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Abstract

Climate change is a huge global issue. However, the severity of negative impacts is higher in the rural areas of developing countries like Pakistan. Thus, this research is carried out with the aim of assessing the impact of climate change on rural areas of Pakistan. The current study will establish a comprehensive assessment of present conditions and future projections with the help of secondary data extracted from various articles, research, and databases. Attention will, therefore, be on the review of the requirement for adaptive actions that shall minimize the negative impacts. The findings serve to motivate these communities to be strategic in adapting and building resilience to increasing problems caused as a result of climate change.

Keywords: Climate Change, Rural Pakistan, Resources, Economic Impact, Social Impact

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Title

Impact of Climate Change on Rural Pakistan

Abstract

Climate change is a huge global issue. However, the severity of negative impacts is higher in the rural areas of developing countries like Pakistan. Thus, this research is carried out with the aim of assessing the impact of climate change on rural areas of Pakistan. The current study will establish a comprehensive assessment of present conditions and future projections with the help of secondary data extracted from various articles, research, and databases. Attention will, therefore, be on the review of the requirement for adaptive actions that shall minimize the negative impacts. The findings serve to motivate these communities to be strategic in adapting and building resilience to increasing problems caused as a result of climate change.

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Keywords: [Climate Change](#), [Rural Pakistan](#), [Resources](#), [Economic Impact](#), [Social Impact](#)

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Introduction

Climate change is the most paramount and pressing global issue of the 21st century, causing profound impacts on various sectors like agriculture, water resources, and human livelihoods. Of these changes, the emerging nation of Pakistan—where a large proportion of its people reside in rural areas—becomes extremely vulnerable. The agrarian economy, based mainly

on agriculture, has been faced with unprecedented problems due to changing climatic conditions. Thus, the impact of climate change on daily routine life and the economics of rural folks in Pakistan has been checked, focusing on the various issues confronted by them. It talks about many related issues in detail, such as changes in



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weather patterns, increasing severe weather events, and shifting agriculture friendly zones.

Another core concern is the manipulation of weather patterns. The unpredictable rain patterns and the prolonged drought periods have brought down agricultural production by a very long way. The conventional ways of agriculture are no longer capable of handling this scenario, and the water shortage problem is exacerbating further as the irrigation systems cannot support the unpredictable water availability.

In large parts of the world, extreme weather events — such as floods and heatwaves — are increasing in frequency and severity. These events damage crops and infrastructures directly, make people homeless, and create long-term economic problems. Flooding has recurrently destroyed arable land, houses, and cattle, leading to huge economic losses and a lack of food.

Second, increasing temperatures are forcing agricultural areas to change. Some crops can no longer thrive in their usual areas, forcing farmers to change crops or abandon farming altogether. This is not only disruptive to local economies but also to cultural traditions associated with farming.

The research will attempt to explore fully all these challenges with a view to establishing the full spectrum of implications for rural dwellers, as well as adaptation strategies. Some probable strategies may include growing drought-tolerant crops, developing better water management systems, and establishing stronger infrastructure that can withstand disastrous weather events. This can be done by improving the resilience of communities by providing farmers with information on climate-resilient practices and diversifying sources of livelihoods.

Literature Review

The literature available on the impact of climate change on the rural areas of Pakistan is huge and diverse. It includes different studies that shed light on the immense effect of climate change on agriculture, water resources, and socio-economic conditions.

Agricultural Productivity

Different researchers have documented a decline in the yield of agricultural products due to the process of climate change. According to one research, there was a major drop in wheat and rice yields because of heat stress and alterations in rainfall patterns. According to another study, the critical elements that hamper farm production are temperature variations resulting from climate change and a shortage of water. Reduced yields of main crops not only pose a threat to food sustainability but also jeopardize the very means for the survival of millions of farmers in rural Pakistan (Hussain and Mudasser, 2007).

