the context-specific, culturally mediated, and socially differentiated ways of human adaptation to climate change in Pakistan are a phenomenon. The perspectives of anthropology demonstrate the drawbacks of the single-size-fits-all adaptation policies and value the importance of the solutions which are locally based and take into consideration the knowledge of the indigenous people and the social inequality. Adaptation is not to be seen then as a strictly technical event but a socio-cultural process influenced by the history, power and the community values.

The summary of the above analysis and discussion can be summarized as follows:

- The culture of Pakistan is highly adapted within cultural practices and indigenous knowledge.
- Social inequality and marginalization determine climate vulnerability.
- Whole community-based approaches are more effective in improving resiliency than individual interventions.
- Anthropology offers some insights on sustainable adaptation policies which are critical.

### **POLICY IMPLICATIONS**

The anthropological perspective on human adjustment to climate change in Pakistan also emphasizes that the policy options should go beyond technical and infrastructure-based solutions. Although major engineering activities and technological interventions are significant, they do not always accommodate the social, cultural and economic aspects of adaptation. Pakistan should thus base climate policies on a people-centered approach that will make the local knowledge systems, community institutions and social inequalities the key elements of effective adaptation policies.

The integration of indigenous and traditional ecological knowledge into national and provincial climate adaptation planning is one of the policy implications. Pakistan communities share a tradition of experience in the field of water management, agriculture, pastoral movement and preparedness to disasters. Mechanisms through which the local voices can be involved in meaningful ways in making decisions on climate should be institutionalized by policymakers. Adaptation efforts can be more relevant, acceptable and sustainable when community consultation and participatory planning are considered.

The other implication is critical and regards the necessity to deal with the issues of social inequality and unequal vulnerability. The policies on climate adaptation should be geared towards the marginalized groups among them being the small-scale farmers, women, landless workers, indigenous populations, and the coastal communities. It is especially critical to adapt planning by making it gender sensitive because women are a key component in resilience to households and agriculture but are still underrepresented in

the policy arenas. Adaptive capacity of vulnerable groups can be supported by using social protection mechanisms, livelihood diversification initiatives, and having reliable access to resources as important factors.

Anthropological insights also highlight the need to strengthen the local institutions and social networks. The resilience could be attained by supporting community-based organizations, cooperative resource management and informal support systems rather than concentrating on top-down interventions. Preparedness and response of disaster risk reduction should also involve local early-warning systems and culturally relevant communication to enhance disaster preparedness and response.

Lastly, climate policies of adaptation to climate in Pakistan need to be interdisciplinary and long-term. Anthropologists, environmental scientists, planners, and policymakers may work together to make sure that the policies of the adaptation strategy are scientifically sound and are rooted in the social context. Pakistan can create more participative, effective and sustainable solutions to the challenge of the climate change by integrating cultural knowledge and social equity into climate governance.

**Table 1: Anthropological Analysis of Human Adaptation to Climate Change in Pakistan**

<b>Ecological Region (Pakistan)</b>	<b>Major Climate Stressors</b>	<b>Community-Based Adaptive Strategies</b>	<b>Anthropological Interpretation</b>	<b>Key Outcomes</b>
<b>Northern Mountain Regions (Gilgit-Baltistan, KP)</b>	Glacial retreat, GLOFs, erratic snowfall	Terrace agriculture, ice water cuts, local swarming, temporary pre-disaster early warnings.	The idea of adaptation as a social and culturally entrenched response formed as per the indigenous ecological knowledge.	Community cooperation and traditional water management are the means of enhanced resilience.
<b>Indus River Plains (Punjab &amp; Sindh)</b>	Floods, irregular monsoons, heatwaves	Diversification in crops, changed agricultural calendar, recovery system by kinship networks	Cultured ecology emphasizes adaptation via the flexible agricultural system and social structures	Enhanced livelihood risk and post disaster recovery.
<b>Arid &amp; Semi-Arid Regions (Balouchistan, Tharparkar)</b>	Droughts, water scarcity, desertification	Moving pastoralists, drought resistant crops, common water sharing.	Adaptation controlled through social norms, pastoralism and community resource management.	Austere weather survival using suboptimal infrastructure.
<b>Coastal Areas (Indus Delta, Sindh Coast)</b>	Sea-level rise, salinity intrusion, declining fish stocks	Lifestyle diversification, fishing changes, immigration.	Political ecology reveals the interplay of the environmental change and marginalization and loss of culture.	Mixed outcomes: economic survival and social and cultural disintegration.
<b>Urban &amp; Peri-Urban Communities</b>	Heat stress, water shortages, climate-induced migration	Grey work, social networking, innovative housing.	Anthropology has been focusing on resiliency via informal economies	Long-term vulnerability coped with in the short term.

