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कर्नाटक राज्य के चिकमगलूर जिले में सनकासले क्षेत्र में (1:10,000) मध्य पैमाने पर भूस्खलन सुग्राहिता
मानचित्रण

MESO-SCALE (1:10,000) LANDSLIDE SUSCEPTIBILITY MAPPING IN SUNKASALE
AREA, CHIKMAGALUR DISTRICT, KARNATAKA.

टोपोशीट सं -48ओ/08

Toposheet no. 48O/08

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Final Report for Field Season 2022-2023

द्वारा/BY

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**Mesoscale (1:10,000) Landslide Susceptibility Mapping in Sunkasale Area,
Chikmagalur District, Karnataka.**

(FSP Code: M4LSSM/NC/SR/SU-KG/2022/42400)

Field season: 2022-23

By

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कर्नाटक राज्य के सनकासले क्षेत्र, चिक्कमगलुरु जिले में मध्य पैमाने (1: 10,000) पर भूस्खलन
सुग्राहिता मानचित्रण

(मद संख्या: एम4एलएसएसएम/एनसी/एसआर/एसयू-केजी/2022/42400)

कार्य सत्र: 2022-23

द्वारा

कमल कुमार, वरिष्ठ भूवैज्ञानिक

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सारांश

कार्य सत्र: 2022-23 के दौरान कर्नाटक राज्य के सनकासले क्षेत्र, चिक्कमगलुरु जिले में टोपोशीट संख्या 48O/08 के कुछ हिस्सों में जिसमें 12.4 वर्ग किमी क्षेत्र का मध्य पैमाने (1: 10,000) पर भूस्खलन सुग्राहिता मानचित्रण का कार्य किया गया। कार्य का उद्देश्य ढलान-विफलता डोमेन की पहचान करना और डोमेन-विशिष्ट भूस्खलन संवेदनशीलता विश्लेषण करना है। इस उद्देश्य के लिए, विभिन्न विषयगत मानचित्रों को तैयार किया गया और इन विषयगत मानचित्रों के लिए रेटिंग निश्चित की गई, जो अध्ययन क्षेत्र में भूस्खलन और भूस्खलन की घटनाओं के लिए अनुकूल स्थितियों के आधार पर है।

एलएसईआर रेटिंग की मदद से, विफलता डोमेन-आधारित संवेदनशीलता मॉडलिंग की जाती है। विभिन्न भूस्खलन विफलता डोमेन में ढलान विफलता को प्रभावित करने वाले कारक भू-कारकों को आवंटित दर और वजन के आधार पर डोमेन-विशिष्ट भू-कारक मानचित्र तैयार करना और डोमेन-विशिष्ट भूस्खलन संवेदनशीलता मानचित्र तैयार करना है।

अध्ययन क्षेत्र के भूविज्ञान में आर्कियन युग के प्रायद्वीपीय गनीस के बाद मेटाबासाल्ट, बैंडेड मैग्नेटाइट क्वार्टजाइट, मस्कोवाइट शिस्ट और मेटा अल्ट्रामैफिक इकाइयों के चट्टानों का बाबाबुदन समूह की चट्टानों से निहित होते हैं, जो अध्ययन क्षेत्र (डब्ल्यूएनडब्ल्यू-ईएसई) के सामान्य अभिवृत्ति का अनुसरण करते हैं। अध्ययन क्षेत्र के उत्तरी और उत्तर-पश्चिमी भाग ने तीव्र कतरनी की है, मिग्नेटाइट इकाइयां (गनीस का मिश्रण, बैंडेड मैग्नेटाइट क्वार्टजाइट, मेटा अल्ट्रामैफिक्स, मस्कोवाइट शीस्ट, गार्नेटिफेरस मस्कोवाइट शीस्ट, क्वार्ट्ज शिरा और मेटाबासाल्ट्स इत्यादि) का गठन किया है जो मुख्य कतरनी क्षेत्र के रूप में पहचाना जाता है और दक्षिणी भाग तुलनात्मक रूप से कम प्रभावित है।

यह पता चला है कि अध्ययन क्षेत्र में कतरनी हो गई है और फिर बाद में भंगुर विकृत हो गया है, और इस प्रकार अध्ययन क्षेत्र में नमनीय-भंगुर विरूपण हुआ है। लिथोनिट्स दो पीढ़ियों के वलन से गुजरा है, तेज हिंज और सीधे लिम्ब (तंग वलन) दिखाता है। इस क्षेत्र के वलन विषम हैं और खुले से संक्षेप वलन हैं।

सामान्य रूप में, सड़कों के लिए व्यापक ढलान में कटौती में, दो संयुक्त सेटों की उपस्थिति बेज बना सकती है, और बेडिंग फोलिएशन को एनाकलिनल ढलान की तरफ उजागर किया जाता है। कुछ उदाहरणों में, संयुक्त सेटों में से एक बेड के साथ प्रतिच्छेद करता है, जो ढलान को विफलता के लिए अतिसंवेदनशील प्रदान करता है। मैदादी रोड सेक्शन के अनेको स्थानों पर ढलान कोण के साथ संयुक्त सेट के उन्मुखीकरण के कारण प्लानर और बेज ने कमजोर संयुक्त चट्टानी ढलान जो कि सड़क की ओर डिप (ढलान) कर रही है।

अध्ययन क्षेत्र की रेजोलिथ मोटाई अधिमानतः 0-2 मीटर रेंज के तहत आती है और सामान्य स्थानों पर मोटाई 2-5 मीटर से भिन्न होती है। अध्ययन क्षेत्र में कुल 95 संख्या भूस्खलन प्रलेखित किया जिसमें, सड़क वर्गों और पुरानी विफलताओं के साथ सभी विफलताओं को अद्यतन किया गया है। अध्ययन क्षेत्र में भू-तकनीकी मिट्टी के 32 नमूने एकत्र किए गए हैं और आर एम आर आधार रॉक मास लक्षण वर्णन और कतरनी शक्ति पैरामीटर निर्धारण के लिए आयोजित किया गया है। बालिगे और दुर्गधहल्ली रोड सेक्शन में कुछ असुरक्षित सड़क खंड की पहचान की गई है। मैदादी व्यू प्वाइंट को जाने वाली सड़क पहले से ही विफल हो चुकी है और आगे फिर से पुनर्संक्रियन की संभावना संभव है।

अध्ययन क्षेत्र में प्राप्त भू-तकनीकी परिणाम दिखाते हैं कि कोहसन मान न्यूनतम 0.17 से अधिकतम 0.32 तक है, जबकि आंतरिक घर्षण का कोण 22.2 से 31 डिग्री तक भिन्न है। ऐतिहासिक भूस्खलन इन्वेन्ट्री डेटाबेस के अनुसार, अधिकांश भूस्खलन चरम मानसून की अवधि (अगस्त 2019) के दौरान भारी लगातार वर्षा के दौरान ट्रिगर हुये हैं। फील्ड अध्ययन के दौरान सभी पुराने और नए भूस्खलन की घटनाओं का विस्तार से अध्ययन किया गया है और महत्वपूर्ण भूस्खलन-प्रवण क्षेत्रों के लिए जोखिम में कमी के उपायों का सुझाव दिया है। एक उपयुक्त रिटेनिंग स्ट्रक्चर और लाइन ड्रेनेज को पहाड़ी के ढलान के टो के हिस्से में व्हीप होल के साथ, स्लोप री-ग्रेडेशन और उचित ड्रेनेज मैनेजमेंट सिस्टम प्रदान किया जाना चाहिए, जो कि स्थान की स्थिति के अनुसार सुझाए गए हैं। भूस्खलन प्रबंधन मानचित्र सतत विकास और आपदा प्रबंधन के लिए नीति निर्माताओं और हितधारकों द्वारा प्रभावी निर्णय लेने के लिए एक रोड मैप प्रदान करेगा।

अध्ययन क्षेत्र की अंतिम संवेदनशीलता यह दर्शाती है कि 28% क्षेत्र अत्यधिक अतिसंवेदनशील क्षेत्र में शामिल है, इसके बाद मध्यम अतिसंवेदनशील क्षेत्र में 14% क्षेत्र शामिल है और निम्न अतिसंवेदनशील क्षेत्र में 58% शामिल हैं।

**Meso-scale (1:10,000) Landslide Susceptibility Mapping in Sunkasale area,
Chikkmagaluru District, Karnataka.**

(FSP CODE: M4LSSM/NC/SR/SU-KG/2022/42400)

Field Season: 2022-23

**By
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&
E. Mohanraj, Sr. Geologist**

ABSTRACT

In accordance with FS: 2022-23, a Meso-scale (1:10,000) landslide susceptibility mapping was conducted in Chikkmagaluru district, Karnataka in parts of toposheet no. 48O/08 covering an area of 12.4 sq km. The objective of this endeavour is to identify slope-failure domains and to perform domain-specific landslide susceptibility analysis. For this purpose, various thematic maps were prepared and ratings were assigned for these thematic maps heuristically, based on terrain conditions favourable for landslide and landslide incidences within the study area. With the help of LSER rating values, failure domain-based susceptibility modelling is carried out. These maps are based on the rate and weight assigned to the causative geofactors influencing slope failure in different landslide failure domains and are integrated to generate domain-specific landslide susceptibility maps.

The geology of the area comprises Peninsular Gneisses of the Archean age, followed by Metabasalt, Banded magnetite quartzite, Muscovite schist, and Meta ultramafic units of the Bababudan Group of rocks. These formations align with the general orientation of the study area (WNW-ESE). The Northern and Northwestern parts of the study area have undergone intense shearing, resulting in the formation of migmatite units (a mixture of Gneisses, Banded Magnetite Quartzite, meta ultramafics, muscovite schists, garnetiferous muscovite schist, quartz veins, and Metabasalts, among others). This zone is identified as the primary shear zone, whereas the southern part remains comparatively less affected.

It has been observed that the study area experienced shearing followed by brittle deformation, indicative of Ductile-brittle deformation processes. The litho units in the area have undergone two generations of folding, displaying sharp hinges and straight limbs (tight folds). The folds in this region are generally asymmetrical and range from open to tight folds. Typically, in extensive slope cuts for roads, the presence of two joint sets can create wedges,

and the foliation of bedding becomes visible along the anacinal slope face. In some instances, one of the joint sets intersects with the beds, rendering the slope susceptible to failure. The orientation of joint sets with slope angle caused planar and wedge at vulnerable jointed rocky slope face dipping towards the road at places along the Maidadi road section.

The regolith thickness in the study area primarily falls within the range of 0-2 meters, with variations of 2-5 meters at gentler locations. A total of 95 nos. of old, new, and reactivated landslides with 42-point geoparameters of landslide attributes are documented. A total of 32 nos of geotechnical soil samples were collected in the study area, and Rock Mass Rating (RMR) analysis was conducted for rock mass characterization and shear strength parameter determination. Vulnerable road sections have been identified, particularly along the Balige and Durgdhahalli road sections. Near the Maidadi viewpoint, the approach road has already experienced failure, and the likelihood of reactivation remains possible.

The geotechnical results obtained in the study area show cohesion values range from a minimum of 0.17 to a maximum of 0.32, while the angle of internal friction varies from 22.2 to 31 degrees. According to the historic landslide inventory database, the majority of the landslides are triggered during heavy incessant rainfall during the peak monsoon period (August 2019). All past and new landslide incidences are studied in detail during field investigation and risk reduction mitigation measures are suggested for critical landslide-prone areas. A suitable retaining structure and lined drainage should be provided at the toe part of the hill slope with weep holes, slope re-gradation, and proper drainage management system, are suggested as per site condition. The landslide management map will provide a road map for effective decision-making by policymakers and stakeholders for sustainable development and disaster management. The final susceptibility assessment for the area reveals that 28% falls within the highly susceptible zone, followed by 14% in the moderately susceptible zone, and 58% in the low susceptible zone.

**Mesoscale (1:10,000) Landslide Susceptibility Mapping in Sunkasale Area,
Chikmagalur District, Karnataka.**

(FSP Code: M4LSSM/NC/SR/SU-KG/2022/42400)

Field season: 2022-23

By

Kamal Kumar, Sr. Geologist

&

E Mohanraj, Sr. Geologist

**CHAPTER 1
INTRODUCTION**

1.1 Background Information

Large-scale landslides involving major natural hazards in the hilly terrain of the Himalayas of extra-Peninsular India and the Western Ghat region of the Indian Peninsula, which accounts for considerable loss of life and damage to communication routes, human settlements, agricultural fields and forest lands are of prime societal concern in recent past, which accounts for considerable loss of life and damage to communication routes, human settlements, agricultural fields and forest lands. In India, nearly 15% (0.49 million sq. km.) area is landslide-prone, which is spread over 1112 Survey of India Topographic map sheets (NDMA 2009). Geological Survey of India, being the nodal agency for landslide studies in India since 2004, vigorously and swiftly implemented the NLSM programme in the hilly terrain of the Himalayas and Western Ghat regions to implement the proposed action plan 2006 of the National Disaster Management Authority (NDMA) on landslide hazard as well as risk mitigation.

Landslide susceptibility maps spatially depict the areas where future slope failures are likely to occur due to specific environmental conditions. Therefore, the NLSM programme has been taken up for generating the seamless landslide susceptibility mapping on a 1:50,000 scale using knowledge-driven AHP methods where weightage is assigned to geofactor maps and different classes within geofactor maps and integrated using multi-class index overlay method for Western Ghat regions of Karnataka & Goa for wide-scale planning and management. In view of the landslide disaster in the year 2018, the Western Ghats hill ranges mainly the Kodagu, Dakshin Kannada and Chikkamagalur districts of Karnataka were badly affected. So, to prepare a road map for administrators, planners and policymakers for developmental work and overcoming such natural disasters affecting life

and property, mesoscale landslide susceptibility mapping on a 1:10,000 scale is taken up on a priority basis by GSI in the public interest to carry detail field investigation and suggest remedial and mitigation measures at unstable landslide susceptible zones.

During the monsoon period of 2019, Chikmangalur and Dakshin Kannada district of Karnataka received very heavy rainfall which caused several landslides in different parts of the district. As per the NLSM map generated on a 1:50,000 scale, the area selected for the detailed investigation comes under moderate to high landslide susceptible zone in specific terrain conditions and many landslides along the road sections were recorded during this disaster. The majority of the landslides are earth slides and debris slides. During the southwest monsoon, the Kothigera-Charmadi National Highway (NH-73) was severely affected by landslide incidences and at many places, communication corridors were blocked/breached. There were considerable losses of life, property, agriculture, plantation and forest land due to the hazardous landslide disaster.

Land use/Landcover changes, whether of natural origin or anthropogenic, can influence the susceptibility of slopes to landslides. Due to the combined impact of natural phenomena like the nature of SFM, thickness of OB, rock mass characteristics etc. and land use changes induced by anthropogenic activities, landslides are common in many places of western ghats which are mostly triggered by heavy and intense rainfall. The specter of climatic change i.e. rainfall pattern necessitates a greater focus on slope failures, identification of hillsides prone to slope failures, identification of causative and triggering factors, depiction of vulnerable areas by field investigation and categorize hillslope as high moderate and low landslide susceptible zones based on causative geofactors responsible for slope failure by data integration and modelling using multi-class index overlay technique in GIS platform. Domain-based landslide susceptibility analysis and an insight into the management of the disaster through a landslide management map will help the policy makers for a futuristic management plan with minimal influence of landslide disaster in the area around Sunkasale area, Chikmagalur District, Karnataka.

1.2 Aim/Scope of present work:

The present work aims to carry out Meso-scale (1:10,000) Landslide Susceptibility Mapping in the Sunkasale area, Chikmagalur District, Karnataka with the following objectives:

1. To identify slope-failure domains and to prepare domain-specific geofactor maps in GIS.

2. To rate and weigh relevant geofactor maps for different failure domains.
3. To integrate the rated and weighted geofactor maps per identified failure domain in a GIS.
4. To combine the domain-specific landslide susceptibility models into a combined and classified landslide susceptibility map on a 10k scale.
5. To qualitatively/ quantitatively assess the landslide risk and to frame a generic mitigation /management plan on a 10k scale for relevant value addition and direct use by the stakeholders.

Table 1: Nature and quantum of the work envisaged during FS 2022-23:

Nature of Work	Target envisaged (in sq. km.)
1. Detailed pre-field landslide inventory map including ground deformation, creeps etc. and identification of failure domains	12.4 sq. km
2. Preparation of pre-field thematic geofactor maps on 10k based on failure domains.	
a. Land Use/Land Cover Map	12.4 sq. km
b. Drainage Map	12.4 sq. km
c. Geomorphology Map / Landform Map	12.4 sq. km
d. Slope Morphometry (Slope Angle, Slope Aspect, Slope Curvature and Relative Relief)	12.4 sq. km
e. Slope forming material Map (Geological)	12.4 sq. km
f. Stream Power Index Map	12.4 sq. km
g. Landslide domain Map	12.4 sq. km
h. Overburden thickness map	12.4 sq. km
i. Slope Facet Map	12.4 sq. km
3. Field-based studies	
a. Validation and updation of all thematic maps and landslide inventory in the field.	12.4 sq. km
b. Data collection for preparation of Geotechnical map	12.4 sq. km
c. Geotechnical field sample collection for determination of geotechnical parameters*	32 nos.
4. Post field studies and modelling	
a. Updation and finalization of thematic maps and landslide inventory in the GIS platform.	12.4 sq. km
b. Preparation of Geotechnical map #	12.4 sq. km
5. Preparation of landslide susceptibility map in GIS platform.	12.4 sq. km
6. Collection of Rainfall data	Rainfall data collected

1.3 Description of the study area:

The study area is located in Chikkamagalur district of Karnataka, around 64 km SW of Chikkamagalur town and is well connected by metaled roads. The study area is bounded between latitudes 13°10'10"N to 13°10'52"N and longitudes 75°23'24"E to 75°26'57"E (figure-1). The study area (Sunkasale) area falls in Mudigere taluk of Chikkamagaluru.

It lies on State Highway-106 which connects to Mangaluru. The major settlements are Balige, Sultanpete, Durgadahalli, Horikan, Maidadi, Maitalkan and Maidadi village. The study area has major land-use coffee plantations and thick vegetation.

