Government of Nepal
Ministry of Forests and Environment

GREEN CLIMATE FUND

FAO

Climate-Induced Extreme Events in Nepal

A Call to Action for Resilience

Climate change is driving more frequent and intense extreme events. Stronger climate impacts require stronger actions towards resilience to adapt at every level. BRCRN is equipping communities and institutions to stay prepared and protected.

What's at Stake?

In July 2025, Madhesh Province experienced a historic drought. Unprecedented monsoon failure severely disrupted rice transplantation and drinking water supply. Few months later in October 2025, extreme unseasonal rainfall caused catastrophic floodings and landslides in Nepal, costing at least 60 lives. As these extreme events become more frequent and intensive in Nepal due to climate change, urgent awareness and action is needed.

What are Extreme Events?

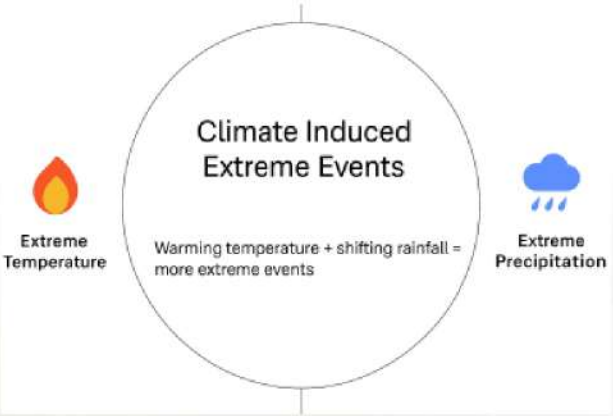
An extreme event is a time and place in which weather, climate, or environmental conditions—such as temperature, precipitation, drought, or flooding—surpass a certain threshold value. Deviations that occur in the highest or lowest 5% or 10% of historical measurements are considered extreme events. Extreme events can be classified into rapid-onset events and slow-onset events. In Nepal, both rapid-onset and slow-onset events are **increasing in frequency, intensity, and magnitude** (MoFE, 2021b) with impacts on agriculture, food security, water resources, biodiversity, ecosystems, and society.

Rapid-onset events are sudden, intense, and short-lived (hours to days) such as flash floods, landslides, or forest fires, which cause immediate destruction.

Slow-onset events emerge gradually, developing over months or years, such as drought, glacier retreat and land degradation.

How are Extreme Events Connected to Climate Change?

Human-induced greenhouse gas emissions are the main drivers leading to an increased frequency and/or intensity of weather and climate extremes. The human-driven rise in the global temperature by up to 2 °C changes the hydrological cycle globally, leading to increasing extreme events. The extremes identified by the IPCC include temperature extremes (such as heatwaves and coldwaves), heavy precipitation, pluvial floods, river floods, droughts, storms (including tropical cyclones), as well as compound events involving multiple or simultaneous extreme conditions.



What are the Impacts of Climate Induced Extreme Events?

Rising temperatures, erratic rainfall, floods, droughts, and heatwaves are intensifying at a pace that has severe impacts despite our adaptation efforts. Climate induced extreme events disrupt lives, economies, societies, and ecosystems. They destroy infrastructure, cause losses of lives and properties, and deepen inequalities. Climate induced extreme events amplify vulnerabilities, disproportionately affecting women, Indigenous Peoples, and marginalized groups. Increasing weather and climate extreme events have already exposed millions of people to acute food insecurity, reduced water security, and displaced livelihoods options (IPCC, 2022).

How do Climate Induced Extreme Events Affect Nepal?

Nepal is also highly vulnerable to climate-induced extreme events due to its diverse topography, fragile ecosystems, and socio-economic challenges. The impacts of climate change are disproportionately felt in rural and mountainous regions and by communities that depend heavily on climate-sensitive sectors like agriculture, forestry, and water resources, such as Indigenous People. Single extreme events can kill and displace tens to hundreds of thousands of people. During 2018 to 2024, Nepal experienced 32,375 disaster incidents causing **2,996 deaths, 446 missing, and NPR 23.6 billion in direct economic losses** (MoHA, 2025).

Extreme Temperature/Extreme Heat

Temperature is a major driver for many extreme events. At **+2 °C** global warming, extreme temperatures of 40+ °C and even 50°C are becoming increasingly frequent worldwide.

Nepal is anticipated to be hotter in the future compared to the baseline period with an **increase in average annual temperature** between **2.4°C to 4.3°C**. Both maximum and minimum temperatures are expected to rise, leading to an overall increase in mean temperature (DHM, 2024). By the end of the century, most regions in Nepal are likely to experience a rise in mean temperature not more than 4.5°C under the Socioeconomic Pathways (SSP)-4.5 scenario, however under SSP5-8.5 scenario, some areas could see an increase of up to 7°C. Extreme heat can lead to a range of serious consequences, including heatwaves, prolonged droughts, increased risk of wildfires, and a rise in heat-related illnesses and mortality.

