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STUDY ON LANDSLIDE DAMAGE IN KODAGU

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Abstract: **Natural hazards are repeated in Madikeri since 2018 that take place during monsoon and damage crops, livestock and settlements. Data on flood, drought, cyclone and waterlogging were collected. Heavy rainfall not only cause floods and debris flows, but also trigger off landslides on steep slopes. The danger due to these slope instabilities is considerably high, as they often evolve into debris flow that may damage cultivated land, buildings and infrastructures, and even cause fatalities. This paper discusses certain technical aspects of the landslides at various locations of kodagu district that triggered off by heavy rainfall in the season of July - August 2018. This article concentrates on the documentation and analysis of rainfall events, with a focus on evaluating the effects of urbanization on landslides. It summarizes the results of one landslide inventories after severe rainstorms in Kodagu during the previous month (August 2018), concentrating on the observations during field surveys and similarities between forest and open land.**

Keywords: **flood, drought, cyclone, heavy rainfall, landslides.**

1. INTRODUCTION

Landslides at different locations of kodagu district that triggered off by heavy rainfall with around 40 days of continues precipitation during the months of July and August 2018. On 17th August 2018, several landslides of different dimensions occurred at Kodagu district (Southern Indian –Western ghats) after a long rainy period. Landsliding is the most important geomorphic process in humid mountains; it can also be the most dangerous. The term “Landslide”, may be referenced to a sliding motion, for all varieties of mass-transport deposits (MTD), which include slides, slumps, debrites, topples, creeps, debris avalanches etc. Slides represent the pre-transport disposition of strata and their reservoir quality (ie. porosity and permeability) of the provenance region, whereas debrites reflect post-transport depositional texture and reservoir quality.

These Landslides problems have enormous implications for studies in sedimentology, engineering geology, oceanography, geomorphology, volcanology, seismology, glaciology, areology (i.e., geology of Mars), deep-sea structural engineering, highway engineering, soil mechanics, climate change, natural hazards, petroleum exploration and production.

Since the early recognition of “landslides” in 186 BC in China (Li, 1989), their common occurrences in subaerial and submarine environments have been well documented worldwide. The data on worldwide damages caused by large subaerial MTD in the 20th and 21st centuries is presented in Table 1.

Table 1: Worldwide large Mass-transport deposits (MTD), their sizes (volume) and damages in the 20th and 21st Centuries.

Year	Location	Name and type	Triggering mechanism	Size, damage, and loss of human life
1921	Kazakh Republic	Alma-Ata debris flow	Snow melt, subsequent rainfall	500 deaths
1938	Japan (Hyogo)	Mount Rokko MTD	Rainfall	505 deaths or missing, 130,000 homes were destroyed or badly damaged.
1941	Peru	Huaraz debris flow	Failure of moraine dam	10,000,000 m^3 4,000-6,000 deaths
1945 .	Peru Cerro	Condor-Sencca MTD	Erosional under-cutting	5,500,000 m^3 13 bridges were destroyed
1953	Japan (Wakayama)	Arida River MTD	Rainfall Major typhoon (cyclone)	1,046 deaths
1953	Japan (City of Kyoto)	Arida River MTD	Rainfall	336 deaths 5,122 homes were destroyed.
1958	Japan (Shizuoka)	Kanogawa MTD	Rainfall	1,094 deaths 19,754 homes were destroyed.
1962	Peru (Ancash)	Nevados Huascaran MTD	Not known	13,000,000 m^3 4,000-5,000 deaths
1963	Italy (Friuli-Venezia Griulia)	Vaoint Reservoir MTD	Not known	250,000,000 m^3 2,000 deaths
1965	China (Yunnan)	MTD	Not known	450,000,000 m^3 444 deaths.
1966	Brazil (Rio de Janeiro)	MTD	Rainfall	1,000 deaths
1974	Peru	Mayunmarca MTD	Rainfall	1,600,000,000 m^3 450 deaths
1980	China (Yichang, Hubei)	Yanchihe MTD	Mining activity-occurred on man-made layered slopes	150,000,000 m^3 284 deaths
1980	United States (Washington)	Mount St. Helens MTD	Eruption of Mount St. Helens volcano This is the world’s largest historical MTD.	3,700,000,000 m^3 250 homes, 47 bridges, 24 km of rail, and 298 km of highway were destroyed; 57 deaths.
1983	United States (Utah)	Thistle MTD	Snow melt and subsequent rainfall	21,000,000 m^3 ; This is the most expensive disaster to fix in U.S. history with a loss of $600,000,000 (1983 dollars).
1983	China (Gansu)	Saleshan MTD	Rainfall	35,000,000 m^3 237 deaths
1983	Ecuador	Chunchi MTD	Rain and/or snow (wettest year of century)	1,000,000 m^3 150 deaths
1985	Puerto Rico (Mameyes)	MTD	Rainfall from tropical storm	129 deaths
1987	Venezuela	Rio Limon, debris flow	Rainfall	2,000,000 m^3 210 deaths
1988	Brazil	Rio de Janeiro and Petropolis MTD	Rainfall	Approximately 300 deaths