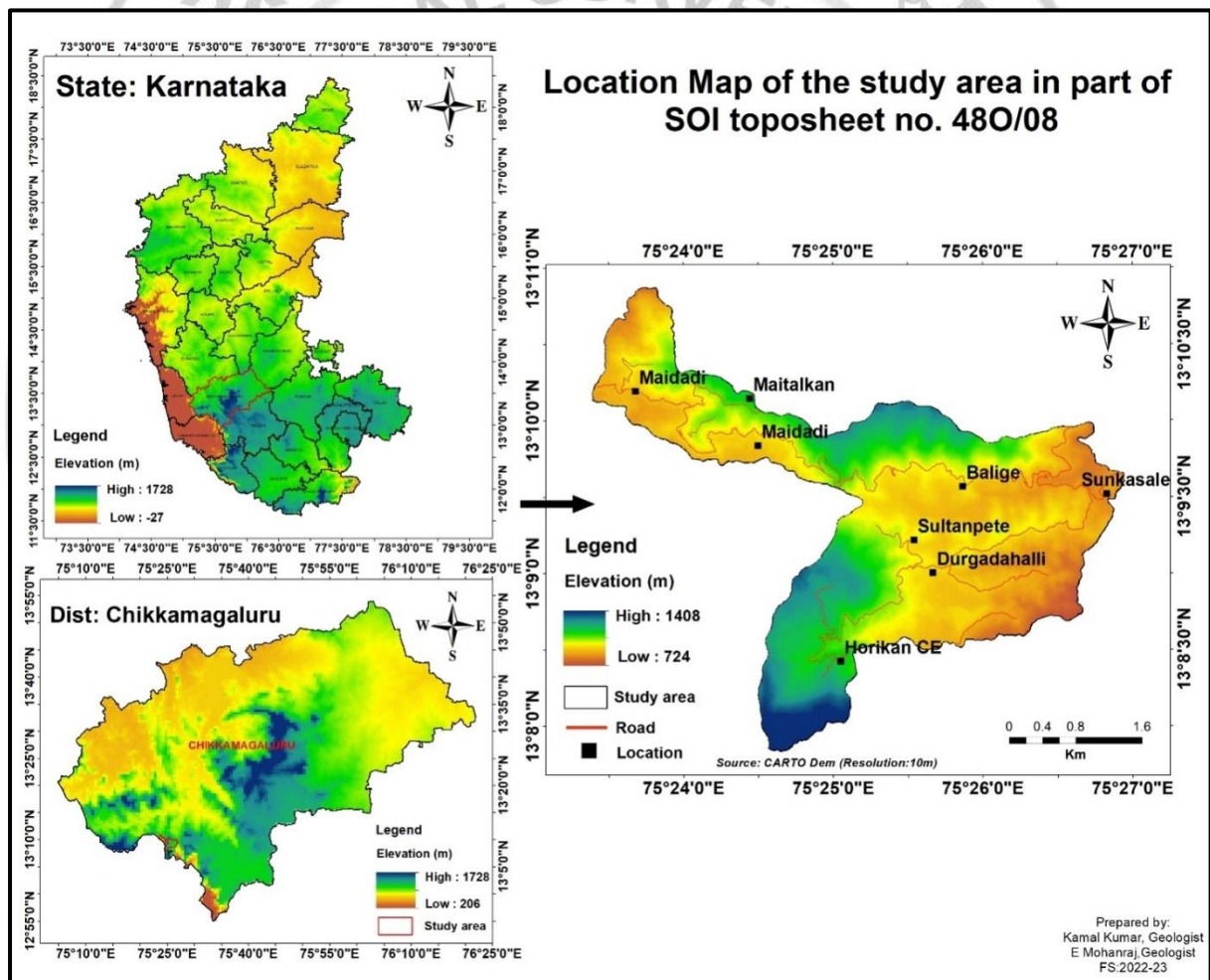


Fig 1: Location Map of the Study Area

1.4 Physiography and Drainage

The study area is highly rugged and forms part of the Western Ghats. The hill range has a slope gradient ranging from 15-40° and >45° on the steep escarpment on the upper reaches of the hillslope. The physiography of the study area is highly rugged terrain with moderate to highly dissected hills and valleys. The hills trend from NNW to ESE direction. Settlements mixed with dense to fair jungle exist. The steep high hill ranges are covered by dense jungle. The maximum and minimum topographic elevation from MSL is 890m and 1270m respectively. The mountain ranges comprise ridges and steep dissected valleys and are covered with thick vegetation on slopes, ridges and steep rocky slopes are barren and sparsely vegetated, and part of the hillslope in the northern part is covered with tea plantation of Kelagur estate. Drainage pattern varies from sub-dendritic to sub-trellis patterns and the major divide forms at the central part of the study area and the major streams flow from West to East.

1.5 Climate and Rainfall

The climate of the study area is moderate too hot in summer and cool in winter. Throughout the year the climate is pleasant. During the summer months from March to May, the maximum day temperature is around 30°C and the night temperature is around 19°C. December and January are the coldest months, the mean maximum temperature ranges from 5-15°C. In the cold weather season from November to February, dry continental winds prevail over the hills. The dry winter season is followed by the pre-monsoon transition period of a hot summer extending from March to the beginning of June. The average annual rainfall of the Chikmangaluru district is 1904mm. The eastern belts receive a rainfall of about 600mm/yr only, while the western belt receives around 3000mm/yr. During the southwest monsoon, the state receives 80% of its rainfall. Rainfall in the winter season (January to February) is less than in the hot weather season (March to May). The distribution of rainfall in August follows the same general pattern as in July but the amounts are generally less. The distribution of September rainfall over the area is similar to that of August but amounts are less. Subsequently, the monsoon withdraws and retreats by October. About this time the winter season of northeast monsoon begins but is generally dry in this area. With the advent of the monsoon rains the maximum temperatures fall rapidly in the Ghats. The monsoon period has almost uniform temperatures with very little variation. The autumn weather follows the rains in the Ghats from November to January. Past 10 years rainfall data obtained from different rain gauge stations of different taluks for the period

(2008-2017) indicates that Kotigehara and Mudigere taluk (1055mm) receives maximum average rainfall in June and July influenced by advancing southwest monsoon that triggers landslip/landslide incidences.

a) Soil types

The Peninsular hill soils are categorized into four main types viz, red soil, black soil, lateritic soil and alluvial soil by Ray Chaudhry et al. (1963). The major soil type in the study area is red loamy & sandy soil. Laterite is generally reddish and often has a vermicular structure. They are formed under conditions of high rainfall with alternating wet and dry periods. The sub-soil contains hydrated oxides of aluminium and iron. The soils of this group are well-developed on the summits of hills. Alluvial soils are formed by transportation by streams and rivers and deposited over plains and valleys. The escarpment of the Ghats is made up of a succession of sub-vertical rocky crags and zones. (Source: Central Ground Water Board, Chikmagalur Brochure)

1.6 Previous Work on Landslide Studies

The study area was covered under the Marco Scale (1:50,000) Landslide Susceptibility (NLSM) Programme during field season 2017-18 in parts of Toposheet No. 48O/07 & 48O/08, Chikmagalur and Dakshin Kannada districts, Karnataka by Tanvi Gupta and Sunandan Basu, Geologists. A note on the post-disaster investigation of landslide Occurrences in Chikmagalur and Mudigere taluks, Chikmagalur district, Karnataka, Dated 27th August 2019 by Kapil Singh, Geologist & Kamal Kumar, Geologist, 2019.

As per the landslide susceptibility map, the central and northeastern parts of the area show considerable patches of high and moderate susceptibility zones, while most of the area in the western and the northern side falls under low susceptibility zone.

During FS 2008 – 09, Maruthi K.V; Pradhan U.P and Mishra A.K carried out “Landslide inventory along NH & SH of ghat roads in Chikmagalur, Coorg and Shimoga districts, Karnataka”. In this report among the various road sections, parts of the Kothighere to Kalasa and Kothighere to Charmadi Ghat section come under the present study area. The authors recorded a total of 69 nos. of landslides along these road sections. As per their observation, all the landslides were rainfall-triggered, shallow debris slides in nature. The cut slope height and angle play a very important role as a root cause for the initiation of the landslides. The average overburden thickness recorded in the area was 4-5m mostly consisting of soil and weathered rock. The authors recommended for proper drainage management system, as

several blockages were found and suggested avoiding vertical slope cuts in future and constructing a retaining wall as per site conditions.

During FS 2008-09 and 2009 -10, Mishra A.K; Pradhan U.P and Maruthi K.V carried out “Landslide hazard zonation on macro scale of Charmudi ghat section from Charmudi to Kotigehara, Kotigehara to Kalasa and Sakleshpur to Uppinangadi in Dakshin Kannada and Chikmagalur districts, Karnataka”. In this report, the Charmadi Ghat section from Charmadi Ghat to Kothighere and parts of Kothighere to Kalasa and Chikmangalur district boundary to Belthangdy road section comes under the authors recorded a total of 98 nos. of landslides along these road sections. As per their observation, the majority of the slides are debris slides that occurred due to cutting of the natural slope for making road. The vertical cut slopes have failed due to heavy rain in the ghat section during monsoon. After the landslide hazard zonation analysis, it was observed that 18% of the area falls under a very low hazard zone, 59% of the area falls under a low hazard zone and 23% of the area falls under a moderate hazard zone. The authors recommended for proper drainage management system as several blockages were found and suggested avoiding vertical slope cuts in future and constructing a retaining wall as per site conditions.

a) Spatial Distribution of Landslide Incidence:

During field season 2017-18, a total of 115 landslides were recorded and documented with detail 42 point geoparametric attributes. All the landslides are located adjacent to the road and mostly resulted from a combination of the failure of vertical extensive cut slopes along the road and heavy rainfall during the monsoons. Most of the landslides of small dimensions are initiated due to the cut slopes (Tanvi Gupta and Sunandan Basu, 2018).

1.7 Acknowledgements

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CHAPTER 2

GENERAL GEOLOGY

2.1 Regional Geology

Geologically, the area exposes rocks belonging to Sargur Group, Peninsular Gneiss – I (PG – I), Bababudan Group and Chitradurga Group of rocks intruded by granite, quartz veins and dolerite dykes. The area is known as the type area for the Bababudan Group of rocks which are well developed here (**Figure 2**). The brief descriptions of the litho units are given below (Source: a geological note of compiled 1:50000 geological map of GSI).

2.2 Sargur Group:

Sargur Group are mostly seen in the western segment of the area as envelopes of varying dimensions within PG – I and it consists of banded magnetite quartzite, kaynite – muscovite schist, & amphibolite.

2.3 Peninsular Gneissic Complex (PGC):

PGC is represented by granite & granite gneiss and occupies the major part of the area. The gneisses are medium to coarse-grained, mesocratic and consist of quartz, plagioclase and biotite. They also exhibit migmatitic banding in places.

2.4 Dharwar Supergroup

The Dharwar Supergroup in the area is represented by the Bababudan Group of rocks and the Chitradurga Group of rocks.

2.4.1 Bababudan Group:

Bababudan Group of rocks is represented by Kudremukh Formation, Kodachadri Formation, Kalasapura Formation, Santhaveri Formation and Mullaingiri Formation in the study area. Kudremukh and Kodachadri Formations are exposed in the central part of the area while Kalasapura, Santhaveri and Mullaingiri Formations are exposed in the eastern part of the area.

2.4.1.1 Kudremukh Formation consists of amphibolite, metabasalt, quartzite, banded magnetite quartzite & metaultramafite. Amphibole is fine to medium-grained, dark green in colour, amygdular occurring as a small lensoidal body along with metabasalt 2km southwest of Venigudda Δ 1026 m hill. Meta basalt is the major litho unit in this segment of the

Western Ghat schist belt. Meta basalt is fine-grained, and greenish consisting of chlorite, actinolite, epidote and plagioclase. Quartzites occur as small linear/lensoidal bodies in the eastern margin of the schist belt and are exposed at the top of Δ 1157 m hill. Persistent bands of banded magnetite quartzite occur along with metabasalt confined to the central part of the area. Meta ultramafites occur as linear folded bands in the western part and as tabular bodies within meta basalt near the eastern margin of the schist belt. Meta ultramafites are greyish green in colour, fine-grained consisting of talc – actinolite – tremolite and chlorite.

2.4.1.2 Kodachadri Formation consists of banded magnetite quartzite and chlorite schist with bands of banded magnetite quartzite and is exposed in south southwestern corner near Jamble.

2.4.1.3 Kalasapura Formation consists of amphibolite that occurs along the eastern margin as linear bands and as lensoidal bodies within the metabasalt of Mullaingiri Formation. Amphibolite is fine-grained, dark green, and consists of hornblende, plagioclase and minor amounts of quartz and biotite.

2.4.1.4 Santhaveri Formation consists of metabasalt and bands of magnetite quartzite are confined to the western margin of the Bababudan schist belt in this segment. Metabasalt is fine-grained and consists of chlorite, actinolite, epidote and plagioclase.

2.4.1.5 Mullaingiri Formation is represented by metabasalt, banded magnetite quartzite, carbonaceous phyllite and ferruginous phyllite. Metabasalt occupy the central part of the schist belt and is fine-grained, schistose consists of chlorite, actinolite, epidote and plagioclase. A small lensoidal body of limestone is exposed along the western margin of the schist belt in the southeastern part of the area. Limestone is fine to medium-grained, grey-coloured, and consists mainly of recrystallized calcite. A lensoidal body of carbonaceous phyllite is present within ferruginous phyllite which is exposed 1.5 km east of Maduguni.

2.4.2 Chitradurga Group: Chitradurga Group is represented by Jhandimatti and Joladhal Formations in the study area.

2.4.2.1 Jhandimatti Formation occupies the central part of the area and consists of conglomerate, amphibolite, banded magnetite quartzite, chlorite schist and garnet biotite schist. A small band of conglomerate is exposed in the southern part of the area south of

Basarikatte at the contact of Kudremukh and Jhandimatti Formations. Amphibolite occurs as small outcrops in the eastern margin of the belt in the northern part of the area. Amphibolite is fine-grained, dark green consisting of hornblende, plagioclase and minor amounts of quartz and biotite. Amphibolite is followed by banded magnetite quartzite and chlorite schist. Chlorite schist is a major unit in this segment. It is fine-grained, light green, well foliated and mostly consists of quartz–chlorite. Chlorite schist is followed by garnet biotite schist in this segment.

2.4.2.2 Joldhal Formation consists of ferruginous phyllites and banded magnetite quartzite. Ferruginous phyllite is fine-grained, well-foliated, fissile and confined to the central part of the schist belt. Iron and manganese quartzite occurs as persistent bands within phyllites.

2.5 Younger Intrusive:

2.5.1 Younger Intrusive Granites: Granite intruding into PG – I and schist belts are observed in the central part of the area. It is grey-coloured, mesocratic and coarse-grained rock. It consists of quartz, plagioclase and minor amounts of biotite. It is exposed near Hornadu and Galigandi.

2.5.2 Basic Intrusive: Basic intrusive is represented by dolerite and gabbro dykes trending in northwest-southeast and north-south directions. Dolerite is fine to medium-grained; dark green consists mainly of pyroxenes and plagioclase.

2.5.3 Acidic Intrusive: Acid intrusive is represented by quartz veins and intrusive granite in the central part of the area.

2.6 Laterite: Due to the high degree of tropical weathering laterization is observed in a few places in the study area. The laterites are reddish in colour and rich in ferric/aluminium oxides. The lateritic weathering profiles exhibit three zones viz. duricrust, underlying clays and bottom saprolite unit. Variation in mineralogy and texture of the parent rock has resulted in the Formation of ferruginous, mangiferous and aluminous laterite. Laterite body is exposed in the southwestern part of the study area.

a) Structure:

Bedding (S0) in banded magnetite quartzite, schistosity (S1) in schist rocks and gneissosity (S1) in gneisses are the major planar features. The bedding in banded magnetite quartzite is striking in the north–south direction and dipping easterly in Shimoga schist belt rocks, northwest–southeast in the Western ghat schist belt, north–south to the NNE – SSW dipping steeply to west in Bababudan belt. A major synformal fold plunging towards the south is recorded within the Shimoga belt in the southern part. Gneissosity in gneiss varies from north–south to N10°W to S10°E with steep dips towards the east.

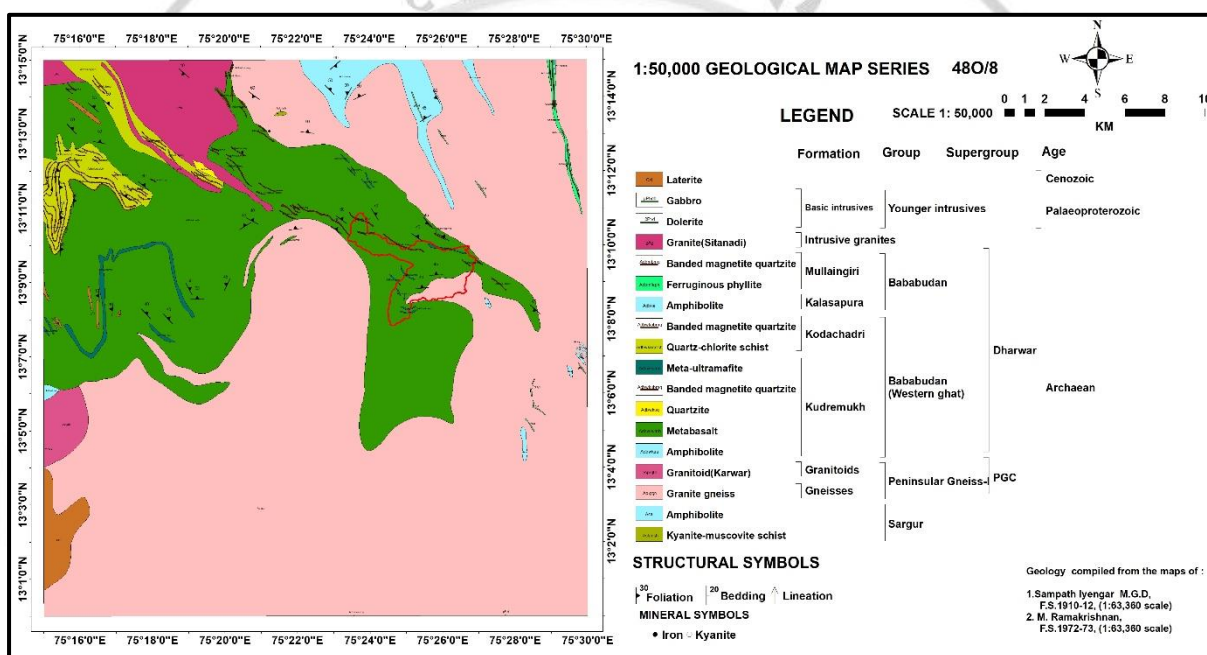


Fig 2: Regional Geological Map of TS No. 48 O/08

Table 2: Regional Stratigraphy of the study area

Age	Supergroup	Group	Formation	Lithology
Cenozoic				Laterite
Palaeoproterozoic		Younger Intrusive	Acid Intrusive	Quartz vein
			Basic Intrusive	Gabbro
			Younger granite	Dolerite
				Granite
			Joldhal	Banded magnetite quartzite,

Archean	Dharwar Supergroup	Chitradurga		Ferruginous phyllite
			Jhandimatti	Garnet biotite schist, Chlorite schist, Banded magnetite quartzite, Amphibolite Conglomerate
		Bababudan	Mullainagiri	Meta basalt Banded magnetite quartzite Carbonaceous phyllite Ferruginous phyllite
			Shantaveri	Banded magnetite quartzite Meta basalt
			Kalaspura	Amphibolite
		Kudremukh	Kodachadri	Banded magnetite quartzite Chlorite schist
				Meta ultramafic rock Banded magnetite quartzite Quartzite Meta basalt Amphibolite

	Peninsular Gneissic Complex	Peninsular Gneiss – I	Granitoid	Granite
			Gneisses	Granite Gneiss
		Sargur		Banded magnetite quartzite Kyanite muscovite schist Amphibolite

(After 1:50,000 compiled geological map, GSI)

2.7 Geology of the Study Area:

Geologically, the area exposes rocks belonging to Peninsular Gneiss-I (PG-I), Bababudan Group of rocks. Meta ultramafic rock, Banded magnetite quartzite, Meta basalt are Bababudan Group of rocks and granite and granite gneiss are Peninsular Gneiss-I. The brief descriptions of the litho units are given below (Source: geological note of compiled 1:50000 geological map of GSI). The geology of the study area is shown in Figure 3.

