International Organization of Research & Development (IORD)
ISSN: 2348-0831
Vol 14 Issue 01 | 2026

Comparative Analysis of Disaster Trends and Impacts Across Different Periods in Nepal with Emphasis on Water-Induced Disasters

Dr. M.Manju
Assistant Professor, Department of Computer Science, Kongu Arts and Science College (Autonomous), Erode, India.
ORCID ID: 0009-0006-9266-1210

DOI:10.5281/zenodo.23889198

ABSTRACT

Nepal is highly vulnerable to natural disasters such as floods, landslides, heavy rainfall, and forest fires. Most previous studies have focused on individual disaster events or longer study periods. This study examines the changes in disaster occurrence and impacts in Nepal during 2021–2026, with special attention to water-induced disasters such as floods and landslides. Disaster information was collected from the Building Information Platform Against Disaster (BIPAD) and other official sources. The study compares disaster events and their impacts across the five-year period. BIPAD-based records show 4,215 disaster incidents in 2021, 3,934 in 2022, 5,856 in 2023, and 8,472 in 2024, indicating an increasing trend in disaster occurrence in recent years. Floods and landslides were among the important hazards affecting communities, infrastructure, agriculture, and livelihoods. The 2024 flood and landslide events caused particularly high economic losses, while landslides and floods continued to pose risks during 2025. In 2026, According to the data issued by Nepal's NDRRMA, 1410 people have been killed and still 61454 people is missing in this flood. The findings show that water-induced disasters are an important part of Nepal's disaster risk and require greater attention. Strengthening early warning systems, improving disaster preparedness, developing resilient infrastructure, and increasing community awareness can help reduce future disaster impacts. The study provides a recent overview of disaster trends in Nepal and highlights the need for effective disaster-risk-reduction measures during the period 2021–2026.

Keywords: Perception, Climate Change, water-induced disaster, Hazards, impacts of floods, People, Livelihood.

1. INTRODUCTION

Climate change is making extreme precipitation events, and the hazards that come with them, more frequent and severe. In June 2021, a catastrophic flash flood struck the Melamchi River in Nepal, causing major loss of life and property. The flood was cascading in nature, driven by several interacting factors. To evaluate the event afterward, the study examined upstream catchment hydrology, glacial lake outbursts, and landslide damming, and modelled downstream flow propagation using the Hydrologic Engineering Centre's River Analysis System (HEC-RAS) together with gauge-to-gauge (G2G) correlation. The outcomes were then checked against field observations. The study also estimated that the high-elevation glacial lake outburst released a discharge of 295.14 m^3/s, which added to the downstream flooding. These findings offer useful guidance for post-flood assessment, and the same approach can be applied to other watersheds to analyse flood conditions after an event [1,2,3].

Projections indicate that even the coldest years in the 2055s and 2090s will be warmer than the hottest years of the baseline period. Both the rise in temperature and the range of uncertainty are expected to be larger in the Mountains than in the Hills. The number of summer days and tropical nights is projected to grow across all three future periods. In addition, the temperatures of the coldest day, coldest night, warmest day, and warmest night are all expected to rise in both regions throughout all three future periods. [4, 5, 6]

The high-altitude areas of the Langtang Valley show a steady rise in temperature, which is clear evidence of global warming and has led to rapid glacier melting, with both horizontal and vertical retreat. The Lirung and Kimjung glaciers have retreated by more than 900 metres and 400 metres respectively, at an average rate of about 40 metres per year, and the vertical retreat of the snout position is 100 metres for both. The study also indicates that this retreat is driven by rising temperatures along with changes in precipitation and snowfall patterns. [7, 8, 9].

High Mountain Asia (HMA) holds the largest concentration of glaciers and ice caps outside the polar regions and is often called the "water tower of Asia," since many of the continent's major rivers depend on a steady supply of glacier meltwater. However, this water tower is vulnerable to climate change, and the temperature increases projected for the coming decades are expected to keep driving glacier recession through the end of the century [10, 11, 12].

Several regions of Nepal face serious flood-related hazards. The central mountain and border districts of Rasuwa, Nuwakot, Dhading, and Gorkha have been severely affected by glacial collapses, ice-rock avalanches, and river blockages along corridors such as the Bhote Koshi and Budhi Gandaki rivers, including the October 2026 floods in Gorkha and Chumanubri and the cross-border disasters of August 2026. The Kathmandu Valley is susceptible to serious urban and riverine flooding when rivers such as the Bagmati and Nakkhu overflow during heavy downpours.

In the east, the hilly and plain districts of Illam and the Koshi and Madhesh Provinces are repeatedly hit by torrential rain, slope failures, and extensive inundation. Meanwhile, the central and western river basins of Tanahun, Gandaki, Lumbini, and Karnali are at high risk because of steep terrain, melting Himalayan glaciers, and rising water levels in the major river systems.

This work is formatted as follows: Section I introduces the importance of knowing about Nepal's weather conditions. Section II describes related research works on Nepal's hazards, precipitation, and crucial flood causes. Section III presents the precautions and rescue of Nepali people. Section IV shows the analytical results and discussion of precaution methods. Finally, Section V describes the conclusion and future work.

2. RELATED RESEARCH WORKS

Adil et al., [2] produced the research paper of “Who suffers most from extreme weather events”. Between 1970 and 2012, weather-, climate-, and water-related disasters totaled 8,835 recorded events, resulting in 1.94 million deaths and economic losses of USD 2.4 trillion (World Meteorological Organization, 2014). By 2019, the WMO (2021) reported roughly 11,000 disasters since 1970, with over 2 million deaths and losses above USD 3.64 trillion. For 1970-2021, these figures rose to about 12,000 events and USD 4.3 trillion in losses, with a death toll of 2 million (World Meteorological Organization, 2023). Similarly, around 9,400 extreme events between 1993 and 2022 caused more than 0.7 million deaths and direct losses exceeding USD 4 trillion worldwide.

This shows that disaster-related losses have risen sharply in recent years compared with several decades ago. During 1970-2021, roughly 90% of global deaths from extreme, climate-, and water-related disasters occurred in developing countries (World Meteorological Organization, 2023).

ADREM et al., [3] discussed about developing countries are more vulnerable to disaster-related losses. In 2024, Asia recorded the highest number of disaster events and disaster-related deaths worldwide, and ranked second globally in economic losses from these events. Between 1970 and 2019, floods accounted for 44% of all disasters globally and about 31% of all economic losses (World Meteorological Organization, 2021). Similarly, among all disaster types in 2024, floods caused the largest share of fatalities, roughly 35% of the total, and affected the greatest proportion of the population worldwide.

