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Climate Change, Social Vulnerability, and Livelihood Transformations: A Sociological Analysis of Communities in the Thar Desert, Pakistan

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ABSTRACT

The present study analysed the effects of climate change on the social vulnerability and livelihood changes of communities in the Thar Desert, Pakistan. Using a qualitative research approach, the study examined the impact of recurrent droughts, water scarcity, and environmental degradation on the socio-economic circumstances and livelihoods of the local people. Focus group discussions (FGD) and in-depth interviews (IDI) were conducted with members of the community, including farmers, pastoralists, and women, as well as key informants who are knowledgeable about the environmental and social dynamics in their community. The results indicated that climate change had resulted in agricultural productivity, livestock loss, and reliance on migration and non-formal employment. These changes increased social vulnerability, especially for the more disadvantaged segments of society, due to limited access to resources, low institutional capacity, and already existing socio-economic disparities, which reduced adaptive capacity. The study also revealed a distinct gender difference, that the impacts on women were severe, and that they were particularly burdened with coping with household survival during scarcity. In the face of such difficulties, communities showed adaptive strategies that were based on their local knowledge and social networks. In Conclusion, the study found that climate change was not just an environmental problem but also a very social problem, which requires multi-sectoral, community-based, and socially participatory approaches to build resilience in the Thar desert.

Introduction

Climate change is one of the biggest environmental, social, and economic issues of the 21st century. It is a change in the average temperature and usual weather conditions of a particular area over a prolonged period of time, mainly attributable to human activities, including the use of fossil fuels, the cutting down of forests, and industrial processes. IPCC has reported that climate change is increasingly impacting global ecosystems, leading to extreme weather, sea level rise, and changes in agricultural productivity, all of which have significant impacts on food security, health, and infrastructure (IPCC, 2021). As the world confronts these challenges, the impact is being borne by the most vulnerable, including in low and middle-income countries (LMICs). The impact of climate change on the poor and marginalized, who are often reliant on natural resources for their livelihood, is most harmful in these areas.

South Asia is one of the climate-sensitive regions in the world, and some countries in the region are particularly affected by climate-related events like floods, droughts, and extreme temperatures. However, Pakistan, due to its wide climatic variations, is highly vulnerable to climate change's effects, which have a direct impact on millions of people, especially in rural and arid areas. The Thar Desert is one such region in Pakistan that lies in the southeastern part of the country in the provinces of Sindh and Rajasthan. The Thar Desert is one of the largest dry land regions in the world, with a population of about 2.5 million people (Hamza et al., 2024). They are largely farmers, pastoralists, and other rural people living within these communities, who are incredibly vulnerable to coping with the impacts of climate change, and who have many socio-economic vulnerabilities.

The Thar Desert is a dry area with harsh weather conditions, insufficient rainfall, and droughts often occurring. Despite the difficult conditions of this desert, it has been inhabited for thousands of years and is still home to many different communities that rely heavily on agriculture and farming as well as livestock rearing. More recently, however, climate change has brought growing pressures to the region as a result of the increased frequency and severity of droughts, water scarcity, and environmental degradation. Consequently, local people's old livelihoods are now at risk.

Frequent droughts and irregular rainfall have caused major agricultural losses, and frequent crop failures are occurring. Water scarcity and pasture degradation have had a significant impact on livestock, a significant source of income and sustenance for many families. As a result, many of these environmental stresses have resulted in livelihood changes, and some communities are now resorting to seasonal migration and informal employment as their major means of livelihood. But such alternatives are not sustainable and will not provide a lasting solution, creating even more exposure of the communities to climate-induced shocks (Hamza et al., 2024).

These alterations to the environment have not only impacted traditional livelihoods but have also intensified social vulnerabilities, especially for marginalized populations like women, young people, and the elderly. In the Thar Desert, the effects of climate change are most severe on women, who are most affected when it comes to coping with scarcity in the household. These women are often tasked with fetching water and with childcare and food security, which becomes even more challenging under climate stressors (Shaikh et al., 2020). The gender gap demonstrates the need to consider climate change not just as an environmental phenomenon but as a social phenomenon that impacts the lives of people in complex and interconnected ways.

