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NEW WAVES OF FLASH FLOODS AND RISKS PERCEPTION OF CLIMATE CHANGE: AN OVERVIEW OF THE 2022 FLOOD DISASTER IN PAKISTAN

Javeria Noor Sawal[*] Sara Shah Jehan[**] Noor Fatima[***]

Abstract

Pakistan ranks as the eighth most vulnerable country across the globe to climate change impacts. It was the second time after the deluge of 2010, that Pakistan faced heavy monsoon rains from June-August 2022 which resulted in flash floods. Flood ravages continued in almost all the regions of the four provinces and have been declared a calamity hit. Rescue operations were underway across the provinces and taking swift action to evacuate people to safer places. The deluge has devastated residences, farmlands, infrastructure, and businesses in abundance. The deadly rain-induced floods displaced many people from their areas and caused causalities of both humans and animals, and washed away the protective embankments set up alongside the River banks. This paper attempts to provide a detailed situational overview of Pakistan's flood-hit areas, and give policy recommendations for mitigation and adaptation strategies. Further, the significance lies in highlighting the role of administrative sectors in conducting rescue operations amid flood emergencies.

Keywords: *Climate Change, Flash Floods, Monsoon rains, Flood affectees, Rescue operations*

Introduction

Climate change is one of the serious and major problems that must be addressed on time. Record-breaking rains and devastating floods are serious threats relating

[*] Lecturer Department of Political Science Women University Mardan, Pakistan. Corresponding author Email: javeriabashar@gmail.com

[**] Mphil Research Scholar Department of Political Science, Abdul Wali khan University Mardan, Pakistan Email: hafsasalman39@gmail.com

[***] Mphil Scholar Department of Political Science, Qurtuba University of Science & IT, Hayatabad, Peshawar, Pakistan Email: noorqazi1997@gmail.com

to climate change. However, a change in climate does not only affect the poorer or developing countries but it devastates any country around the globe. Pakistan contributes less than 1% to the global greenhouse gases that warm our planet but the geographical location of Pakistan makes it immensely vulnerable to the risks perception of climate change. Geographically Pakistan is located at a place on the world map that bears the brunt of two major weather patterns. That is, one can cause heavy monsoon rains, and the other causes high temperatures and heat waves. Therefore, linking the change of climate to intense monsoon rains is quite simple. Global warming is making sea and air temperatures rise which leads to more evaporation. The warmer the air it can hold more moisture, resultantly making monsoons more intense (Springer, 2023).

The occurrences of natural calamities are either gradual or sudden onset. However, it is predicted that by the year 2050, a significant number of people will be susceptible to the deadliest natural disasters. Consequently, the economic and social sectors will become jeopardized. Perhaps, flood disasters have been seen as the most prevalent cause of societal destruction and the number of casualties. Nevertheless, natural hazards in the form of flood catastrophes seem to be the cause of climate change, which has affected several countries across the world. Approximately, 30% of the natural hazards are accountable for flooding during the past century. Therewith, Pakistan is one of the countries vulnerable to flood disasters. It was not the first time that Pakistan has faced huge devastation amid flash flooding in 2022. The 2010 monsoon flood disaster in Pakistan was unprecedented and massive. It had affected over 20 million people, and made more than 1700 causalities and affected over 20% of the total land area, causing huge damage to infrastructure, agriculture, livestock, housing, and other family assets. Whereas, the flood of 2022 is even more worse than 2010, with almost 33 million people affected so far. Resultantly, the flood damages increased poverty and vulnerability of the flood affectees. Hence, the education system and the socioeconomic mechanism were consistently lagging (Nangraj et al., 2022).

As per, the Climate Risk Index (CRI) Pakistan ranks the world's seventh most vulnerable country to climate change. Besides, monsoon rains Pakistan has something else making it susceptible, its immense glaciers that due to global warming melts and eventually become one of the causes of flooding. Glaciers in Pakistan's Province of KP and Gilgit Baltistan are melting at a faster rate, creating approximately 3000 lakes which could lead to a sudden unleash of water and could put seven million people at risk. In short, the flood damages took a long time to overcome the devastation. Previously in the year 2010, the majority of regions of the province of Khyber Pakhtunkhwa, Sindh, Punjab, and Balochistan were highly affected. Thus, it was the century's worst flood considered that happened, but it was unexpected to happen again in (June-August) 2022. The monsoon rains, rapid deforestation, blocking of bridges by tree trunks, and subsequent temporary dams bursting, resulted to cause flash flooding across many regions of the country (Thapa et al., 2023)