In the hottest region of Terai, summer temperature can reach up to 45°C during heat waves and longer periods of drought with reported cases of annual heat mortality (Singh et al., 2014). Meanwhile in densely populated metropolitan areas in the Kathmandu Valley and the Terai region's urban core (Nepalgunj, Dhangadi, Chitwan, Biratnagar), the urban heat island effect (UHI) prolongs and intensifies heat waves, amplifying morbidity and mortality. Kathmandu Valley experienced its highest temperature in 25 years in May 2024 at 35.3°C. This year, the maximum temperature exceeded 30°C on many days — heat that till a few decades ago would have been considered unusual.

Extreme Heat Wave Events in Nepal

May–June 2009
- Temperatures in Terai districts such as Nepalgunj, Dhangadhi, and Biratnagar exceeded 44°C.
- Reported fatalities due to heat stroke, schools were closed in several districts.

May 2012
- Temperatures rose above 45°C in Nepalgunj.
- Hospitals reported a surge in heat-related illnesses, Government issued heat alerts for the first time in some areas.

May–June 2016
- One of the longest recorded heat waves in the Terai.
- Temperatures crossed 46°C in Nepalgunj, Many vulnerable people, especially the elderly, were hospitalized due to heat exhaustion.

May 2019
- Record-breaking heat in parts of western Nepal.
- Temperatures around 45°C in Bardiya and Banke, Public health emergency declared in some districts.

June 2023
- Terai districts including Dhangadhi, Bhairahawa, and Janakpur reported temperatures above 44°C.
- Severe heat stress in outdoor workers, students, and farmers. Government advised people to stay indoors during peak heat hours.

April–May 2024
- Unusually early and intense heat waves in western and central Terai.
- Nepalgunj again recorded temperature above 45°C.
- Shutdown of schools for several days.

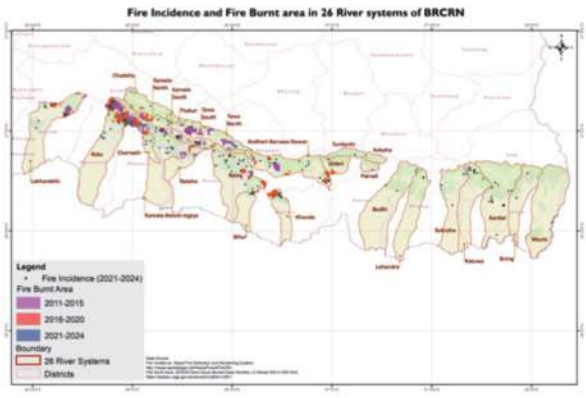
May–June 2025
- Hottest temperature (44°C) in Nepalgunj for several days.

(Sources: Various news and reports)

Pic 1: Drought in Ratu River system

Heat waves cause illnesses such as heat cramps, heat stroke or heat exhaustion. Outdoor workers are particularly exposed. Higher temperature increases allergens and harmful air pollutants which cause asthma, expanding ground for communicable diseases. From 2000–2019, approximately 489,000 heat-related deaths occurred each year around the world (WHO, 2024).

Extreme heat and drought also increase the risk of wildfires. The fire incidences map of the 26 river systems of BRCRN show that Madhesh Province has a high record of forest fires (see Map 1). In the beginning of 2025, wildfires destroyed about 82 hectares of forest in Sindhupalchok's upper Jugal and Bhotekoshi rural municipalities.



Map 1: Fire incidents on the 26 River Systems of BRCRN.

Extreme Precipitation

Extreme precipitation events are defined as instances in which the amount of rain or snow experienced in a location substantially exceeds what is normal, which some scholars consider as 40 mm/h (Adhikari et al., 2025). Extreme rainfall typically succeeds maximized moisture transport into a region, high temperatures (or large temperature gradients) and significant atmospheric instability. With climate change temperatures rise, which is critical for precipitation because the warmer the air, the more moisture it can carry. Extreme precipitation is uncertain, as local conditions over a broader region can dictate the dynamic process of triggering an event. Still, physical conditions like topography can expose areas to higher risk of extreme precipitation.