1989	China (Huaying, Sichuan)	Xikou MTD	Rainfall	221 deaths
1991	China (Zhaotong, Yunan)	Touzhai MTD	Rainfall	18,000,000 m^3 216 death.
1991	Chile	Antofagasta debris flows	Rainfall	500,000,000-700,000,000 m^3 “Hundreds” of deaths were reported
1993	Ecuador	La Josefina MTD	Mine excavation and heavy rainfall	20,000,000-25,000,000 m3 13 bridges destroyed

Year	**Location**	**Name and type**	**Triggering mechanism**	**Size, damage, and loss of human life**
1998	Northern India (Malpa Himalaya Region)	Large MTD	Rainfall	221 deaths
1998	Italy (Campania)	MTD	Rainfall	More than 100 individual slope failures
1998	Honduras, Guatemala, Nicaragua,	El Salvador MTD heavy rain fall	Rainfall Hurricane Mitch caused torrential rainfall.	Approximately 10,000 deaths
1999	Venezuela (Vargas, northern coastal area)	MTD	Rainfall	Nearly 1m of heavy rain fall in a 3-day period. There were as many as 30,000 deaths. Loss: $1,900,000,000 in 2001 U.S. dollars
2000	Tibet	Yigong MTD	Meltwater from snow and glacier	100,000,000 m^3 109 deaths
2002	Russia (North Ossetia)	Kolka Glacier debris flows	Detachment of large glacier, causing a debris flow	Travel distance: 19.5 km; 110,000,000 m^3 volume of glacial ice deposited 2,000,000-5,000,000 m^3 of ice debris at end of runout; 125 deaths
2003	Sri Lanka (Ratnapura and Hambantota)	MTD	Rainfall	24,000 homes and schools destroyed, 260 deaths
2003	United States (San Bernardino County, California)	Debris flows	Rainfall	>1,000,000 m^3 (total volume) 16 deaths
2006	Philippines (Leyte)	MTD	Rainfall	15,000,000 m^3 1,100 deaths
2008	Egypt (East Cairo)	Al-Duwayqa MTD	Destabilization due to manmade construction	Affected area was 6,500 m^3 volume and rocks weighed about 18,000 tons.107 deaths
2010	Uganda (Bududa)	Debris flows	Heavy rainfall	400+ deaths
2010	Brazil (Rio De Janeiro)	Debris flows	Heavy rainfall	350 deaths

2. LANDSLIDE STUDY AREA

Kodagu is located on the eastern slopes of the Western Ghats. It occupies an geographical area of 4,102 square kilometres in the Western Ghats of south-western Karnataka. The district has a mountainous configuration, which presents a grand panorama of verdant valleys, ravines, fast flowing streams, lofty peaks, and awe-inspiring spurs. Most part of the district is covered with thick vegetation. The topography of the area ranges from gently sloping plains on the south eastern part to rugged hilly lands, with elevations ranging from about 910 m above mean sea level to 1,908 m above mean sea level. The hills and valleys of this undulating region are generally aligned in NW-SE direction.