The agricultural sector in Pakistan is most vulnerable to any climatic change. Any alteration in temperature and precipitation has both direct and indirect impacts on crop production. For example, increasing temperatures can accelerate crop growth cycles and cause early maturity, ultimately resulting in reduced harvests. Meanwhile, higher temperatures can exacerbate water shortages in regions reliant on rainwater supply. Changed rainfall patterns—variations in the time and intensity of rainfall—further complicate agricultural planning and production. Any deviation in areas dependent on regular monsoon rains can lead to drought or floods, both harmful to agriculture.

Water Resources

Another critical issue of climate change exacerbates the situation of water scarcity. Climate change poses a high threat to the water resources in Pakistan, and, according to the World Bank, reduced glacier thawing and erratic precipitation patterns have been negatively impacting river flows and groundwater replenishment. The condition is extremely dire in rural areas these days mainly because agriculture relies on irrigation a great deal.

The Pakistan Council of Research in Water Resources has recorded an increase in the saline

levels of water resources contributory factor to water scarcity.

Climatic changes have a significant impact on the Indus River, which caters to the water needs of Pakistan's agriculture. With increasing temperatures, the quantum of ice melting from glaciers is increasing. This however initially results in a surge of water flow in rivers, which eventually causes floods. Nevertheless, this eventually declines with the shrinking of the glaciers and reduces the water supply. Unpredictable precipitation patterns and reduced water supply from glaciers further strain the supplies. Groundwater levels are falling because of over-extraction for irrigation purposes and drinking water and also its extraction rate is higher than the natural recharge rate. (PCRWR, 2010)

Socio-Economic Conditions

Climate change has a significant impact on the socio-economic conditions of rural people.

Reduced agricultural productivity along a lack of water complement each other and increase the poverty rate as well as food insecurity. The Food and Agriculture Organization has reported that rural populations are increasingly vulnerable to extreme weather events causing relocation and loss of livelihoods. This places heavy stress on the socio-economic structure of these communities because conventional coping mechanisms are unable to handle such magnitude and severity of climatic effects. The lack of diversity in rural economies enhances their vulnerability to economic vulnerability. For most rural families, agriculture is the major source of income.

Climatic downturns in agricultural production directly translate to reduced family incomes, which in turn deepen poverty levels. In addition, increased food insecurity due to reduced agricultural yields has adverse implications for nutrition and health, thus reinforcing the poverty cycle. In addition to devastating crops, severe weather phenomena like floods and droughts also damage the infrastructure, leading to further

economic hardship for already susceptible people (FAO, 2015).

Policy and Adaptive Measures

A number of policy papers and adaptation solutions have been proposed to address the challenges brought about by climate change. In this regard, the Ministry of Climate Change, Pakistan, has developed a National Climate Change Policy that outlines strategies to enhance resilience and adaptive capacity. However, their implementation remains a significant challenge due to a lack of resources and institutional capacity.

In essence, climate change adaptation involves processes at all levels—from local to national—that need to function cohesively. This means that however comprehensive the National Climate Change Policy may be, its implementation remains insufficient unless these policies are integrated into local planning and development procedures. This makes building capacity at the local community level in effectively applying adaptive strategies all the more relevant. This is so because developing countries like Pakistan usually lack the financial resources to invest in large-scale adaptation measures taken by them, hence international cooperation and financial aid are necessitated (MOCC, 2012).

Theoretical View of Climate Change in Anthropology

Anthropological insights on climate change bring in crucial knowledge about how human civilizations relate to the environment. This approach explores reciprocal relationships between environmental changes and the impact of cultural practices, social institutions, and local knowledge systems on the same.

Human–Environment Interaction

The responses to climate change are largely supported in rural areas of Pakistan by traditional agricultural practices, systems of water

management, and mechanisms of community resilience. Effective adaptation techniques have been shown to include a deep understanding of the cultural aspects of climate change. Normally, indigenous knowledge and practices, nurtured over centuries, are usually tuned to specific ecological conditions. However, rapid climate changes may outstrip traditional adaptation capacity, demanding external interventions and support.