Social vulnerability plays a key role in the research of climate change impacts, because it takes the vulnerability of people or communities to the adverse effects of environmental hazards into

account. The determinants of social vulnerability are diverse, ranging from socio-economic conditions and resource access to education, gender, and ability to cope with climate-related stresses. The Thar Desert communities are especially at risk from the effects of climate change, as they already have high poverty rates, weak infrastructure, and a lack of access to health facilities. These populations face little institutional support, weak water management systems, and little governmental outreach, further compounding the situation because of the devastating impacts of climate-induced stress(Memon et al., 2018).

Climate change shocks, including droughts and heatwaves, further deepen social inequalities and raise vulnerability, particularly of the poor and the vulnerable. The impact of environmental deterioration and socio-economic marginalization has resulted in a vicious circle that makes it harder and harder for communities living in the Thar to get out of poverty and gain control over their situation. This is especially the case for marginalized groups like women, who are not given the opportunity to participate in decision-making processes and are also excluded from climate adaptation planning and policy-making. They are also less able to respond to and adapt to climate stresses due to a lack of representation and empowerment (Memon et al., 2018).

Climate change has brought about a change in the lives of the communities of the Thar Desert. Traditional agricultural practices are no longer viable because they are now less fertile, have limited water resources, and experience more droughts. Consequently, in many instances, farmers have been compelled either to give up their farms or to scale down their operations. Economic struggles have additionally been exacerbated by the decline of livestock, which is an important indicator of drought and water scarcity and is highly vulnerable to droughts (Hamza et al., 2024).

Many have therefore found themselves, in their struggle to survive, forced to resort to migration. Seasonal migration – to cities or to other areas in search of work – is a prevalent coping strategy. But migration also entails a set of difficulties: precarious living conditions, low employment prospects, social exclusion, etc. Besides, migration negatively impacts social networks and community cohesion, which in turn adds to the vulnerability of these communities (Shaikh et al., 2020).

In addition to migration, many families have also shifted to informal employment, including daily wage labor, which is a less stable and predictable income source. The changes in livelihoods are generally associated with a drop in living standards and a rise in economic insecurity. The ability of families to cope under changing climate conditions decreases as they find themselves more vulnerable and poorer in the future, resulting in a vicious cycle of vulnerability and poverty (Hamza et al., 2024).

The gender dimensions of climate change effects in the Thar Desert are undeniable. Women in these communities have a greater role in coping with the climate-induced pressures and keeping the household alive. They are in charge of fetching water, which can be more challenging as water sources dwindle, as well as making sure their families have access to food. Women are also often the first responders and are responsible for the health and well-being of the children and elderly (Shaikh et al., 2020).

The unequal division of labor increases the vulnerability of women, as they are less likely to be part of decision-making processes on climate adaptation and resource allocation as climate stress grows. This disconnect from decision-making power not only has a negative effect on the coping capacity of women in response to climate impacts but also reduces their access to resources like education, healthcare, and economic opportunities (Hamza et al., 2024)

Hence, the vulnerability of women and children in the Thar region is a direct consequence of

gender inequality, and gender should be a central concern in adapting to the impacts of climate change.

Research Objectives

1. To assess the impact of climate change on traditional livelihoods in the Thar Desert, focusing on agriculture and pastoralism.
2. To explore the gendered effects of climate change in the Thar Desert, with emphasis on women's roles in household survival.
3. To evaluate community adaptation strategies in response to climate change and their contribution to resilience.

Research Questions

1. How has climate change, particularly recurrent droughts and water scarcity, affected the livelihoods and survival strategies of communities in the Thar Desert?
2. What are the gendered implications of climate change in the Thar Desert, and how do women experience and cope with the challenges posed by environmental degradation?
3. What adaptive strategies have communities in the Thar Desert developed to mitigate the impacts of climate change, and how effective are these strategies in promoting resilience and long-term sustainability?