			and social capital.	
<b>Marginalized Groups (Women, Landless Laborers)</b>	Disproportionate exposure to climate risks	Informal networks Household-level coping.	The vulnerability of gender based on power and the inequitable distribution of resources.	Very strong resilience and weak adaptive capacity.

## CONCLUSION

This paper has explored the anthropological facet of human adaptation to climate change with lots of focus being given to the intricate geo-cultural and societal interaction between the environment, culture, and society in Pakistani context. The discussion shows that climate change in Pakistan is not merely an environmental or technical issue but very much a social phenomenon that has a direct influence on livelihoods, social relationships, cultural practices, and human welfare. Shifting anthropological perspective towards a holistic approach the study points out that adaptation is a dynamic process that is culturally mediated and context specific as opposed to consistent reaction to environmental pressure.

The results show that Pakistan communities living in different ecology regions have acquired various adaptive mechanisms based on indigenous knowledge, interpersonal relationships, and historical experience. Altered agricultural activity in the Indus plains and pastoral movement in arid areas, community-based water management in hilly regions, and livelihood diversification in coastal areas all the strategies show human resilience in the face of climate uncertainty. Nevertheless, the paper also highlights the fact that the extent of adaptive capacity is unevenly dispersed with marginalized populations experiencing the disproportionate burden of the impact of climate change through social inequality, economic issues, and institutional weaknesses.

The conclusion of this piece of work highlights the important role of anthropology in climate change studies and policy. Anthropology could provide the necessary information to build adaptive strategies that are inclusive and sustainable by preempting the local voices, cultural knowledge systems, and social realities. The paper concludes that climate adaptation in Pakistan needs to be based on the combination of the community-based knowledge and the scientific methods, structural inequalities should be tackled, and the institutions in Pakistan should be reinforced. This is not merely a strategy that could help to create resilience, but that would also help to make climate responses socially just, culturally proper, and sensitive to the real lives of people who are most at risk because of the climate change.

## REFERENCES

Pisor, A. C., & Jones, J. H. (2021). *Human adaptation to climate change: An introduction to the special issue*. *American Journal of Human Biology*, 33(4), Article e23530. <https://doi.org/10.1002/ajhb.23530>

O'Reilly, J., Isenhour, C., McElwee, P., & Orlove, B. (2020). *Climate change: Expanding anthropological possibilities*. *Annual Review of Anthropology*, 49, 13–29. <https://doi.org/10.1146/annurev-anthro-010220-043113>

Jones, J. H., Ready, E., & Pisor, A. C. (2021). *Want climate-change adaptation? Evolutionary theory can help*. *American Journal of Human Biology*, 33(4), e23539. <https://doi.org/10.1002/ajhb.23539>

Ocobock, C. (2023). *Human bodies in extreme environments*. *Annual Review of Anthropology*, 52, 257–277. <https://doi.org/10.1146/annurev-anthro-052721-085858>

Pisar, A. C., Lansing, J. S., & Magargal, K. (2023). *Climate change adaptation needs a science of culture*. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 378(1889), Article 20220390. <https://doi.org/10.1098/rstb.2022.0390>

Nepali, S., & Tamang, R. (2022). *Local perception and adoption to climate change: A review of agricultural perspective*. *International Journal of Agricultural and Life Sciences*, 8(3), 375–383. <https://doi.org/10.22573/spg.ijals.022.s122000110>

Rivera-Collazo, I. (2022). *Environment, climate and people: Exploring human responses to climate change*. *Journal of Anthropological Archaeology*, 68, Article 101460. <https://doi.org/10.1016/j.jaa.2022.101460>