In many rural areas, farming practices have been aligned with culture and often adapted to the specific natural conditions in which they operate. On the other hand, traditional practices like crop rotation, mixed cropping, and agroforestry could contribute to increased resilience against climate variability. This will help in increasing fertility, controlling pests, and aviding biodiversity all of which are requirements for agriculture sustainability over the long term. However, the accelerated rate of climatic change is testing these customary systems so the integration of contemporary scientific knowledge with local practices is highly necessary to improve adaptive capacity as Crate and Nuttall support (Crate and Nuttall, 2009).

Social Systems and Vulnerability

The vulnerability and capacities to adapt for rural residents are also influenced by social systems. Indeed, research finds the extent of a society's networks and trust, also called social capital, to be a robust determinant of collective action and resilience. Hence, the most connected and collaborative of Pakistan's rural communities can mobilize resources and also receive assistance when under severe climatic strain. In turn, groups such as landless laborers and women are usually more vulnerable in these communities because they lack easy access to resources and are often excluded from decision-making. In this sense, social capital could promote resilience through the exchange of knowledge, mutual support, and collective action. Communities with better social

cohesion are more resilient in times of climate shock because they rely on each other for support.

In a drought, for example, the communities that have strong social ties will work together to share water resources or offer support to those who are worse off. Social inequities bring detrimental impacts on a community's total resilience. The degree to which the landless laborers and mostly women from disadvantaged demographics are integrated into the access to resources and lengthier decision-making procedures makes them more vulnerable to climate change.

Cultural Practices and Adaptation

Cultural practices and ideas impact a great deal on how people respond to climate change. Crop rotation and mixed cropping are examples of adaptive practices that make them more resilient to climate variability. Traditional local festivals, rituals, and other collective activities may potentially enhance community cohesion and collective actions for responding to environmental challenges. However, these cultural norms hinder the potential of adopting new technologies or practices necessary for effective adaptation to climatic changes. Culture is a driver of worldview that influences the conceptualization of and reaction to climate change within communities. Indeed, conventional beliefs about climatic variability origin in some cultures can affect their willingness to accept scientific interpretations and adopt adaptive strategies.

Secondly, cultural norms and values affect access to resources and power within groups—thereby determining who shall have access to adaptive strategies and who shall benefit from them. Therefore, knowledge and engagement of the cultural setting within a region should be integrated as a precondition for the formulation of effective and inclusive adaptation strategies (Sesana et al., 2021). An anthropological perspective recognizes that dealing with climate change effectively has to consider the complex interplay of cultural, social, and local knowledge

systems in understanding its dire consequences. Bringing these dimensions into the policy and adaptation response may help achieve more effective and sustainable climate change responses within rural Pakistan.

Research Methodology

The current study relied on secondary data analysis as the prime tool of research. The secondary data is derived from scholarly journals, government papers, publications by international organizations, and existing databases. Based on this information, obtained from different sources, an attempt is made to present a comprehensive scenario of the climate change implications in rural Pakistan.

Sources of Data

- i. Peer-reviewed articles published in journals such as Agricultural Systems, Climatic Change, and Journal of Environmental Management are all credible sources that contain facts and informed assessments of the various impacts of climate change.
- ii. Official reports, such as those from the Ministry of Climate Change in Pakistan and the PCRWR, present official statistics and policy views on the implications of climate change and plans for adaptation.
- iii. International agencies' reports like the World Bank, FAO, IPCC, etc., incorporate detailed assessments of the climate change issue at both the country and regional levels, with a view to Pakistan.
- iv. Pre-existing datasets: World Bank Group, IMF Climate Change Dashboard.

Data Analysis

Information obtained from these sources is, therefore, systematically scrutinized and analyzed to identify trends, patterns, and important findings concerning the impacts of climate change in rural Pakistan. Descriptive statistics and qualitative analysis are used to clarify the understanding of the challenges.

Descriptive statistics can be used to summarize the quantitative data analytically about aspects like natural disasters over time. Qualitative analyses entail text analysis of written material from reports and studies in order to identify common themes, patterns, and insights concerning the climatic stressors in several districts of Pakistan. This study offers comprehensive and multi-dimensional knowledge of how rural Pakistan is being affected by climate change through the integration of quantitative and qualitative assessments.