However, in northern Pakistan, the Khyber Pakhtunkhwa (KP) province remained underwater and was reported as a badly hit region. Given that, the government announces a rain emergency due to gushing floods in many districts of the KP including Swat which was heavily wreaked. Apart from Swat Valley, the flash flooding resulted in far-reaching havoc in Mingora, DI Khan, Shangla, Kohistan, Kalam Valley, and Hazara divisions. As per the report of the Provincial Disaster Management Authority (PDMA) around 193 people died and at least 251 got injured amid ongoing flooding so far (PDMA 31 August-2022 Report).

How does climate change drives Flash Flooding?

The long-term shifts in weather patterns and temperatures refer to as climate change. Despite the fact, that these changes are natural over time but human activities since the 1800s, have been the significant factor of climate change. Predominantly, combustion of coal, gas, and fossil fuels are the main drivers. This keeps the atmosphere hot which holds more water vapors, and resultantly leads to heavy rain. As per predictions of climate scientists the more the earth heats up

more will be the chances of heavy rains. The situation of heavy rain storms causes high inland flood risks in all kinds of places even in the areas far from the coasts. Climate change is greatly influencing the occurrence and strength of sudden and severe flooding around the world. Flash flooding is a type of flooding that occurs when heavy rainfall falls on an area with steep terrain or poor drainage, causing water to accumulate quickly and leading to dangerous and destructive flooding. One of the main ways that climate change is driving flash flooding is by increasing the frequency and intensity of heavy rainfall events. As the earth's atmosphere warms, it can hold more moisture, which can lead to more intense precipitation events (Adedeji, 2014). This means that when it does rain, it is more likely to be heavy and fall in a shorter period, which can lead to flash flooding. Another way that climate change is driving flash flooding is by melting glaciers and snowpacks. As temperatures rise, glaciers and snowpacks can melt more quickly, which can lead to an increase in runoff and flooding. This can be particularly problematic in areas that rely on snow and ice melt for their water supply, as changes in the timing and amount of meltwater can have significant impacts on water availability.

In addition to these direct impacts, climate change can also exacerbate the impacts of other factors that contribute to flash flooding. For example, changes in land use, such as deforestation or urbanization, can increase the risk of flash flooding by reducing the amount of vegetation that can absorb rainfall and increasing the amount of impervious surfaces that can cause runoff. Climate change can make these impacts worse by increasing the frequency and intensity of heavy rainfall events, which can overwhelm even well-designed drainage systems (Kaddo, 2016).

Overall, the impacts of climate change on flash flooding are complex and can vary depending on a variety of factors, including local topography, weather patterns, and land use. However, climate change is causing extreme weather events to occur more often and become more intense. To address this issue, it is important to take steps to reduce greenhouse gas emissions and to adapt to the

impacts of climate change by improving infrastructure, land use practices, and emergency response systems. By taking these steps, we can help to reduce the risk of flash flooding and protect communities in Pakistan and around the world from the impacts of climate change.

Human activities and effects on climate

Human activities have had a significant impact on the earth's climate, contributing to a range of changes that are having far-reaching impacts on the planet's ecosystems and the well-being of human societies. Some of the key ways that human activities are affecting the climate include greenhouse gas emissions, deforestation, land use changes, and industrial processes. Greenhouse gas emissions are a significant contributor to climate change. Human activities, particularly the burning of fossil fuels like coal, oil, and gas, have led to a significant increase in the concentration of greenhouse gases in the earth's atmosphere. These gases, including carbon dioxide, methane, and nitrous oxide, trap heat in the atmosphere, leading to a warming of the earth's surface. Moreover, Deforestation, particularly in tropical regions, has contributed to an increase in atmospheric carbon dioxide levels by reducing the amount of vegetation that can absorb carbon dioxide through photosynthesis. Changes in land use, such as urbanization and agriculture, can also contribute to greenhouse gas emissions by releasing carbon dioxide and other gases from the soil and reducing the amount of vegetation that can absorb carbon dioxide. Industrial processes, such as cement production and the manufacture of chemicals and fertilizers, can also contribute to greenhouse gas emissions by releasing carbon dioxide and other gases into the atmosphere. The impacts of these human activities on the earth's climate are significant and wide-ranging (Adnan & Shahid, 2021).