Caretta et al., [7] presented the details of cautions of climate change. In this paper, the number of people vulnerable to water-related disasters triggered by global warming is projected to rise steadily worldwide, with about 50% of them living in South Asia, followed by Central Asia, West Africa, and East Asia.

Fort et al. [11] reported that the anomalous hyper-concentrated flood of 13 August 2023 in Kagbeni, in the Himalayan district of Mustang, caused extensive damage to property and infrastructure, with estimated losses of about 1 billion Nepalese rupees.

Ghimire et al., [12], discussed about the temperatures in this region are expected to keep increasing in the coming decades [4, 5, 9], which may lead to water-induced disasters.

Jain et al., [13] reported that South Asia accounts for about 9.3% of global greenhouse gas emissions, whereas Nepal’s share is only 0.027% (Government of Nepal, 2016). Even though its contribution is negligible, Nepal is among the countries most affected by climate change. Snow cover in the Nepalese mountains has declined significantly over the last decade, owing to rising temperatures in the mountain region.

Kaini et al. [17, 18, 19, 20] identified heavy rainfall, floods, landslides, inundation, Glacial Lake Outburst Floods, and avalanches as the main hazards behind water-induced disasters. Climate-induced disasters account for roughly 65% of total annual casualties in Nepal (MoFE, 2021).

Lamichhane et al. [21] found that the extreme rainfall of September 2024 in Kathmandu Valley and the resulting floods exposed the capital’s vulnerability: floodwater spread to more than 2.5 times the bank-full extent, causing dozens of deaths, millions of dollars in economic losses, extensive damage to housing and critical infrastructure, and major disruption to essential urban services.

Maharjan et al. [23] showed that the complex interplay between natural processes such as extreme precipitation, earthquakes, and landslides often triggers cascading or compounding events that amplify overall risk and impact. Cascading hazards are increasingly common in Nepal, which calls for a more integrated and comprehensive framework for hazard assessment and risk management.

Parajuli et al. [25, 26] noted that the Melamchi flood of 15 June 2021 was inherently cascading, resulting from the interplay of multiple driving mechanisms [1], and caused a total economic loss of around 66 billion Nepalese rupees. Similarly, the glacial lake outburst flood in Thame, Solukhumbu, on 16 August 2024 swept away around 20 houses and widely damaged houses, schools, bridges, and agricultural land, with an economic loss of approximately 800 million Nepalese rupees.

Pörtner et al. [28] noted that climate change has had a direct and substantial effect on how often disasters occur and how large they are, with floods and droughts becoming more frequent and severe worldwide as increasingly extreme climate events interact with deep-rooted societal vulnerabilities.

3. DISASTER EVENTS AND THEIR IMPACTS IN NEPAL

3.1 Study Area

Nepal, in northern South Asia, has strongly varied topography, with elevation rising from about 60 m in the southern lowlands to 8,848 m at its highest point within a north-south span of roughly 150 km (Fig. 1). The country is divided into seven provinces (Koshi, Madhesh, Bagmati, Gandaki, Lumbini, Karnali, and Sudur Pashchim) arranged from east to west.

Madhesh Province, in the low-lying southern plains, is especially prone to recurrent flooding, while Karnali Province, with its rugged hills and high mountains, is more exposed to landslides, earthquakes, and problems of remoteness and access. The other provinces combine high-Himalayan, middle-hill, and lowland settings, exposing them to multiple hazards such as floods, landslides, earthquakes, and extreme weather.

3.2 Data

The National Disaster Risk Reduction and Management Authority (NDRRMA), helps to the Government of Nepal's Ministry of Home Affairs manages the floods loss details, through the Building Information Platform Against Disaster (BIPAD) portal (https://bipadportal.gov.np/), an integrated disaster information system built on a centralized national portal linked with provincial and municipal platforms and a bottom-up approach to data collection (NDRRMA, 2020). It supports preparedness, disaster communication, response, and post-incident coordination. Although the portal holds records from 2011 onward, this study analyzes events of all hazard categories from 2021 to 24 August 2026 (last accessed on 24 August 2026).

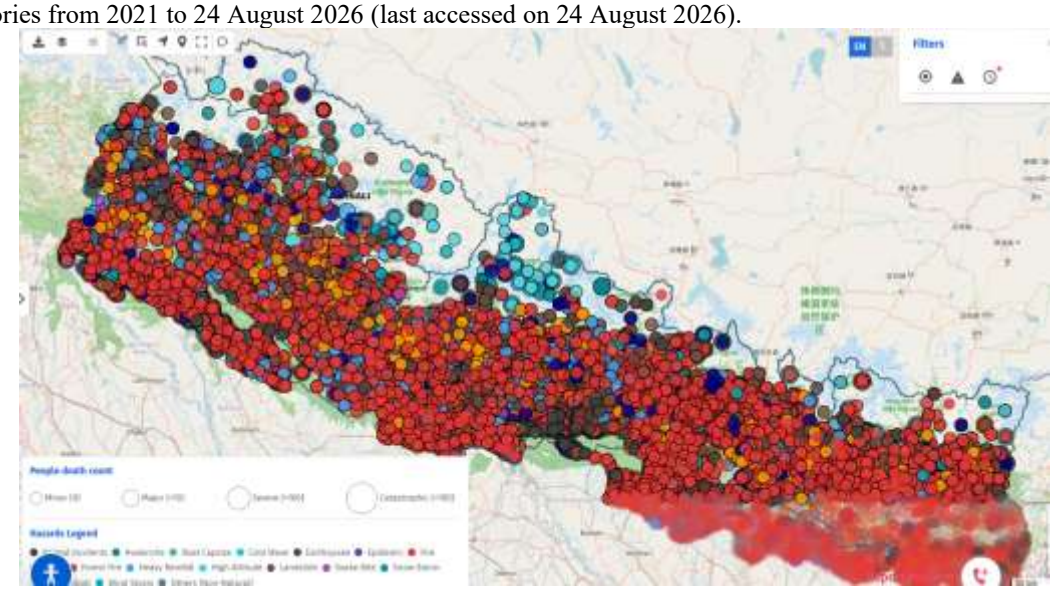


Figure 3.1 Shows the Impacts of Hazards and Water-Induced Disasters

BIPAD identifies 47 hazards: 24 natural (e.g., landslide, flood, heavy rainfall, earthquake, avalanche, glacial lake outburst, drought, and inundation) and 23 non-natural (e.g., road accident, drowning, bridge collapse, industrial disaster, and gas explosion). In figure 3.1 shows the hazards and impacts of water induced disasters.