2.7.1 Peninsular Gneissic Complex (PGC):

PGC is represented by granite & granite gneiss and occupies the major part of the area. The gneisses are medium to coarse-grained, mesocratic consists of quartz, plagioclase and biotite. They also exhibit migmatitic banding in places.

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colour, amygdular occurring as a small lensoidal body along with meta basalt 2km southwest of Venigudda Δ 1026 m hill. Meta basalt is the major litho unit in this segment of the Western Ghat schist belt. Metabasalt is fine-grained, greenish consisting of chlorite, actinolite, epidote and plagioclase. Quartzite occurs as a small linear/lensoidal body in the eastern margin of the schist belt and is exposed at the top of Δ 1157 m hill. Persistent bands of banded magnetite quartzite occur along with metabasalt confined to the central part of the area. Meta ultramafites occur as linear folded bands in the western part and as tabular bodies within metabasalt near the eastern margin of the schist belt. Meta ultramafites are greyish green in colour, fine-grained consisting of talc-actinolite - tremolite and chlorite.

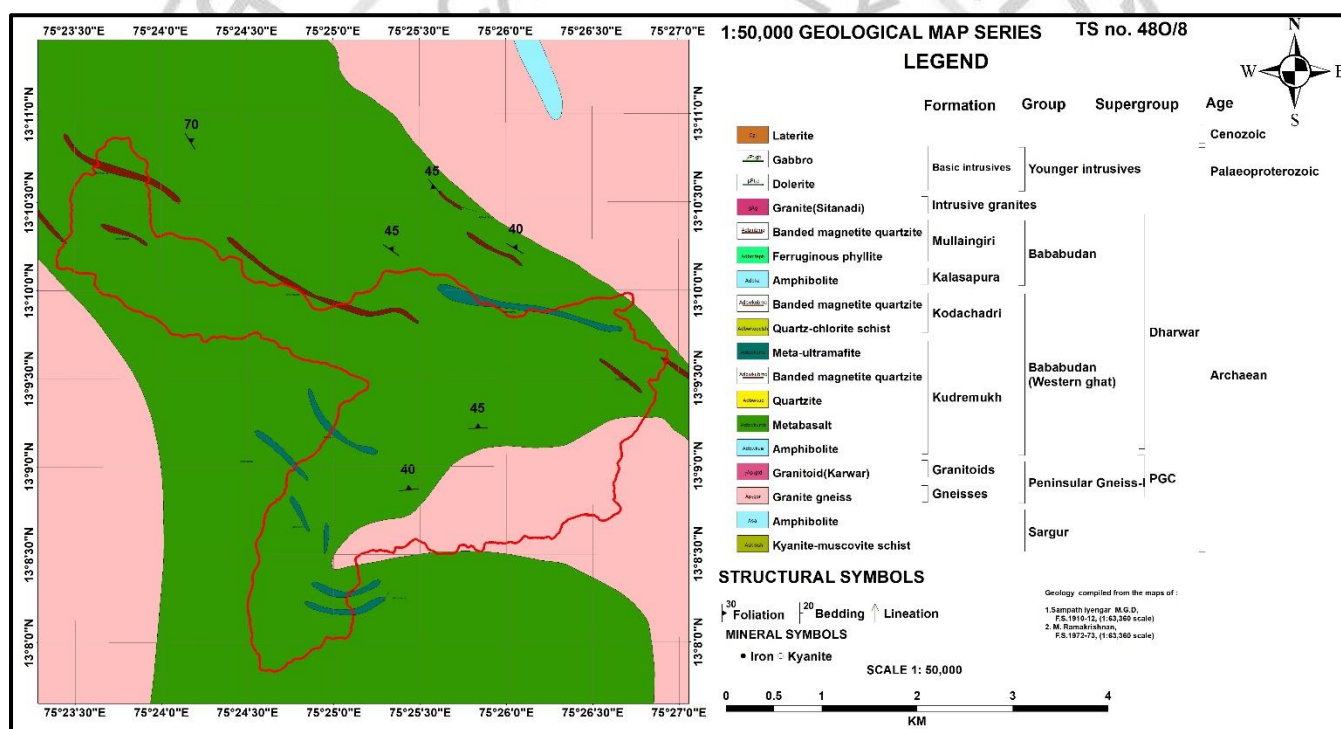
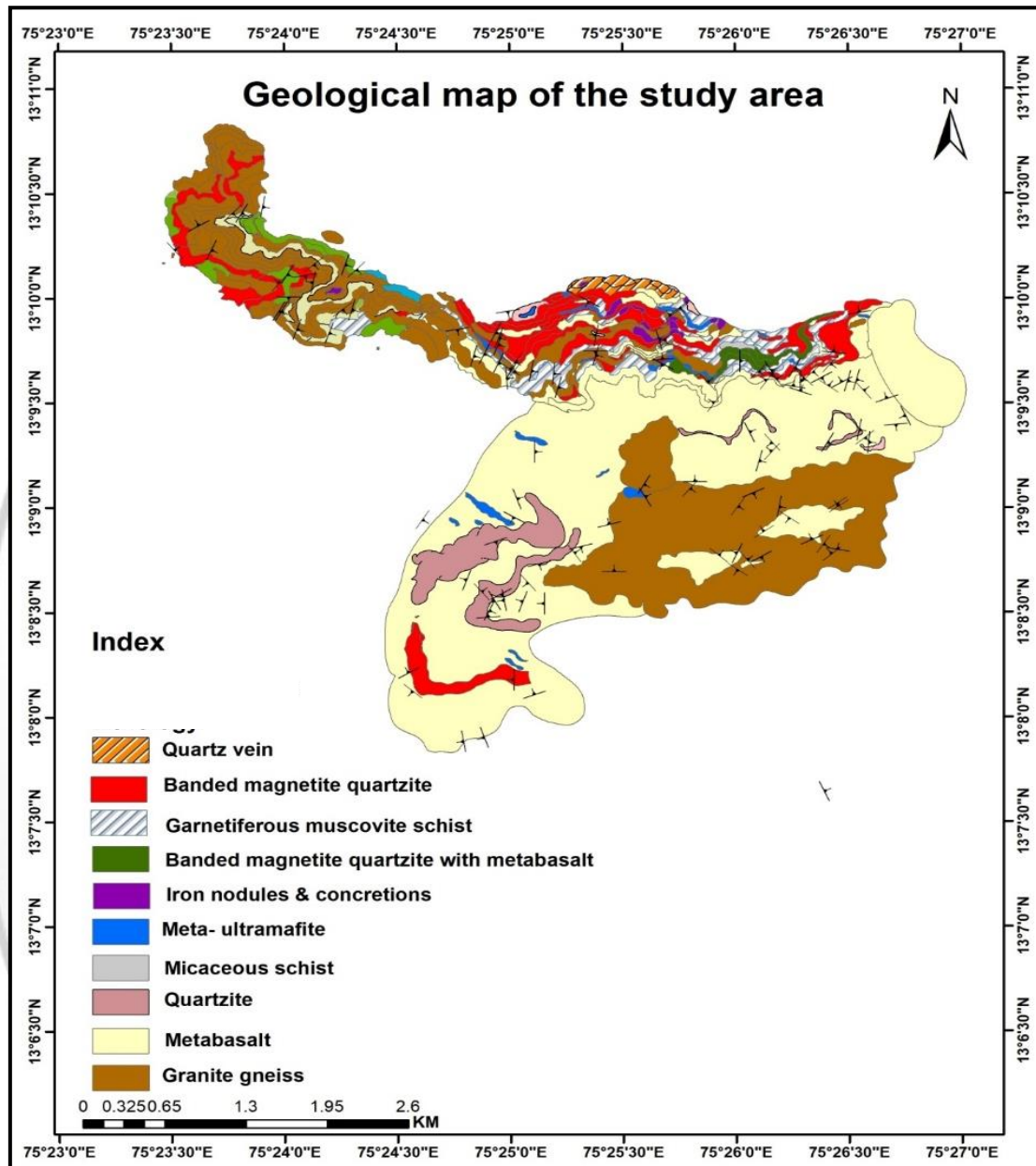


Fig 3: Geological Map of the study area parts of TS No. 48O/08

Fig 4: Updated Geological map of the study area mapped on (1:10,000) scale



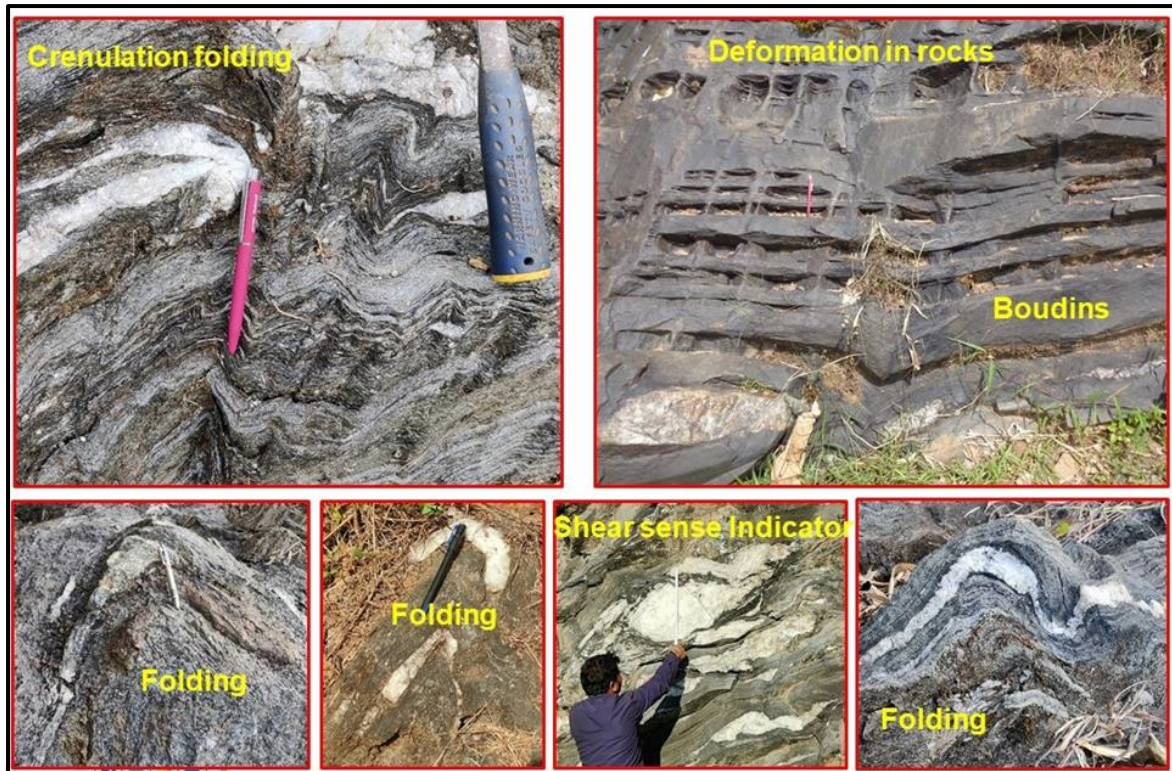


Photo 1: Sheared Boudin quartz in Gneissic rock near Balige.

The study area can be categorized into two distinct regions: the Northern and Southern parts. The Northern part of the hill ranges extends in a NW-SE direction, while the Southern part trends along NE-SW directions. The geological composition of the area comprises Peninsular Gneisses dating back to the Archean age, followed by metabasalt, Banded magnetite quartzite, Muscovite schist, and Meta ultramafic units belonging to the Bababudan Group of rocks. In certain areas, occasional Quartzite bands can be mapped alongside the metabasalt units, aligning with the general orientation of the study area (WNW-ESE). Garnetiferous muscovite schist and muscovite schist are prevalent in the northern part, while chlorites associated with quartz veins and chlorite schist can be observed in the southern region. The Northern part of the study area exhibits numerous Quartz veins associated with muscovite, which have intruded into the weak fractures of the litho units, following the general trend of the beds and deforming at various locations. Comparatively, the presence of Quartz veins is more pronounced in the Northern part compared to the Southern part. Occasional occurrences of anthophyllite rock boulders and minor fuchsite quartzite and chlorites have also been identified during mapping. Mappable beds of Quartzite bands, in conjunction with metabasalt, follow the same general trend of WNW-ESE and are primarily located in the southwestern part of the study area. In the higher elevations of the southwestern part, a thin layer of Banded magnetite quartzite units has been identified, where the

prominent Ballalarayan Durga fort is situated. Within the migmatites in the Northern part, the presence of meta-ultramafics has been identified, and the extension of meta-ultramafic bodies in the southern part has also been recognized. It's important to note that these units were recently mapped and were not represented in earlier Geological maps (1:50000).

The Northern and Northwestern parts of the study area have undergone intense shearing, resulting in the formation of migmatite units. These migmatite units are a mixture of Gneisses, Banded Magnetite Quartzite, meta ultramafics, muscovite schists, garnetiferous muscovite schists, quartz veins, and Metabasalts. This zone is identified as the main shear zone, while the southern part remains comparatively less affected. The Northern part of the study area also features highly sheared granites, boudin quartz veins, and shear sense indicators (Sinistral sense > Dextral sense). Additionally, well-developed Schistosity is evident in Gneisses, muscovite schist, and garnetiferous muscovite schist. These structures are associated with Banded magnetite quartzite, meta ultramafic, and meta basalts, aligning with the general trend of WNW-ESE directions. The Southern part of the study area primarily consists of two litho units: metabasalts and Gneisses of PGC. The presence of Chlorites in the southern part indicates a lower grade of metamorphism, while the presence of garnets in the northern part suggests higher pressure and temperature conditions (medium grade) compared to the southern part. This difference in metamorphic conditions indicates that the northern part underwent higher pressure and temperature, leading to the identification of migmatite units as the main shear zone. The presence of Garnets in all litho units further indicates a medium grade of metamorphism. The study area has experienced shearing followed by brittle deformation, indicating a Ductile-brittle deformation process. Numerous muscovites have been identified within the soil layer of the study area. The Gneisses are leucocratic, medium-grained rocks containing feldspar, biotite, quartz, and garnet. The presence of garnet in both Gneisses and metabasalt indicates a high grade of metamorphism. Metabasalts are melanocratic, fine to medium-grained, bedded, and are associated with quartzites in some areas. Banded magnetite quartzites exhibit alternating layers of Quartzite and magnetite bandings, characterized by high specific gravity. Muscovite Schists display crenulations and various shades of green colour, while meta ultramafics are medium-grained.



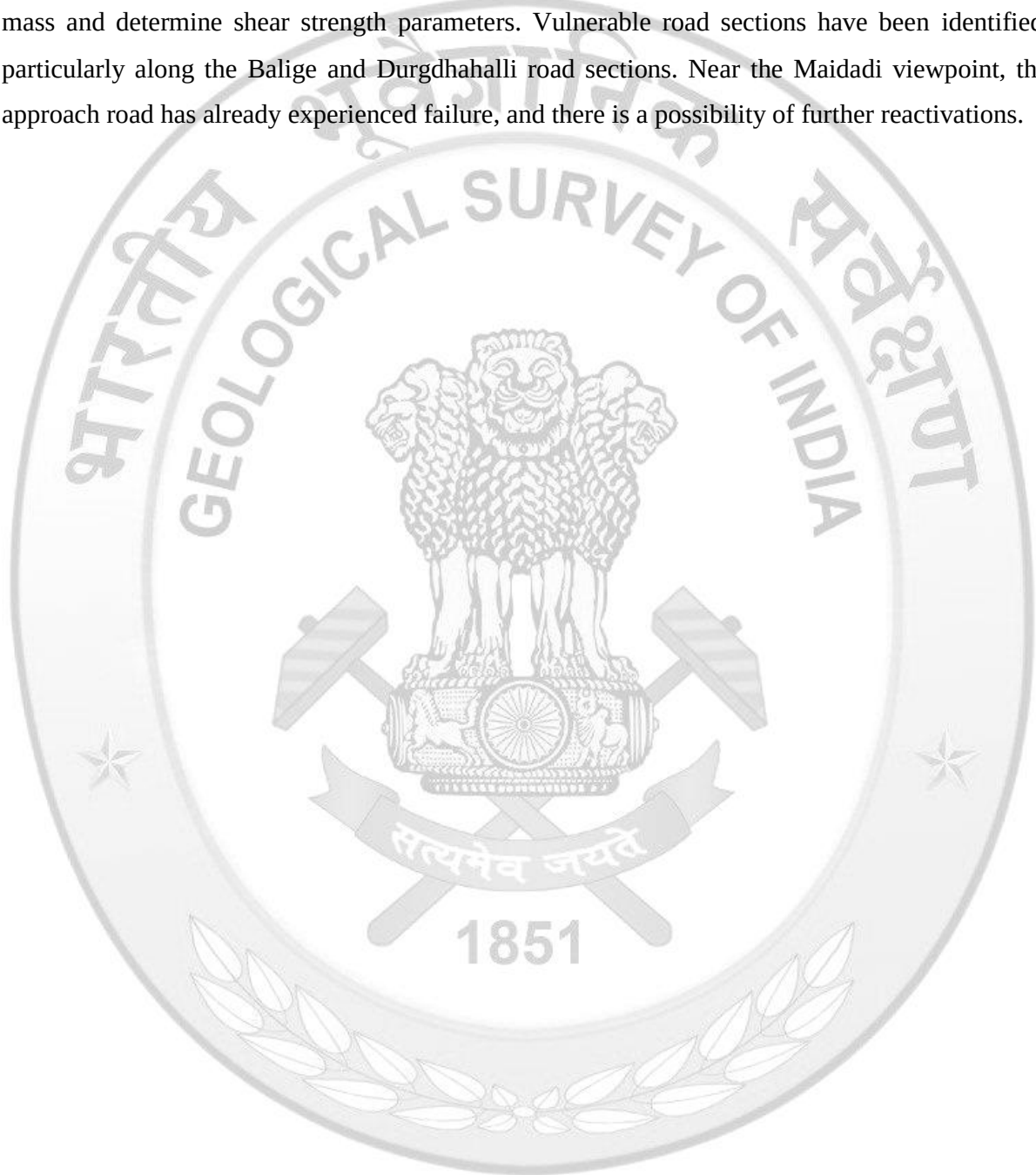
Photo 2: Deformation in rocks

The litho units in the study area have undergone two generations of folding, resulting in sharp hinges and straight limbs, forming tight folds. These folds are often asymmetrical and can range from open to tight folds. The axial plane of the folds varies from NW to NE directions, showcasing different orientations and plunging angles, referred to as polyclinal folds. The earlier fold has undergone refolding, leading to a superposition of folds and a fold interference pattern of the zigzag type. Flexural slip folds have also developed. The study area features two sets of joints, with one trending in the NW direction and dipping along NE/SW directions, while the other set strikes along NE directions and dips along SE/NW directions. In extensive slope cuts for roads, these joint sets, in combination with the bedding/foliated beds, create wedges and expose the foliation of bedding along the anacinal slope face. This configuration makes the slope vulnerable to failure. Kinematic analysis of most rock/debris slides reveals a positive correlation between wedge/daylight slope failures and persistent joint sets along the anacinal slope face.