The earth's average surface temperature has increased by about 1 degree Celsius since the pre-industrial era and is projected to continue to rise in the coming decades. This increase in temperature is leading to a range of impacts, including more frequent and intense heat waves, changes in precipitation patterns, and

rising sea levels. Climate change is leading to changes in precipitation patterns, with some regions experiencing more frequent and intense rainfall events, while others experience more frequent and severe droughts. As the earth's temperature rises, glaciers and ice sheets are melting, leading to a rise in sea levels. This rise in sea levels is already having significant impacts on coastal communities around the world, including increased flooding and erosion (Beniston, 2010).

Thus, climate change is also leading to changes in ecosystems around the world, with some species and habitats at risk of extinction due to changes in temperature, precipitation, and other factors. To address this, individuals, businesses, and governments need to take action to reduce greenhouse gas emissions and mitigate the impacts of climate change. This can include measures such as transitioning to renewable energy sources, improving energy efficiency, reducing deforestation and promoting reforestation, and investing in climate adaptation measures. It is of utmost significance to raise sensibility concerning the impacts of climate change and to uplift civic and communities' involvement in initiating activities to lessen their carbon footprint. This can include measures such as reducing energy consumption, using public transportation or carpooling, eating a plant-based diet, and reducing waste. By taking these actions, individuals can help Working towards decreasing the greenhouse gases building a more environmentally conscious future.

Assessing the 2022 Flood Damages in Pakistan

Climate change is a global phenomenon that affects different countries in different ways, depending on their geographic location, ecological conditions, and level of economic development. Pakistan, as a developing country, is particularly vulnerable to the negative impacts of climate change. Due to the increased variability of monsoons, rising temperatures, melting Himalayan glaciers, and more frequent extreme weather conditions and natural disasters, Pakistan is now experiencing its eighth cycle of monsoons this year, which is unusual. The provinces of Sindh and Balochistan have been severely affected, with rainfall reaching 680.5 mm and 284 mm, respectively. This is about six times more than

the average rainfall for this year. The 2022 floods have caused unprecedented destruction across the country, surpassing the scale of the floods in 2010. (Bhimani et al., 2022).

The National Disaster Management Authority (NDMA) has declared a national emergency due to the catastrophic floods caused by the ongoing monsoon rains, which have severely affected more than 33 million people in Pakistan. Since mid-June, the floods have claimed the lives of at least 1208 people, including 416 children, and injured 6082 others. The unexpected and unprecedented amount of rainfall has caused devastation across one-third of Pakistan, particularly in the provinces of Sindh and Balochistan. In Sindh, 23 districts have been affected, with thousands of homes destroyed and over 700 people injured. At least 239 people have lost their lives in the province.

Balochistan has also suffered significant damage to its infrastructure, with over 263 people dead and nearly 166 injured. However, the 2022 flood in Pakistan was destructive and huge, affecting millions of people including Khyber Pakhtunkhwa province. Millions of people were affected, with many deaths, injuries, and people displaced. The flood also destroyed infrastructure, including homes, roads, and bridges, causing massive economic losses. The damage from the flood is estimated to be in billions of dollars (Davies, 2023). The Government of Pakistan and international aid organizations provided relief and support to the affected people, including food, shelter, and medical assistance. The flood caused loss of lives, property, and livelihoods, and also led to disease outbreaks. The Khyber Pakhtunkhwa province was also one of the hardest-hit areas, with many homes and businesses destroyed and many people displaced. The authorities and humanitarian organizations provided relief and support to the affected people. Due to the extensive damage to residential homes, over half a million people are currently residing in relief camps throughout Pakistan. Reports suggest that nearly 80% of crops in Sindh have been affected, including about one-third of the country's cotton crop. Since a significant portion of Pakistan's economy relies on the agricultural sector, this will further affect the already struggling economy.

