IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Study Of Landslide Hazard In Bageshwar District

[1] Abha Negi, [2] Dr. Bhagwati Negi

[1]Research Scholar, [2]Assistant Professor

[1,2] Department of Geography,

[1] Kumaon Kesari Pt. Badridutt Pandey, Government P.G. College, Bageshwar-263642 (Soban Singh Jeena University Almora -263601), Uttarakhand, India

Abstract: Along with changing the landscape of an area, the disaster also causes loss of life and property in Bageshwar district. Increasing loss of life and property in that area. Increasing population for some years and increasing construction work to meet their needs, the construction of roads leading to development has also increased the number of landslides in hilly areas. The geology of the particular area greatly affects the landslide, depending on it, what kind of changes are to be made in which area. If attention is paid to the geology and physiography of the Bageshwar district, then this area comes in the lesser Himalayas and central Himalayas. The geological setup is very complex due to the repeated tectonic disturbances caused by different orogenic cycles(Valdiya 1980). This area is made up of weak rocks, due to which the possibility of landslides increases greatly during the rainy season. Depending on the type of slope and the intended use of the structure, different scientific methods exist for evaluating the stability of slopes. In this research paper, we identify the areas in the Bageshwar district where landslides are occurring and where they are likely to occur and know the causes of landslides, and present suggestions to reduce the possibility of landslides.

Index Terms - Disaster, Landslide, Geology. Anthropogenic, Slope

I. INTRODUCTION

A disaster is a significant disruption of a community or society's ability to function that involves broad losses and impacts in terms of people, property, the economy, and the environment. Anthropogenic activities reduce or increase the hazard caused by natural processes. Such as the cutting of hills during road construction, deforestation, quarrying, construction of the dam on valley sides, etc. According to the united nation disaster relief coordinator (UNDRO), 90 Percent of natural hazards and disaster comes in developing countries and third-world countries (uia.org). This observation is based on the fact that most of the developing countries fall in the tropical and subtropical regions of the world and the atmospheric process in these regions in such a way that the possibility of hazard and disaster becomes. The rapid rate of urbanization, industrial expansion, agricultural development, population growth, and social development are continuously accelerating the frequency and magnitude of natural hazards and disasters in developing countries. The possibility of this disaster increases due to the lack of least disaster preparedness, response due, and poor disaster management planning. According to the UNDP report(2001), about 61 percent of injuries and deaths due to disasters occur in such countries where per capita income is less than 760 US dollars because there are no facilities either at individual levels or at government levels to tackle the problems.

In India, about 0.42 million sq. km. or 12.6 percent of land area, excluding snow-covered areas, is prone to landslide hazards. Out of this 0.18 million sq. km. falls in northeast Himalaya, including Darjeeling and Sikkim Himalaya: 0.14 million sq. km. falls in northwest Himalaya (Uttarakhand, Himachal Pradesh, and Jammu and Kashmir), 0.09 million sq. km. in western ghats and Konkan hills (Tamil Nadu, Kerala, Karnataka, Goa, and Maharashtra) and 0.01 million sq. km. in eastern ghats of Aruku area in Andhra Pradesh. (Geological survey of India)(gsi.gov.in)

The Himalayas are a newly formed chain where tectonic activity happens from time to time. Which is helpful in the coming of a major disaster. The state of Uttarakhand frequently experiences natural disasters

like Earthquake, landslides, forest fires, floods, and cloud bursts. The third worst natural hazard in terms of potential damage and casualties is a landslide. (Zillman 1999, Feizizadeh and Blaschke 2011, Zeeshan and mirza 2021)

Major thrusts like Main Central Thrust (MCT) and Main Boundary Thrust (MBT) pass through the state of Uttarakhand. This major thrust welcomes major disasters in the past years. Bageshwar district is one of the areas through which the main central thrust (MCT) passes. Due to its location in Seismic Zone 5, the Bageshwar district is susceptible to natural disasters like famine, cyclones, landslides, and earthquakes. North of Bageshwar town, which is primarily connected by active and complicated tectonic contact, high rates of weathering, and copious rainfall, significant slope stability difficulties exist. The environment is being harmed by climate change and human activity, which is manifesting as some sort of disaster. So protection of life and properties from landslide disasters is indispensable in creating a safe environment for society. In this study, we will focus on the main factors causing landslides, such as rainfall, slope and geology.