Basically, the research strategy is a deep review and integration of the existing information to come up with a detailed analysis of the impact of climate change in the rural parts of Pakistan. The findings are based on a sound knowledge base and empirical evidence.

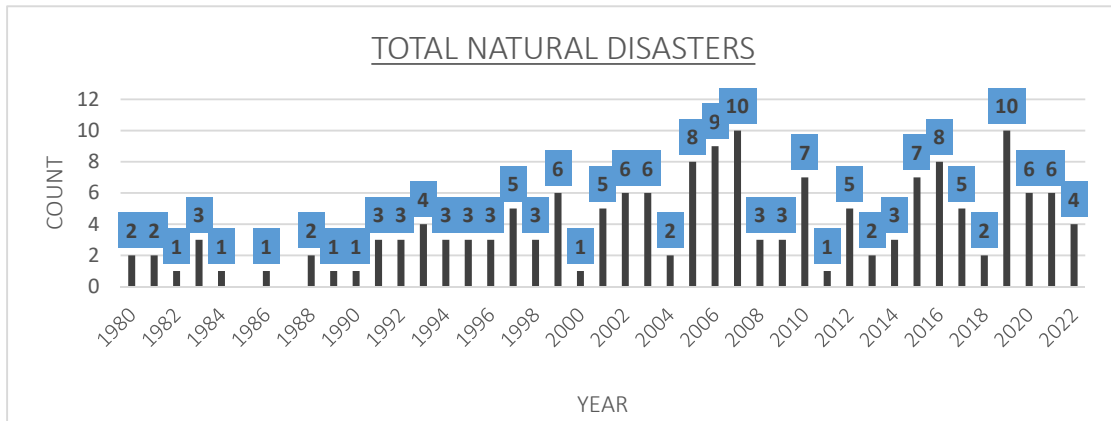
Findings and Analysis

Frequency of Natural Disasters:

Increasingly, a wide array of natural calamities that affected Pakistan include drought events, extreme temperatures, floods, landslides, storms, and wildfires. Data from 1980-2022 gathered, illustrative and representative of these trends and frequencies of events, indicate enhanced climate resilience and disaster management systems to be adopted.

Chart 1:

Total Natural Disasters



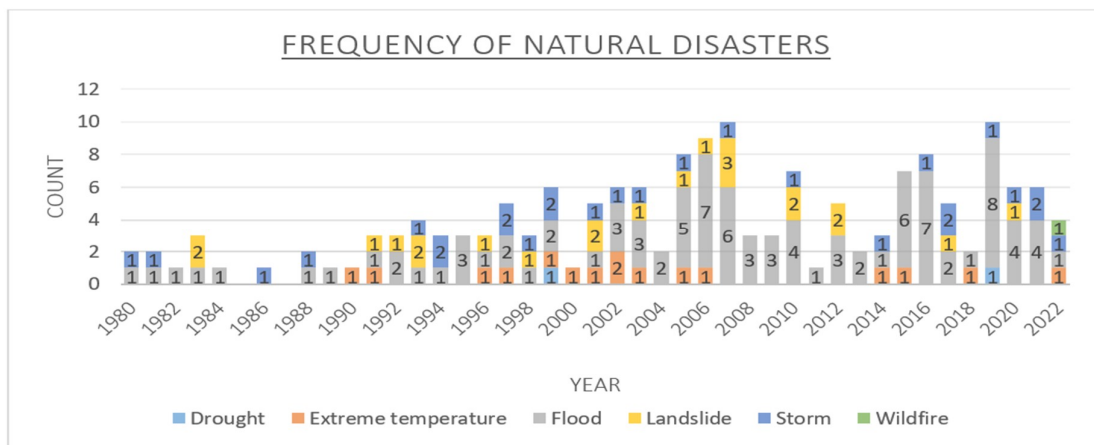
Source: The Emergency Events Database, EM-DAT, accessed from the IMF Climate Change Dashboard

Pakistan has been prone to periodic bouts of drought. Severe periods where droughts are recorded occur in the years 1986, 2000, and 2018.