Literature Review

With impacts beyond the atmosphere, climate change is one of the most critical challenges of the 21st century, especially in climate-sensitive places, affecting society, economy, and culture. The Intergovernmental Panel on Climate Change (IPCC) found that the increased intensity of droughts, heatwaves, and the uncertainty of precipitation patterns over the past century have occurred at an unprecedented rate (IPCC, 2021). Climatic phenomena are more conspicuous in the arid and semi-arid areas, as water scarcity and environmental stress have a greater impact on livelihood options (Giri et al., 2023).

The Thar Desert in the south-east part of Pakistan and north-west of India is one of the most vulnerable regions (Hamza et al., 2024). Its population is traditionally reliant on agriculture, livestock, and pastoralism, which are very vulnerable to climatic variability. Conventional livelihood activities have been adversely affected by recurrent droughts, rising number of extreme hot days, and reduced groundwater availability, which have together reduced the livelihood sustainability (Hamza et al., 2024; Memon et al., 2018). Researchers have found that these climate impacts can trigger livelihood insecurity, forced migration, and increased economic fragility (Garg & Choudhary, 2021). In this context, the effects of climate change on climatic conditions of natural environments are also discussed, and the socio-economic context in which communities are trying to survive.

Vulnerability, in the climate change discourse, is not simply a reflection of exposure to climate change but is influenced by social, economic, and institutional inequalities (Adger, 2006; Drakes & Tate, 2022). Social vulnerability is the vulnerability of populations due to exposure, sensitivity, and adaptive capacity (Turner et al., 2003; Birkmann, 2007). It encompasses characteristics like poverty, infrastructure accessibility, education, health services, and social services, and all these are important for a community's capacity to foresee, withstand, and respond to climatic shocks (Fussel & Klein, 2006).

Socio-economic inequality, poor governance, and low levels of social protection increase the vulnerability of the rural population in the South Asian region. According to the climate

vulnerability index, Pakistan is among the top countries in the world that face greater risks due to frequent floods, droughts, heat stress events, etc., which are disproportionately visited upon the resource-poor areas of the country (World Bank, 2022). In this context, the Thar Desert appears as a char: a red zone of compound environmental and social risks, where livelihoods are vulnerable due to a lack of resilience, exacerbated by structural inequalities in access to productive land, credit, and limited support from the State (Shaikh et al., 2020; Memon et al., 2018).

There is evidence that socially vulnerable groups (such as women, elderly people, and landless laborers) are more vulnerable to climate shocks, as they have limited decision-making power and access to assets (Oliver Smith, 2016; Fussel, 2019). The focus on vulnerability is that climate change effects are not equal—they are socially differentiated, thus exacerbating existing inequalities in rural societies.

The food production systems in rural areas are dynamic and flexible, and interdependent with natural resources, skills, social networks, and economic opportunities (Chambers & Conway, 1992). The Sustainable Livelihoods Framework suggests that families rely on five key assets – human, social, natural, physical, and financial – to increase their resilience and maintain their well-being (DFID, 1999). These assets are affected by climate change, and households need to adapt or abandon traditional livelihood strategies.

In the Thar region, the climate-induced scarcity of water and failure of crops has reduced natural capital (soil fertility, pastureland, and water bodies) and financial and physical assets (loss of livestock and accumulation of debt (Hamza et al., 2024). This, in turn, forces households to seek alternative means of income generation, including seasonal migration to urban areas or informal sources. However, these are often low-wage, insecure, and there are no sustainable livelihood-building opportunities (Hamza et al., 2024).

Migration and diversification of livelihoods in similar dry environments, such as the Sahel and the Horn of Africa, have demonstrated that they can be tools used to adapt to the hardships of the environment, but are not necessarily instruments of sustainable development (Bryceson, 2002; Gebre, 2021).

