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Consideration of Events, Measures and Reasons of Disaster in Himalaya

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Abstract – A disaster is characterized as the result of a hazard contrarily affecting a social ecological framework. The magnitude of the disaster is straightforwardly related with the force of the hazard just as with the introduction and the powerlessness of the social-ecological framework. In any case, the disasters could be evaluated from multiple points of view: number of deaths, number of structures fallen, kilometers of roads wrecked, cash misfortune because of the disturbance of financial exercises. Disasters frequently invalidate the endeavors and diligent work of quite a long while in merely hours and even minutes and seconds. Disasters can be seen as a progression of stages on a period continuum. Despite the fact that the advancing circumstance may seem ceaseless, recognizing and understanding these stages portrays related necessities and to conceptualize suitable disaster management exercises. The territory crushed by sad on first July 2016 is situated in Didihat and Thal Tehsils of Pithoragarh district and fall in the catchments of East Ramganga and Charma waterways individually. Heavy rains caused landslide incidences and harms in the territory around Didihat, Bastari and Naulra towns. Upwards of 21 human lives were lost in these incidences. The effect on these areas of landslides brought about by heavy rainfall occasions and quick changes in scene. Landslide incidences are credited to development on free soil/overburden material and drainages. Expanding anthropogenic exercises, wandering in hazardous regions because of constrained land accessibility and heavy confined precipitation. These are constantly expanding the weakness of these to landslides. In perspective on that, the paper will give experiences into suggestive measures that may help in setting up a roadmap towards sustainable development inside the influenced territories.

Keywords: Pithoragarh, Causes, Suggestive, measures, Himalaya, Disaster, Landslide, Slope

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1. INTRODUCTION

Natural disasters over such a tremendous region (38,000 sq km) and including such a significant number of factors – the Himalayan mountains, rivers, forests, glaciers and individuals – will undoubtedly be perplexing. Ordinarily, a natural disaster and its effects are an aftereffect of different things happening together. The current Uttarakhand disaster features the anthropogenic reasons that enormously expanded its effects.

Scenes of landslide and flood disasters are standard highlights in the news media; they flash over the screen and are immediately overlooked. Indeed, even in the influenced area, when the debris is cleaned up and harmed infrastructure fixed, consideration proceeds onward and all that remaining parts is a half-existence of litigation, official reports, and periodic moderation designing. As often as possible, geographers are called upon to aid such consequence examinations and to make suggestions for approach producers (Kapur, 2010). This paper reflects upon one such circumstance and upon the aftereffects of an examination concerning its causes and, explicitly, to clarify why a disaster influenced this area and not some other. This investigation is likewise a wakeup call in light of the fact that, by some coincidence, it happens to demonstrate how deductively led and statistically approved research on a solitary disaster occasion can produce discoveries that become far less secure when seen from a more drawn out term point of view.

All mountain districts over the world have their one of a unique vulnerability to various natural hazards extensive extent of which are credited to the developmental history of the terrain that is reflected in geology, structural set up and physiography of the territory concerned. Of the diverse hazard's landslide is basic to practically all the rocky districts and is credited to their high relative alleviation.

Landslide is only downslope movement of rock mass and debris with fluctuating extent of water. It anyway requires an external trigger to set the ball rolling else it would oppose the Law of Inertia that expresses that except if external force is connected an item in motion would continue moving and that

in the condition of rest would stay stationary never-endingly. In howsoever shaky express the rock mass be it can't hence plunge downslope and consequently for a landslide to start external force or trigger is basically required.

■ **Disaster**

Disasters - natural or human-made are regular all through the world. Disasters keep on happening all of a sudden and are seen to be on an expansion in their magnitude, multifaceted nature, recurrence and economic impact. Hazards present dangers to individuals and accept genuine extents in the immature nations with thick populace. Amid the second 50% of the twentieth century, in excess of 200 most exceedingly terrible natural disasters happened in the distinctive pieces of the world and guaranteed lives of around 1.4 million individuals. Misfortunes because of natural disasters are multiple times more noteworthy (as % of GDP) in the creating nations than in industrialized one. Asia best the rundown of casualties because of natural disasters.

