

A review of flood and environmental issues in the context of climate change in mountainous areas of Pakistan for indirect losses

Mohammad Nafees^{*} Muhammad Ashraf Khan^{*}, Shah Rukh Khan^{**}, Khaliq Nawaz Khan^{***}, Sajid Ullah^{****}, Kamran Khan^{****} and Hidayat Ullah Khan^{****}

^{*}Department of Environmental Sciences, University of Peshawar

^{**}, Department of Journalism, University of Peshawar

^{***}Bright Future Training Institute Burjuman Dubai

^{****}Centre of Plant Bio-Diversity University of Peshawar

Abstract: This article attempts to review the 2022 flash flood effects in the context of climate change and heat waves. Temperature increases accelerate the hydrological cycle by accumulating a large amount of water vapors in the atmosphere. According to the UN report, in 2022, around three hundred glaciers will have turned into lakes. 33 glaciers have been declared dangerous. The process of melting glaciers and mixing them with rainwater is linked to climate change impacts. Due to the combined effects of flash rain and glacier melt, the amount and flow of water have increased rapidly. In comparison to 2010, the flood of 2022 was larger in volume. The flow of the 2010 flood was 175 thousand cusecs, while the flow of the 2022 flood was 247 thousand cusecs. It is worth mentioning here that after the 2010 floods, protective nets were constructed on both sides of the Swat River from Madayan to Batkhila, due to which many villages along the river bank were saved. However, the buildings built on the banks of the Swat River in the upper hilly areas obstructed the way for water, which increased the volume of water and started flowing into the populated areas. This intensified the damage further. As per the government estimate, Pakistan faced financial losses worth 14900 million USD. Pakistan is highly vulnerable to such floods in the future and needs to work out its long-term strategy in light of the climate change policy of 2022 and the River Protection Act of 2012.

Key words: Flash flood, Climate change Policy, Glacier melt, Post flood rehabilitation, Heat wave

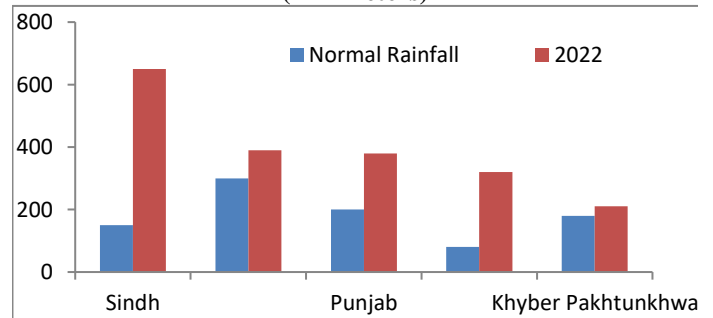
1. INTRODUCTION

Mountains are big sources of water across the globe and provide up to 80 percent of all freshwater on our planet (Viviroli et al., 2003). Mountains cover 22% of the earth's surface, where 14 percent of the world's population lives, and at least half of the world's population depends on mountain ecosystem services to survive (Messerli et al., 2004; Ehrlich et al., 2021). Mountains are not only a source of water, but we also get food and clean energy (Ehrlich et al., 2021; Woodwell, 2004). Pakistan is rich in mountains, with 60% of the total area of Pakistan being mountains, while there are 7253 glaciers in the northern mountains of Pakistan. In terms of aesthetics and resources, the mountains present a beautiful scene. But on the other hand, there are also natural disasters associated with it, such as storms, rains, snowfall, low temperatures, mountain movements, avalanches, and landslides (Rasul and Hussain, 2015; Nafees et al., 2008). As the

temperature increased over a period of time, there were possibilities of large-scale glacier melting with ultimate impacts on flooding (Bacha et al., 2018).

According to a recent BBC report, 3,000 glaciers in Pakistan have melted and turned into lakes. Out of these, 33 have been declared dangerous. If these 33 lakes erupt and come down, seven million people may die, causing a huge financial loss to the entire country (UN Development Programme, 2022; Khan et al., 2024). This means that in the future, rain and floods may be more dangerous. There is one possibility that in the coming winter, these lakes will turn into ice again and become safe for us. Or it may freeze in the coming winter but become dangerous again in the coming summer. In the context of current climate change, there is a possibility that this process of melting glaciers continues, and from time to time, one or more glaciers come down in the form of floods (Ullah et al., 2017).