Marks, D., Bayrak, M.M., Jahangir, S. *et al.* Towards a cultural lens for adaptation pathways to climate change. *Reg Environ Change* 22, 22 (2022). <https://doi.org/10.1007/s10113-022-01884-5>

Krawczyk, A., & Wyczesany, M. (2021). *Anthropological perspective on human adaptation and resilience to climate change*. *Life*, 11(9), 898. <https://doi.org/10.3390/life11090895>

Cianconi, P., Hanife, B., Grillo, F., Zhang, K., & Janiri, L. (2021). Human Responses and Adaptation in a Changing Climate: A Framework Integrating Biological, Psychological, and Behavioural Aspects. *Life*, 11(9), 895. <https://doi.org/10.3390/life11090895>

Burke, A., Peros, M. C., Wren, C. D., Pausata, F. S. R., Riel-Salvatore, J., Moine, O., de Vernal, A., Kageyama, M., & Boisard, S. (2021). *The archaeology of climate change: The case for cultural diversity*. *Proceedings of the National Academy of Sciences of the United States of America*, 118(48), e2108537118. <https://doi.org/10.1073/pnas.2108537118>

Scheinsohn, V., Muñoz, A. S., & Mondini, M. (2023). *Climate change and long-term human behaviour in the Neotropics: An archaeological view from the Global South*. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 378(1889), Article 20220403. <https://doi.org/10.1098/rstb.2022.0403>

Oakes, R., Banerjee, S., & Warner, K. (2020). *9 Human mobility and adaptation to environmental change*. *World Migration Report*, 1. Wiley. <https://doi.org/10.1002/wom3.19>

Schlingmann, A., Graham, S., Benyei, P., Corbera, E., Martinez Sanesteban, I., Marelle, A., Soleymani-Fard, R., & Reyes-García, V. (2021). *Global patterns of adaptation to climate change by Indigenous Peoples and local communities: A systematic review*. *Current Opinion in Environmental Sustainability*, 51, 55–64. <https://doi.org/10.1016/j.cosust.2021.03.002>

Kramer, K. L., & Hackman, J. (2020). *Scaling climate change to human behavior: Predicting good and bad years for Maya farmers*. *American Journal of Human Biology*, 33(4), e23524. <https://doi.org/10.1002/ajhb.23524>

von Seggern, J. (2021). Understandings, Practices and Human-Environment Relationships—A Meta-Ethnographic Analysis of Local and Indigenous Climate Change Adaptation and Mitigation Strategies in Selected Pacific Island States. *Sustainability*, 13(1), 11. <https://doi.org/10.3390/su13010011>

Hossain, M. S., Basak, S. M., Amin, M. N., Anderson, C. C., Cremin, E., & Renaud, F. G. (2024). *Social-ecological systems approach for adaptation to climate change*. *Sustainable Development*, 32(3), 2766–2778. <https://doi.org/10.1002/sd.2801>

Sanjatmiko, P., & Supriatna, E. (2020). “*Compromise*” between human and nature: A multi-species ethnography approach for redefining the concept of human adaptation. *Technium Social Sciences Journal*, 9(1), 567–576. <https://doi.org/10.47577/tssj.v9i1.1083>

Brewer, J., & Riede, F. (2018). *Cultural heritage and climate adaptation: A cultural evolutionary perspective for the Anthropocene*. *World Archaeology*, 50(4), 554–569. <https://doi.org/10.1080/00438243.2018.1527246>

Cinner, J. E., Adger, W. N., Allison, E. H., Barnes, M. L., Brown, K., Cohen, P. J., Gelcich, S., Hicks, C. C., Hughes, T. P., Lau, J., Marshall, N. A., & Morrison, T. H. (2018). *Building adaptive capacity to climate change in tropical coastal communities*. *Nature Climate Change*, 8(2), 117–123. <https://doi.org/10.1038/s41558-017-0065-x>

Gagné, K. (2019). *Climat*. In *Anthropen.org*. Éditions des Archives Contemporaines. <https://doi.org/10.17184/eac.anthropen.110>

Orlove, B., Milch, K., Zaval, L., Ungemach, C., Brugger, J., Dunbar, K., & Jurt, C. (2019). *Framing climate change in frontline communities: Anthropological insights on how mountain dwellers in the USA, Peru, and Italy adapt to glacier retreat*. *Regional Environmental Change*, 19(5), 1295–1309. <https://doi.org/10.1007/s10113-019-01482-y>