Climatic and rainfall varieties are major compelling variables behind orogenic disfigurement in the Himalaya. Water anyway assumes a significant job in triggering landslides and it is nothing unexpected that real landslides happen amid or after delayed heavy rains just like the instance of Malpa and Okhimath landslides of 1998. Water expands pore water weight and expanded load of the dirt and debris because of retention of water results in expanded magnitude of the forces acting in downslope direction. Water in the meantime lessens frictional forces standing up to downslope movement. Water hence encourages downslope movement by diminishing the forces opposing movement and expanding the forces attempting to destabilize the slope material. Water subsequently triggers landslides. Slope disappointment incidences occurred at numerous spots in the Pithoragarh district on first July 2016 in the midst of heavy rainfall around 160 mm inside 4-5 hours in Didihat locale (Data source; District Emergency activity Center). So as to examine the influenced territories, the present paper gives general deductions, healing ideas and direction for the site dependent on starter surface perceptions as it were.

2. THE STUDY AREA

The territory researched lies in the Lesser Himalaya in Pithoragarh district of Uttarakhand, India. The little township of Didihat (29°48' 8.84" N and 80°15' 9.44" E) is arranged around 55 kilometers from Pithoragarh on the left bank of Charma Gad. The regions crushed by disasters are situated in Thal and Didihat tehsils of Pithoragarh district and fall in the catchments of East Ramganga and Charma rivers separately (Figure 1). Urma town is situated on the declining side of Bastari (29° 52' 20.70" N and 80° 09' 54.12" E) and both these towns are arranged on the left flank of south flowing Charma stream and can be drawn closer by Didihat-Ogla-Singhali motor road. Naulra (29° 52' 20.70" N and 80° 09' 54.12" E) is situated on the correct flank of southerly flowing local stream and can be drawn closer by Thal-Munsiyari motor road (NH 309A).

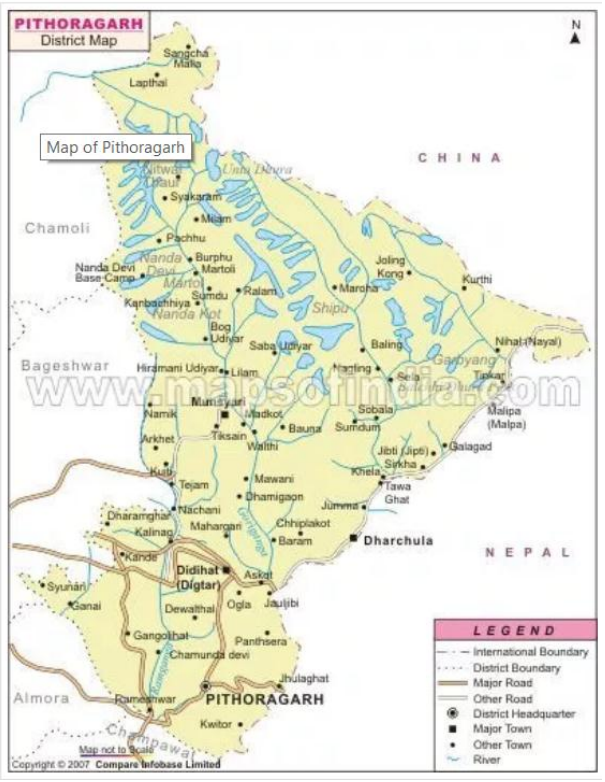

Figure 1: Location map of the study area.

a) Geological setup

Geologically the territory falls in Lesser Himalaya and the rocks of Pithoragarh region have a place two structural units; one having a place with the Almora Crystalline Zone and the other having a place with the sedimentary zone of Garhwal Group. In the zone the rocks of Almora nappe are seen to be pushed over quartzites and limestones of Garhwal Group along North Almora Thrust. Rocks and augen gneisses of Almora Crystallines are seen around Didihat and Bastari zone. Quaternary deposits (RBM) and limestones of Garhwal Group are seen around Naulra landslide zone.