Fig. 1: 2022 Rainfall in comparison with Normal Rain (millimeters)



Source: Pakistan Meteorological department, 2022

2. FLOOD HAZARD IN MOUNTAINS

The thirty-year average rainfall in Pakistan from July to September is about 130.8 mm. In 2022, it rained up to 375.5 mm. This increase is 190 percent more than normal (Nabi, 2023). The flood-related damages are intensified by man-induced impacts as well; for example, construction activities in the Bahrain and Kalam regions (Swat Valley) are according to environmental set-up and are not comparable with the mountains and Swat River (Fig. 1). Due to this, two large-scale losses had to be incurred twice: in 2010 and 2022 (Nafees, 2022). If a lesson was taken from the 2010 flood, then this damage would not have happened in 2022, or it would have been much less. We still have time to take

lessons in 2022 (Naveed, 2022). If such an incident occurs in the future, we should think about reducing the loss in terms of human lives and property (Shabir and Nafees, 2018).

Bahrain and Kalam are two important tourist spots famous for greenery and fresh water. There should be greenery, toll trees, and fresh water springs and streams. A certain number of hotels must be located at a sufficient distance from the river (Jabeen et al., 2015; Nafees et al., 2012). But there are only hotels, shops, markets, and plazas everywhere. Apart from this, the waste from the hotels is dumped directly into the river. This affects the health of humans as well as causing damage to aquatic life (Khan et al., 2022). The efforts explained in the flood protection plan for 2025 and the local administration of Swat regarding the removal of encroachments have given a lot of encouragement. If such a plan were implemented, then the loss of life and property could be reduced to a considerable extent (Government of Pakistan, 2015).

If we do not learn from the floods of 2010 and 2022, then in the near future we will fear more damage than the current floods. We have to define our objectives and streamline economic development by understanding the fragility of the natural, social, and cultural systems of the areas (Manzoor et al., 2022). Mountainous areas, especially Swat Valley, are environmentally sensitive areas. There are hundreds of glaciers that must be conserved. A sustainable approach to mountain tourism is essential in all countries to promote long-term development while maintaining a balanced use of resources. The floods of 2010 and COVID-19 affected tourism to a large extent. After the floods of 2010, we had barely realised that the problem of the Corona virus had taken hold. And common people suffered a lot financially. We have to give a new shape to the tourism sector in light of such conditions and their effects and try to save tourist and non-tourist places (Rukh et al., 2020; Nafees et al., 2020).

Pakistan Flood Losses

Climate change directly affects water bodies and causes damage. This loss is of two types. Either we face a drought or we have to deal with a flood. As we saw in 2022, we had to see severe drought in March and April and then heavy rains and floods in July and August. According to government sources, the total damage from the 2022 flood is 14900 million USD (Fig. 2). That has slowed down the economic growth to 0.29%, which was hardly recovered in 2023–24 and was brought to 5%. Before this, the economic growth rate was 6.1 percent (Government of Pakistan, 2023).

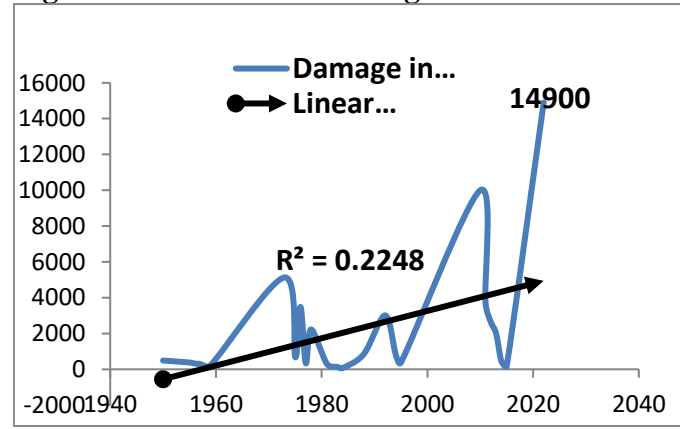
In this way, if this series continues, Pakistan may suffer economic and social losses on a large scale in the near future. According to an estimate, by 2050, the GDP of Pakistan may decrease by 18–20% due to climate change impacts (Express Tribune, 2022). In this context, according to the Asian Development Bank, Pakistan will receive large-scale damages in the coming 40 years, with a range of 6 to 14 billion USD (Asian Development Bank, 2017). According to the estimates of the World Development Bank, Pakistan has lost an average of 3.8 US dollars due to climate change, while 40 billion US dollars have been lost due to floods (Mahmood & Hassan, 2022). Due to this, it is estimated that in 2023, the GDP of Pakistan will fall to 3.5% instead of 6% (Asian Development Bank, 2023). The estimate is about 20 billion USD.