Source: Media

Pic 2: Flood in Koshi

Extreme precipitation and projections in Nepal

The average annual rainfall in Nepal is 1,600 mm, but it varies by eco-climatic zones, such as 3,345 mm in Pokhara and below 300 mm in Mustang. Eighty percent of all the rain in Nepal is received during the monsoon (June-September/early October). Most regions in Nepal typically receive around 1,500mm of annual rainfall, except for the High-Himalayan region which records notably lower precipitation levels at 680mm. The Department of Hydrology and Meteorology (DHM) estimates that average annual precipitation is projected to **vary between 7% to 37%** across the country compared to the baseline period (1981-2010). Intense rainfall triggers flashfloods, floods, glacial lake outburst floods and landslide outburst floods. Extreme precipitation events were widespread across Nepal in early October 2025, notably recording of 300 mm of rainfall in one day in Illam and 330m in Rautahat. This extreme rain caused landslides and floods, costing at least 60 lives and widespread damage to critical infrastructure.

Extreme Rainfall Events in Nepal

Year/Month	Location	Life loss
2015 July	Western Nepal	30
2017 August	Eastern and Central Terai	160
2019 July	Central and Eastern Nepal	78
2021 June	Melamchi, Sindhupalchok	20
2021 October	Illam, Dhankuta, Baitadi,Sudurpashchim, Karnali, Lumbini	100
2021 November	Mustang Avalanche	
2022 August	Eastern (Saptakoshi) and Central Nepal	30
2022 September and October	Karnali, Sudurpaschim, Lumbini	36
2023 July	Koshi Basin/ Monsoon Havoc	78
2024 August	Thame	
2024 September	Nationwide	236
2025 May	Nationwide rainfall, GLOF in Tilgau, Namkha, Humla	4
2025 July	Rasuwa, Upper Mustang	19
2025 October	Eastern Nepal (Ilam, Jhapa, Morang, Sunsari)	71
2025 November	Snowstorm disaster	9

(Source: Compiled from various reports and media)

What are the Climate Scenarios for the 26 BRCRN River Systems?

The Ministry of Forests and Environment (MOFE, 2019) conducted a study on climate change scenarios for Nepal considering Global Circulation Models (GCMs). The study considered two Representative Concentration Pathway (RCP) scenarios, RCP 4.5 (assuming global GHG emissions stabilize and decline around mid-century) and RCP8.5 (assuming GHG emissions continue to rise). The key scenarios of temperature and precipitation from 26 Critical Ecosystem Restoration Plans are as follows:

Table 2: Climate Scenarios for 26 river systems of BRCRN sites

S.N	River Systems	Temperature in Climate change scenario					Precipitation in Climate change scenario				
		°C	Change (°C)				mm	Change (%)			
			RCP 4.5		RCP 8.5			RCP 4.5		RCP 8.5	
		Reference Period (1981-2010)	Medium Term (2016-2045)	Long Term (2036-2065)	Medium Term (2016-2045)	Long Term (2036-2065)	Reference (1981- 2010)	Medium term (2016-2045)	Long term (2036-2065)	Medium term (2016-2045)	Long term (2036-2065)
1	Balan	22.7	0.84	1.206667	1.05	1.77	1580.3	3.7	5.0	4.1	8.4
2	Bataha	24.2	0.86	1.23	1.07	1.8	1521	4.46	5.86	4.87	9.45
3	Bihul	24	0.85	1.22	1.06	1.79	1567	3.26	4.57	3.76	7.87
4	Chadaha	19.7	0.83	1.17	1.04	1.75	1768	4.63	7.53	6.06	11.87
5	Charnath	24.4	0.87	1.24	1.08	1.83	1529	5.16	7.26	5.89	10.9
6	Kamala North	19.7	0.83	1.17	1.04	1.75	1768	4.63	7.53	6.06	11.87
7	Kamala South	19.7	0.83	1.17	1.04	1.75	1768	4.63	7.53	6.06	11.87
8	Kamala Belsot Jogiya	22.05	0.8425	1.2025	1.0525	1.775	1180.7	3.5	4.7	3.8	7.5
9	Khando	24	0.85	1.22	1.06	1.79	1567	3.26	4.57	3.76	7.87
10	Lakhandehi	24.4	0.85	1.17	1.04	1.77	1529	4.17	9.83	6.87	12.27
11	Ratu	24.4	0.87	1.23	1.08	1.83	1539.5	5.335	8.105	6.495	11.76
12	Tawa North	24.4	0.86	1.2	1.06	1.8	1653	3.37	4.58	3.55	7.93
13	Thakur	19.7	0.83	1.17	1.04	1.75	1768	4.63	7.53	6.06	11.87
14	Tawa South	19.9	0.81	1.17	1.02	1.72	1653	3.37	4.58	3.55	7.93
15	Sunkoshi	19.9	0.81	1.17	1.02	1.72	1653	3.37	4.58	3.55	7.93
16	Adheri-Baruwa-Dwar	19.9	0.81	1.17	1.02	1.72	1653	3.37	4.58	3.55	7.93
17	Bakraha	23.2	0.84	1.2	1.04	1.76	2015	2.88	3.53	2.12	6.49
18	Biring	24.2	0.83	1.03	24.2	1.18	2454	3.35	3.74	2.0	6.95
19	Gideri	19.9	0.81	1.17	1.02	1.72	1653	3.37	4.58	3.55	7.93
20	Kankai	24.2	0.83	1.03	1.02	1.18	2450	3.18	3.72	1.82	6.54
21	Kokaha	23.4	0.83	1.197	1.04	1.75	1773	2.49	3.58	2.68	6.59
22	Lohandra	23.2	0.84	1.2	1.04	1.76	2015	2.88	3.53	2.12	6.49
23	Mechi	24.2	0.83	1.03	1.02	1.18	2450	3.18	3.72	1.82	6.54
24	Patnali	23.4	0.83	1.197	1.04	1.75	1773	2.49	3.58	2.68	6.59
25	Ratuwa	23.7	0.835	1.115	1.04	1.47	2450	3.18	3.72	4.50	6.54
26	Budhi	23.3	0.8	1.20	1.04	1.8	1894	2.685	3.555	2.40	6.54