(Mishra, 2023). However, while assessing the flood damages in Pakistan it is concluded that one of the major causes of the 2022 flooding disaster in Pakistan was due to climate change. Increased greenhouse gas emissions have resulted in the warming of the planet, leading to more intense weather events, including heavy rainfall and flooding. The higher-than-expected monsoon rains in Pakistan exceeded the capacity of the local river systems, resulting in flash flooding across the region. Additionally, the country's vast deforested areas and the destruction of natural habitats have also contributed to the increased risk of flooding in the region. The 2022 flood impacted the Pakistani people in an unprecedented way.

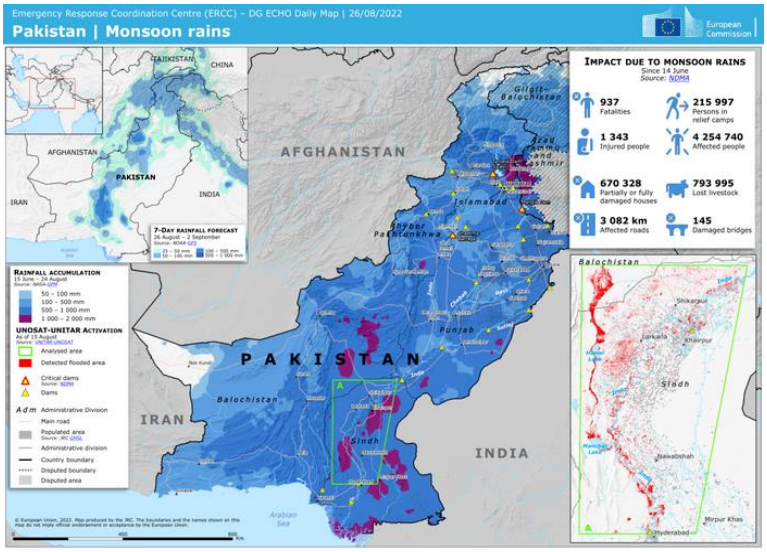
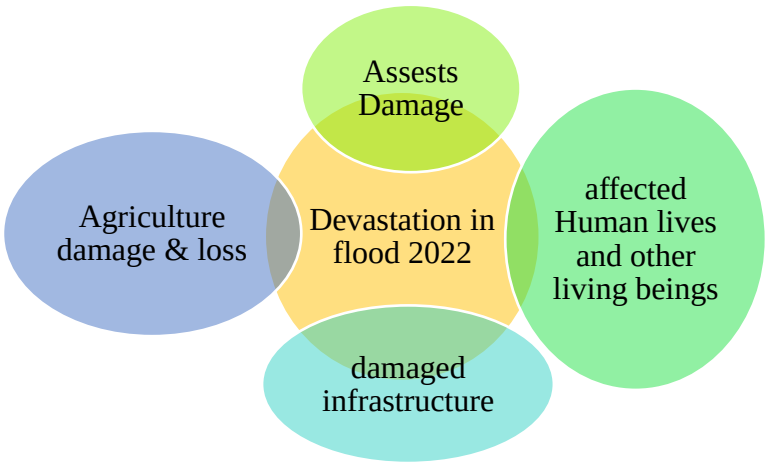


Figure 1: Shows the Monsoon Rainfall - 2022 Impacts in Pakistan

As the flood hit areas lacked basic needs and requirements, people are in dire need of resources to overcome the damages. However, the inflation rate has also raised high due to the limited resources available. People living in an underdeveloped regions of Pakistan are entirely depended on the financial and basic needs assistance from the government or the NGO’s working for this cause. As flash flooding have not only affected the human life, but their assets, agricultural production, infrastructure and much more. Below is the figure

illustrating the key elements affected amid flash flooding in Pakistan. In summary, the floods in 2022 had devastating impacts on various regions of Pakistan. The excessive rainfall caused rivers to overflow, leading to widespread flooding and destruction of infrastructure, homes, and agricultural lands. The floodwaters also resulted in the displacement of thousands of people and loss of lives. The assessment of flood damages involved evaluating the extent of the destruction caused by the floods. This included analyzing the damage to buildings, roads, bridges, and other critical infrastructure. Additionally, the assessment focused on estimating the economic losses incurred, such as the impact on agriculture, livestock, and businesses. Furthermore, the assessment also involved evaluating the social and environmental impacts of the floods. It considered the displacement of communities, the disruption of livelihoods, and the potential long-term effects on the environment, including water contamination and damage to ecosystems. To conduct the assessment, experts and authorities collaborated to gather data and information from affected areas. This involved on-ground surveys, satellite imagery analysis, and consultations with local communities. The collected data was then analyzed to understand the scale of the damages and formulate strategies for recovery and reconstruction. It is important to note that the assessment of flood damages is an ongoing process, as the full extent of the impacts may take time to evaluate. The