Furthermore, there is no equal distribution of household coping strategies within communities. Some may have access to social networks and community support to mitigate the effects of climatic shocks, while other vulnerable families may not have access to these networks and remain vulnerable to multiple shocks (Adger, 2003; Few, 2007). These changes in livelihoods reflect the manner in which climate change engages with social and economic systems and can often exacerbate poverty and vulnerability cycles.

One of the key debates in the climate change literature is on the gender aspect of vulnerability. Women are more vulnerable to climate impacts than men, as they are often disproportionately responsible for household care and labor, and thus for managing resources and coping with the impacts of climate change (Dankelman, 2010; UN Women, 2016). Women in desert areas, such as the Thar, are mainly responsible for gathering water, cooking, taking care of children, and providing agricultural support services. These jobs become time-consuming, physically exhausting, and emotionally draining with the depletion of water sources and the dwindling of pastures (Shaikh et al., 2020; Habib, 2021).

Various studies have demonstrated that women's engagement in climate adaptation planning is constrained by social norms, low levels of mobility, and less access to decision-making platforms and education (Pearse, R. 2017; Bedeke, 2013). This exclusion has the potential to hinder the effectiveness of adaptation programs, as well as create and exacerbate gender inequalities in access

to adaptation resources, including credit, training, and livelihood diversification. Research studies conducted in rural areas of Pakistan also reveal that women suffer adverse effects of climate stress, such as food insecurity, psychological stress, and health challenges, compared to men, both owing to their social roles and limited agency (Solomon, 2019; Noor & Parveen, 2023).

In the face of climate change, rural communities can adapt by finding ways to respond to climate stress. Adaptive strategies may include altered cropping sequences, water harvesting, community resource sharing, mobility strategies, and social networks of support (Smit & Wandel, 2006; Thornton et al., 2007). These adaptations can be planned (institutionally-supported) or autonomous (emerging out of local knowledge and practice).

Traditional knowledge is an integral part of how communities are able to deal with environmental uncertainty in the Thar Desert. Historically, there has been an improvement in the chances of survival in arid conditions due to the local practices like seasonal livestock rotation, rainwater harvesting, and community grain sharing mechanisms (Memon et al., 2019). But with the escalating climatic extremes that are taking place beyond historical levels of severity, these measures are increasingly put to the test. It has been revealed that traditional adaptation measures are still relevant and sustainable, but they cannot be the only solution to the systemic climate risks without policy measures (Memon et al., 2018; Hussain & Qureshi, 2024).

There are a number of studies that emphasize multi-level governance strategies: linking together knowledge on the community level, institutional support, climate finance, and policy planning that are inclusive (Adger et al., 2009; Ford et al., 2016). For example, water resource management programs are effective in enhancing water security in arid areas where local water harvesting methods are also employed and supported by government infrastructure (Rahman & Gupta, 2022). Likewise, women-based livelihood support activities have proven positive results in strengthening household resilience and their economic empowerment (Zafar et al., 2025).

The literature on the effects of climate change on livelihood and vulnerability is vast; however, there are a few major gaps in the literature, particularly in the context of Pakistan. First, most empirical studies are aimed at the macro level effect on climate or biophysical studies, while fewer studies use a community-centered sociological approach, which brings together environmental change and the experiences of vulnerability and adaptation of people. Secondly, the analysis of gendered impacts of climate change in South Asia is nascent – but not systematic, and largely not done from the perspective of women's voices. Third, little exploration is done related to the influence of social structures, social networks, and cultural norms on community reactions to climate stress, especially in arid and rural settings such as the Thar Desert.

Through this study, we are looking to bridge these gaps by examining the social vulnerability and livelihood changes in the Thar Desert in an in-depth manner with special focus on the perception and response of community members to these changes. This research seeks to advance our understanding of climate adaptation as a socially embedded process and not just an environmental or economic one through the inclusion of a qualitative approach that captures the lived experiences of households, particularly women.