The rocks uncovered around the zone are crossed by various joints that contain significant structural discontinuities influencing the quality of the rock mass and strength of slopes. The phylites uncovered in the slide zone of Bastari are commonly seen to strike NW-SE and plunge towards upper east at angle of around 35°. Conspicuous joints saw in the territory are additionally seen to strike NW-SE parallel to the foliation and plunge at moderate to high angles (55°) towards SSW.

At Kumalgaon landslide region uncovered limestone rocks are seen to strike E-W and dip onwards south at an angle of around 50°. These rocks are seen to be very much jointed

3. MAIN REASONS OF LANDSLIDE

The heavy precipitation expands discharge through streams and counterfeit channels, and furthermore the subsurface drainage, prompting bed erosion, and ground immersion and subsequent disappointments in the influenced regions. Fundamental driver of the slope issues is as per the following.

- Frequent presence of feeble natural materials around the zone.
- Deforestation
- Construction near natural water courses.
- Loading
- As the space among slope and house is less.
- Water management (Groundwater Draw-down and Water spillage)
- Steep slope cuttings in weak materials.
- Land use (for example development of roads, houses and so on.)
- Unlined natural water channels.
- Mining and Quarrying
- Lined artificial drains with inadequate measurement.
- Vibration
- Increased permeation from damaged drains and straightened zones.
- Excavation
- Inadequate surface water management and unregulated drainage.
- Rapid snow melting
- Loading of powerless slopes by heavy developments.
- Forest fires
- Unplanned road development without taking essential slope treatment
- Erosion
- Landmasses undercut because of water from natural and counterfeit sources.
- Heavy rainfall in the region causing saturation of inside erosion of the endured rock and soil materials.

4. LANDSLIDES DURING JUNE, 2016

Around Didihat town quick unplanned urbanization is found to be the causative factor for the slope disappointment. This is reflected nonappearance of proper drainage arrange, over-burdening of debris slope, excavation and left untreated, construction on old landslide debris and road construction. Recently developed road around Bastari in which there would have been utilization of explosives and ground excavation for the construction around Kumalgaon (Naulra) are such changes seen amid the field examination. Subtleties of landslide incidences are described in the areas underneath.

■ Event 1

The geology of the Didihat town zone is in dynamic condition of degradation and the majority of the slope disappointments have been caused because of immersion of the delicate and feeble endured rock/soil materials together with heavy rainfall. Because of this, a sum of 232 families are influenced by the landslide incidences in the region around Didihat, out of 101 families live in GIC Ward alone. This is trailed by 92 in Tehsil Ward, 32 in Ambedkar Ward and 07 in Shiv Mandir Ward (Data Source: Nagar Panchayat, Didihat). Most extreme landslides incidences were seen to be happened in GIC and Tehsil Wards while moderate in Ambedkar and less in Shiv mandir Wards.

The landslide is found just beneath the Didihat-Adichaura motor road that is involved by outcrops just as thick overburden. Because of heavy rainfall a noteworthy landslide occurred in Ambedkar ward and Deendayal Park was severally damaged. This slide has somewhat damaged two houses to its left side and right flanks and these are under extreme risk (Figure 2a). Furthermore, a few houses in Shiv Mandir and Tehsil Wards were likewise influenced via landslide incidences (Figure 2b and 2d). Debris slide is situated close District Institute of Education and Training (DIET), Didihat. Directly, Govt. polytechnic is led in a structure of DIET, arranged simply over the landside (Figure 2c).

At certain spots incorporating Nain Basti in Tehsil Ward, Shiva Colony in Ambedkar Ward and Kandai town on the tough side to Shiva province subsidence, breaks on structures and landslides are credited to construction on late material/free

soil/overburden material and poor drainage network.

Since, the territory around Didihat town has bounty of exceptionally frail materials, lies in a high precipitation area, and as of now has numerous constructions; water management is the way to security in this town. This ought to be exhaustively made arrangements for the whole territory, and should consider the accompanying measures, be that as it may, site explicit conditions must be considered in detail while applying the measures.