Figure 2: Shows the key elements Devastated amid Flash Flooding



findings from these assessments are crucial for informing disaster management strategies, improving infrastructure resilience, and providing support to the affected communities. Due to shrinking foreign exchange reserves, inflation reached 27.3% in August. The extensive damage has put Pakistan in an economic crisis, with losses estimated at around $10 billion. Many people in the affected areas rely on livestock for their food and livelihoods. A 2021 study found that children in flood-affected areas have insufficient levels of essential nutrients like vitamin A, calcium, zinc, iron, and iodine. The loss of over half a million livestock has worsened the situation. Additionally, the destruction of 129 bridges has hindered the distribution of fruits and vegetables, leading to food shortages and price increases. These events have made the flood-affected people more vulnerable to malnutrition and livelihood challenges (Anees, 2022).

Table 1: Quantifying the impacts of 2022 flood damages in Pakistan (Mid June 2022-Nov 18 2022)

Year	Area (Km^2)	Causalities	No. of People Displaced	No. of Districts affected	Total Economic Loss	Major Cause
2022	2,65,365	1,739	7,900,000	35	$15.2 billion	Heavy rains/Flash Flooding

Source: UN Office for the Coordination of Humanitariian Affairs OCHA, Aug 2023

Source: (Bhimmani et al, 2022 p. 21)

The above mentioned table showcases the extent of flood damages in Pakistan. It presents data on the scale of destruction caused by the floods, including the number of affected districts, the total economic losses. The figures highlight the severity of the damages and the challenges faced by the affected communities. In terms of affected areas, the floods have impacted numerous regions across Pakistan, leading to widespread devastation. The

economic losses incurred due to the floods are substantial, affecting various sectors such as agriculture, housing, and businesses. The damages to infrastructure, including roads, bridges, and buildings, have further hindered recovery efforts. Moreover, the floods have had a significant impact on the livelihoods of the affected population. Many individuals have lost their homes, agricultural lands, and sources of income, resulting in long-term socio-economic challenges for the communities. It is crucial to understand the quantification of flood damages to assess the magnitude of the impact and prioritize relief and rehabilitation efforts. By analyzing these figures, policymakers, organizations, and communities can work together to implement effective strategies for disaster management, infrastructure development, and livelihood restoration.

Pakistan's Post-Flood Recovery and Reconstruction Efforts

Pakistan has been struggling to recover from the devastating flash floods that have caused widespread destruction and loss of life. The floods have affected millions of people, with many losing their homes and livelihoods. The country's infrastructure has been severely damaged, with roads, bridges, and buildings destroyed or damaged beyond repair. The floods have also had a significant impact on the country's economy, with agriculture, which is a major source of income for many people, being severely affected. Crops have been destroyed, and livestock has been lost, leading to food shortages and rising prices (Arai, 2012).

The government has been working to provide relief to those affected by the floods, and the government of Pakistan has taken several measures to support the post-flood recovery efforts in 2022. They have allocated funds to provide financial assistance to the affected areas, distributed relief goods such as food, water, and medical supplies, and initiated reconstruction projects to rebuild damaged infrastructure of the country. The government has also established relief camps to provide temporary shelter to displaced people. Additionally, the government has worked with international organizations and foreign governments to secure additional aid and support for the recovery efforts. The government of Pakistan has allocated PKR 10 billion for post-flood recovery efforts in 2022. The

funds are being used to provide financial assistance to the affected areas, distribute relief goods, and initiate reconstruction projects. The government has initiated efforts by the National Disaster Management Authority (NDMA) to coordinate the relief and recovery activities. The NDMA is working closely with the provincial governments, international organizations, and foreign governments to ensure effective and efficient recovery efforts. But the scale of the disaster has made it difficult to reach everyone in need. Many people are still living in temporary shelters, and access to clean water and sanitation facilities remains a challenge.