Materials and Methods

The present study was a qualitative research study to investigate the effects of climate change on social vulnerability and livelihood changes in the Thar Desert, Pakistan. The sample size was 140, with equal numbers of males and females, using a purposive sampling technique. Farmers, pastoralists, women, and key informants (community leaders and local government

representatives) were all involved. The data gathered included semi-structured in-depth interviews (IDIs) and focus group discussions (FGDs), which enabled the exploration of participants' experiences and perceptions relating to climate change and its socio-economic impacts in rich, detailed ways.

The interviews and discussions centered on issues related to climate change and the changes in farming practice, migration, coping strategies, and the gendered effects of climate change. Interviews took between 45 and 60 minutes, and FGDs took between 60 and 90 minutes. All sessions were audio taped, transcribed, and translated into English. The thematic analysis method was used to find patterns and key themes in the data, with the help of NVivo software that facilitated data organization and coding.

Member checking was carried out with a subgroup of the sample to ensure the validity of the results, while peer debriefing was done to ensure that the interpretations were correct. Ethical issues brought up were informed consent, confidentiality, and the right to withdraw at any time without penalty. This approach enabled a holistic understanding of adaptation strategies and vulnerabilities of the local community in relation to climate change.

Results and Discussion

The findings of this study have shown that the lives of the people of the Thar Desert have been affected by climate change in the region, especially through the recurrent droughts and water scarcity affecting agriculture and livestock farming. Adaptive strategies reported by the participants were adaptation to seasonal migration and informal employment. It was also clear that gender had played a significant role in the impacts on the household's ability to survive, especially in water collection and food security. Moreover, communities are dependent upon social networks for support, and the absence of institutional support and policy gaps limit the community's capacity to manage climate stress effectively. Mental health was also found to be adversely impacted, as there was greater anxiety and stress regarding the future. The results show the importance of adaptation strategies that are gender-sensitive and based in the community and of the institutions to build resilience and promote long-term well-being in climate-sensitive areas.

Impact of Climate Change on Livelihoods

The in-depth interviews (IDIs) and focus group discussions (FGDs) results indicate that the traditional livelihoods in the Thar Desert have been greatly affected by climate change, especially in agriculture and animal husbandry. Droughts, low rainfall, and crop failures were mentioned as experienced by the participants, resulting in decreasing crop productivity. *"Rainfall is erratic each year, and if it does not come, then they have nothing to harvest,"* said one farmer. Another participant pointed out the serious impact on farming livestock, saying, *"The cattle are dying due to the lack of water; we can't even provide them with enough food.''*

Many families have been forced to move seasonally for jobs, some even to jobs in nearby towns, but in the informal sector. One pastoralist shared, *"We have no other option, we have to go to the cities and work at construction sites when the land doesn't provide.''* The results corroborate previous studies, which indicate that livelihood changes are widespread in dry areas in response to climate stress (Bryceson, 2002; Gebre, 2021).

Gendered Impact of Climate Change

In both the interviews and the discussion, women felt a disproportionate impact from climate change. The housework in the Thar Desert is largely the responsibility of women who collect

water, cook, and look after the children. "*When wells run low, I walk for hours to get water, sometimes accompanied by my children, and no assistance comes from anyone,''* as one woman said. ‘’*These added burdens increase their vulnerability, as they tend to be less economically endowed and to have fewer powers of decision-making.''*

Another woman said, *"My husband works in town, but I have to do everything here. When it doesn't rain, it is more difficult for me to feed the family."* This aligns with the literature that emphasizes women's central role in food insecurity and health issues during climate stress, which makes them more vulnerable to food insecurity and health issues during climate stress (Shaikh et al., 2020;Solomon, 2019). Additionally, the climate change-gender gap nexus in the Thar Desert further emphasizes the importance of gender-responsive adaptation measures.