Objective

1. Identifying the areas in Bageshwar district, where landslides are occurring and where they are likely to occur.
2. Knowing the basic causes of landslides and presenting suggestions to reduce the possibility of landslides.

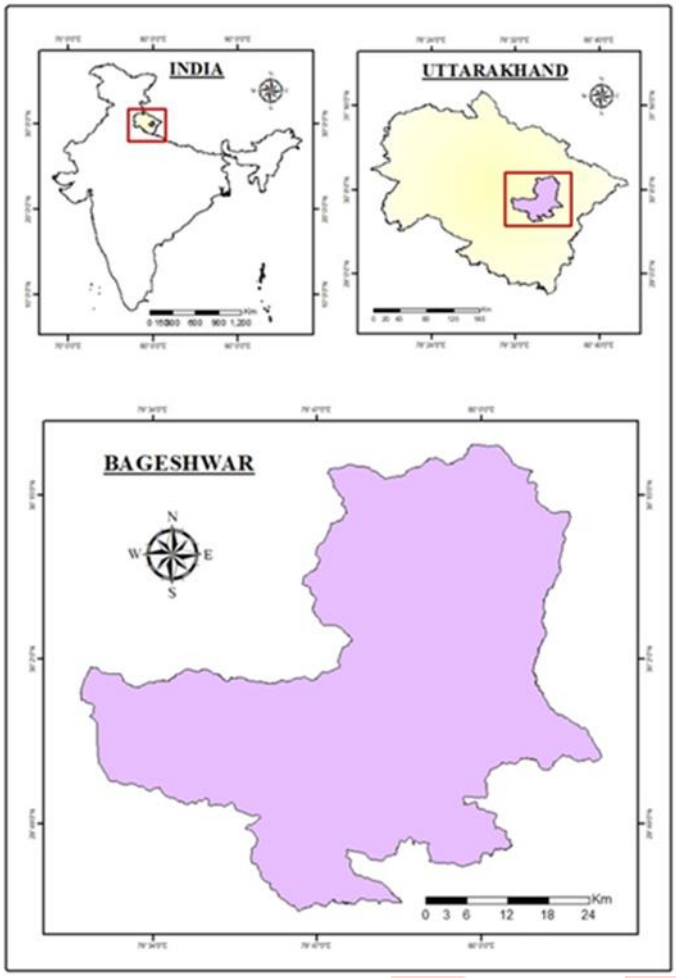
Methodology

The present paper is based on the secondary sources data mainly collected from Research papers, socio-economic abstracts, and different government websites, map of the study area were prepared with the help of ArcGIS software.

Study region

Geographically district Bageshwar extends between 290 42' 40" N. to 300 18' 56" N. latitude and 790 28' E. to 800 09' 42" E. longitudes. The total area of the study region is 2246 Km2. The study area is situated in the Kumaon region of Uttarakhand state. District Bageshwar is spread in the area of altitude ranging from 800 m. to 6000 m. above sea level, but most of the population is settled in river valleys and northern highlands are less populated. The district has 6 Tehsils namely Bageshwar, Kapkot, Grur, Kanda, Kafligair, Dug nakuri, and 3 blocks Kapkot, Bageshwar, and Grur. Geographically this district is very sensitive due to its location between two very dynamic thrusts, the main central thrust, and the north Almora fault. Apart from this thrust, there are many other thrusts in the district, including Bejnath fault, Berinag fault, and Munshyari faults are main, all these faults are very dynamic. Due to the movement of the fault, the landform of this area is constantly changing.

Study area – Bageshwar District



Fatal and vulnerable areas:

Kapkot Block – Kuwari, Dobad, Badet, Bamsera, Nokudi, Siri, Karmi, Baghar, Bacham, Gairkhet, Kilpara, Toli, Lamaghar, Gunthi, Kalapair, Kapdi, Pothing, Liti, Syundladi, Malladesh, Fulai, Badaikot tok Gurkuti.