4. DISASTER OCCURRENCES AND THEIR CONSEQUENCES IN NEPAL

4.1 Disaster Occurrences

Between 2021 and 24 August 2026, the BIPAD portal (https://bipadportal.gov.np/) recorded 38,190 incidents in total, with the breakdown by hazard presented in Table 1. According to the table, the leading hazards driving the rising number of disaster incidents in Nepal are fire, landslide, forest fire, animal incidents, heavy rainfall, thunderbolt, snake bite, wind storm, flood, high altitude, and earthquake. Fire is by far the most frequent, with 19,836 recorded occurrences, followed in descending order by landslides (3,874), forest fires (2,503), animal incidents (2,332), and heavy rainfall (2,061) over the same period.

Table 4.1. Hazard type, number of incidents, and affected people in Nepal from 2021 to 24 August 2026 (Source: https://bipadportal.gov.np/).

S.N.	Hazard Type	Number of incidents	People dead	People missing	People injured
1	Fire	19,836	573	0	2,641
2	Landslide	3,874	772	113	704
3	Forest Fire	2,503	33	0	57
4	Animal Incidents	2,332	270	2	1,366
5	Heavy Rainfall	2,061	49	1	144
6	Thunderbolt	1,893	343	0	1,378
7	Snake Bite	1,887	255	0	1,645
8	Wind Storm	1,657	52	1	224
9	Flood	1,398	267	118	113
10	High Altitude	391	117	0	305
11	Earthquake	238	162	0	439
12	Others (Non-natural)	69	113	2	51
13	Avalanche	27	27	6	41
14	Boat Capsize	15	11	7	5
15	Snow Storm	5	5	0	1
16	Epidemic	3	4	0	774
17	Cold Wave	1	0	0	0
	Total	**38,190**	**3,053**	**250**	**9,888**

Water-induced hazards (landslide, heavy rainfall, flood, and avalanche) accounted for 7,360 of the 38,190 recorded incidents (about 19%) between 2021 and 24 August 2026, yet they were responsible for 1,115 deaths (about 37% of the total), 238 missing people (about 95%), and 1,002 injuries (about 10%). Landslides were the deadliest hazard in the entire dataset, with 3,874 incidents causing 772 deaths, 113 missing, and 704 injuries, which is roughly one death for every five incidents and about 25% of all deaths, ahead of fire (573 deaths). Floods recorded fewer incidents (1,398) but caused 267 deaths and 118 missing people, the highest missing count of any hazard, and together with landslides they account for about 92% of all missing people.

Heavy rainfall was frequent (2,061 incidents) but had relatively low direct casualties (49 deaths, 1 missing, and 144 injured), which suggests that its impact is mainly felt through the landslides and floods it triggers. Avalanches were rare (27 incidents) but highly lethal per event, with 27 deaths, 6 missing, and 41 injured. Overall, landslides and floods together caused 1,039 deaths, about 34% of the total, from only about 14% of all incidents, which highlights the disproportionate severity of water-induced disasters in Nepal. Table 4.2 shows the water induced related losses and damages.

The chronological distribution of disaster incidents across the provinces from 2021 to 24 August 2026 is shown in Fig. 4.2 The annual number of incidents was lowest in 2022 (3,928), then increased sharply to 5,851 in 2023 and peaked at 8,475 in 2024, followed by 8,345 in 2025. Koshi Province recorded the highest number of incidents in every year, peaking at 2,525 in 2024.

Madhesh, Lumbini, and Bagmati also rose steadily until 2024 and 2025. Karnali had the lowest counts in the early years (200 in 2021) but rose more than threefold to 742 by 2025. In 2026, 7,372 incidents were recorded up to 24 August, and Gandaki (900) and Sudur Pashchim (871) are already close to their highest yearly values. Figure 4.1 show the chronological distributions of disaster events across provinces and also Figure 4.2 shows the province distribution from 2021 to 2026.

Table 4.2. Shows the losses and damages related to water-induced hazards.

Hazard	Incidents	Dead	Missing	Injured
Landslide	3,874	772	113	704
Heavy Rainfall	2,061	49	1	144
Flood	1,398	267	118	113
Avalanche	27	27	6	41
Combined	**7,360**	**1,115**	**238**	**1,002**
Share of all hazards	**19.3%**	**36.5%**	**95.2%**	**10.1%**

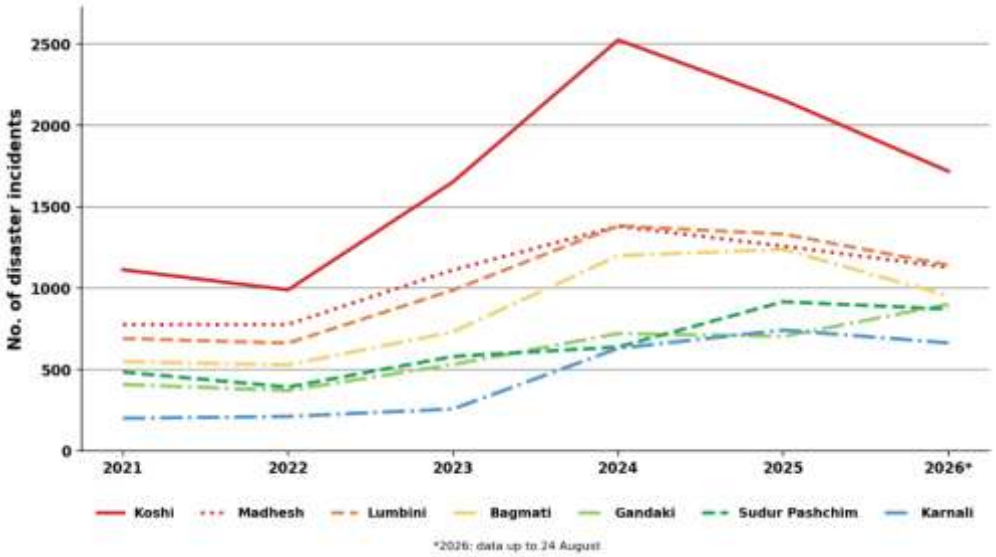


Figure 4.1 chronological distributions of disaster events across provinces.