Adaptation Strategies and Coping Mechanisms

A variety of adaptive measures were observed, such as livestock diversification and migration, and local knowledge. Seasonal migration was the most common coping mechanism, and many households moved temporarily to find jobs. *"Every 6 months we go to the city where we do what we can to earn a living,"* said one of the participants. Likewise, a few farmers have adopted drought-tolerant crops, but this has not been successful because of limited resources. One farmer said, *"I have planted various crops, but with no water, nothing will grow.''*

The use of social networks was also mentioned as an important strategy to manage stress in the FGDs. *"It's our way of surviving, we come together, we share food, and we support each other when we're in trouble,"* explained a community leader. The social networks are indeed important in enhancing the community's resilience, as literature reveals that collective coping strategies were effective in rural areas (Adger, 2003; Few, 2007). For the participants, however, even though these adaptations have been achieved, there was a sense of frustration that there was no institutional support. *“Government does not do enough to support us; we are on our own,"* was noted by one participant. This is a reflection of the difference in coping strategies and government interventions in the region.

Institutional Support and Policy Gaps

Some participants felt there was still a lack of institutional support despite the community's efforts to adapt. Access to water resources, credit, and agricultural extension and advisory services were commonly cited as challenges for effective adaptation. One said, *"The government should do irrigation systems, but we don't get any support.*'' Another added, *"If we don't get assistance, we can't change our situation; we need better access to seeds, tools, and advice.''*

This is in line with studies which underscore the link between weak governance and poor infrastructure in South Asia and climate change vulnerability (Hamza et al., 2024; Memon et al., 2018). There is a need for greater coordination between government, local authorities, and communities in order to better help build long-term resilience, and communities are trying to adapt using traditional knowledge and local resources.

Social Networks and Resilience

A theme that emerged in both the interviews and FGDs was the importance of social networks in promoting social cohesion and community resilience. Several respondents commented that their social network was an important resource when facing the challenges of climate change. One of the participants said, *"When people don't have food and water, we share it with them. If one family is in need, the other gives it to them. We need to rely on each other.*'' Such a feeling of solidarity is

a very important adaptive tool in the Thar Desert, where outside resources are limited.

Another responded, *"We are a strong community because we work together, otherwise we would have been quiet long ago.''* This is a reminder that social capital, in the form of mutual support, sharing of resources, and collective problem solving, makes a significant contribution to building community resilience (Adger et al., 2009). As one participant warned, however, *"People move away, or people don't stay in the village anymore, and the bond is lost this time. It's more difficult to manage.''* This was a reminder of the fragilities of social networks in the context of migration or displacement.

Psychological Well-being and Climate Stress

One additional major theme that surfaced from the data was the emotional impact of climate change. Stress, anxiety, and worry were reported as increased, especially relating to the future of children. One woman said, *"I am concerned every day that my children are not getting enough to eat, and I don't know how to keep them safe in the future.*'' Another participant commented, *"Everyone gets sick in the heat, but there is nothing to treat anyone when it gets hot''.* This is because communities under chronic climate stress are increasingly experiencing mental health crises, with fears for survival and concerns about the future deeply impacting their emotional well-being.

These results are in line with the literature on the psychological impacts of climate change, which frequently include increased anxiety, depression, and trauma in vulnerable populations (Berry et al., 2010; Dawes, 2020). To tackle all effects of climate change, mental health support and adaptive strategies will be essential.

Discussion

This study's findings underscore the far-reaching and complex nature of the effects of climate change on the lives of communities in the Thar Desert. The impact on traditional livelihoods, especially those of agriculture and livestock farming, highlights the fragility of rural livelihoods in dryland areas. This finding is consistent with the previous studies that have reported the critical contribution of environmental stressors such as water scarcity, drought, etc., causing livelihood changes (Hamza et al., 2024).