Weathering in the study area is influenced by shearing deformation, leading to a moderate to highly weathered range. The sheared, boudin, folded, fractured, and jointed rock units display ductile-brittle deformation, with brittle fractured and fragile upper weathered rocks exposed.

These weathered rocks are sporadically spread within the soil zone. Notably, the most highly weathered units were washed away by a recent landslide on August 9, 2019, resulting in debris

flows along the major nalas. The thickness of regolith in the study area primarily falls within the range of 0-2 meters, with variations of 2-5 meters in gentler locations. A comprehensive documentation of 95 landslides has been carried out in the study area, encompassing failures along road sections and updates on old failures. A total of 32 nos. of geotechnical soil samples were collected, and Rock Mass Rating (RMR) analysis was conducted to characterize the rock mass and determine shear strength parameters. Vulnerable road sections have been identified, particularly along the Balige and Durgdhahalli road sections. Near the Maidadi viewpoint, the approach road has already experienced failure, and there is a possibility of further reactivations.



CHAPTER 3

METHODOLOGY

3.1 Selection of mapping units:

Before the evaluation of landslide susceptibility, the mapping unit should be selected first, which directly determines the extraction accuracy of the influencing factors and the suitability of the final evaluation results. Currently, common mapping units include grid units, slope units, and watershed units. Among them, slope units can more closely reflect the topography of the study area, so they are widely used in landslide susceptibility mapping. Therefore, slope units were adopted for landslide susceptibility mapping in the form of slope facets. The basic principle of slope units is the division of the study area into map units by ridge lines and valley lines. The slope facet map is prepared with the help of contour, ridges, spur, gullies and drainage as major topographical boundaries and slope breaks to delineate slope facets with similar/homogeneous slope inclination and slope direction.

3.2 Input data and maps:

For the mesoscale landslide susceptibility mapping on a 1:10000 scale, the work is divided into three stages i). Pre-field map preparation, ii). Field-based thematic map preparation and updation of the pre-field thematic maps iii). Post-field data modelling and analysis. The input data and maps required for landslide susceptibility analysis are described below:

Thematic Geofactor Maps Preparation:

I. Pre-field Studies: The pre-field thematic maps prepared for field validations are Landuse/Landcover, Landform, Drainage, and Slope Morphometry (Aspect, Curvature, Slope & Relief) maps, Landslide inventory maps prepared from satellite imagery.

- **Topographic Base Map** is prepared with DEM-derived contour, important location, road, river and slope facet in the GIS platform. CartoDEM (10m resolution) georeferenced satellite data product (UTM projection using WGS84 datum). Topographic map sheet and CartoDEM (10m resolution) is used for generating Topographic base maps on a 1:10,000 scale. The contour interval of preferably 10m interval is used for the preparation of the base map.

- **Slope Facet Map** is prepared by digitizing facet boundaries in a GIS by visualising the hillshades, drainage boundaries, contour intervals, and their spatial disposition, etc.
- **Landuse/Landcover Map** is prepared with the aid of satellite data and multi-temporal Google imagery in a GIS platform.
- **Landform, Stream Power Index, Drainage, and Slope Morphometry (Aspect, Curvature, Slope & Relative Relief) Maps** are DEM derivative categorical maps prepared from CartoDEM data of 10m resolution.
- **42 points geoparametric Landslide inventory database** is prepared with the help of multi-temporal satellite data, Google Earth imagery, historical and event-based data reported in earlier GSI reports, and other relevant papers/articles.

II. Field-based studies: The field-based studies includes pre-field thematic map validated during the mapping and preparation of field-based thematic maps.

- **Pre-field Map validation:** Land use/Land cover, drainage, and slope facets are modified after field validation
- **Field-Based Maps:** **a.** Geological map, **b.** Regolith Thickness map **c.** Slope Forming Material (SFM) map and **d.** Geotechnical map using the point maps with location and data of RMR_{basic} , regolith thickness, and feature/polygon maps with landslides and instability features on the ground are prepared in the field. The above maps are prepared by taking close field observations, and vital field-based data on lithology and structure are plotted onto the pre-field maps for updating lithological boundaries and other details.

III. Post-field Derivative Maps: The post-field derivative map is prepared from field-based data i.e. structural and RMR data collected during mapping.

- **Kinematic Map:** The kinematic map is prepared from structural data collected during field studies to determine the probability of planar, wedge, and topple failure along vulnerable joint/foliation planes with respect to the slope angle.
- **Geotechnical Map:** The geotechnical map is prepared from geotechnical results of soil/rock samples obtained from geotechnical sample analysis (Laboratory-based) for the determination of shear parameters of slope forming material.

3.3 Categorization of the study area into Domains:

Based on slope forming material type and landslide failure mechanism, the landslide/slope failure domain is classified into the following domains such as rocky slope is classified as the rock domain, soil/debris-covered areas are classified under the earth/debris domain, the extensive vertical cut slope is classified as cut slope domain whereas river and water body where there is no probability of occurrence of landslides is classified under no landslide domain.

3.4 Selection of geo-factors for Domains:

Based on detailed mapping and field-based investigations, the geofactors influencing the slope stability condition are determined and selected for each landslide failure domain for the domain-based landslide susceptibility map generation. For the rock domain, the kinematic failure map and geotechnical map are selected, for the cut slope domain, relative relief is considered apart from other geofactors associated with slope failure.

3.4 Ratings and Weights of Geofactors Maps and their Classes:

Ratings of geofactor classes and weights of geofactor maps are determined heuristically considering the different failure domains, the prevalent terrain conditions, and landslide inventory data. The spatial correlation of geofactor thematic maps and their classes and their role in the occurrence of landslides are explicitly studied during mapping for terrain-specific landslide susceptibility map generation.

3.5 Map Integration, Classification, and Validation:

To get the total estimated landslide susceptibility evaluation value (TESV), for each domain, the LSER value is assigned separately for the preparation of a landslide

susceptibility map on a 1:10,000 scale in the GIS platform. The heuristic knowledge-driven modelling and data integration using a multi-class index overlay of different thematic maps for each landslide failure domain are done. The validation of the model/success curve is determined using landslide incidences, surface cracks and subsidence with respect to the landslide susceptibility map.

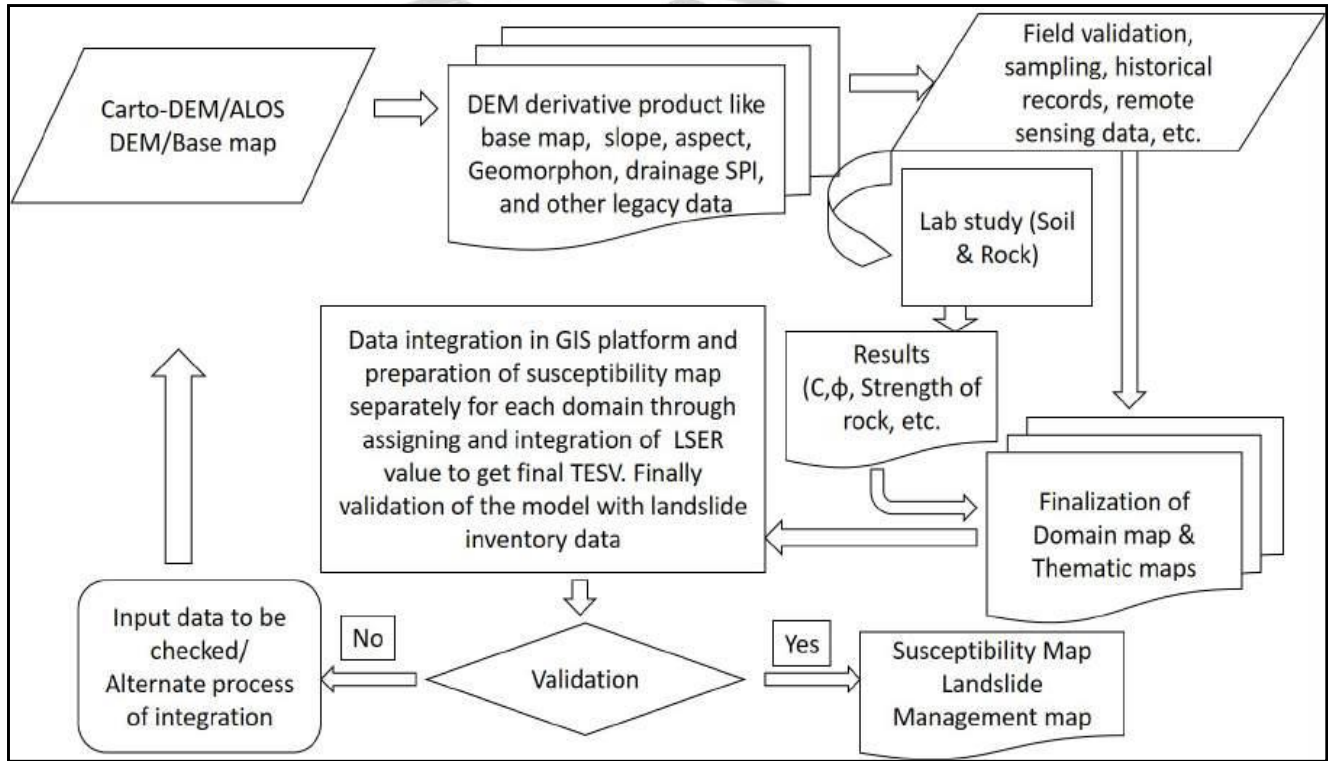


Fig 5: A generic methodological flow diagram showing mesoscale landslide susceptibility mapping.

CHAPTER 4

GEO-FACTORS THEMATIC MAPS

4.1 Selection of Geofactor Thematic Maps:

Landslide occurrences in any terrain are governed by various factors. So, multivariate analysis is taken into account for landslide susceptibility mapping which includes different terrain-specific causative geofactor themes and is taken into consideration which include:

- (i) Physical state of slope morphometric parameters: slope gradient, slope aspect, slope curvature, and relative relief.
- (ii) Geological slope forming material/lithology.
- (iii) Spatial variation in thickness of slope forming material.
- (iv) Geotechnical Shear parameters of slope forming material.
- (v) Geomorphic features i.e. landform units
- (vi) Geology and rock structure: orientation of planar/linear discontinuities in the rock mass (rock kinematics) in relation to the topography.
- (vii) Drainage/Distance to drainage buffer.
- (viii) Stream erodibility parameters (Stream Power Index).
- (ix) Land use/Land cover.

Based on the estimation of the above pre-disposing geofactors, the preparatory geofactors and their possible factor classes are considered for the preparation of the geofactor thematic maps for GIS-based landslide susceptibility analysis. Thematic data layers corresponding to the six causative geofactors were prepared in GIS. The data used to prepare these maps were collected from the topographic maps available on (1:25,000 scale), remote sensing data (Cartosat satellite imagery and multi-temporal satellite image accessed through Google Earth), published literature, and field data collected during field-based mapping.

As per the data model, some of the geofactor themes landslide inventory, land use/land cover, Geological slope forming material, and overburden thickness maps are categorical and DEM derivative maps i.e. slope morphometric parameters such as slope gradient, slope aspect, and slope curvature and relative relief, drainage and landform map are continuous data. These different spatial geofactor thematic maps are prepared using various source data and employing different mapping techniques. The different thematic maps are described below and only significant geofactor thematic maps are incorporated for data modelling and landslide susceptibility map generation on 1:10,000 scale selected for each landslide failure domain.

4.1.1 Slope Morphometry (Slope, Aspect, Relative Relief, Curvature) Maps:

Raster maps of Slope, Aspect, Relief and Curvature are DEM derivative geofactor maps generated from CartoDEM (10 m resolution) using the Spatial Analyst/3D Analyst Module of Arc GIS software.

(a) Slope Gradient Map:

The slope is a deterministic geofactor class governing the failure plane. The slope angle of the study area varies from 0-70° and according to the classified slope gradient map of the landscape, 20.29% of the area falls in slope class (0-10°), 37.01% in (10-20°), 30.69 % in (20-30°), 10.72% in (30-40°), 1.19% in (40-50°) and 0.09% in (>50°) (Fig. 6). The percentage distribution of different slope gradient classes are listed in *Table 3* based on classified slope map.

Table 3: The Percentage distribution of Classified Slope Gradient/Angle Map

Slope Classes	Area in (sq. km)	Percentage (%)	No. of Landslides
0-10°	2.5302	20.29	5
10-20°	4.6142	37.01	28
20-30°	3.8269	30.69	38
30-40°	1.3367	10.72	22
40-50°	0.1489	1.19	1
>50°	0.0111	0.09	0

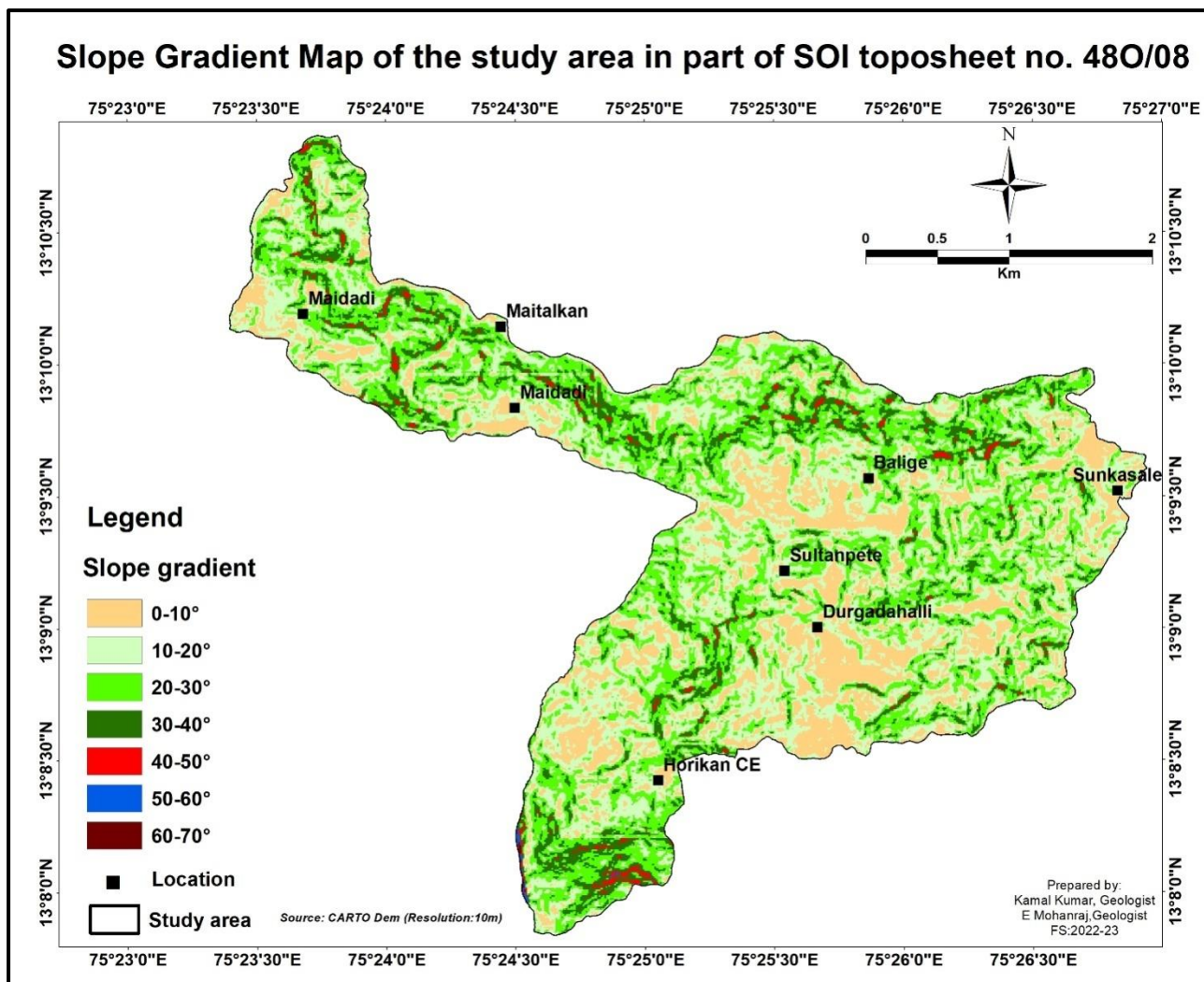
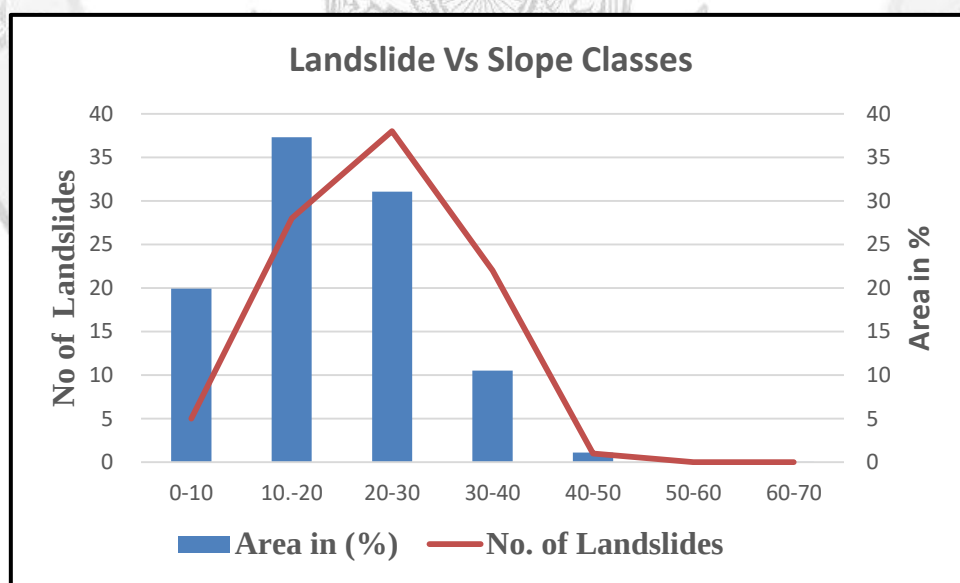


Fig 6: Slope Gradient Map of the study area (1:10,000 scale).



Graph 1: Graph showing the distribution of Landslides with respect to Slope Gradient Classes.

(b) Slope Curvature Map: Slope curvature shows negative and positive curvature values that represent concave and convex upward slopes respectively and zero curvature shows a flat surface (Fig.7). The percentage distribution of different slope curvature classes is listed in Table 4.