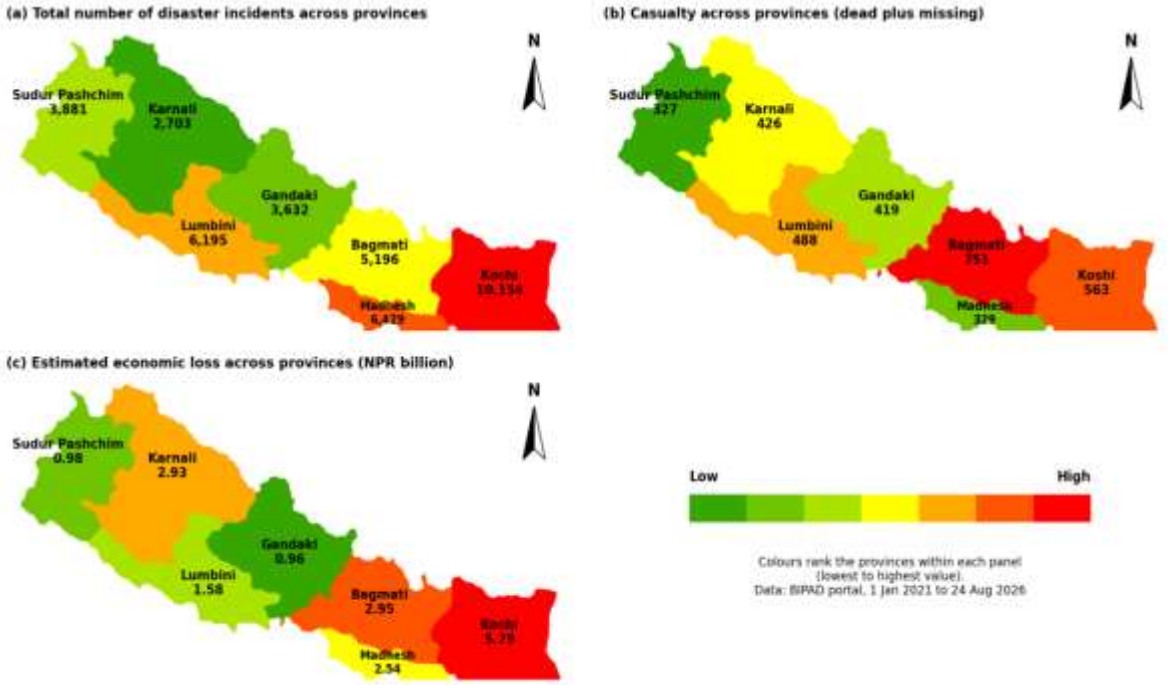


Figure 4.2 provincial distribution 2021- 2026

The chronological distribution of disaster events across the provinces from 2021 to 24 August 2026 is illustrated in Fig. 4. The number of events rose markedly from 4,219 in 2021 to 8,345 in 2025, roughly doubling in five years, with a peak of 8,475 in 2024. A further 7,372 events were recorded in 2026 up to 24 August. In absolute terms, the increase was largest in Koshi Province, where incidents rose from 1,113 in 2021 to 2,156 in 2025 (peaking at 2,525 in 2024), a larger gain than in any other province. In 2021, incident numbers were comparatively low across the provinces, ranging from 200 to 1,113. By 2025, however, the recorded incidents had risen sharply to 2,156 in Koshi, 1,332 in Lumbini, 1,258 in Madhesh, and 1,238 in Bagmati. This pronounced escalation points to a disproportionately large increase in disaster occurrence in Koshi Province, which may reflect greater vulnerability or improved reporting mechanisms compared with the other regions.