Being a developing country, this will be a huge, unaffordable loss for Pakistan.

Now, if we look at the aid received by Pakistan, the Asian Development Bank has announced a package of 2.5 billion US dollars. The World Development Bank has announced two billion US dollars, while the International Monetary Fund has indicated an aid of 1.17 billion US dollars, and the United Nations has announced an aid of 81 million US dollars. Apart from this, the possibility of allocating \$10 billion has been shown in the conference of parties in Egypt, which is known as COP-27, in relation to climate change this year. If all of them are combined, and even if all this money is given to Pakistan, the damage caused to Pakistan will not be remedied. Therefore, it is important for Pakistan to live up to its expectations and prepare now to avoid the possible damage of climate change (Khan, 2013; Foreign and July, 2010; Rest, 2022).

The list of losses faced by Pakistan at the level of the entire country is very long. Only in Swat, 66 deaths, 44 injuries, 2336 houses were completely destroyed, and 3189 were partially damaged. Apart from this, 517 roads, 35 hospitals, 13 playgrounds, 438 schools, 141 bridges, and 183 irrigation canals have been

Fig. 2: Pakistan Flood Damages over the Years



damaged. The total loss in Swat was PKR 20 billion in Swat district only. This can have two meanings: one is that 20 billion rupees have gone, and the other is that more than twenty billion rupees will be required to restore the said infrastructure (Government of Pakistan, 2022). It will take five to ten years for restoration and rehabilitation. In other words, the rate of profit in this area will remain low for five to ten years. These statistics are for the Swat district only. If you estimate the rest of the country in this way, it will reach trillions. Thus, we can say that the rate of economic growth in Pakistan will remain low for at least five years (Shehzad, 2023). Being a developing country, Pakistan cannot afford such a massive loss. Therefore, Pakistan will have to make big decisions and work hard so that the investment made in hilly and backward areas can be saved from wasting.

Everyone agrees that Pakistan received more rain during 2010 and 2022 than normal, but very few people would agree that the main reason for this was climate change (Otto et al., 2023). Mountains have always played an important role in monsoon rains. In this context, it can be said that all the water comes from the rain; there are other sources as well, in the form of glaciers, that boost up the

rain and cause floods in the mountain area. The impacts of floods are intensified by human-induced impacts in the form of irregular construction in floodplains (Khan, 2013).

3. INDIRECT ECONOMIC IMPACT

Challenges specific to mountain living and tourism development include health and safety issues as well as crisis management, as natural or man-made hazards such as floods, landslides, earthquakes, and conflicts can last for months or years. Can disrupt access and services and destroy land assets. It can endanger the lives of people living there and tourists (Nafees et al., 2020).

Tourism in the mountainous regions of Pakistan, especially the valleys located in the north, is important not only in the country but also in the outside world in terms of tourism. Swat has a unique position in this. Tourist places here attract tourists due to their natural beauty, attractions, and rich cultural heritage. Tourism is an excellent source of employment and income for rural areas. It can also help revive local traditions and food systems (Ismail, 2024; Khan, 2022).

According to an estimate, 2.6 million people visit Swat every year for sightseeing. Only on the occasion of Eid do millions of tourists go to the northern regions for sightseeing. On the occasion of Eid in 2022, 12 lakh people came to Swat Valley for sightseeing and entertainment. Due to which, about 3 lakh vehicles entered Swat (Express Tribune, 2021). According to the data from 2018, there are about 400 hotels in Swat that are considered inadequate in the summer season. According to the district administration of Swat, 37% of the economy depends on tourism (Government of Khyber Pakhtunkhwa, 2020).

If tourism is seen from the perspective of the economy, then it is a welcome development. From an environmental perspective, the picture is somewhat ambiguous. Like the rest of Pakistan, the population of mountainous areas is growing rapidly. Along with the increase in factories, crushing machines, solid waste, and transport, the environment in these areas is badly affected. The waste generated from the hotels and restaurants further contributes to this deterioration (Najum et al., 2019; Nisa, 2024). Swat is a mountainous region, and the provision of land for waste disposal is not easy to manage. Apart from this, deforestation and water pollution are other factors that contribute to environmental problems.