- It is prescribed that the drain areas adequate, with respect to gradients, for the monsoon and leakage discharge that they are intended to carry.

- It is prescribed that wear resistant drain lining in higher gradient scopes of drains to withstand abrasion.

Figure 2: Landslide incidences in the region around Didihat damaged Deen Dayal Park at Ambedkar Ward

(a), slope disappointment in back and front of certain houses at Shiv Mandir Ward (b), debris slide in front bit of District Institute of Educational and Training (DIET) at GIC Ward (c) and mass movement in front piece of house at New Basti zone in Tehsil Ward (d).

a. It is suggested that all current or proposed retaining and different dividers, and some other covers on slopes, must have proper game plans to permit free drainage of slope material with the goal that destructive pore pressures don't create in the slope.

b. It is prescribed that as the space among slope and house is less, secured solid shade divider must be considered at the equivalent.

c. It is suggested that the rock fill buttress or gabion divider can be given to secure the totally weathered rock/soil slopes.

d. It is suggested that the low retaining dividers at various dimensions of the slope with free draining backfill, to help the fill around structure.

- **Event 2**

As per onlooker accounts cloudburst like incidence occurred around Bastari village on first July 2016 out of two stages. Debris stream happened after heavy rainfall toward the beginning of the day hours (around 0430 hrs) in which one house was damaged. The occupants of the equivalent were saved by the villagers. From that point the vast majority of the village (around 24) took cover in a well-constructed house in the village that was seen to be protected by the general population. While they were all the while trusting that rain will stop another debris stream occurred around 0600 hrs. This inundated the very house in which individuals had taken asylum. Every one of the people were consequently buried in the debris that streamed down along a first order drainage going through Urma village, which is arranged underneath Bastri village. 19 people were killed in this incidence. Of these assortments of 08 couldn't be recuperated. Complete 16 structures were destroyed or damaged and 174 cows were lost.

The slope in the territory is commonly watched dip towards southwest at soak angles (55-60°). This has encouraged quick downslope movement of debris. Various farming fields alongside houses were in this manner damaged because of debris streams in the Bastari territory (Figure 3). The thickness of the debris gathered in the region is seen to be around 3.5 to 4.0 meters. This material is seen to involve hill wash and debris comprising of darker, fine grained silty-sandy matrix with uncommon rocks and pieces of granitic gneisses.

- **Event 3**

Heavy rainfall additionally quickened gulley erosion on river born material (RBM) and debris stream occurred at Kumalgaon (close Naulra village) too. 3 people were killed in this incidence while places of 5 families were burried under the debris. Around 70 creatures were lost in the incidence. 2.5-3.0 m thick heap of debris was seen at the site. Presence of river born material (RBM) is seen behind the home. Slope at this area is seen to dip towards east at an angle of around 40°. Signs of heavy rainfall incited gulley erosion and debris stream are seen amid field examination.

RBM is constantly powerless for the slope disappointment because of the roundness of its constituents and poor union. The debris slide is seen to have happened on the eastern slope of N-S drifting edge. The width of the disappointment slope is around 50 meters along the developed

fields and tallness of the crown from developed fields is around 30 meters.

The landslide debris that plunged down from the area upslope of the village is seen to have invaded both rural fields and houses (Figure 4a and 4b). The thickness of the debris aggregated in the area is seen to be around 3.0 meters. This overburden material is seen to contain river borne material comprising of dark brown to ruddy, fine grained silty-sandy matrix with adjusted boulders and rocks.

The landslide is derived to be very helpless to disappointment, especially in case of heavy or delayed rainfall. Geologically, the area is found to be in a basic condition of harmony and the accompanying suggestive measures are proposed:

- The occupants are consequently encouraged to be careful distance from the vulnerable slope and clear the area, particularly amid heavy or delayed rainfall
- During field examination it was seen that the devastation for the most part happened along areas where Quaternary deposits were available.

Figure 3: Debris flow on slope made up of RBM at Kumalgaon near Naulra village (a) and devastation around Kumalgaon village (b).