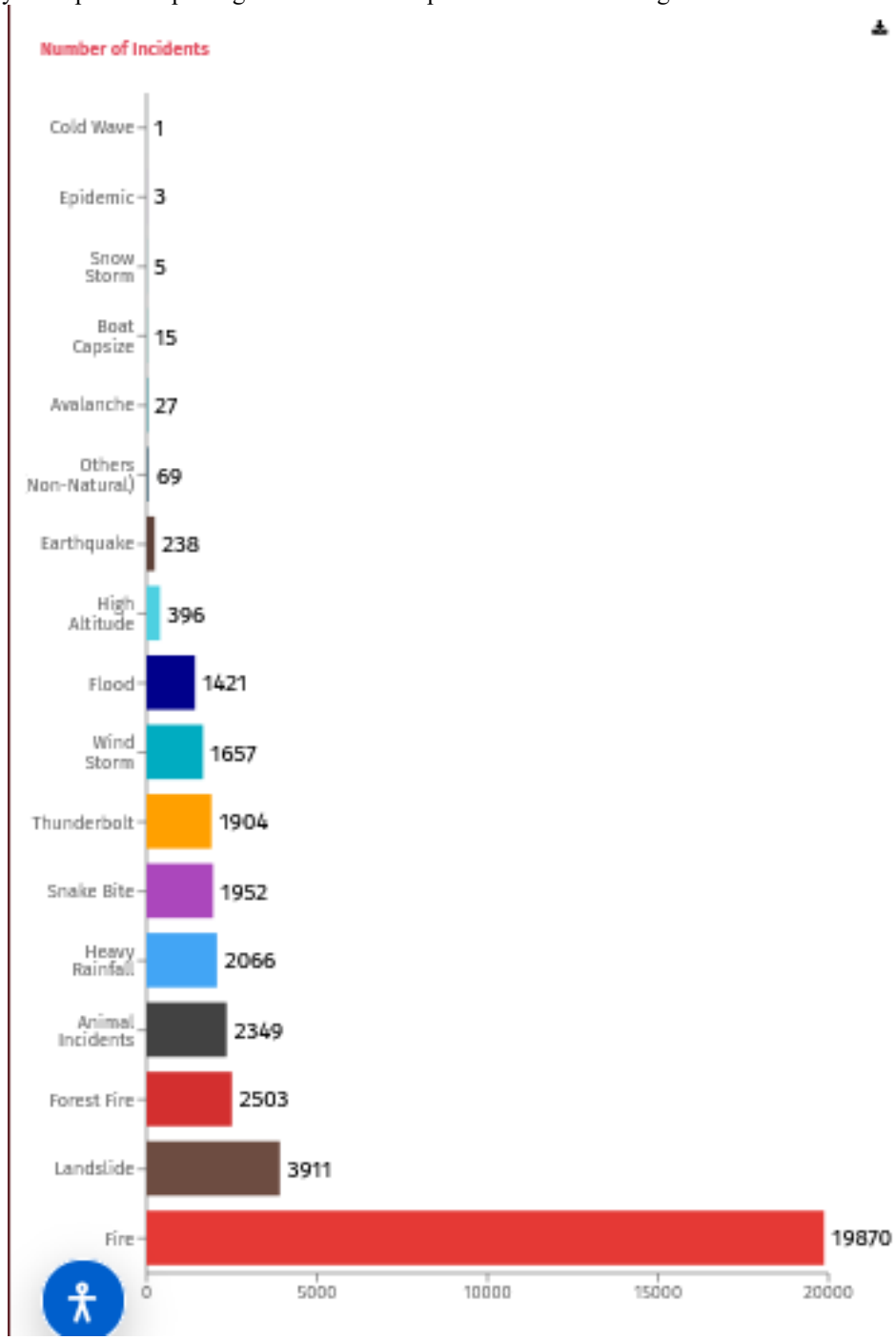


Figure 4.3 visualization data of incidents from 2021- 2026

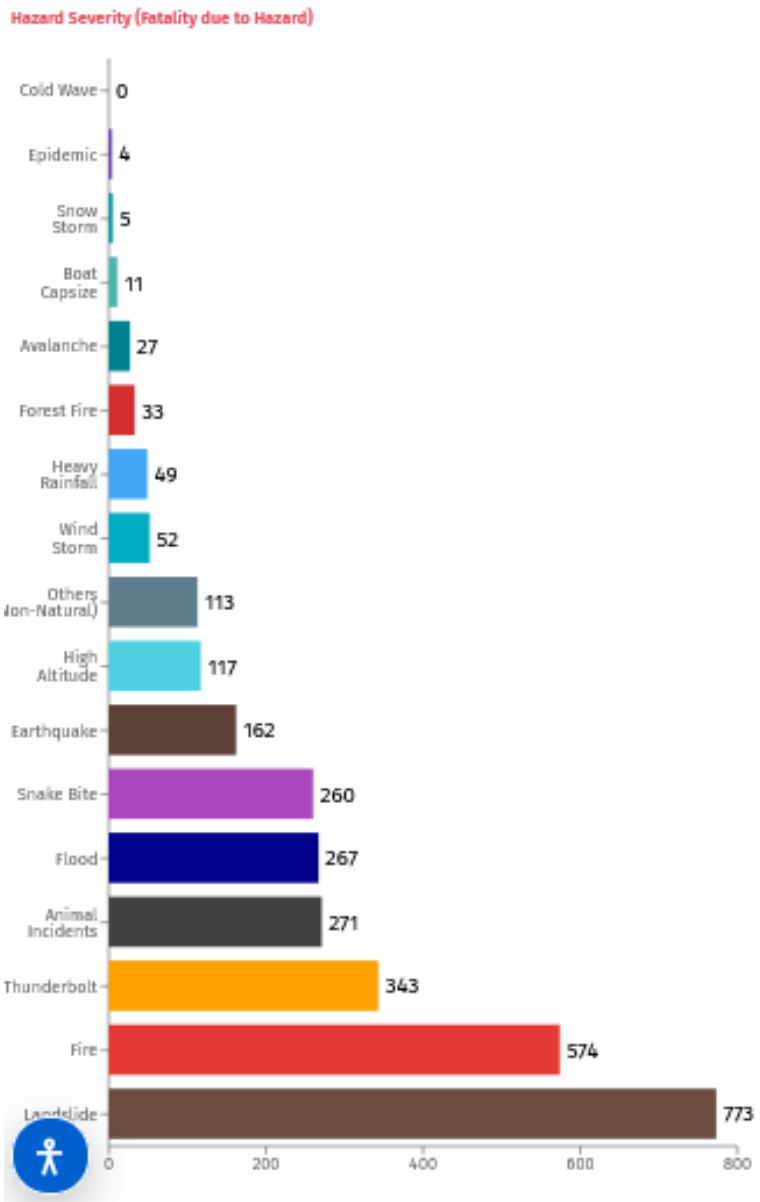


Figure 4.4 visualization data of Hazards severity from 2021- 2026

4.2 Losses due to disaster consequences in Nepal

4.2.1 Casualty

The figure 4.3 and 4.4 shows the incidents and hazards severity from 2021 to 2025. Table 4.1 shows that disaster events from 2021 to 24 August 2026 caused 3,053 fatalities, with a further 250 people reported missing. According to the hazard severity chart, landslide was the deadliest hazard (773 deaths), followed by fire (574), thunderbolt (343), animal incidents (271), and flood (267). As illustrated in Fig. 4.2, Bagmati Province recorded the highest number of casualties (combined fatalities and missing persons), totalling 751. It was followed by Koshi (563), Lumbini (488), Karnali (426), Gandaki (419), Madhesh (329), and Sudur Pashchim (327), indicating a markedly higher burden in Bagmati than in the other provinces. The total number of incidents, casualties (dead plus missing people), and economic losses is shown in chronological order in. Fig. 4.5 shows that casualties were 580 in 2021, fell to 454 in 2022, and then rose to a peak of 824 in 2024, while incidents also reached their highest level (8,475) in that year. Casualties then declined to 509 in 2025 and 342 in 2026 (up to 24 August), even though the number of incidents remained high. Overall, casualty numbers have stayed within a fairly narrow range despite the sharp rise in disaster incidents, which suggests that the increase in recorded incidents has not been matched by a proportional increase in casualties.

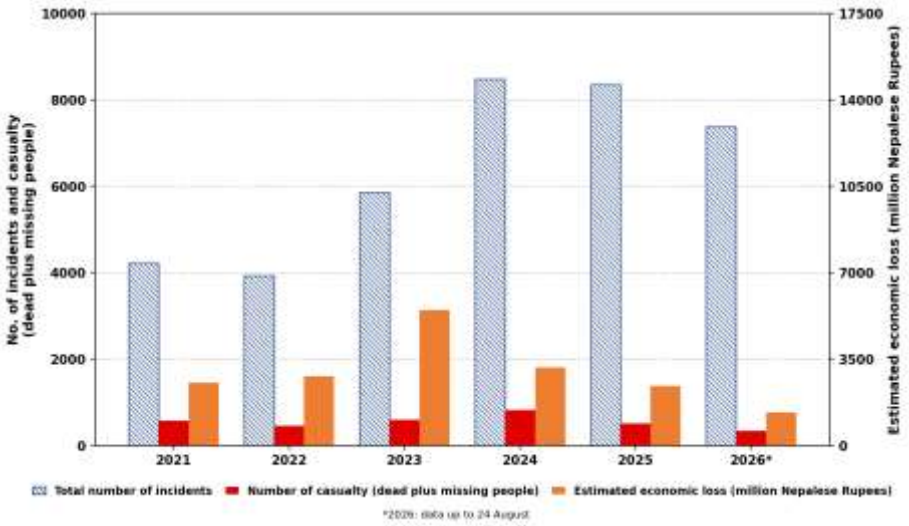


Figure 4.5 incidents causality loss data from 2021 to 2026

5 WATER-INDUCED DISASTER EVENTS AND LOSSES IN NEPAL

5.1 Water-induced disaster events

Water-induced disasters in Nepal rank among the most catastrophic hazards, resulting in substantial loss of life, widespread infrastructure damage, and significant economic disruption. The key hazards in water-induced disasters include rainfall, flood, landslide, inundation, Glacier Lake Outburst Flood, and avalanche. Nepal experiences an average annual rainfall of about 1,530 mm, characterized by significant spatial and temporal variability, with around 80% of the total precipitation occurring during the monsoon period from June to September (Water and Energy Commission Secretariat, 2005). Intense monsoonal rainfall routinely triggers floods and landslides annually, leading to fatalities, widespread damage to housing, loss of arable land, and significant impairment of essential infrastructure. The chronological distribution of water-induced disaster incidents for 2021 to 24 August 2026 is shown in Fig. 5.1.