Table 4: The Percentage distribution of Classified Slope Curvature Map

Curvature Classes	Area in (sq. km)	Percentage (%)	No. of Landslides
<-0.1 (Concave)	5.500	44.127	34
-0.1-0 (Flat)	1.527	12.247	13
>0.1 (Convex)	5.438	43.626	47

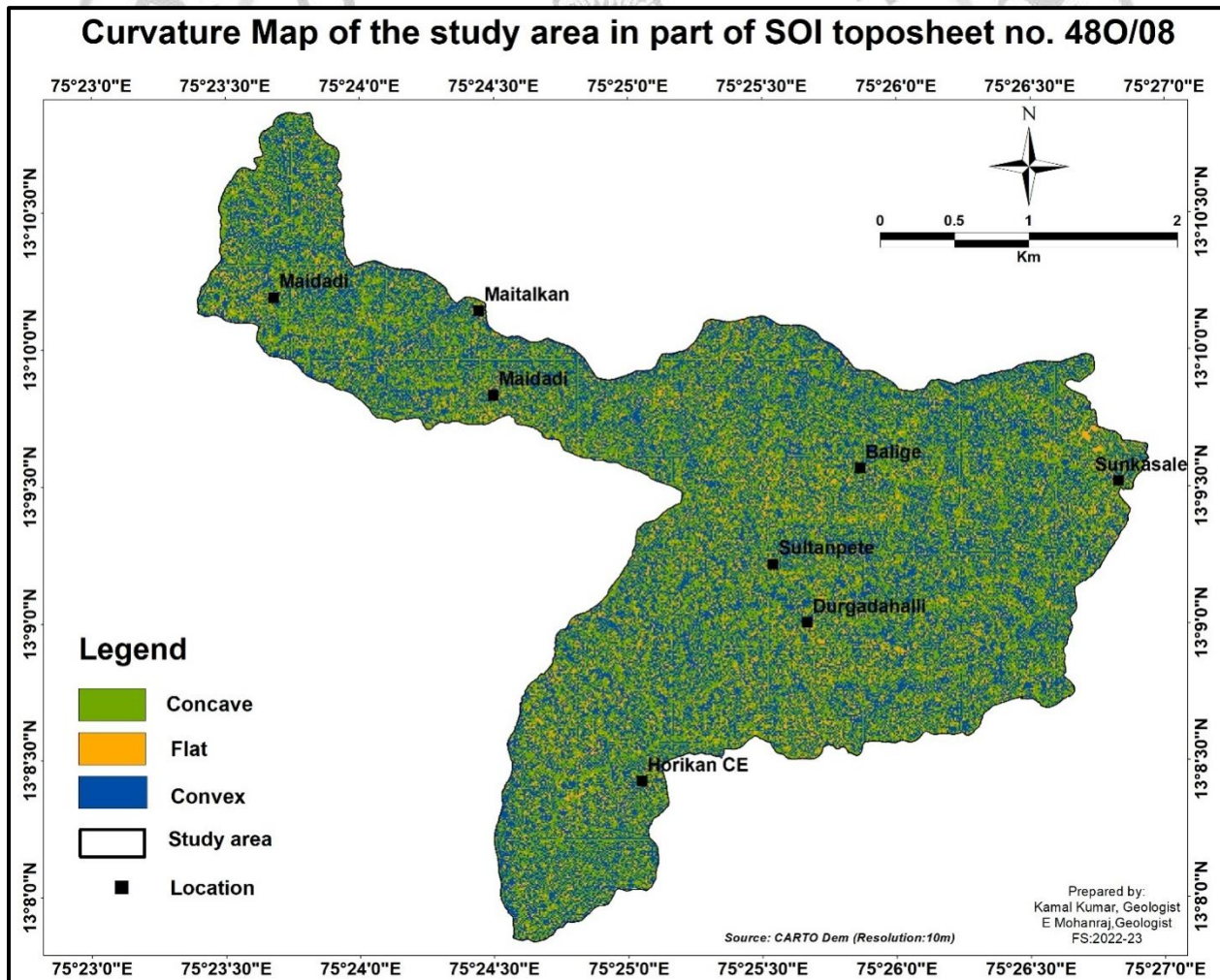
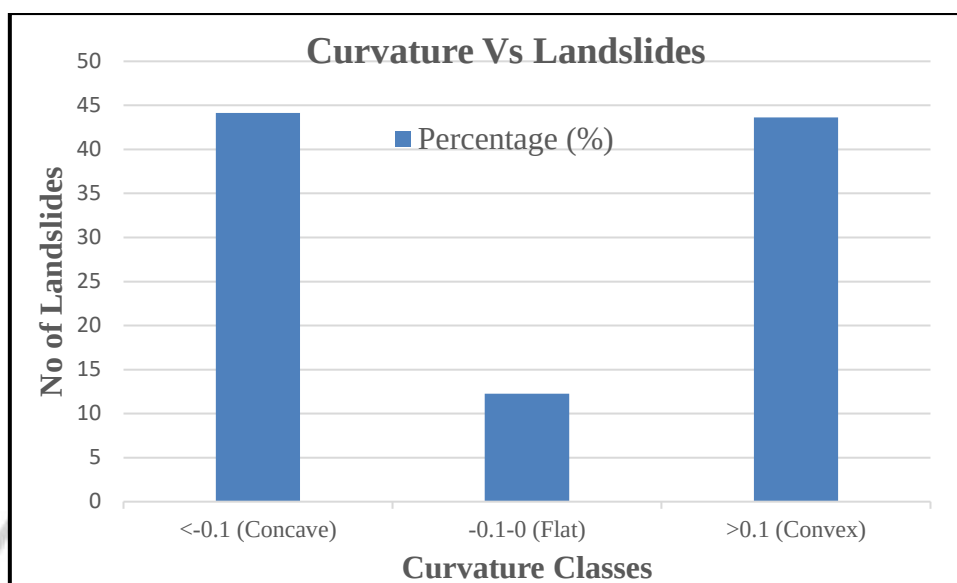


Fig. 7: Curvature Map of the Study Area



Graph 2: Graph showing the distribution of Landslides with respect to Curvature Classes.

(c) Slope Aspect Map: The direction of slope faces is the slope aspect and it is derived from the Carto DEM of 10m spatial resolution. It has been classified using the spatial analyst tool of Arc GIS (Fig.8). The geofactor theme aspect is categorized into 12 classes namely NNE, NE, ENE, ESE, SE, SSE, SSW, SW, WSW, WNW, NW & NNW. Raster maps of Aspect are generated for analyzing the Slope Morphometry. The percentage distribution of different slope aspect classes is listed in *Table 5*.

Table 5: The Percentage distribution of Classified Slope Aspect Map

Slope Aspect Classes	Area in (sq. km)	Percentage (%)	No of Landslides
Flat (-1)	0.0228	0.1833	0
North (0-22.5)	0.7998	6.4176	8
Northeast (22.5-67.5)	1.3439	10.7838	4
East (67.5-112.5)	1.5087	12.1059	9
Southeast (112.5-157.5)	2.1997	17.6508	24
South (157.5-202.5)	2.3825	19.1176	24
Southwest (202.5-247.5)	1.5933	12.7847	16
West (247.5-292.5)	0.9210	7.3898	4
Northwest (292.5-337.5)	0.9955	7.9882	3
North (337.5-360)	0.6952	5.5783	2

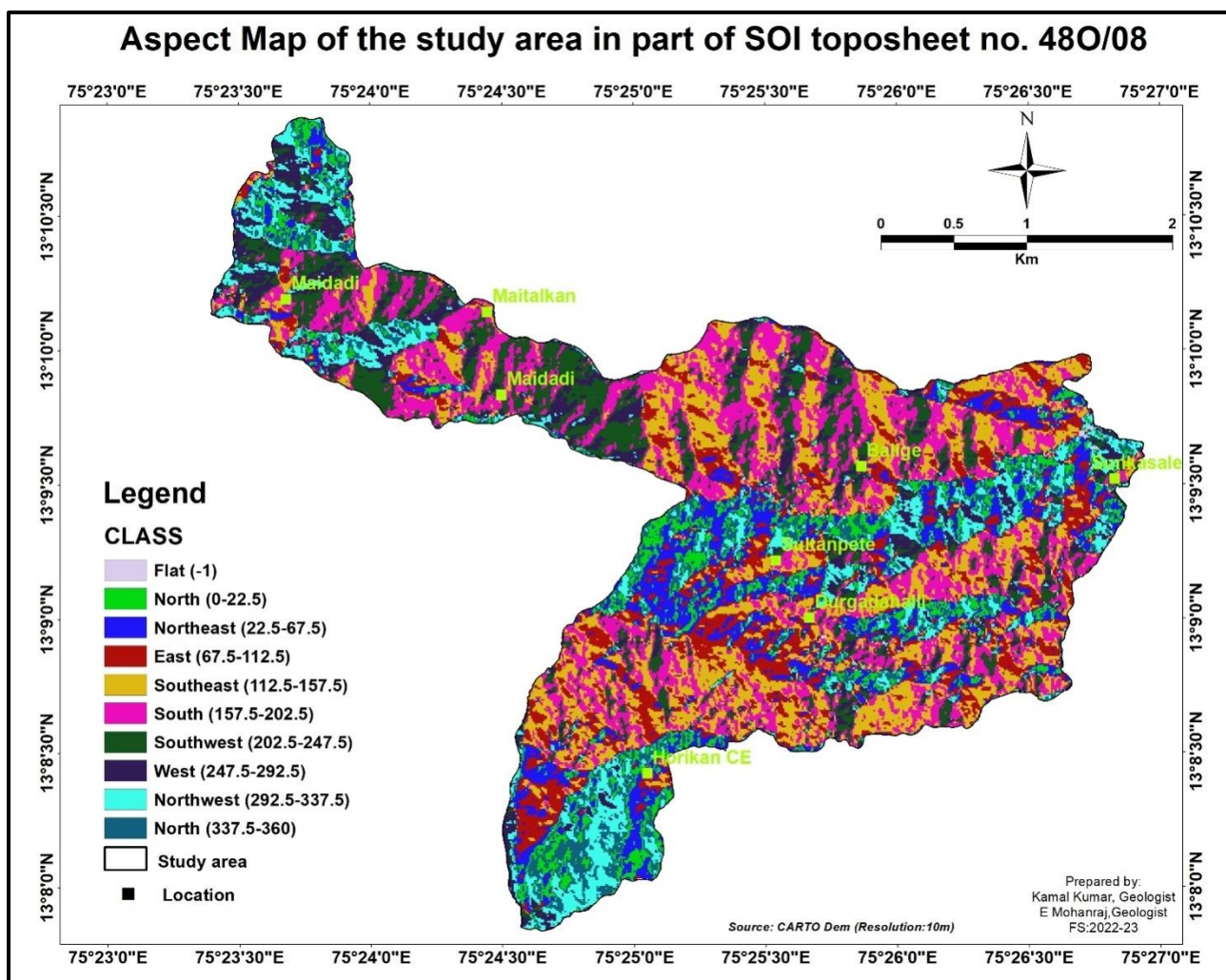
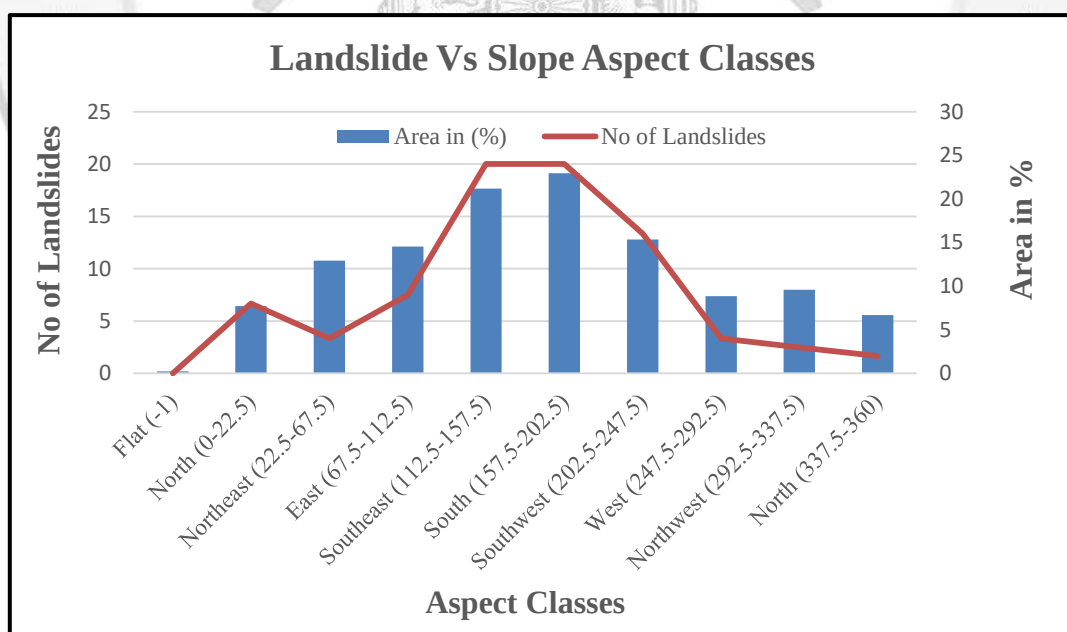


Fig 8: Slope Aspect Map of the study area (1:10,000 scale).



Graph 3: Graph showing distribution of Landslide with respect to Slope Aspect classes.

4.1.2 Relative Relief Map: Raster maps of Relief are generated for analyzing the Slope Morphometry and are extracted using CartoDEM data of 10m resolution using the spatial analyst tool in the GIS platform (**Fig 9**). The relative relief represents the actual variation of altitude in a unit area with respect to its local base level. The relative relief classes can be indicative of vulnerability to erosion.

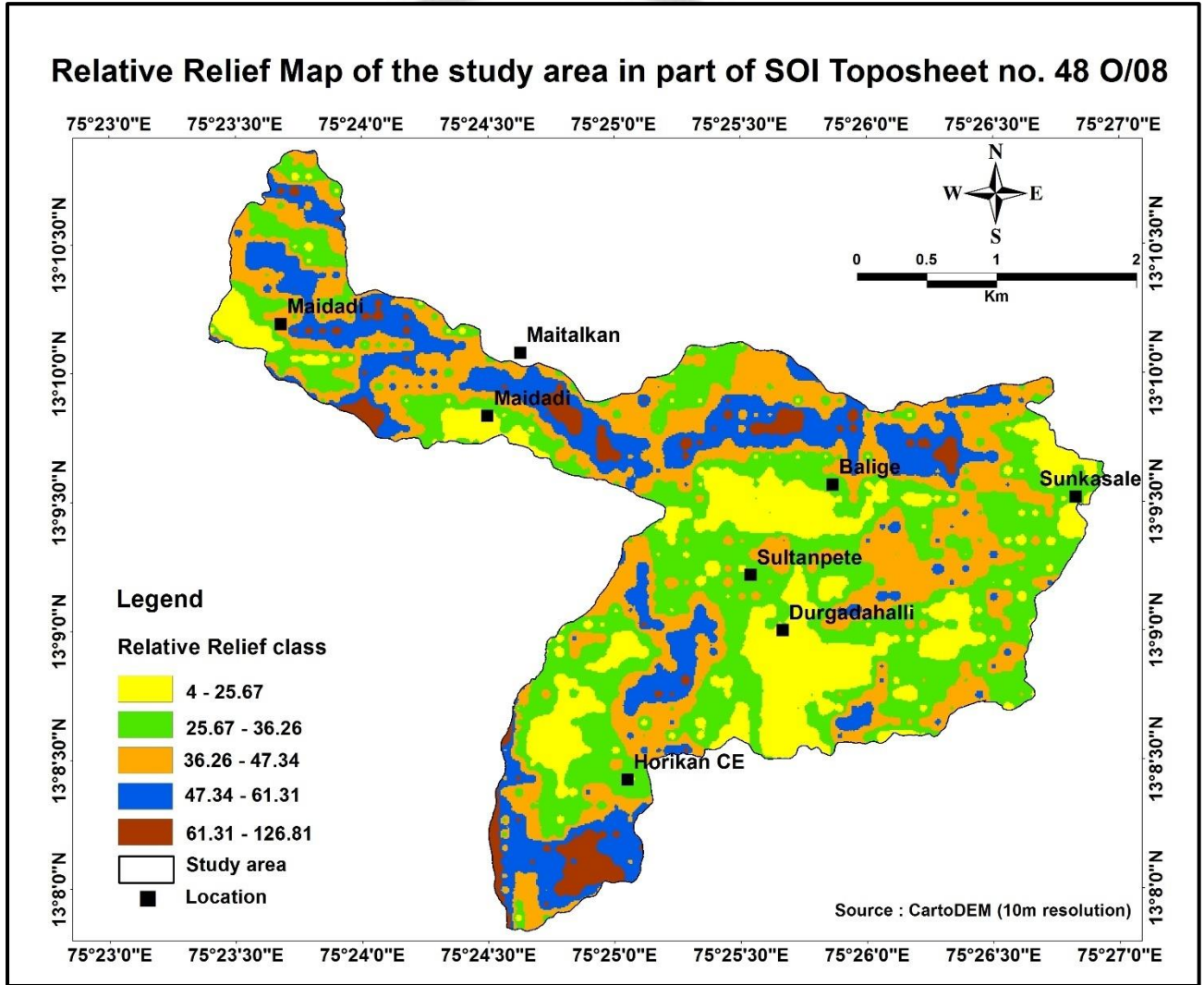
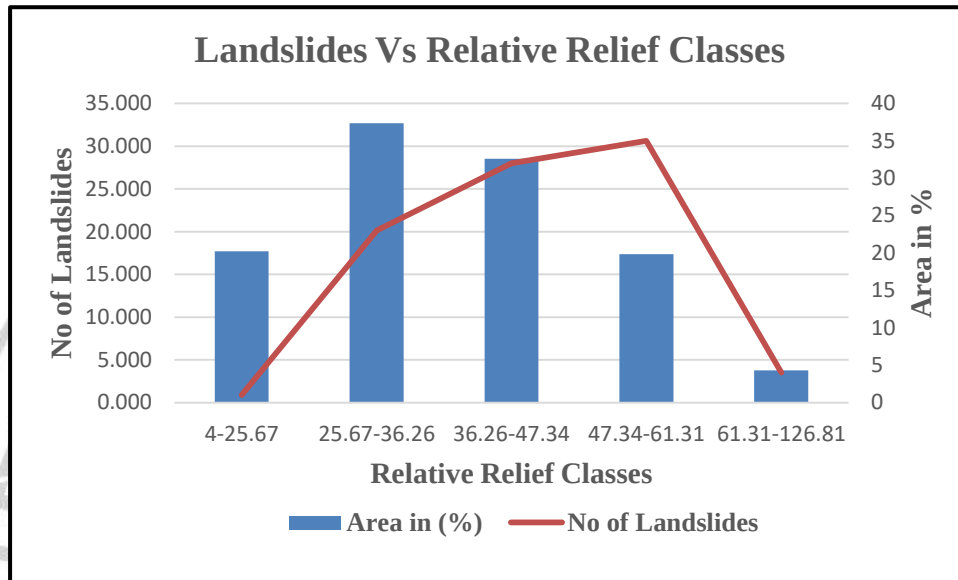


Fig 9: Relative Relief Map of the study area (1:10,000 scale).