5. SUGGESTED PRECAUTIONS

In view of starter field examination, it is seen that important precautionary measures are required to be taken, particularly in perspective on the way that the slide is in nearness of thickly populated area of Urma village and remaining piece of Bastari village. Other than major

Figure 4: View of Bastari debris flow

Figure 5: Landslide scars developed after heavy rainfall around Bastari village.

landslide a few landslide scars are additionally seen on the uphill side to Bastari village. Enactment of these has the capability of presenting threat to the village. Geologically, the area is found to be in a basic condition of equilibrium and the accompanying suggestive measures are proposed:

- The hill slope around Bastari village is concluded to be profoundly vulnerable to disappointment, especially in case of heavy or delayed rainfall. The inhabitants are in this manner encouraged to be careful distance from the vulnerable slope and abandon the area, particularly amid heavy or delayed rainfall.
- It is very imperative to guarantee every single future construction just on firm ground. In the meantime, excavation on soak slope ought not be permitted. The exhumed slope whenever left untreated is certain to present risk amid heavy rainfall.

Construction on RBM and old landslide debris ought to subsequently be maintained a strategic distance from

Figure 6: View of relief / medical camps at Singhali on the uphill side to Bastari village.

The remedial advices given in this paper are given, alongside the primer geographical data of the site. So as to be viable, the treatment measures must be planned in detail by enough qualified and experienced geotechnical/structural designer, with due regard to the ground conditions and subtleties of the particular destinations.

6. DISCUSSION OF THE STUDY

The villages influenced by disaster incidences are traditional habitations where individuals had been living cheerfully for a long time. Despite the fact that mass movement is a component of various variables of which presence of water assumes a definitive job, none can truly guarantee that the area has never in the past gotten this sort of heavy rainfall. Thus, it tends to be concluded that in spite of spells of heavy and delayed rainfall these habitations were not influenced by mass movement before. One subsequently needs to examine if the area has seen some physical changes in the ongoing past (5 to 7 years) and if there has been increment in the recurrence of such incidences after these changes. These progressions could be identified with land use, construction, drainage, road, forest, agriculture and such.

Didihat town, similar to some other urban area in the hills of Uttarakhand, is looked with the problem of striking a balance between quickly developing populace and constrained accessibility of land for fulfilling their lodging and other related requirements. Prior (before 10 to 15 years back) individuals living there were not vulnerable to landslide hazard and had the choice of picking a superior site for settling down. The situation has changed significantly in the present occasions to a great extent because of quick land use/land spread changes. Widespread excavation of toe segment of slope for structure and road construction is seen to be basic spot around Didihat. Aimless construction, over-burdening of debris slope, infringement along drain/streams and nonattendance of drainage network for safe transfer of rainwater are some different variables in charge of slope disappointment.

7. CONCLUSION

Considering outrageous rainfall occasions in Uttarakhand Himalaya, it is recommended that rather than valleys and along surrendered channel of drains individuals ought to occupy on the hard rock or firm ground of slopes for safety reasons. At areas where ground gaps have created and subsidence has occurred suitable measures are required for checking invasion of rainwater just as surface water. This ought to go before usage of changeless treatment measures. Individuals living around these slopes ought to stay cautious, especially amid the monsoon time frame and any physical change in the slope ought to promptly bring into the notice of specialists.

Unpredictable and informal construction ought to be prohibited particularly in landslide influenced areas. Other than this safe disposal of rainwater should be given due significance. Both surface and subsurface drainage measures ought to in this way be arranged and executed. For this drain pipes could be given on debris slope. The arranged drainage network ought to be ventured and sufficiently wide to suit heavy deluge occasions.

Excavation of slope regularly presents changes in slope attributes and in the hills, it for the most part changes moderately inclining area into soak slanting area. Propensity of leaving the uncovered slopes untreated is unsafe, particularly amid spells of heavy rainfall. On the off chance that unpredictable construction couldn't be managed every single suggestive measure would remain an insignificant convention and would be of little use.

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