Hattihole a small village which is the study area of the landslide described in this article is located at around 15 kilometers from Suntikoppa along the road connecting between Madikeri and Somwarpet as shown in figure 1.

3. FIELD SURVEY AND DATA EVALUATION

Information from the local public at flood rehabilitation centres of Suntikoppa area is used to locate the Hattihole landslide site which is as shown in Figure 2. The data from Indian meteorological department, Bengaluru showed that, Talacauvery received 375 mm of rainfall in 24 hours (from 8 a.m. on Monday 13-08-2018). This is said to be a record amount of rainfall on one day in the past few years. Somwarpet received 52 mm of rainfall, Madikeri 106.4 mm, Bhagamandala 113.2 mm and Virajpet 185.8 mm rainfall in 24 hours beginning 8 a.m. on Monday (13-08-2018). In the corresponding period last year (2017), Somwarpet had not received any rain while Madikeri had received 1.5 mm, Bhagamandala 17.6 mm and Virajpet 12.2 mm. The precipitation data showed that 45% (768mm) of the August rainfall was received within three days i.e., August 15, 16, 17. Such a high quantum of rain within a short duration of 72 hours could be the reason for heavy landslides in the history of Kodagu district. During heavy rains, when underground water percolates the sloping layers, it might have resulted in erosion of soluble mineral salts in the rock mass, thereby creating fissures and fractures inside the sloping ground that disturbs the strength of the slopes, resulting in landslides.