These events had a high impact on farming and water resources, even health effects on people, and made the rural communities more vulnerable.

Chart 2:

Frequency of Natural Disasters



Source: The Emergency Events Database EM-DAT, drawn from the IMF Climate Change Dashboard

Extreme temperature events have followed an increasing trend with a higher frequency in recent years. Notable events were recorded in the early 2000s and the mid-2010s. These events have spawned severe heat waves, and health risks, and affect both the rural and urban residents. Flooding is one of the most prevalent natural disasters in Pakistan and has shown a clear trend of increase in frequency and intensity over several decades.

Major floods that had hit the country before were in 1992, 2010, and 2011, causing massive destruction, displacement, and economic losses. The trend indicates a growing challenge in water resource management and flood risk reduction. Landslides have been relatively rare, but a dangerous phenomenon, particularly in the hilly and mountainous regions. Major landslides took place during the late 1990s and early 2000s.

These events commonly happen after heavy rainfall or seismic activities that hit the affected structure and inhabitants of the vulnerable areas. There have been ups and downs in storms—so, more specifically, cyclones, and severe weather events. The years with remarkable storm occurrences are 2000 and 2010. They are very destructive, including infrastructural, agricultural, and house damages, more precisely in coastal areas. Wildfires have been pretty rare; however, considering climate change and growing

temperatures, they become an increasingly important risk. In 2022, there was a case of major wildfires. Wildfires might lead to the loss of vegetation, and loss of habitat for animals, and also create health-related issues from smoke and air pollutants. The total number of disasters has shown an increasing trend with peaks in the late 2000s and early 2010s. The combined disasters raise the imperative of putting in place comprehensive strategies for disaster risk reduction and adaptation to climate change.

Table 1

Descriptive Statistics of the Data

	Drought	Extreme Temperature	Flood	Landslide	Storm	Wildfire	Total Disasters
Mean	0.04	0.16	2.02	0.38	0.44	0.02	3.06
Median	0	0	1	0	0	0	3
Mode	0	0	1	0	0	0	3
Standard Deviation	0.196	0.37	1.91	0.74	0.6	0.14	2.42
Minimum	0	0	0	0	0	0	0
Maximum	1	2	8	3	2	1	10

Climate Stressors in Rural Areas of Pakistan:

The rural areas of Pakistan face the following climate stressors, according to the study "Climate change in rural Pakistan: evidence and

experiences from a people-centered perspective". This data was obtained from 97 Respondents in 11 different districts.

Table 2

Climate Stressors in Rural Pakistan

Location	District	Province	Climate Stressors
Kakapir village	Karachi	Sindh	Cyclones, seawater intrusion, heatwaves, change in rainfall pattern
Mubarak village	Karachi	Sindh	Heatwaves, drought
Soomar village	Karachi	Sindh	Sea-level rise, heat waves
Keti Bandar	Thatta	Sindh	Seawater intrusion, cyclones, change in rainfall pattern
Jamshoro	Jamshoro	Sindh	Change in rainfall pattern, floods
Nagarparkar	Tharparkar	Sindh	Drought, heat waves, change in rainfall pattern
Umerkot	Umerkot	Sindh	Drought, heat waves, change in rainfall pattern
Lake Manchhar	Dadu	Sindh	Change in rainfall pattern, heatwaves

