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Organized Assessment of Landslide Vulnerability in the Swala Area along Kumaon Champawat Highway

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ABSTRACT

This study is based on the landslide-prone Champawat district of Kumaon division in Uttarakhand, India. This disaster refers to an unstable mountain prone to landslides. The site of the landslide is located on Champawat NH-09 in the Swala region, which passes through several villages. This place is known as the Tanakpur-Champawat-Pithoragarh highway. The study provides the persistent landslide vulnerability perspective of the Swala area. This study considers legal aspects and various case analysis articles. A detailed explanation of the environmental conditions and human challenges of Swala has been provided to understand the ground-level problems of the landslide. The analysis addresses environmental impacts, economic destruction, loss of biodiversity, and road and infrastructure damage. This research has examined many landslides year after year through newspaper reports and data so that landslide risks can be mitigated through early warning systems and better infrastructure.

Keyword: *Landslide, Champawat, Swala NH 09, Vulnerability, Environment risk, Slope instability.*

I. INTRODUCTION

A landslide is an event that appears to occur suddenly. Its incidence rate is particularly high in the Himalayan region and other geographically sensitive areas. Landslides cause destruction to both natural and man-made assets. In simple terms, a landslide means "the breaking of pieces of rocks, pebbles, stones, and soil from the mountain and moving downwards." Uttarakhand is particularly vulnerable to landslides as it is a hilly region. As a result, people remain fearful of the risk to their lives and property during landslides. From a legal perspective, Article 21 of the Constitution of India ensures the safety of people in disaster-prone areas during disasters. Additionally, Article 48A addresses the conservation of the environment.[1] In India, the Disaster

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[1] India Const.

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Management Act, 2005 exists to address landslides and other such disasters. This legislation outlines measures for preparedness, prevention, response, and mitigation, thereby enabling protection against natural hazards.[2]. Many studies indicate that certain areas are highly prone to landslides as natural disasters. Pream Kairan, Jyoti Joshi, et al. (2023) examined landslides as one of the most common causes of natural disasters, often due to mountainous terrain, mass movement, slope instability, and human activity.[3] Ashutosh Pathak (2019) analyzed how continuous heavy rainfall and rapid melting of snow caused the Mandakini River and its tributaries to flood, causing landslides in the surrounding valley.[4] Yaggesh Sharma, Arjun Tyagi, et al. (2023) explored that the Himalayan region has been described as a highly sensitive area. It has been considered necessary to establish a centre in Champawat to assess the surrounding areas due to landslides. Considering the increasing landslides in Champawat over the years, it has been declared a sensitive area in 2023, and research is being done on the various areas and mountains.[5] K.K. Agarwal, Chandra Prakash, et al. (2012) conducted that landslides are prevalent on various stretches of the Champawat-Tanakpur road. The landslides include 16 debris flows and 15 rockslides, totaling 31. Both major and minor landslides have been reported. The location of these landslides is near the Ladhiya River Valley and the Sukhidhang area. The large-scale landslide is related to the main boundary fault.[6] In the context of risk areas, Swala is a locality situated in the Champawat district of Uttarakhand.[7] This section of National Highway NH-09 is frequently damaged due to recurring landslides. The condition of the mountain has become dire as a result of these landslides.

II. METHODOLOGY

This study is based on a qualitative and quantitative approach. Primary data from interviews and field observations, and secondary data from statutes, research articles, official websites, and news websites have been used so that a solution to the study's problem can be reached and

[2] Government of India, National Disaster Management Authority (NDMA) available at: https://ndma.gov.in (last visited on April 29, 2026).

[3] Prema Kaira, Jyoti Joshi, et al. "Disasters and sustainable development: A case study from kumaun Himalaya 5(1) INTERNATIONAL JOURNAL OF GEOGRAPHY, GEOLOGY AND ENVIRONMENT 183-192 (2023)

[4] Ashutosh Pathak, "Climate Change Impact on Hazards in Garhwal Himalaya of Uttarakhand: A Case Study of Kedarnath Catastrophe" 6 (1) INTERNATIONAL JOURNAL OF RESEARCH AND ANALYTICAL REVIEWS 1066-1076 (2019).

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[6] K.K. Agarwal, Chandra Prakash, et al., "Morphometric analysis of the Ladhiya and Lohawati rivers basins, Kumaun Lesser Himalaya, India", 56(2) Zeitschrift für Geomorphologie 201–224 (2012).

[7] Government of Uttarakhand, District Administration Champawat, "About District", Champawat District Administration, available at: https://champawat.nic.in (last visited on April 29, 2026).

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authenticity can be demonstrated.

III. REPORTED LANDSLIDE EVENT IN SWALA AREA

i. **Disruption of Essential Commodities:** Frequent landslides on the National Highway in Swala have completely blocked the entire route, preventing travel to cities and other districts. The alternative route from Haldwani to Lohaghat is used to reach other districts. Consequently, the public faces difficulties in accessing essential commodities such as fruits, vegetables, and fuel.[8].

ii. **Human Inconvenience:** On August 23, 2021, due to three days of heavy rain in the Tanakpur-Pithoragarh NH-09 Swala area, Champawat, a portion of the mountain suddenly slid down, blocking NH-09. Tourists, passengers, and drivers were frightened and panicked. Other serious problems also arose.[9].

iii. **Human Life and Emergency Services:** Due to the blocked road, the ambulance was unable to reach the hospital on time, resulting in a 10-year-old girl dying on arrival. Due to the landslide, proper treatment was denied.[10]. **Fig. 2**

iv. Impact of Complete Road Closure: In September 2024, a dangerous situation arose several times due to debris and stones at about 10 places on the NH-09 route. Due to this landslide situation, movement was completely blocked. As a result, the cost of the 100 km long route increased and there were huge difficulties in getting essential commodities, dairy products, and construction materials. Another effect of the road closure was a daily loss of Rs 8 lakh to the Uttarakhand State Transport Corporation. NH-09 in Swala, Champawat is the route connecting Tanakpur and Pithoragarh. This district is near the China and Nepal borders, which highlights its national and international significance.[11].