Kanda Block- Seri
Garud Block – Tallapyya, Jakh

Bageshwar Block – riverside villages – Kathaytwara, Bhatrola, Mandalsera, Katyurmad, Maijiyakhet, Vathiguth, Sej, Chaurasi, Bhaitalgaw, Menarbunga

Dugnakuri Tehsil - Jarti

Landslide affected village and vulnerable households numbers

Sr.no.	Tehsil	Village	Number of affected families	Number of excessive sensitive families	Number of more sensitive families	Number of sensitive families
01.	Kapkot	Dobad	17	13	-	02
		Badet	19	11	-	05
		Kuwari	76	76	-	18
		Liti	13	-	-	13
		Baghar	13	-	-	13
		Karmi	12	-	-	12
		Siri	06	-	-	06

		Nakodi	18	-	-	18
		Gairkhet	04	-	-	04
		Bamsera	03	-	-	03
		Bacham	22	-	-	22
		Kilpara	10	-	-	10
		Toil	07	-	-	07
		Lamaghar	08	-	-	08
		Gundi	08	-	-	08
		Kalapair kapdi	13	-	-	13
		Pothing	43	-	-	41
		Shyuldladi	18	-	-	18
		Malladesh	04	04	-	-
		Fulai	05	05	-	-
		Badiyakot	07	07	-	-
		Garkuti	-	-	-	-
02	Kanda	Seri	16	04	-	8
03	Garud	Tallapyyar	03	-	-	03
		Jakh	03	02	-	
04	Dugnakuri	Jarti	10	-	-	10
	Total		357	122	06	225

Source: Disaster management bageshwar work plan year- 2023, page-29

Details of natural calamities from 2013 to May 2023

Sr.no.	Year	Tehsil	Event date/place	Affected person			Other detail
				Deceased	Injured	Missing	
01	Bageshwar	2013	Bageshwar	-	02	-	
		2014	Bageshwar	-	-	-	
		2015	Bageshwar	-	-	-	
		2016	Bageshwar	01	01	-	
		2017	Bageshwar	01	-	-	
		2018	Bageshwar	-	-	-	
		2019	-	-	-	-	
		2020	Gunakot 21.05.2020	02	-	-	Tree falling on house
		2021	-	-	-	-	
		2022	Thunai 30.08.2022	01	-	-	Landslide
		2023	Leti 27.04.2023	-	-	-	09 bulls,04 cows died due to lightning
			Bilona 21.05.2023	01	-	-	Reasons for drowning in river while taking bath
	Total			06	03	-	
02	Kapkot	2013	1. Bamshera	03	-	-	Cloud bursting, spilling into drains and getting buried in debris
			2. Pothing	03	-	-	
			3. Jagthana	01	-	-	
		2014	1.Shama	03	-	-	Cloud bursting,

							spilling into drains and getting buried in debris
			2.Theli	01	-	-	Buried in stone
			3.Nani panyali	01	-	-	By flowing
			4.Aso	01	-	-	Buried in stone
			5.Gogina	01	-	-	lightning
		2015-16	-	-	-	-	-
		2018	Kapkot shivaly vard	01	-	-	Resons for drowning in saryu river
			Bhanar	01	-	-	Excess rain
		2019	Village- lahur tok dhura 01.06.2019	-	-	-	88 sheep died due to lightning
			Ratir keti 29.07.2019	01	-	-	Rock fall
			Kapkot 06.11.2019	01	-	-	Due to falling in the river kanalgad
		2020	Chchai 04.04.2020	02	01	-	Due to forest fire
		2021	Patiyasar 14.02.2021	-	-	-	Buffalo died due to lightning
			Sungadh 11.07.2021	03	-	-	House buried under debris
		2022	Hamptikapdi 07.01.2022	01	-	-	Stone falling from rock
			Goginakimu 13.06.2022	04	-	-	Death by drowning
			Shiri shama 22.08.2022	-	-	-	10 goats died due to lightning
			Shikhar temple 29.06.2022	01	-	-	Lightning
		2023	Toil 23.03.2023	-	-	-	10 goats died due to lightning
	Total			29	01	-	-
03	Garud	2013	Jkheda	01	-	-	-
		2014-15	-	-	-	-	-
		2016	Dangoli	01	-	-	-
		2017	Harbagd	01	-	-	By drowning
		2018	Kotfhulari 26.04.18	01	-	-	01 woman and 01 goat kid died due to house collaps due to heavy rains
		2019	Pinglo 29.05.2019	01	-	-	01 nepali labour died due to forest fire
		2020-21	-	-	-	-	-
		2022	-	-	-	-	-
		2023					
	Total			05	-	-	
0	Kanda	2013	-	-	-	-	-