Source: CERPs of 26 river systems

The 26 river systems of the BRCRN project area will consistently get **warmer and wetter**. The average temperature increases range from **+0.8°C to +1.8°C**, while precipitation increases by **2–12%**, indicating intensification of the regional hydrological cycle**.** The monsoon, post-monsoon, and winter seasons may receive higher precipitation, but pre-monsoon precipitation might decline for both future periods and RCPs.

Table 3: Vulnerable river systems

Category	Most Vulnerable River Systems	Key Risks
Extreme Heat	Ratu, Lakhandehi, Charnath, Bataha, Kamala South, Kamala North, Bihul, Khando, Kamala Belsot Jogiya	Heatwaves, Droughts, evapotranspiration stress, crop yield loss
Extreme Rainfall	Lakhandehi, Kamala North, Kamala South, Kamala Belsot Jogiya, Thakur, Chadaha	Flash floods, river floods, sedimentation
Overall Vulnerability	Kamala North, Kamala South, Kamala Belsot Jogiya, Lakhandehi, Ratu	Combined flood–drought hazard, high exposure and sensitivity

The vulnerability across the 26 river systems shows the **Kamala (North and South), Kamala Belsot Jogiya, Lakhandehi** and **Ratu river systems** stand out as the **most climate-sensitive zones** (see Table 3). This demands immediate climate-smart and nature-based adaptation measures. Madhesh Province is highly vulnerable to drought, forest fires, and floods compared to Koshi and Sindhuli.

What is BRCRN doing to Build Resilience against Extreme Events?

- **Minimize rising temperature and drought risks** through various interventions like water recharge ponds.
- **Agroforestry and shaded farming** to reduce heat stress on crops.
- **Encourage micro-irrigation systems (drip/ sprinkler)** to optimize water use during dry spells.
- **Promoting climate-resilient agriculture:** Farmer Field Schools, promotion of drought tolerant and heat resilient crop varieties (e.g., rice, legumes)
- **Strengthen Flood and Water Management**
- **Upgrade embankments and drainage systems** in Lakhandehi, Kamala, and Ratu basins to handle increased rainfall intensity.
- **Promote flood-tolerant paddy and short-duration crops** to reduce yield loss.
- **Construct community water retention ponds and recharge pits** to capture excess monsoon runoff.
- **Restoring critical ecosystems**: Forest management, agroforestry, afforestation, and watershed management.
- **Strengthening disaster risk reduction:** Riverbank stabilization, gully treatment, and early warning systems.
- **Building local capacity**: Training communities and local governments in climate-resilient land use planning.

Pic 3: Water recharge pond in Pragatisheel CFUG, Urlabari

Pic 4: Check dam at Rong, Illam

Pic 5: Recharge Pits in Churе to trap runoff, to retain moisture, to increase recharge and prevent drought.

How to Take Action with BRCRN?

- **Stay alert:**
  - **Extreme Heat:** Protect your and your family's health by staying hydrated, avoiding outdoor work during peak heat, and enhance greenery for shade or cool spaces.
  - **Extreme Cold:** During cold waves, protect family, vulnerable community members, pets and livestock using additional layers of clothes or safe heating methods as well as plastic tunnels for crops.

- **Extreme Rainfall:** Avoid crossing flooded paths, keep emergency essentials ready, and move family and livestock to higher ground early. Clear drainage around homes and follow community early warnings to stay safe from flash floods.

- **Stay informed:** Use early warning systems and weather forecasts from different media.
- **Participate:** Join ward disaster management committees and community-based disaster risk reduction activities.
- **Advocate:** Support policies and programs that build resilience and protect vulnerable communities and ecosystems.

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