Migration (seasonal and permanent) has become a common adaptation strategy for many families in the Thar Desert. This transition to informal labor and migration, however, has its own set of problems, such as social exclusion, lack of job security, and low wages. The results further corroborate the results of other research in rural South Asia, indicating that migration is often a short-term survival option, but a long-term solution is difficult to achieve (Bryceson, 2002). Furthermore, this study shows that the effects of climate change are gender specific, with women being more vulnerable to the work they must do in facing the challenges of household survival. This observation goes beyond previous research that has pointed to the gendered aspects of vulnerability to climate change, especially in rural and traditional societies (Pearse, R. 2017; Bedeke, 2013).

Social networks proved to be essential when it came to coping with climate stress, with users using these networks to share resources and help each other manage difficulties. These networks are essential for survival, but the study also emphasized that migration and social fragmentation may affect the strength of social bonds, thereby reducing the collective coping abilities. The discovery highlights the importance of policies to build social cohesion and enhance community resilience to climate-induced stress. Further, there were significant psychological effects, with rising anxiety

and stress levels among participants, particularly in terms of future concerns. It reflects other studies revealing that mental health is more negatively impacted by climate change than physical health, and especially in vulnerable groups (Berry et al., 2010; Dawes, 2020).

Inadequate institutional support and policy gaps became big challenges for effective adaptation. Poor water management, lack of credit facilities, and poor government outreach worsened the problems of the communities in the Thar Desert. The findings are indicative of the general issues of poor governance and lack of climate adaptation policies in rural Pakistan (Memon et al., 2018).

Conclusion

This study offers significant clues to the effects of climate change on social vulnerability and livelihood changes in the Thar Desert, Pakistan. It emphasizes the impact of environmental conditions on traditional livelihoods, which have been affected by climate change, and their socio-economic and psychological consequences. As household survival is increasingly precarious in the face of scarcity, women are subjected to greater burdens. Migration and the labor market have become common adaptation strategies, but are not sustainable solutions. Social networks continue to be vital to resilience, but they are undermined by migration and social disintegration.

Moreover, the study highlights the need to consider both physical and psychological effects of climate change when designing adaptation strategies. Communities have adapted with local solutions based on traditional knowledge, but the absence of institutions and the unequal exposure to climate risks call for more holistic, gender-inclusive, and gender-responsive policies.

Recommendations

The gender-specific effects of climate change on women's agency to adapt and build resilience, especially in water collection, food security, and household management, should be taken into account in policy prioritization for gender-sensitive adaptation strategies.

1. Educational and empowerment initiatives offering women opportunities for education, access to resources, and participation in decision-making processes will strengthen communities' resilience.
2. Support enhancement of social networks, and implement community-based initiatives that promote social cohesion and resource sharing to enhance community resilience. This may involve local cooperatives, community resource pools, skills training, and more to help buffer the impact of migration and provide sustainable livelihoods.
3. Greater Institutional Support: Governments need to provide better water management systems, support for agriculture, and climate finance. Institutional interventions should be to make available drought-resistant seeds, agricultural training, and health services.
4. Mental Health Support: Promoting efforts to support mental health in the face of climate change is essential. Increasing integration of mental health services into climate adaptation programs, especially in vulnerable areas, to support people in managing stress, anxiety, and depression related to climate-induced stresses.
5. Continued research into the strategies for adapting to climate change in arid zones such as the Thar is required. Further empirical research is required to assess the impact of various adaptation strategies and also to determine the long-term effects of climate change on rural livelihoods, including areas that are not well studied, such as Pakistan.
6. Sustainable Migration Solutions: Migration can be a coping strategy, but policies need to be created and implemented to ensure migrants are able to access stable work, housing, and social support in urban areas. This may include the establishment of short-term

employment schemes, training, and provision of shelter to migrant populations.

The threats from the changing climate in the Thar Desert are complex and multifaceted and necessitate a holistic approach that takes into account environmental, social, and psychological aspects. Collaborative work among local communities, local governments, and international organizations is essential, and a clear gender equity focus and focus on mental health and sustainable development will be key to effective adaptation.

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