In addition, NGOs have played a significant role in the post-flood recovery and reconstruction efforts in Pakistan. They have provided financial assistance, distributed relief goods, and initiated reconstruction projects to rebuild damaged infrastructure. NGOs have also established relief camps to provide temporary shelter to displaced people and have worked with local communities to provide long-term support and assistance. One of the most prominent NGOs in Pakistan is the Pakistan Red Crescent Society (PRCS). The PRCS has been actively involved in the post-flood recovery efforts in 2022. They have provided medical assistance, distributed relief goods such as food, water, and shelter kits to help those in need amid flood disaster. The PRCS has also established relief camps to provide temporary shelter to displaced people. Other NGOs such as Oxfam, UNDP, Save the Children, and United Nations International Children Emergency Fund (UNICEF) have also been involved in the post-flood recovery efforts in Pakistan. These NGOs have also worked with local communities to provide long-term support and assistance (UNDP- Report October 17, 2022).

NGOs have worked closely with the government and other organizations to ensure effective and efficient recovery efforts. They have coordinated with the National Disaster Management Authority (NDMA) and the provincial governments to ensure that the relief and recovery efforts are well-coordinated and effective. NGOs have also worked with international organizations and foreign governments to secure additional aid and support for the recovery efforts.

In conclusion, NGOs and International organizations have played a significant role in the flood relief activities in Pakistan in 2022. The flood caused immense destruction and displacement, and the government's resources were stretched thin. NGOs provided essential support to the affected people, including food, shelter, medical care, and basic necessities. They also helped in the rescue and evacuation of people stranded in the flood zones. The NGOs included both local and international organizations, and they worked together with the government to provide relief. The humanitarian efforts of the NGOs were crucial in mitigating the impact of the flood and supporting the people affected by the disaster.

Mitigation and Adaptation Strategies

Pakistan is expected to face increasing risks of flash flooding due to climate change in the future. Therefore, the implementation of several mitigation and adaptation strategies must be needed to reduce the risks of flash flooding. Below are some strategies that Pakistan could adopt to further reduce the risks of flash flooding:

Firstly, to Improve water management: Pakistan could improve water management by investing in new infrastructure, such as dams and reservoirs, to help regulate water flow and prevent flooding. Additionally, Pakistan could work to improve its irrigation systems to help reduce the amount of water that runs off into rivers and streams. Implement land-use planning and zoning regulations: Pakistan could implement stronger land-use planning and zoning regulations to help prevent development in flood-prone areas. This could include restrictions on building in areas that are at high risk of flooding, as well as requirements for developers to implement flood-resistant building techniques. Secondly, Reforestation: Pakistan could continue to implement its reforestation program to help reduce soil erosion and improve water retention (Ullah, 2017). This could help reduce the amount of water that runs off into rivers and streams, which can contribute to flash flooding.

However, the adaptation strategies include; Improving early warning systems: Pakistan could improve its early warning system to provide more accurate and timely information to communities at risk of flash flooding. This could include the installation of new weather monitoring equipment, as well as the development of new software to help predict flash flooding. Improve flood management infrastructure: Pakistan could invest in new flood management infrastructure, such as the construction of new flood shelters and the implementation of flood-resistant building techniques. This could help protect communities from the impacts of flash flooding. Develop community-based flood management plans: Pakistan could work with local communities to develop community-based flood management plans. This could include the development of evacuation plans, as well as the identification of safe areas for people to go to during floods (Muhammad & Ahmad, 2020).

Overall, Pakistan should take a multi-faceted approach to reduce the risks of flash flooding, including both mitigation and adaptation strategies. However, there is still much work to be done to reduce the risks of flash flooding in Pakistan.

Conclusion

In conclusion, the new waves of flash floods in 2022 in Pakistan have highlighted the risks associated with climate change. The floods have caused significant damage to infrastructure and have displaced thousands of people, which has led to increased awareness of the risks of climate change in the country. Pakistan has implemented several strategies to reduce the risks of flash flooding, including the construction of new dams and reservoirs, the rehabilitation of existing infrastructure, and the implementation of land-use planning and zoning regulations. Additionally, Pakistan is working to improve its early warning system to provide more accurate and timely information to communities at risk of flash flooding. However, there is still much work to be done to reduce the risks of flash flooding in Pakistan, and continued efforts are needed to protect communities from the impacts of flash flooding. The risks associated with climate change are

becoming more apparent in Pakistan, and the country needs to continue to take proactive steps to mitigate and adapt to these risks.

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