IV. DAMAGE ASSESSMENT IN SWALA REGION

- **Environmental Impacts**

Due to soil erosion, the impacts taking place in Champawat can be estimated from the dangerous hill near Champawat Swala, where drinking water sources are being affected since the road

[8] Prem punetha, " Pithoragarh- Tanakpur National Highway Blocked Again Due To Landslide" THE TIMES OF INDIA, March 20, 2020, available at: https://timesofindia.indiatimes.com(last visited on April 30, 2026)
[9] Sumana Nandy, "Vedio: Cars Turn Around, Local Run To Escape Landslide In Uttrakhand" NDTV, Aug 24, 2021, available at: https://www.ndtv.com (last visited on May 1, 2026).
[10]Pream Punetha, "10-Yr-Dies Of Waps Bite As Blocked Road Delays Treatment" THE TIMES OF INDIA, Aug. 8, 2022, available at: https://timesofindia.indiatimes.com (last visited on May 1, 2026).
[11] Pream Punetha, "Pithoragarh admin shuts NH 09 for 3 days due to landslides" THE TIMES OF INDIA, Sept. 23, 2024, available at: https://timesofindia.indiatimes.com (last visited on May 2, 2026).

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widening work started. The district administration has been talking of widespread participation in tree plantation. Champawat, a scenic area known for its beauty, has emerged as a place where environmental impacts can be seen. A lot of changes have been seen due to climate change. Another important thing is that farming in Champawat has decreased significantly in the last few years.

- **Economic Distribution**

When a National Highway is closed due to a landslide, people's problems increase. People have to face many difficulties. There is panic in the villages around the place of the landslide, and travelers have to go to the city. To travel, one has to take another route, due to which passengers have to pay double.

- **Impact On Daily Life Along NH 09 Swala**

When a National Highway is closed due to a landslide, people's problems increase. People have to face many situations. There is an increase in the number of people in need of vegetables and fruits. There is panic in the villages around the place of the landslide, and travelers have to go to the city. To travel, one has to go through another route due to which passengers have to pay double the fare. The cause of destruction is increasing every year. People face vehicle-related problems due to non-availability of diesel and petrol. The biggest problem patients are facing is physical. Many times, people lose their lives because the ambulance does not reach on time.

- **Loss of Biodiversity**

Due to landslides, there is a lot of change in climate. It rains heavily in some places and doesn't rain at all in others. Blowing of icy winds and falling of snow during winter can lead to crop failure or reduction in yield. Due to the frequent occurrence of landslides, the habitats of animals are being destroyed because soil, pebbles, and stones fall on trees and plants. The repeated use of bulldozers and other machines also impacts the life of wild animals. Animals have started leaving their habitats and appearing towards towns and villages, due to which it becomes difficult for people to move out during the day and night.

- **Road and Infrastructure Damage**

Roads and infrastructure are getting badly damaged due to landslides. Roads are being constructed again and again, due to which the mountains are facing more problems. Due to the sensitive area, even the people living there are finding it difficult to live. People and animals are facing more problems. People face vehicle-related problems due to non-availability of diesel and petrol. The biggest problem patients are facing on this route is physical.

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V. Analysis and Discussion

The Champawat district of Uttarakhand is considered prone to frequent landslides. These landslides occur annually during the monsoon season and frequently assume a critical magnitude. The construction of NH-9 in the Swala area was completed on July 7, 2019[12]. However, despite the subsequent widening of the road, the frequency of landslides along this route has continued to rise. The threat of landslides at this location has not been averted from 2020 to 2026. The primary impacts of landslides include loss of life of motorists and passengers trapped on the route. Other factors include the lack of access to essential commodities like fruits, vegetables, dairy products, and fuel, significant disruption to public transport due to the blockade, and increased expenses for travelling 100 km. The landslide threat has not been completely eliminated in 2026 (Fig.3, Fig.4). Flowing debris and falling stones on the NH-9 Swala route have not yet completely disappeared. Mitigation work is underway at this location, with efforts being made to assess the landslide. The local community faces the threat of landslides every day.

VI. Conclusion

The Champawat National Highway road in Swala, district of Uttarakhand, where landslides have been happening continuously for many years, is included in the sensitive area. Generally, landslides are natural disasters, but indirectly humans are also responsible for these incidents. It is affecting our ecosystem. Soil fertility is being lost due to soil erosion caused by landslides. Human responsibility for these events affects the situation. Soil fertility is being lost due to soil erosion caused by landslides, which is resulting in climate change. Taking the help of technology for landslide prevention and sustainable development, active participation of people should be ensured at the local level so that a solution to the problem can be reached.

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[12] Government of Uttarakhand, District Administration Champawat, "Operation Completed at Swala and NH-09 is Opened", Champawat District Administration, July 7, 2019, available at: https://champawat.nic.in (last visited on May 3, 2026).

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