4							
		2014	Pokhari	-	01	-	-
		2015-16	-	-	-	-	-
		2017	Dholgaw ,nayal	02	01(north dug)	-	-
		2018	-	-	-	-	-
		2019	Mantoli 07.02.2019	-	-	-	01 goat died due to lightning
			Dholgaw 15.08.2019	01	-	-	Due to falling of the roof of the house
		2020	-	-	-	-	-
		2021	Shaknuda	-	-	-	Death due to falling of said stone
		2022	-	-	-	-	-
		2023					
	Total			03	02	-	
05	Dugnakuri	2014-22	-	-	-	-	-
	Kafligair	2014-16	-	-	-	-	-
		2017	Lob	01	-	-	Lightning
		2018-22	-	-	-	-	-
		2023					
	Total			01	-	-	
	Total			**44**	**06**	-	

Source: Disaster management Bageshwar work plan year- 2023, page-19

It is clear from the analysis of landslide data of Bageshwar district that this district is prone to natural calamities. There are many villages which are affected by landslides, in which most of the villages of Kapkot tehsil are affected. Here 357 families are affected, of which 122 households are excessively sensitive. Its number is highest in Kuwari village of Kapkot, where 76 families are affected. Lesser Himalayan phyllites exposures were seen nearby on the Nala bed beneath the Kuwari village and along the trail segment. The rocks had a broad NW-SE trend, with partially steep dips in the direction of the NE. numerous joints were seen slicing through the rock. The significant joint sets were seen to dip in the direction of NE and SE.800 / 0500 and 730 / 1400) (Disaster Mitigation and management center) Kapkot's 22 villages are affected by landslides, and this entire block is highly vulnerable to disaster. 29 people died and 109 animals died due to natural calamities in Kapkot from 2013 to May 2023, out of which 13 people were buried under debris, stone falling, and rock falling, also in Bageshwar block between 2013 and May 2023, 6 deaths occurred due to natural calamities, in which 1 death was due to landslide, 05 deaths occurred in Garuda block, 3 deaths in Kanda block and 1 death in Kafligair during this time period.it is known from the loss of lives caused by the disaster that, in the district planning and measures for rescue are necessary even before the natural disaster in the district.

Basic causes of landslides –

Geology and landslide:

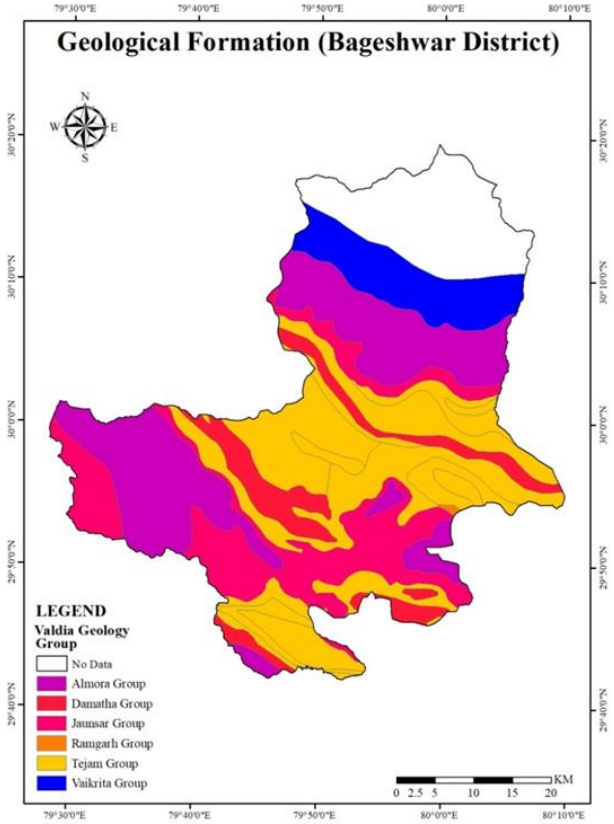
Landslides are influenced by a variety of natural factors, including weather, geology, topography, and vegetation cover. Regarding the start of landslides, rainfall, and geological conditions may be the most important external and internal variables, respectively. Landslides are the most common geological risk in many hilly terrains. In the rainy season, its strength increases even greater.