Table 6: Percentage distribution of Relative relief classes for the study area.

Relative relief Classes	Area in (sq. km.)	Percentage (%)	No of Landslides
4-25.67	2.204	17.692	1
25.67-36.26	4.072	32.682	23
36.26-47.34	3.553	28.519	32

47.34-61.31	2.163	17.358	35
61.31-126.81	0.471	3.783	4



Graph 4: Graph showing distribution of Landslide with respect to Relative Relief classes.

4.1.3 Landform Map: The “Landform Map” is prepared using Carto DEM (10m resolution) in the GRASS GIS software platform (open source). The different landforms are implicitly system generated based on DEM derivative terrain attributes: slope and curvatures. The geomorphic unit is reclassified into 08 landform classes: Summit, Ridge, Spur, Slope, Hollow, Footslope, Valley and Depression (Fig. 10).

Description of the different Landform units are described below:

- i) **Summit** – The topographically highest portion of a hillslope profile with a nearly level (planar or only slightly convex) surface.
- ii) **Ridge** – A long narrow elevation of the land surface, usually sharp-crested with steep ridges and forming an extended upland between valleys.
- iii) **Spur** – A subordinate ridge or lesser elevation that projects sharply from the crest or side of a hill mountain or other prominent range of hills or mountains.

iv) Slope – (also called slope gradient or gradient) inclination of the land surface from horizontal.

v) Foot slope- the hillslope profile that forms the concave surface at the base of a hillslope. It is a transition zone between upslope sites of erosion and transport (shoulder, backslope) and downslope deposition (toeslope).

vi) Valley-An elongated relatively large externally drained depression of the earth's surface that is primarily developed by stream erosion.

vii) Depression- Any relatively sunken part of the earth's surface, especially a low-lying area surrounded by higher ground.

The percentage distribution of different landform classes is listed in *Table 6* based on the classified landform map. Geomorphon units have been given below:

Table 7: The Percentage distribution of Classified Landform Map

Landform Classes	Area in (sq. km)	Percentage (%)	No. of Landslides
Summit	0.066	0.528	0
Ridge	0.713	5.727	1
Spur	2.558	20.534	13
Slope	5.876	47.170	64
Hollow	2.347	18.844	16
Footslope	0.000	0.001	0
Valley	0.818	6.571	1
Depression	0.078	0.623	0

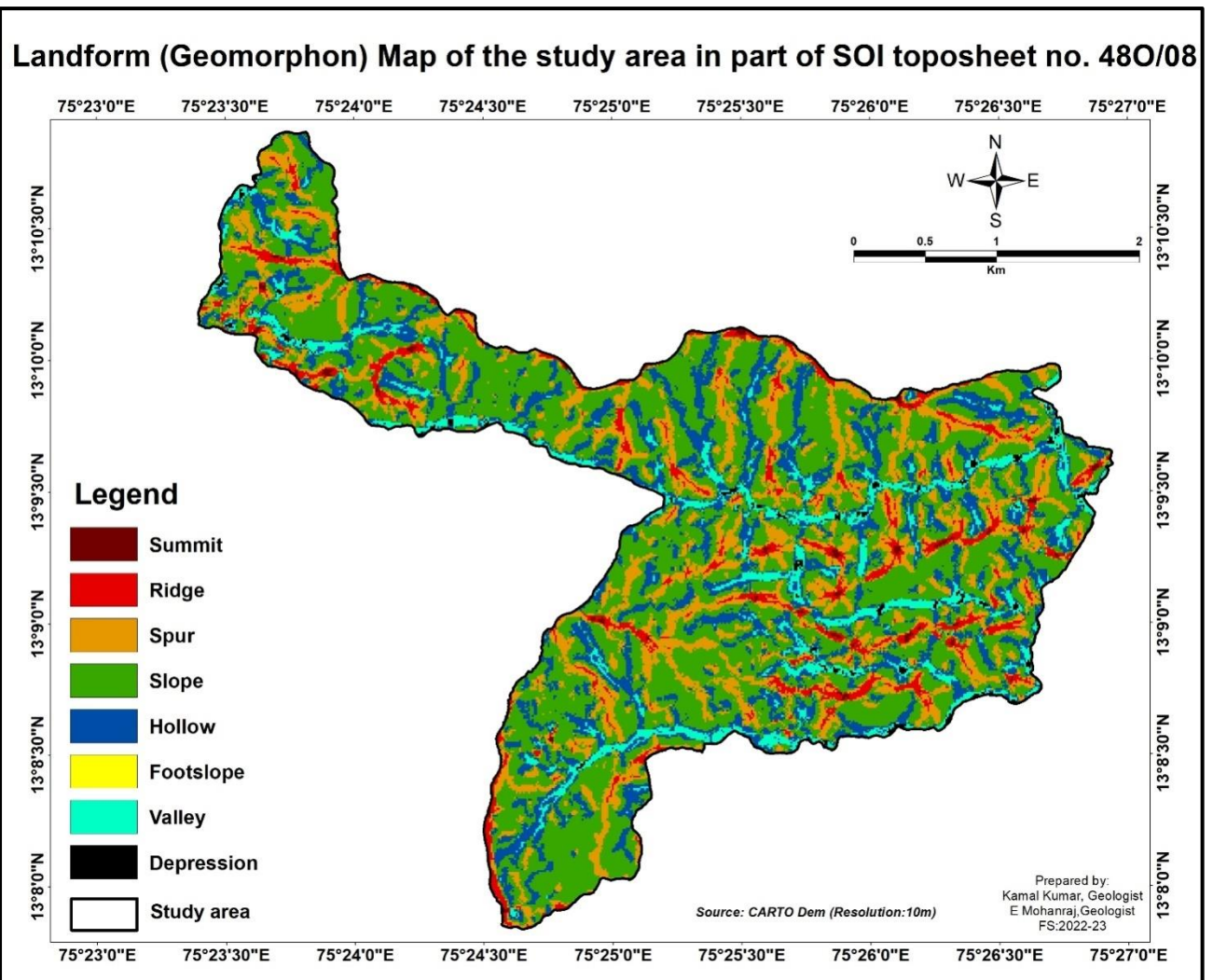
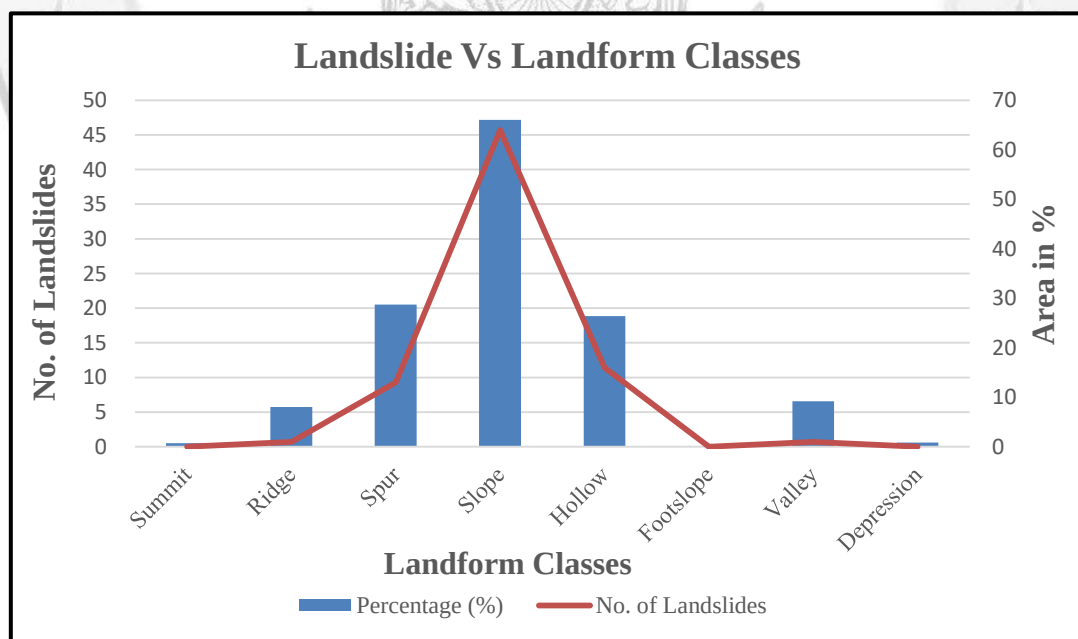


Fig 10: Landform Map of the study area (1:10,000 scale).



Graph 5: Graph showing distribution of Landslides with respect to Landform classes.

4.1.4. Drainage Map: Concerning hydrological parameters, the different order of streams are extracted and classified as first-order, second-order and higher-order streams using Strahler's (1957) ordering system. Drainage map of different stream orders i.e. 1st Order, 2nd Order, 3rd Order, and 4th Order streams (Fig11) are extracted in the GIS platform using spatial analyst tool using CartoDEM data of 10m resolution. Drainage pattern varies from sub-dendritic to sub-trellis patterns in nature.

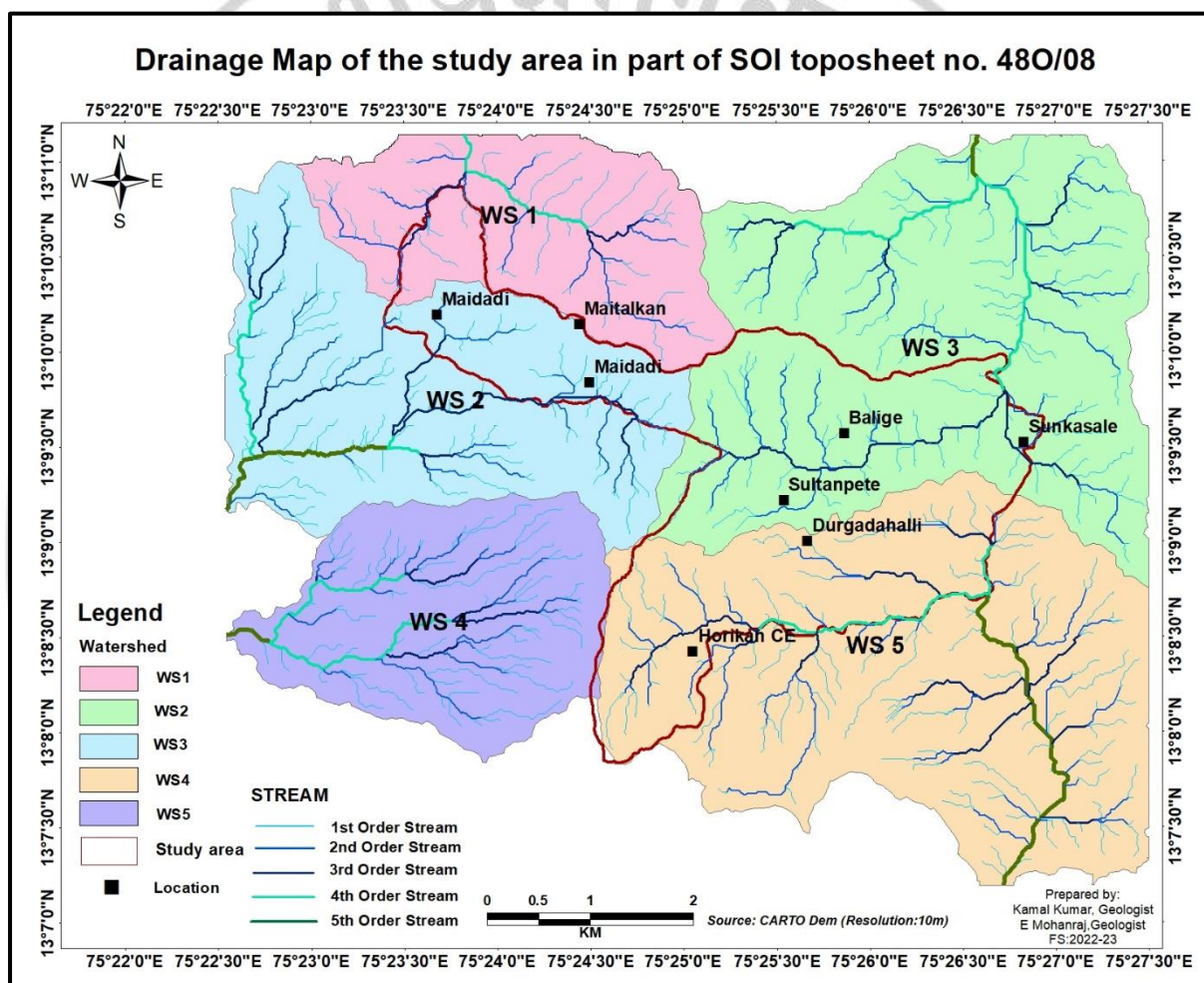


Fig 11: Drainage Map of the study area (1:10,000 scale).

4.1.5 Stream Power Index Map: The stream power index map estimates the stream power as well as its variability along the mainstream and its tributaries. The sudden and more substantial variation in stream power was then related to the process acting in the fluvial system. The approach made it possible to highlight how erosion, solid transport, and sedimentation phenomena occurring along the fluvial reaches area are related to the increase and decrease in the stream power erosion capacity. The stream power variability along a stream can be used as a preliminary diagnostic element to identify the most sensitive points

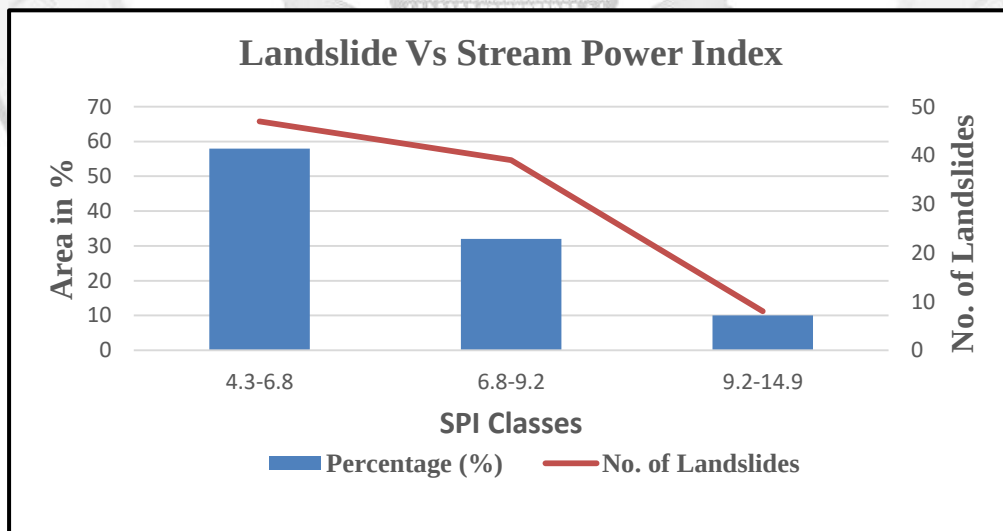
on the stream. Stream power index (SPI) is which accounts for the local slope gradient and catchment area and hence the proportionate discharge or erosive power of the drainage is accounted for.

Stream power index is expressed as $SPI = A_s \times \tan \sigma$

The catchment by flow area is represented by accumulation raster A_s and σ is the slope gradient in degrees (Conforti et al., 2011, Shit et al., 2015). It is generated using the primary terrain attributes which include the slope, flow direction, and flow accumulation through the map algebra tool in ArcGIS. In the current study, the erosion condition-stream power index matrix will adequately reflect slope erosion processes along with the erosive power of running water directly influencing slope instability. In the current study, the erosion condition-stream power index matrix will adequately reflect slope erosion processes along with the erosive power of running water directly influencing slope instability. DEM derivative stream power index map is reclassified into three classes: 4.3-6.8, 6.8-9.2, 9.2-14.9. Based on the erosion capacity of streams maximum weightage and rating are assigned to SPI Class: 9.2-14.9. (Fig.12)

Table 8: Percentage distribution of Stream Power classes in the study area

SPI Class	Area	Percentage (%)	No. of Landslides
4.3-6.8	7.220802	57.931372	47
6.8-9.2	3.991766	32.025322	39
9.2-14.9	1.251839	10.043309	8



Graph 6: Graph showing distribution of Landslide with respect to SPI classes.

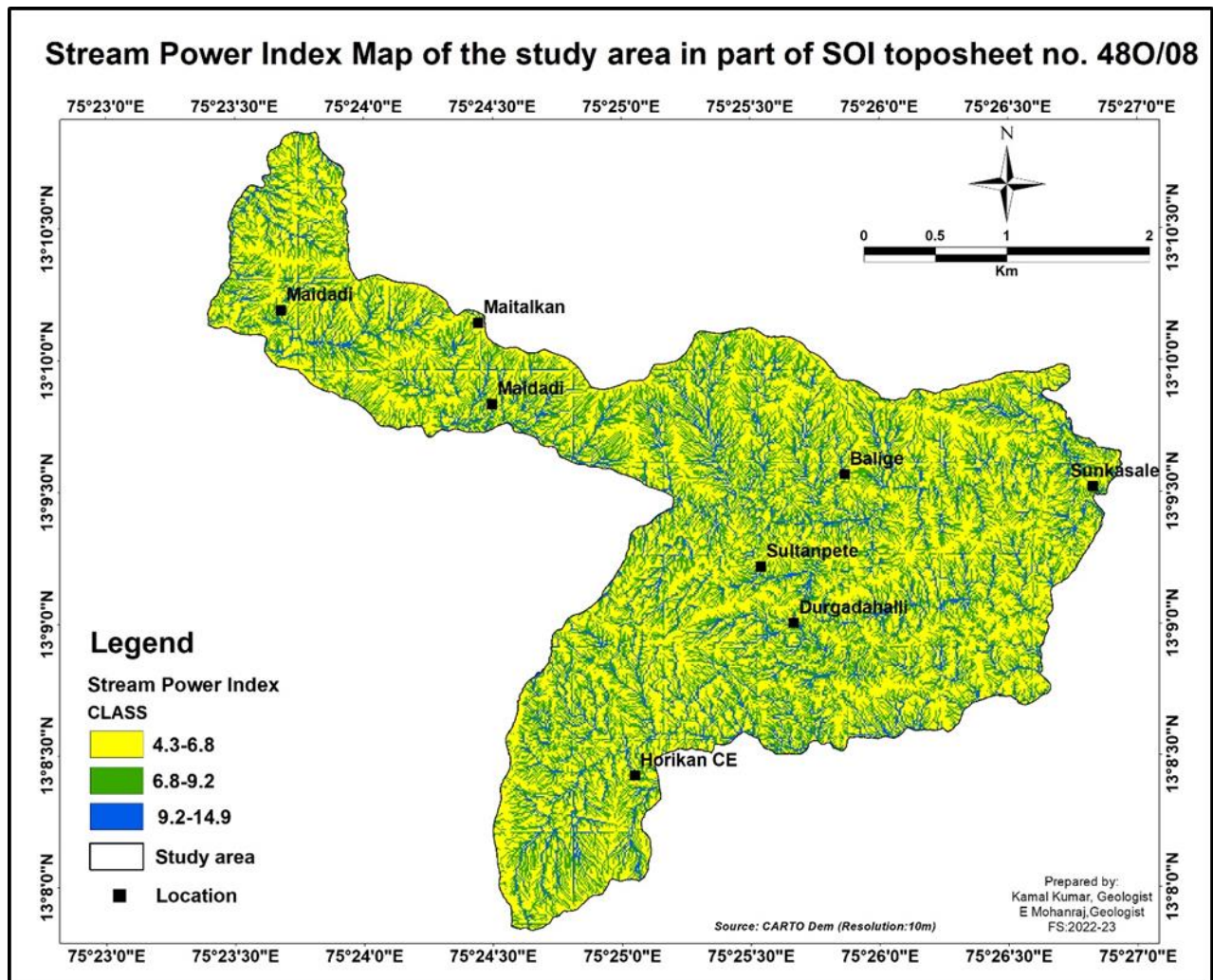


Fig 12: Stream Power Index Map of the study area on (1:10,000 scale).