Location	District	Province	Climate Stressors
Depalpur	Okara	Punjab	Heat waves, changes in rainfall patterns, flash floods
Bumburet, Kalash valley	Chitral	Khyber-Pakhtunkhwa	Heatwaves, GLOF
Booni	Chitral	Khyber-Pakhtunkhwa	Change in rainfall pattern, GLOF, heatwaves
Reshun valley	Chitral	Khyber-Pakhtunkhwa	GLOF, change in rainfall pattern, flash floods
Sonoghar valley	Chitral	Khyber-Pakhtunkhwa	GLOF, heatwaves, change in rainfall pattern
Bagrote valley	Gilgit	Gilgit-Baltistan	Change in rainfall pattern, heatwaves, landslides
Badswat	Ghizer	Gilgit-Baltistan	GLOF, flash floods
Gilgit	Gilgit	Gilgit-Baltistan	Change in rainfall pattern, flash floods
Hassanabad	Hunza	Gilgit-Baltistan	GLOF
Karimabad	Hunza	Gilgit-Baltistan	Landslides, heatwaves
Passu	Hunza	Gilgit-Baltistan	Flash foods, change in rainfall pattern

Source: <https://link.springer.com/article/10.1007/s11625-021-01036-4>

Sindh

Karachi: (Kakapir village, Mubarak village, Soomar village):

- **STRESSORS:** cyclones, seawater intrusion, heatwaves, drought, sea-level rise.
- **IMPACT:** These stresses are of key interest because Karachi is a coastal city. With the rise of the sea level and intrusion of saltwater, there is the danger of loss of useable land by humanity and an effect on freshwater supplies. Heatwaves and cyclones pose a direct threat to human health and infrastructure.

Thatta (Keti Bandar):

- **STRESSORS:** Seawater intrusion, cyclones, changes in rainfall patterns.
- **IMPACT:** As in the case of Karachi, coastal stresses are equally important as the changes in rainfall pattern and impact agriculture, fisheries and freshwater supply.

Jamshoro:

- **STRESSORS:** Changes in rainfall patterns, floods.

- **IMPACT:** Changes in rainfall patterns may bring uncertainty in agriculture, while floods would result in deteriorating infrastructure and displacement of population.

Tharparkar (Nagarparkar):

- **STRESSORS:** Drought, heatwaves, changes in rainfall patterns.
- **IMPACT:** Tharparkar is intrinsically a dry landscape, therefore drought and heat waves exacerbate the existing meager levels of water accessibility and agricultural sustainability.

Umerkot:

- **STRESSORS:** Drought, heat waves, change in precipitation patterns.
- **IMPACT:** As above in Tharparkar, these stresses threaten water supplies and agriculture production.

Dadu (Lake Manchar):

- **STRESSORS:** Change in precipitation patterns and heat waves.

- **IMPACT:** Lake Manchar is a large water body, and any disturbance in the pattern of precipitation has direct effects on the various water levels, which in turn, directly impact the population and ecology around the lake.

Punjab

Okara (Depalpur):

- **STRESSORS:** Heatwaves, changed precipitation patterns, flash flooding
- **IMPACT:** These hazards have adverse effects on agriculture output and increase the risks of flash floods, thus affecting agriculture as well as local infrastructure.

Khyber Pakhtunkhwa

Chitral:

- **STRESSORS:** heat waves, Glacial Lake Outburst Floods, change in precipitation patterns
- **IMPACT:** With the melting glaciers, Chitral mountainous areas are vulnerable to GLOF. Besides that, heatwaves and changed

precipitation patterns pose an additional challenge to agriculture and water use.

Gilgit-Baltistan

Gilgit, Ghizer, Hunza (Bagrote valley, Badswat, Hassanabad, Karimabad, Passu):

- **STRESSORS:** change in precipitation patterns, heat waves, landslides, GLOF, flash floods.
- **IMPACT:** The topography of the area at high altitude makes it extremely vulnerable to hazards created by melting glaciers that may result in GLOFs. This could have devastating impacts on infrastructures and human communities through flash floods and landslides.

Economic Impact of Climate Change

According to the Global Climate Risk Index 2021 briefing paper, Pakistan ranks number 8 in the list of countries most affected from 2000-2019.