The Bageshwar district, which is the research area, is located in eastern Uttarakhand's Kumaun Himalayas. The Kumaun Himalaya is divided into five litho-tectonically and physically distinct district domains or subprovinces. The boundaries are active, localized thrusts. The majority of the geological characteristics in the Bageshwar district are the central and lesser Himalayan hills.

The geological environment is very complex because of the recurrent tectonic disruptions caused by different orogenic cycles (Valdiya 1980). The rock units exposed in different areas of the Bageshwar district include quartzite that is currently bedded with associated volcanic, mica-talc schist, limestone, conglomerate, slate, quartzite, granodiorite, augen gneiss, and migmatite and granite gneiss.

According to the Uttarakhand State Forest Department (2008), the geology of the Bageshwar district may be split into three main plates: west, northeast, and southeast, running from south to north.

1. Approximately 40 km broad plates are made of transforming rocks.
2. About 60 km broad micro-folded plate of quartzite and limestone is located in the northern part of the district. Magnetite, soapstone, and base metals are located in the form of deposits in this plate.
3.Customized shell with granite situated in the northern part of the sisakhani-tejam line.

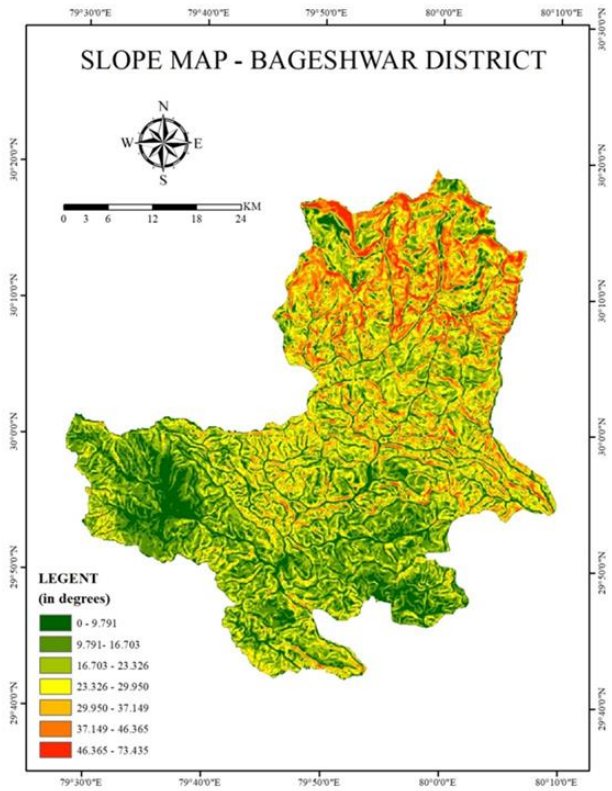


A landslide's likelihood can be influenced by the type of rocks present and how they are arranged on the slope. It is evident from the Himalayan region's geology that this area is susceptible to dangers.

Because of its position between the northern Almora fault and the major central thrust, two highly dynamic faults, the Bageshwar district is especially susceptible. Namely, the rock of the Modali formation and the Nagthat and Gradiorat formations of the Jaunsar group, the Almora group, and the Tejam group. All of the major faults in this area have become dynamic as a result of the dynamics of neotectonic activity in this area. Because of the movement of faults, the topography of this region is continually changing, which is the main cause of landslides, falling debris, and the rolling of large stones from locations with steep slopes.