Jorgenson, A. K., Fiske, S., Hubacek, K., Li, J., McGovern, T., Rick, T., Schor, J. B., Solecki, W., York, R., & Zycherman, A. (2019). *Social science perspectives on drivers of and responses to global climate change*. *Wiley Interdisciplinary Reviews: Climate Change*, 10(1), Article e554. <https://doi.org/10.1002/wcc.554>

Baer, H. A., & Singer, M. (2018). *The anthropology of climate change: An integrated critical perspective* (2nd ed.). Routledge. <https://doi.org/10.4324/9781351273121>

Schug, G. R., Parnell, E. K., & Harrod, R. P. (2018). *Changing the climate: Bioarchaeology responds to deterministic thinking about human-environmental interactions in the past*. In J. E. Buikstra (Ed.), *Bioarchaeologists speak out* (pp. 133–159). Springer. [https://doi.org/10.1007/978-3-319-93012-1\\_6](https://doi.org/10.1007/978-3-319-93012-1_6)

Leonard, W. R. (2018). *Centennial perspective on human adaptability*. *American Journal of Physical Anthropology*, 165(4), 813–833. <https://doi.org/10.1002/ajpa.23401>

Whyte, K. (2017). *Indigenous climate change studies: Indigenizing futures, decolonizing the Anthropocene*. *English Language Notes*, 55(1–2), 153–162. <https://doi.org/10.1215/00138282-55.1-2.153>

Fuentes, A. (2016). *The extended evolutionary synthesis, ethnography, and the human niche: Toward an integrated anthropology*. *Current Anthropology*, 57(S13–S26), S13–S26. <https://doi.org/10.1086/685684>

Gibson, H., & Venkateswar, S. (2015). *Anthropological engagement with the Anthropocene: A critical review*. *Environment and Society: Advances in Research*, 6(1), 5–27. <https://doi.org/10.3167/ARES.2015.060102>

Bates, D. G., Tucker, J., & Lozny, L. R. (2023). *Human adaptive strategies: An ecological introduction to anthropology* (4th ed.). Routledge. <https://doi.org/10.4324/b23278>

Marks, D., Bayrak, M. M., Jahangir, S., Henig, D., & Bailey, A. (2022). *Towards a cultural lens for adaptation pathways to climate change*. *Regional Environmental Change*, 22, Article 22. <https://doi.org/10.1007/s10113-022-01884-5>

Inderberg, T. H., Eriksen, S., O'Brien, K., & Sygna, L. (Eds.). (2014). *Climate change adaptation and development: Transforming paradigms and practices*. Routledge. <https://doi.org/10.4324/9781315774657>

Cianconi, P., Hanife, B., Grillo, F., Zhang, K., & Janiri, L. (2021). *Human responses and adaptation in a changing climate: A framework integrating biological, psychological and behavioural aspects* (Preprint). Preprints. <https://doi.org/10.20944/preprints202106.0732.v1>

Cianconi, P., Hanife, B., Grillo, F., Zhang, K., & Janiri, L. (2021). Human Responses and Adaptation in a Changing Climate: A Framework Integrating Biological, Psychological, and Behavioural Aspects. *Life*, 11(9), 895. <https://doi.org/10.3390/life11090895>

Burke, A., Peros, M. C., Wren, C. D., et al., (2021). *The archaeology of climate change: The case for cultural diversity*. *Proceedings of the National Academy of Sciences of the United States of America*, 118(30), e2108537118. <https://doi.org/10.1073/pnas.2108537118>

Orlove, B., Milch, K., Zaval, L., Ungemach, C., Brugger, J., Dunbar, K., & Jurt, C. (2019). *Framing climate change in frontline communities: Anthropological insights on how mountain dwellers in the USA, Peru, and Italy adapt to glacier retreat*. *Regional Environmental Change*, 19(5), 1295–1309. <https://doi.org/10.1007/s10113-019-01482-y>

Monks, G. G. (Ed.). (2017). *Climate change and human responses: A zooarchaeological perspective* (Vertebrate Paleobiology and Paleoanthropology). Springer. <https://doi.org/10.1007/978-94-024-1106-5>