4.1.6 Land use/ Landcover Map: Pre-field Land use/ Land cover map was validated and updated and the Post-field Land use/ Landcover map was prepared in the ArcGIS platform. The change in Landuse/ Landcover will affect the stability of slopes which will change the hydrological condition of hillslopes, and influence rainfall patterns, surface water infiltration, and runoff. All these factors contribute to the determination of the shear strength of the soil. The vegetation cover on the slope plays a vital role in binding the loose soil by root cohesion.

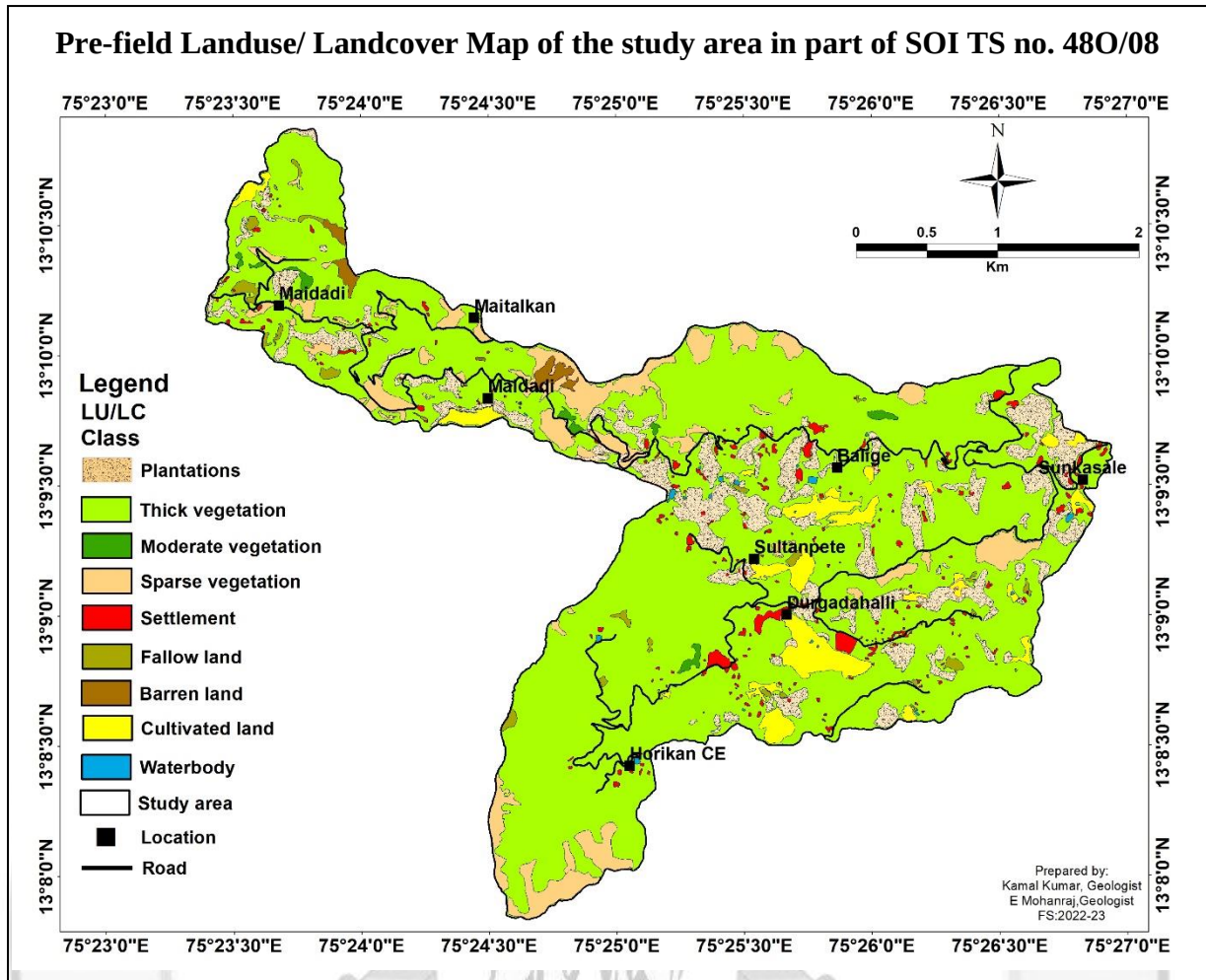


Fig 13: Pre-field Landuse/ Landcover Map of the study area on (1:10000 scale).

The LULC class of plantation marked during pre-field studies are corrected as coffee plantation after field check. Those settlements on a slope that may be vulnerable, are also marked separately in the updated LULC map. A settlement on slopes has been classified from the field as a settlement on a modified slope.

Table 9: Percentage distribution of LULC classes vs Landslides in the study area.

LULC Classes	Area in (sq. km)	Percentage (%)	No. of Landslides
Thick Vegetation	6.693	53.097	47
Moderate vegetation	0.055	0.439	0
Sparse vegetation	0.550	4.365	8
Coffee Plantation	3.671	29.120	37
Cultivated land	0.927	7.355	2
Barren	0.444	3.526	0
Settlement	0.168	1.333	2
Fallow land	0.086	0.685	1

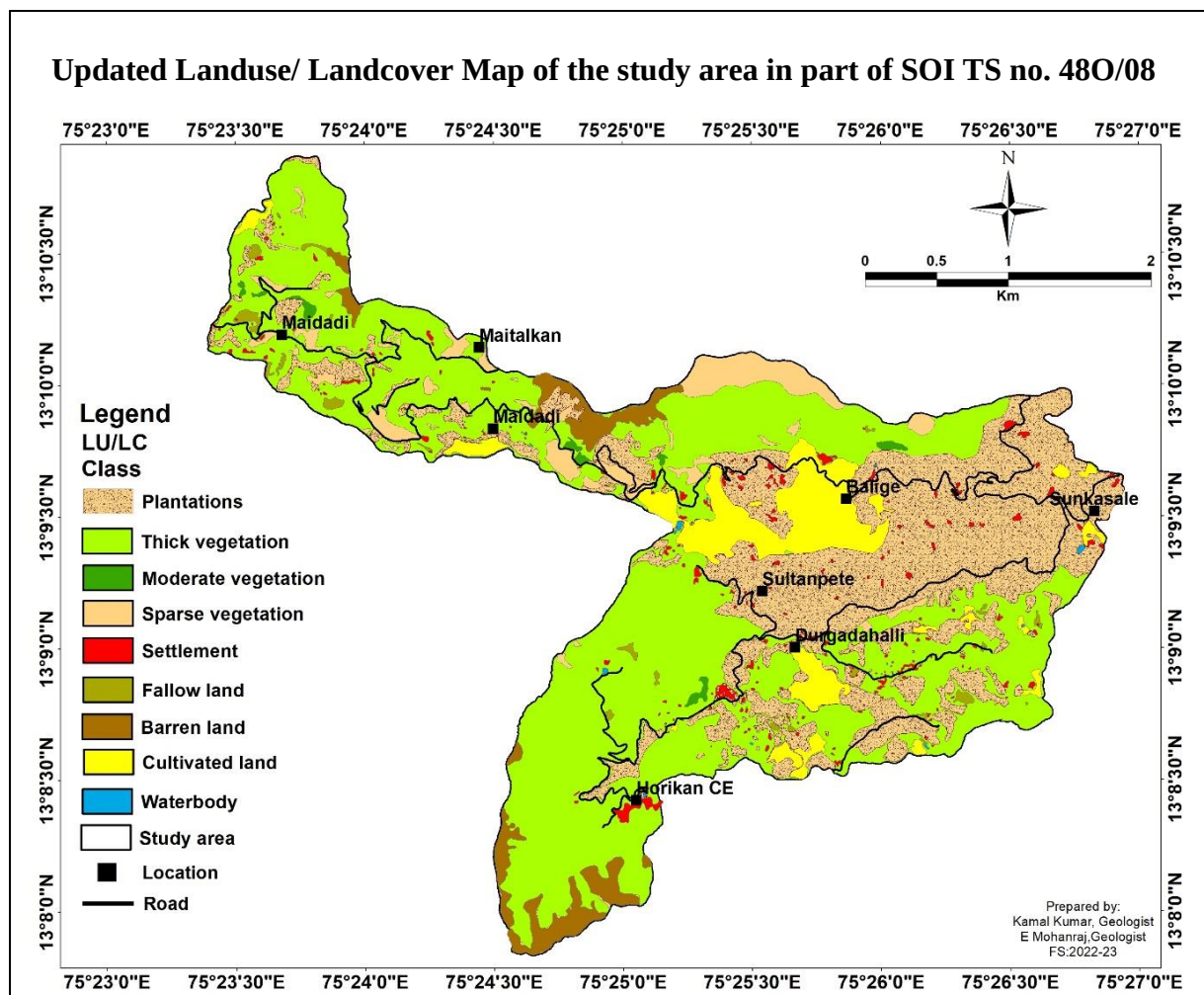
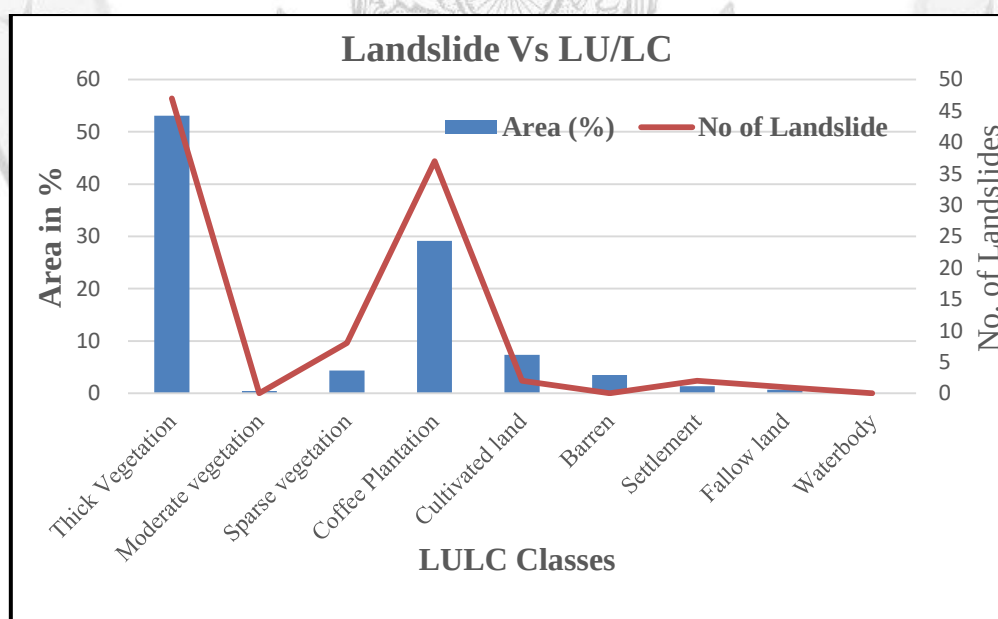


Fig 14: Updated Landuse/ Landcover Map of the study area on (1:10000 scale).



Graph 7: Landuse/ Landcover Vs landslide distribution

4.2 Field-based Geo-factor Thematic Maps Preparation:

4.2.1 Geological Slope Forming Material (GSFM) Map

The slope-forming material map has been prepared from the classes of LULC i.e. cultivated land and barren land, and sparse vegetation has been used to classify the slope-forming material map as in situ soil. Google Earth has been used to classify the rock units and the transported soil from the slided zones and foothills of the nalas etc. After venturing into the field weathered rock and remaining classes have been classified from the field evidence. Even mature and immature soil has been classified only from the field evidence as represented in the post-field map. In the pre-field map, it has been classified only as a soil. The units present in the pre-field SFM map are soil, Rock and transported soil and in the post-field slope forming map the soil unit has been classified into mature and immature soil and the weathered rock zones have been classified.

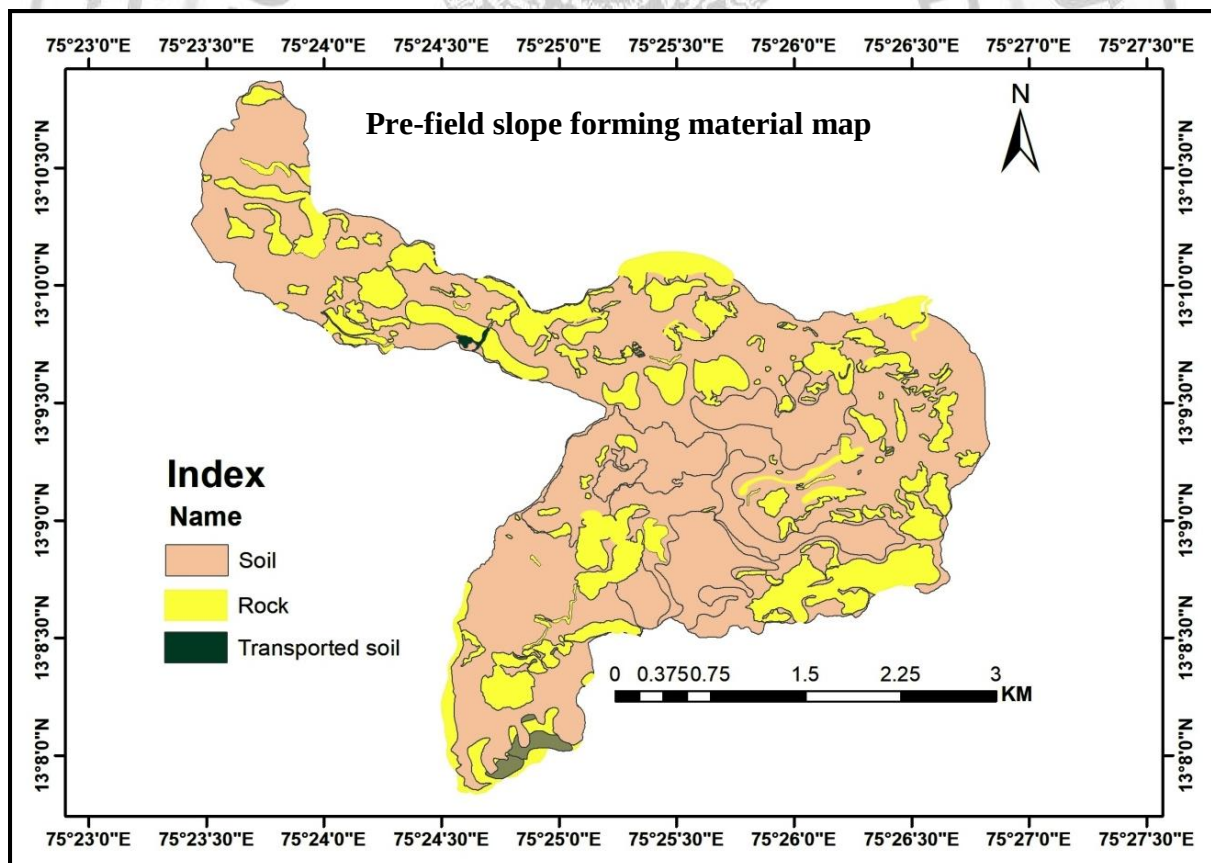


Fig 15: Pre- field Slope forming material map of the study area on (1:10,000 scale)

Google Earth has been used to classify the rock units and even transported soil from the slided zones and foothills of the nalas etc. After venturing into the field weathered rock and remaining classes have been classified from the field evidence. Even mature and immature soil has been classified only from the field evidence as represented in the post-field map. In the pre-filed map, it has been classified only as a soil. More than 80% of the landslides fall on the mature and immature soil zones.