Slope and landslide

The slope angle must be taken into account while thinking about landslides. According to Jenson, the slope is a method for determining how steep or inclined a feature is about a horizontal plane. Which is frequently stated as a percentage, an angle, or a ratio. High angles from rock units enhance the likelihood of a landslide, whereas low angles increase the thickness of the weathering zone. This slope is thought to make slopes more prone to landslides. The study of the slope, which is the rise and fall of the earth's surface, is crucial for creating a landslide analysis. One of the most significant incidental aspects that impact slope stability is the slope aspect. (Kayastha,2015) the ability of the slope parameter to be produced, analyzed, and mapped from digital elevation model(DEM) data using geographic information system tools is its most special feature. An original factor, the slope is employed in slope instability, laying the foundation for stability investigation, and influences shear and normal tension on the shear surface. As the slope rises, the maximum displacement in the colluvium of the remaining or consolidated soil covering rises, axial tension falls, and stability declines. Similarly, due to the Himalayan region of the study area, the slope is more here and incidents like landslides are seen more.



The northern part of the study area comes in the higher Himalayas and the southern part comes in the lesser Himalayas. It is divided into two parts by the main central thrust(MCT). Most of the Kapkot block comes in the higher Himalayas, it is visible on the map that the slope angle in the Kapkot block is between 46.365 to 73.435 degrees, due to the steep slope in this part, it is also possible to see more occurrences of landslide. The slope of 0 to 9.791 degrees is visible in some parts of the Garud and Bageshwar block, these areas are river valley regions, where there is the possibility of flood due to heavy rains. Because of this, there is a danger of landslides in the rainy season. Natural aspects as well as human activity in areas with moderate slopes are prone to hazards

Rainfall and landslide

The most frequent direct or indirect cause of landslides is rainfall (Derbyshire, E. (ed.), Geomorphology and climate, Wiley, London, 1976, p. 512). The heavy rain region has been identified as the primary cause of slope failure in the majority of historical landslides. The monsoon season's excessive rainfall causes landslides and soil erosion, and In steep areas, reckless jhum, or slash-and-burn agriculture, is common and contributes to soil erosion. Rainfall-induced landslides are natural disasters that cause a significant number of accidents and financial losses each year. As they descend steep slopes, particularly those that enter stream channels where they may mix with additional water and sediment, debris flows (rapidly moving slurries of water, soil, and rock) develop. (USGS.gov.in)

which there is loss of life and property in a very large area in some time. A material's strength may be compromised, leading to the possibility of a landslide. This affects the strength of the "bond" holding the soil or rock grains together. When a rock is situated on a slope, it loses its ability to withstand the effects of gravity, a landslide is more likely to occur when there is water added to the material on a slope. This is because water makes its materials easier to move downhill by adding weight, decreasing the material's strength, and reducing friction. The average annual rainfall in the study area is 1229.0 mm, and about 79 percent of the rainfall in the study area falls between June and September. (imdpune.gov.in) it is the wind that rises from the bay of Bengal and brings rain in Uttarakhand at this time. August is the rainiest month and the average precipitation is 369.4 mm. the winter rainfall in the whole of Uttarakhand is due to western disturbances. Most of the landslides are seen in the study area only during the rainy season, due to landslides, the roads are closed in many places.

Conclusion and Suggestions

In this research work, we studied landslides in the Bageshwar district which is a disaster-prone area. Due to the Himalayan region, there are natural movements here, as well as the weak rocks are affected by these movements and welcome the disaster. Particularly during the rainy season, landslides are highly regular and common. Human lives are lost, and highways, agricultural land, structures, homes, and other infrastructure are destroyed. Landslides are very frequent and common, especially during the wet season. Highways, agricultural land, buildings, residences, and other infrastructure are all devastated, along with human life.