In developing mountain tourism, diversification of income and revitalization of products and services are very important. Where more attractive tourist destinations, regional products, and activities are shifted to low-impact, climate-sensitive sources. New and innovative incentives can transform hilly areas into attractive tourist destinations, especially for low-temperature areas. Among the many possibilities are medical tourism, community-based tourism, spiritual tourism, wellness tourism, rural tourism, agricultural tourism, and cultural tourism. Many have involved revising tourism initiatives or creating new opportunities, and all seek to deliver tangible benefits to local communities while helping to enhance the conservation of unique mountain heritage.

Tourism cannot ignore the potentially negative effects on the ecosystem, such as pollution and damage to biodiversity, especially wildlife. Climate change is one of the biggest challenges in mountainous areas, with impacts including reduced snow cover and an increased risk of extreme weather events.

Looking at tourism from a different angle due to climate change, it is important to take into account the sensitivity of a mountainous region.

4. ROLE OF INSTITUTIONS

Currently, there are separate national and provincial institutions for sustainable development, environmental protection, resource conservation, and sustainable tourism in Pakistan. The task at hand is to protect mountainous ecosystems and promote tourism. But when we look at the environment, the health of mountains and rivers, and the status of tourism, we don't see an effective role for them. For instance, consider the tourism department (Nafees et al., 2020). It seems that they have created a separate domain for themselves and have nothing to do with this unconventional tourism. If we look at the other side, there are also provincial and district offices for environmental protection. Laws, rules, and regulations related to the environment and environmental protection have also been made (Nafees et al., 2015). But hoteliers are silent about the waste coming out of the restaurant. In 2019, we saw some action from the Swat Environment Agency, and notices were given to 127 hotels. But there was no substantial result (Nafees and Shah Rukh Khan, 2024). Similarly, a building and housing authority also exists. There is also a separate law from 2002 to protect rivers. Accordingly, it is a crime to construct any kind of building up to two hundred feet from the river bank. Apart from this, according to the second clause of this law, it is a legal offence to throw any kind of waste in the river (Muzafar et al., 2013).

5. CONCLUSION

Pakistan is a land of beautiful valleys in which mountains play a very important role. This mountain not only adds to the beauty of Pakistan but also plays a key role in the country's economy. But due to the growing climate change scenario, all the mountains are prone to deterioration and damage. We are cutting trees from these mountains. Due to this, not only are the effects of climate change intensifying, but floods are also becoming more violent. We are encouraging a river flood plain that intensifies the impacts of flooding. We have only one route with no alternative transport programme, which puts tourists in trouble during extreme weather incidents. Various economic activities, such as tourism, are at stake due to climate change. Agriculture production may also decrease, which will intensify the poverty ratio.

6. RECOMMENDATIONS

1. We should protect our mountains and make them safe for the future. So that the effects of climate change are kept to a minimum.
2. A few important recommendations Promote climate-sensitive tourism in the mountains. For this, it is necessary to prepare a comprehensive plan based on modern principles.
3. Tourism in the mountains and its effects should be monitored frequently for better resource management. It should be the responsibility of every hotel to properly dispose of the generated waste. For this, it is necessary that they have their own waste disposal point at a distance from the population.

4. Empower mountain dwellers to advance tourism development and persuade them to implement the national and provincial laws so that they can play their positive role. Strengthen public-private partnerships to innovate and develop year-round tourism offerings.
5. Invest in infrastructure in remote hilly areas and work on alternative routes. The mountains should be inhabited, and the trees removed from them should be planted back on them.
6. Remove encroachments from the rivers and give the water a proper channel. A programme should be started regularly for the collection and disposal of waste from hotels.

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AUTHORS

First Author – Mohammad Nafees, PhD in Environmental Sciences, University of Peshawar

Second Author – Muhammad Ashraf Khan, PhD in Environmental Sciences, University of Peshawar

Correspondence Author – Muhammad Ashraf Khan

Third Author – Shah Rukh Khan, Department of Journalism, University of Peshawar

Fourth Author – Khaliq Nawaz Khan

Bright Future Institute Burjuman Dubai

Fifth Author – Sajid Ullah

Centre of Plant Bio-Diversity University of Peshawar

6th Author – Kamran Khan

Centre of Plant Bio-Diversity University of Peshawar

7th Author – Hidayat Ullah Khan

Bright Future Institute Burjuman Dubai