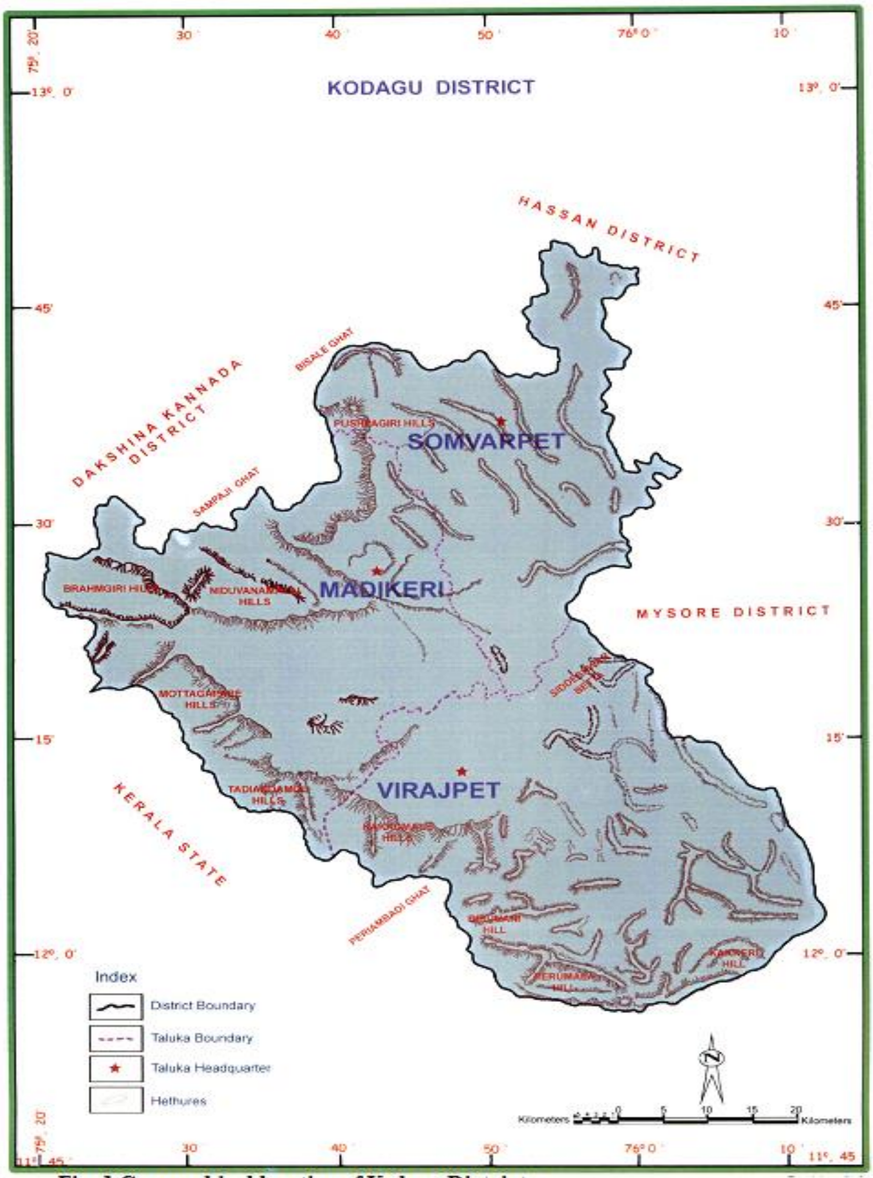

Fig. 1 Geographical location of Kodagu District

.Fig. 2 Landslide Trigerred off by the August 2018 Rainfall Event in Hattihole Region, Kodagu

It is evident from Figure 2 that slope inclination is a crucial factor for slope stability. On slopes with an inclination of less than about 20°, the driving forces are normally low compared to soil strength. On slopes steeper than 45°, the landslide density decreases resulting in the dislodging of heavy mass (Residential Building) from its original position.

Due to this heavy rains, and high rate of inflow to the Harangi dam, Around 40,000 cusecs of water was discharged from the Harangi dam resulting in submerging Some localities (Sai Layout, Kuvempu Layout and Kariappa Badavane) in Kushalnagara town which were flooded as shown in Figure 4. This is due to the fact that these layouts were existing very close to the river Cauvery.

4. TECHNICAL CHALLENGES

The physical processes that are responsible for transporting sediment downslope into the valley are still to be explored. This is simply because the physics and hydrodynamics of these processes are difficult to observe and measure directly in the cyclone affected environments. This observational impediment has created an enormous challenge for understanding and communicating the mechanics of gravity-driven downslope processes with clarity. Furthermore, deep-understanding of the soil material at liquefying environments are known for their complexity of processes and their deposits, composed not only of mass-transport deposits but also of bottom-current reworked deposits.

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Fig.3: Image of the flooded area at Sai Layout, Kushalanagara.

5. CONCLUSIONS

The most important conclusions are summarized below.

1. Volunteers with expertise and powers to coordinate all disciplines and phases in such disaster locations is a basic requirement.

2. Forests around Hattihole area are actually on steeper slopes that are more susceptible to landsliding.

3. The infrastructure road connecting Madikeri-Somwarpet and similarly flood affected areas has delayed the rehabilitation tasks.

4. With this large scale Landslides many of the local public in kodagu living on the hills found themselves homeless when their dwellings caved in under the onslaught.

5. Uncontrolled urbanization close to the stream flow leads to submerge the whole area as a consequence of maximum discharge through the reservoirs.

6. Evolving a participatory pre- and post-disaster management plan and taking a multidisciplinary approach based on scientific inputs on the causes and remedies are needed much attention.

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REFERENCES

[1] Flood Victims Rehabilitation centres, Suntikoppa.

[2] Taluk Panchayat office, Kushalanagara, Government of Karnataka.

[3] Deccan Herald, English daily News Paper.

[4] Prajavani, Kannada daily News Paper.

[5] Times of India, English daily News Paper.

[6] Google website.

[7] Website of Karnataka state Natural Disaster Monitoring Centre.

[8] Special Camp Report of NSS-2019, Government Engineering College Ramanagara.