To assess which places are most prone to landslides, geologists and engineers plot slope steepness and form, bedrock and surface geology, past landslide location, soil data, and groundwater level on maps. This information can then be used to inform land-use decisions made by planners, emergency management, and the general public. In the genesis of rainfall-induced landslides, rainfall, soil, and slope all play important roles that must be examined individually. The problem, therefore, needs to be tackled for mitigation and

management for which hazard zone has to be identified and specific slides to be stabilized and managed in addition to monitoring and early warning systems to be placed at selected sites. During a disaster, the government should provide locals with information on shelter sites, evacuation routes, and medical resources. A comprehensive and sustainable development strategy and approach must be created, taking into account the region's susceptibility, in order to lessen the frequency, severity, and negative effects of natural disasters there. To achieve the greatest possible impact in the field, it is also necessary to develop effective disaster management plans and ensure their proper implementation.

We must examine how we promote economic progress. Hydropower projects and building dams themselves are not the cure. But, we must recognize that Uttarakhand and other mountainous areas are distinct from the rest of India. Thus, using the same formula to achieve economic advancement is not the answer. There is a loss of life and property as a result of these upgrades, which are unintentional. Since 2006, the district-level disaster management department has created an annual disaster management action plan.

Reference

[1] Aapda prbndhn kary yojna, 2019-20, Jila aapda prbndhn pradhikrn , janpad- Bageshwar, part- 01
[2] Celleck S., (2020), Effect of the slope angle and its classification on Landslide. Natural Hazards, and Earth System Science.
[3] Climatological summaries of state series, No.21 , Climate of Uttarakhand, pp.38(imdpune.gov.in)
[4] Derbyshire, E., (1976). Geomorphology and climate. Wilely, London, pp.512
[5] Disaster Mitigation and Management Center, Department of Disaster Management, Government of Uttarakhand, November 2012, page 3,28
[6] Disaster management bageshwar work plan year- 2023, page- 19
[7] Duan J. and Grant (2000), Shallow Landslide delineation for steep forest watersheds based on topographic attributes and probability analysis: Principles and Application. John Wiley & Sons, New York(United States), pp. 311-330.
[8] Feizizadeh, B. and Blaschke, T., (2011) Landslide risk assessment based on GIS multi-criteria evaluation: a case study is Bostan-Abad country, Iran," J. Earth Sci. Eng, 1, pp.66-71
[9] Geological Survey of India (gsi.gov.in)
[10] Jenson, S.K. (1994) Application of hydrologic information automatically extracted from digital elevation models, terrain analysis and distributed modeling in hydrology, John Wiley and Sons, New York (United States), pp.59
[11] Kayastha, p.,(,2015) Landslide Susceptibility mapping and factor effect analysis using frequency ratio in catchment scale: A case study from Garuwa sub-basin, East Nepal. Arabian Journal of Geosciences, pp. 8601-8613
[12] Narain,S.(2013), Himalayan Blunders. Down to Earth
[13] Ohlmacher, G.C.(2000), The Relationship between geology and landslide hazards at Atchison Kansas and vicinity. Current Research in Earth Science 244, pp-1-16)
[14] Tiwari V. N., Pandey V. H. R., Kainthola A., Singh P. K., Singh K. H., Singh T. N.(2020) Assessement of Karmi Landslide zone, Bageshwar, Uttarakhand India, Journal od the Geological Society of India, Vol.96, pp.385-393
[15] USGS.gov.in
[16] Valdiya,K.S. (1980) Geology of Kumaun lesser Himalaya. The Himachal Time Press Rajpur road, Dehradun, pp.68-256.
[17] Yin. A., (2006) Cenozoic evolution of the Himalayan orogeny as constrained by along strike variation of structural geometry, exhumation history, and foreland sedimentation, earth science, rev. 76, pp. 1-134
[18] Zeeshan, M., and Mirza, K., (2021) Landslide Detection and susceptibility Mapping using Geological and Remote Sensing Data: A case study of Azad Kashmir, Nw Sub- Himalayas. Acta Geodynamic et Geromaterialia, 18(1), pp. 29-45
[19] Zillaman, J., (1999) The physical impact of the disaster in Ingleton, J.(Ed). Natural disaster management Leicester: Tudor Rose Holdings Ltd.,pp.32.