Table 3

The Long Term Climate Risk Index (CRI): The 10 countries most affected from 2000 to 2019 (annual averages)

CRI 2000-2019 (1999-2018)	Country	CRI score	Fatalities	Fatalities per 100,000 inhabitants	Losses in million US\$ PPP	Losses per unit GDP in %	Number of events (2000-2019)
1 (1)	Puerto Rico	7.17	149.85	4.12	4149.98	3.66	24
2 (2)	Myanmar	10	7056.45	14.35	1512.11	0.8	57
3 (3)	Haiti	13.67	274.05	2.78	392.54	2.3	80
4 (4)	Philippines	18.17	859.35	0.93	3179.12	0.54	317
5 (14)	Mozambique	25.83	125.4	0.52	303.03	1.33	57
6 (20)	The Bahamas	27.67	5.35	1.56	426.88	3.81	13
7 (7)	Bangladesh	28.33	572.5	0.38	1860.04	0.41	185
8 (5)	Pakistan	29	502.45	0.3	3771.91	0.52	173
9 (8)	Thailand	29.83	137.75	0.2	7719.15	0.82	144
10 (9)	Nepal	31.33	217.15	0.82	233.06	0.39	191

Pakistan's climate risk index (CRI) score is 29.00, highlighting its vulnerability and exposure to climate-related hazards. A higher CRI score means greater susceptibility to such events. On average, climate-related incidents in Pakistan result in 502.45 fatalities annually, underscoring the substantial human toll of

these disasters. The mortality rate due to these events is 0.30 per 100,000 inhabitants, which is moderate compared to countries like Myanmar and Haiti but still notable.

Economically, Pakistan endures significant losses from climate events, with an average

annual loss of 3771.91 million US\$ in purchasing power parity (PPP). This is one of the higher economic losses among the countries analyzed, reflecting a severe impact. These losses constitute 0.52% of Pakistan's GDP, presenting a moderate economic burden relative to its economic size. Although this percentage is lower than that of some other countries like Puerto Rico and the Bahamas, it is still considerable (Eckstein, Künzel, & Schäfer, 2021).

The financial impact of climate events on Pakistan is substantial, marking a serious economic challenge. The data makes it clear that Pakistan is heavily affected by climate-related risks, both in human and economic terms. This highlights the crucial need for investment in climate resilience, disaster risk reduction, and adaptation strategies to counteract the adverse effects of climate change.

Conclusions

Climate change is a tangible threat to Pakistan's agricultural production, water resources, and socioeconomic stability in rural areas. This paper emphasizes the imperative need for the execution of strategic adjustments and resilience-enhancing steps against the rising challenges brought about by climate change. Many key conclusions have been drawn from this research investigation:

1. Lower Agricultural Productivity: Climatic change is reducing the amount of staple crops produced mainly due to rising temperatures, altered rainfall patterns, and increased pests and diseases. The reduced production level poses a significant threat to food security as well as the economic livelihoods of many farmers.

2. Reduced glacier melt, unpredictable rainfall patterns, and increasing water salinity are slowly causing a shortage of water in rural areas. Such scarcity affects agricultural productivity and access to safe drinking water, thus forming major challenges for people in the rural setting.
3. Lowered agricultural production and lack of water exacerbate poverty and food insecurity, which results in socio-economic vulnerability. The rural areas are faced with high vulnerability to extreme weather conditions, entailing displacement and loss of livelihoods for the people.
4. Adaptive measures are of the essence in reducing the impacts of climate change, like the promotion of climate-smart agriculture, improving water management systems, and community-based adaptation programs. Interventions and support in the form of policies from government and international agencies are critical to strengthening resilience in rural communities.
5. To develop active community-driven climate adaptation measures, it is crucial to leverage local knowledge and cultural customs. These elements can provide highly effective and feasible solutions tailored to specific community needs. Gaining insight into socio-cultural aspects is needed to ensure these measures are relevant and sustainable.
6. Therefore, efforts to effectively address climate change issues in the rural areas of Pakistan must cover a multi-dimensional approach: efficiency in adaptive practices, policy frameworks, and integration of local knowledge and practice. Improved resilience and recovery of the rural population from the impacts of climate change are relevant to their long-term viability and prosperity.

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