The total number of water-induced disasters in the 2021 to 24 August 2026 period is 7,360, about 19% of all recorded incidents. The major hazard contributing to water-induced disaster incidents in this period is landslide (3,874), followed by heavy rainfall (2,061), flood (1,398), and avalanche (27). The annual number was 852 in 2021, fell to its lowest level of 554 in 2022, and then rose sharply to a peak of 1,976 in 2024, illustrating a marked increase in recent years. After 1,370 incidents in 2025, 1,776 incidents had already been recorded by 24 August 2026. The provincial distribution of total water-induced disaster incidents, casualties (dead plus missing people), and estimated economic losses across the provinces from 2021 to 24 August 2026 is shown in Fig. 8. It shows that Koshi Province recorded the highest number of water-induced disasters (1,790), followed by Bagmati (1,368), Gandaki (1,134), Lumbini (1,090), Karnali (824), Sudur Pashchim (779), and Madhesh (375). In terms of casualties, Bagmati recorded the highest number (489), while the largest estimated economic loss occurred in Koshi (about NPR 1.07 billion).

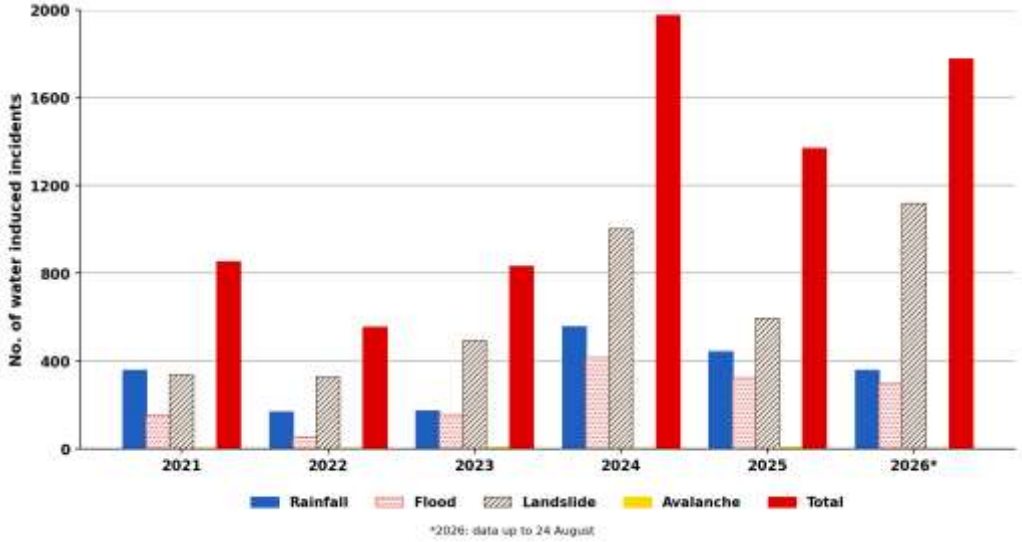


Figure. 5.1. Chronological distribution of water-induced disaster incidents for the 2021– 24 august 2026

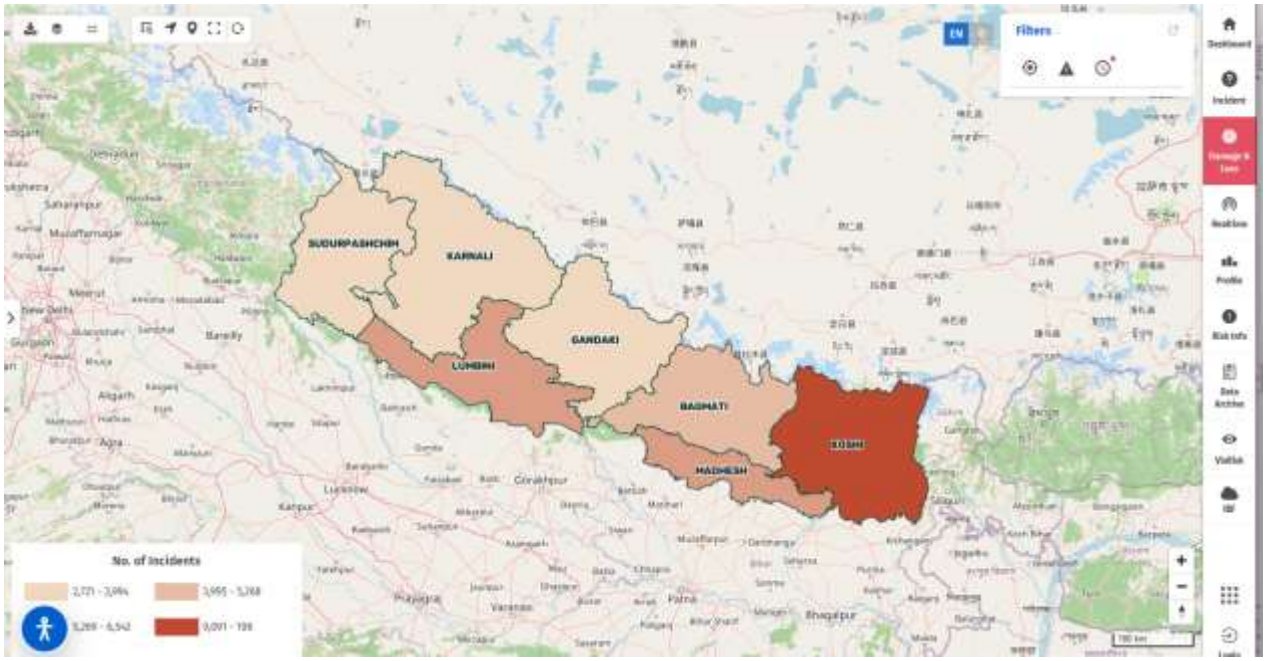


Figure 5.2 The problematic provinces of Nepal.

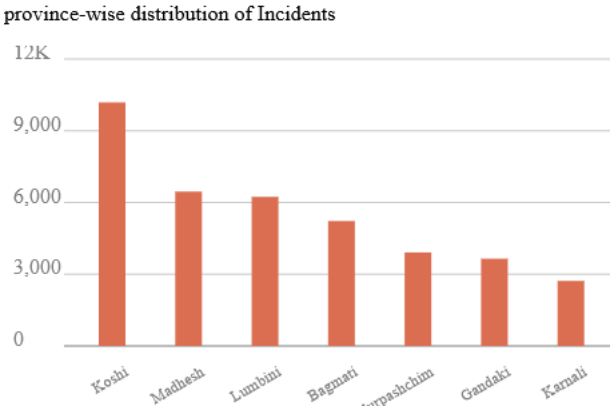


Figure 5.3 Province wise distribution of Incidents

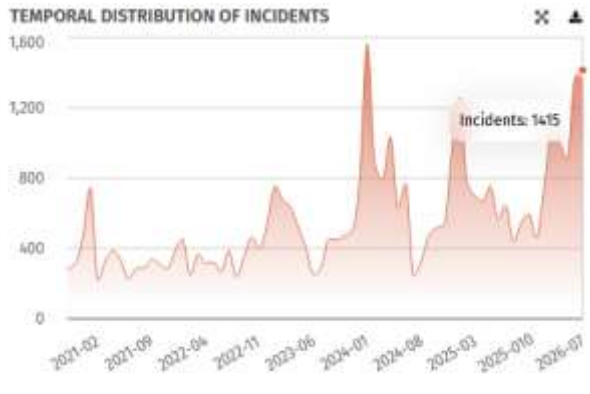


Figure 5.4 Temporal Distributions of Incidents

This comparative study shows the dramatic changes that occurred over five years in the provinces of Nepal. Many people died or went missing, and many lost their livelihoods, as a result of hazards and water-induced events. Water-induced events in particular caused serious incidents and deaths, and Nepalese people lost their lives, homes, and resources. People also lost their health and wealth in floods and other water-induced events. This study therefore presents the dramatic changes over five years, along with the incidents, losses, and impacts on the people of Nepal.

6. CONCLUSION

These study analyses disaster events in Nepal from 2021 to 24 August 2026, with a focus on water-induced disasters, using data from the BIPAD portal. A total of 38,190 incidents were recorded, causing 3,053 deaths and leaving 250 people missing. Annual incidents rose from 4,219 in 2021 to a peak of 8,475 in 2024. Koshi Province recorded the most incidents (10,154) and the highest economic loss (about NPR 5.79 billion), while Bagmati Province recorded the most casualties (751). Water-induced disasters (landslide, heavy rainfall, flood, and avalanche) made up about 19% of all incidents but about 41% of all casualties, with landslide the dominant hazard (3,874 incidents).

To protect people from these hazards, the study recommends hazard and risk mapping with risk-informed land-use planning, relocation of settlements away from high-risk slopes and riverbanks, slope stabilisation and embankment construction, and early warning systems backed by community preparedness and evacuation drills. It also recommends resilient infrastructure, with stronger drainage, bridges, and roads, and coordinated action among all tiers of government, communities, researchers, and the private sector. The study covers only about five and a half years, so future research should use longer records.

7. REFERENCES

1. Adhikari, T.R., Baniya, B., Tang, Q., Talchabhadel, R., Gouli, M.R., Budhathoki, B.R., Awasthi, R.P., 2023. valuation of post extreme floods in high mountain region: A case study of the Melamchi flood 2021 at the Koshi River Basin in Nepal. Natural Hazards Research 3, 437–446. https://doi.org/10.1016/j.nhres.2023.07.001.
2. Adil, L., Eckstein, D., Kunzel, V., Schafer, L., 2025. Who suffers most from extreme weather events? Germanwatch Climate Risk Index 2025.
3. ADREM, SNSE, NDRC, CADP, IRDR, 2025. 2024 Global Natural Disaster Assessment Report. Academy of Disaster Reduction and Emergency Mgt., School of National Safety and Emergency Mgt., Beijing Normal University, National Disaster Reduction Center of China, Chinese Association for Disaster Prevention and Integrated Research on Disaster Risk.
4. Agarwal, A., Babel, M.S., Maskey, S., Shrestha, S., Kawasaki, A., Tripathi, N.K., 2016. Analysis of temperature projections in the Koshi River Basin, Nepal. International Journal of Climatology 36. https://doi.org/10.1002/joc.4342.
5. Bajracharya, S.R., Bajracharya, O.R., Baidya, S., Maharjan,S.B., Shrestha, F., 2014. Climate change impact on glaciers in the Langtang and Imja sub-basins of Nepal from late 70s to2010. *AGU Fall Meeting Abstracts* 2014, C31B-0278.
6. Bhattacharya, A., Bolch, T., Mukherjee, K., King, O., Menounos,B., Kapitsa, V., Neckel, N., Yang, W., Yao, T., 2021.High Mountain Asian glacier response to climate revealed by multi-temporal satellite observations since the 1960s. NatureCommunications 12, 4133. https://doi.org/10.1038/s41467-021-24180-y.
7. Caretta, A.M.M.A., Arfanuzzaman, R.A.B.M., Morgan, S.M.R.,Kumar, M., 2022. Water, in: Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working GroupII to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK. https:/ /doi.org/ 10.1017/ 9781009325844.006.
8. Department of Water Resources and Irrigation, 2026. Water Resources and Irrigation Annual Book. Department of Water Resources and Irrigation, Government of Nepal, Lalitpur, Nepal.
9. Eckstein, D., Kunzel, V., Schafer, L., 2021. German watch Global Climate Risk Index 2021, Who suffers most from extreme weather events? Weather related loss events in 2019 and 2000–2019. Germanwatche.V, Germany.
10. Eckstein, D., Kunzel, V., Schafer, L., 2021. Germanwatch Global Climate Risk Index 2021, Who suffers most from extreme weather events? Weather related loss events in 2019 and 2000 – 2019. German watch e.V, Germany.
11. Fort, M., Gurung, N., Yvrard, P., Bell, R., Burrows, K., Rimal, B., Arnaud-Fassetta, G., 2025. The Kagbeni flood event (August 13, 2023), Mustang District (Nepal): Triggers, sediment cascades, aggravating infrastructures and disaster risk management. Géomorphologie: Relief, Processus, Environnement 31. https://doi.org/10.4000/154up.
12. Ghimire, M., Shrestha, D., Chauhan, R., Thapa, A., Sharma, T.P.P., Sharma, K.P., Gurung, S.B., Devkota, S., Bhandari, P., Koirala, S., 2026. Dynamics of snow and glacier cover in the Upper Karnali Basin, Nepal: an analysis of its relationship with climatic and topographic parameters. The Cryosphere 20, 551–572. https://doi.org/10.5194/tc-20-551-2026.
13. Jain, A.K., Seshadri, S., Anand, J., Chandra, N., Patra, P.K., Canadell, J.G., Chhabra, A., Ciais, P., Gilani, H., Gumma, M.K., 2025. South Asia's ecosystems are a net carbon sink, but the region is a major net GHG source to the atmosphere. Global Biogeochemical Cycles 39, 2024 008261. https://doi.org/10.1029/2024GB008261.
14. Kaini, S., 2025. Integrated Approach To Disaster Management, The Rising Nepal. https://risingnepaldaily.com/news/68182. [accessed on 15 January 2026].
15. Kaini, S., Gardner, T., Sharma, A.K., 2020a. Assessment of socio-economic factors impacting on the cropping intensity of an irrigation scheme in developing countries. Irrigation and Drainage 69, 363–375. https://doi.org/10.1002/ird.2427.
16. Kaini, S., Nepal, S., Pradhananga, S., Gardner, T., Sharma, A.K., 2020b. Representative General Circulation Models selection and downscaling of climate data for the transboundary Koshi river basin in China and Nepal. Int. J. Climatology 40, 4131–4149. https://doi.org/10.1002/joc.6447.
17. Kaini, S., Harrison, M.T., Gardner, T., Nepal, S., Sharma, A.K., 2022. The impacts of climate change on the irrigation water
demand, grain yield, and biomass yield of wheat crop in Nepal. Water 14, 2728. https://doi.org/10.3390/w14172728.
18. Kaini, S., Nepal, S., Pradhananga, S., Gardner, T., Sharma, A.K., 2021. Impacts of climate change on the flow of the transboundary Koshi River, with implications for local irrigation. *International J. Water Resources Dev.* 1–26. https:// doi.org/10.1080/07900627.2020.1826292.

19. Kaini, S., Comprehensive analysis of disaster events and their impacts with emphasis on water-induced disasters in Nepal, International Journal of Disaster Studies and Climate Resilience. Vol. 2 No. 2, 174–188, https://doi.org/10.64866 /j.ijdscr.2026. 10031.
20. Kaini, S., Nepal, S., Pradhananga, S., Gardner, T., Sharma, A.K., 2021. Impacts of climate change on the flow of the trans boundary Koshi River, with implications for local irrigation. *International J. Water Resources Dev.* 1–26. https://doi.org/10.1080 /07900627 .2020.1826292.
21. Lamichhane, K., Karki, S., Sharma, K., 2025. Unraveling the causes and impacts of increasing flood disasters in the Kathmandu valley: lessons from the unprecedented September 2024 floods. *Natural Hazards Research* 5, 875–897. https:// doi.org/10.1016/j.nhres.2025.04.001.
22. Lee, H., Calvin, K., Dasgupta, D., Krinner, G., Mukherji, A., Thorne, P., Trisos, C., Romero, J., Aldunce, P., Barret, K., 2023. IPCC, 2023: Climate Change 2023: Synthesis Report, Summary for Policymakers, in: Lee, H., Romero, J. (Eds.), Contribution of working groups I, II and III to the sixth assessment report of the IPCC. IPCC, Geneva.
23. Maharjan, S.B., Steiner, J.F., Shrestha, A.B., Maharjan, A., Nepal, S., Shrestha, M.S., Bajracharya, B., Rasul, G., Shrestha, M., Jackson, M., 2021. The Melamchi Flood Disaster: Cascading Hazard and the Need for Multihazard Risk Management. ICIMOD, Kathmandu, Nepal. MoFE, 2021. National Framework on Climate Change Induced Loss and Damage (L&D). Ministry of Forests and Environment, Government of Nepal, Kathmandu, Nepal.
24. NDRRMA, 2020. BIPAD: An Integrated Disaster Information Management System-User Handbook. The Government of Nepal, Ministry of Home Affairs, National Disaster Risk Reduction and Management Authority (NDRRMA), Kathmandu, Nepal.
25. Parajuli, B.P., Baskota, P., Shrestha, A., Sedhai, N., Bhattarai, S., Paudel, J., Adhikari, P., Khatri-Chhetri, P., 2024. Loss and Damage in the High Mountains of the Everest Region: Realities, Pains, and Perils from Thame Village. Digo Bikas Institute, Kathmandu.
26. Parajuli, B.P., Baskota, P., Singh, P.M., Sharma, P., Shrestha, Y., Chettri, R.P., 2023. Damage Finance in Nepal: A Case of Melamchi Flood 2021. Prakriti Resources Centre, Kathmandu.
27. Pradhan, A.M.S., Silwal, S., Kaini, S., Shrestha, S., 2025. Un Unveiling groundwater potential zones in the hilly region of central Nepal using logistic regression and random forest modeling. Hydrogeology Journal 33, 1465–1482. https://doi.org/ 10.1 007/s10040-025-02932-0.
28. Pörtner, H.-O., Roberts, D.C., Adams, H., Adler, C., Aldunce, P., Ali, E., Begum, R.A., Betts, R., Kerr, R.B., Biesbroek, R., 2022. Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the IPCC.
29. Seneviratne, S.I., Zhang, X., Adnan, M., Badi, W., Dereczynski, C., Luca, A.Di, Ghosh, S., Iskandar, I., Kossin, J., Lewis, S.,
2021. Weather and Climate Extreme Events in a Changing Climate. Climate Change 2021: The Physical Science Basis. Working Group I Contribution to the Sixth Assessment Report of the IPCC.
30. Talchabhadel, R., Panthi, J., Pandey, V.P., 2025. Yesterday's extremes, today's new normal: flood risk in the Kathmandu Valley, Nepal. Natural Hazards 121, 19409–19423. https:// doi.org/10.1007/s11069-025-07524-5.
31. Upadhyaya, B.R., Pradhan, A.M.S., Kaini, S., 2024. Groundwater potential mapping in central hills of Nepal: A comparative study of conventional and modified frequency ratio methods. J. Nepal Geol. Soc. 67, 11–22. https://doi.org/10.3126/jngs. v67i1.74580.