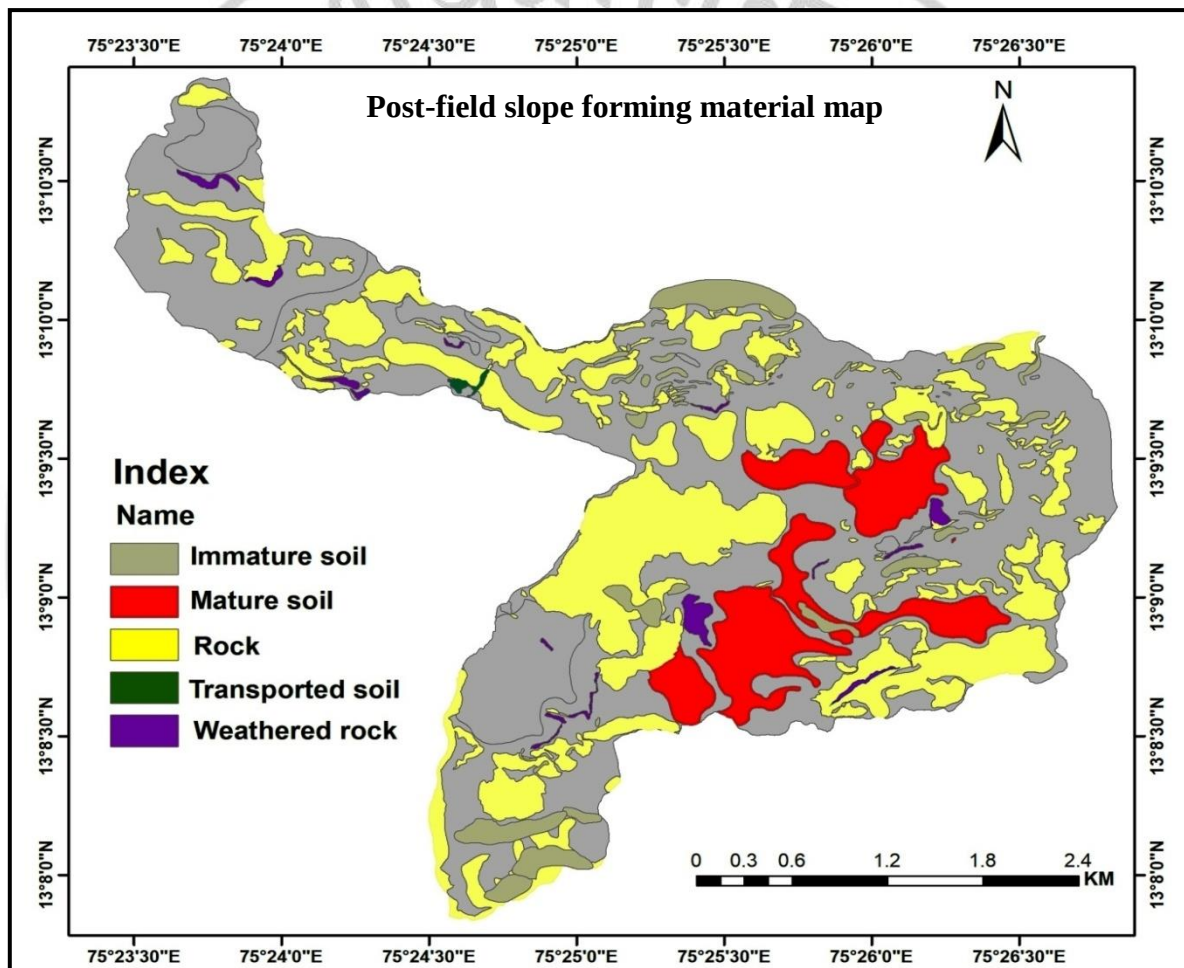
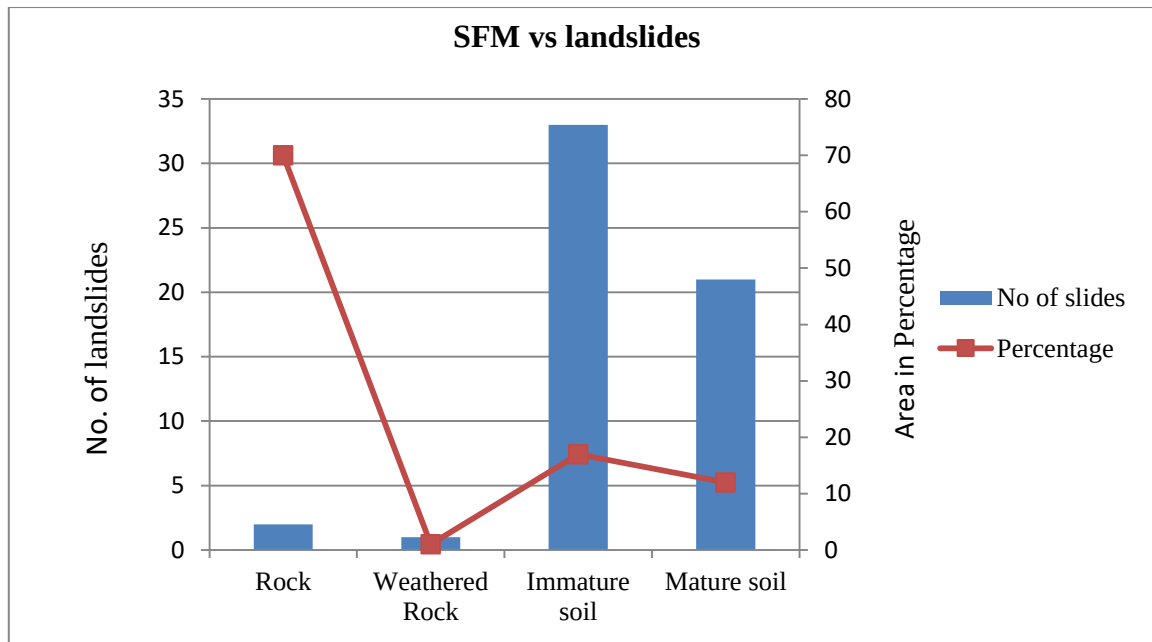


Fig 16: Post- field Slope forming material map of the study area on (1:10,000scale)



Graph 8: Slope forming material Vs landslide distribution

4.2.2 Regolith/Overburden Thickness Map: The Regolith thickness map has been classified in the pre-field map from the proxy map classes of the Lulc and SFM maps. But in the field, the classification is clear from the direct evidence. The in-situ soil layers and weathered units have been classified under the (0.5 -2m) range of Regolith thickness. The floodplain area from Google Earth has been classified as (2-5m) thick. The rocky area has been demarcated under <0.5m thickness. The pre-field map has been prepared and after visiting the field the whole map has been validated through the available data from the road cut sections and cut slope sections for the house. The Regolith thickness of 0.5 to 2m has more no of landslides reported followed by 2-5m thickness.

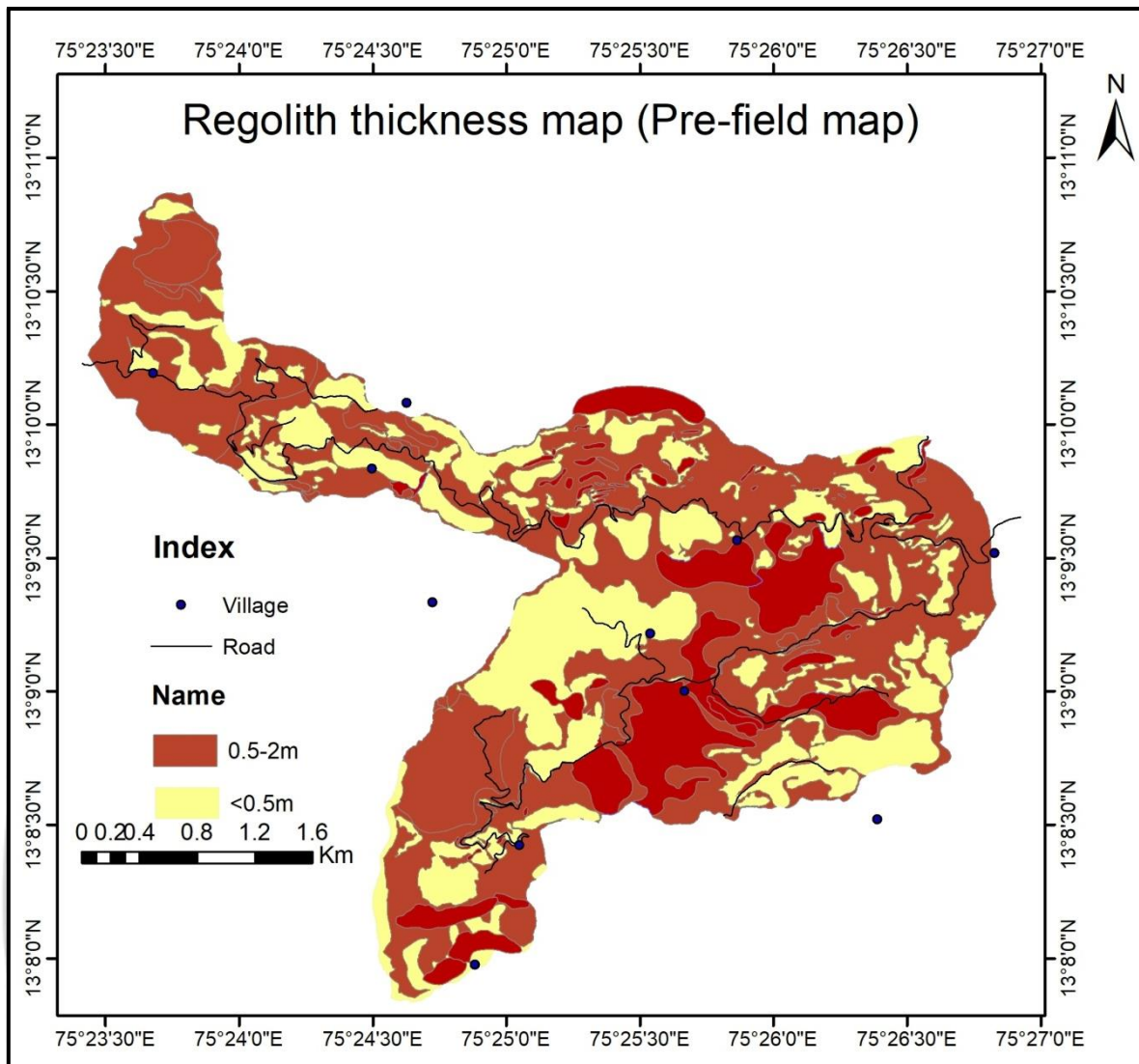
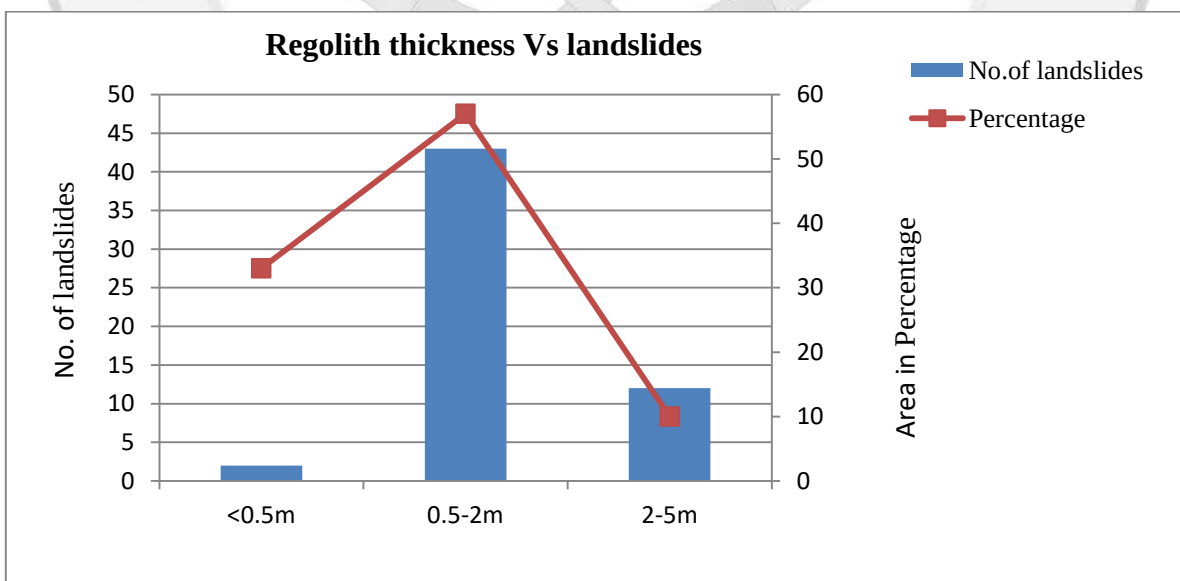


Fig 17: Pre-field Regolith thickness map of the study area on (1:10,000 scale).



Graph 9: Landslide distributions over the Regolith thickness

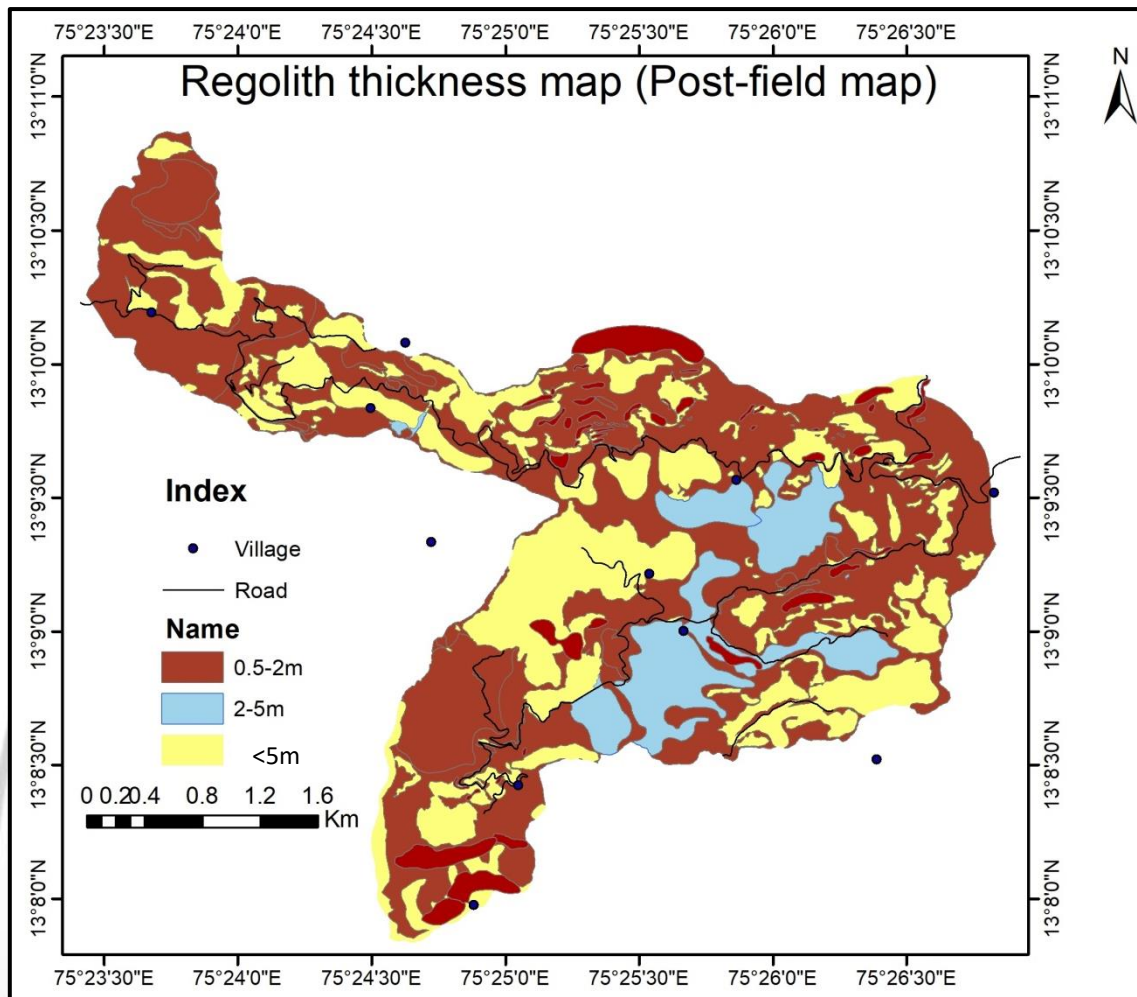


Fig 18: Post- field Regolith thickness map of the study area on (1:10,000 scale).

4.2.3 Landslide Incidences and Landslide Failure Domain Map:

During the landslide inventory mapping, a total of 95 nos. of old and reactivated landslide incidences with 42-point geoparametric attributes were recorded and updated. A 42-point geoparametric landslide inventory database is documented in (**Annexure I**). The landslides are classified as shallow landslides/flows of either translational or rotational. The majority of landslides are shallow, translational, debris slides recorded and a few are rock slides and earth slides. The spatial distribution of landslide incidence illustrates that for slope stabilization remedial measures and mitigation measures are suggested to minimize the risk to life and property if any.

The domain map has been prepared based on the field inputs. It is classified into Cut slope domain, rock domain and overburden domain. The break in slope from the road cut has been demarcated as the upslope for the cut slope domain and the downslopes up to the slope break are demarcated. The rock domain and the overburden domain (Earth & debris) have been mapped based on the field inputs as the landslide failure zones and cut sections along

hill slopes gives clue about the presence of a type of material and map the area as per our preference. Here the landslide incidence analysis with the domain map shows that more than 80% of the landslide incidences fall on the cut slope and the overburden domain.

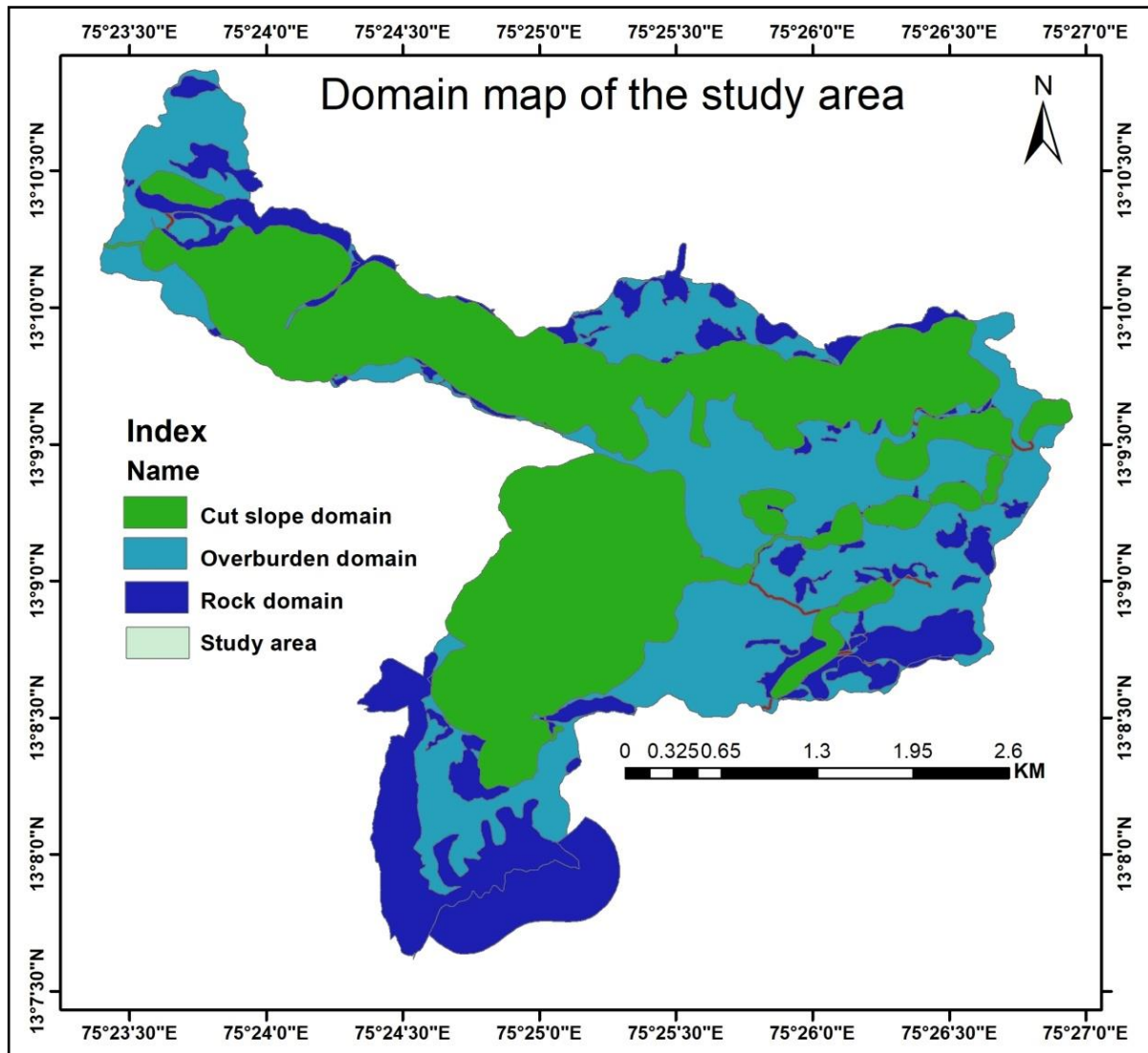
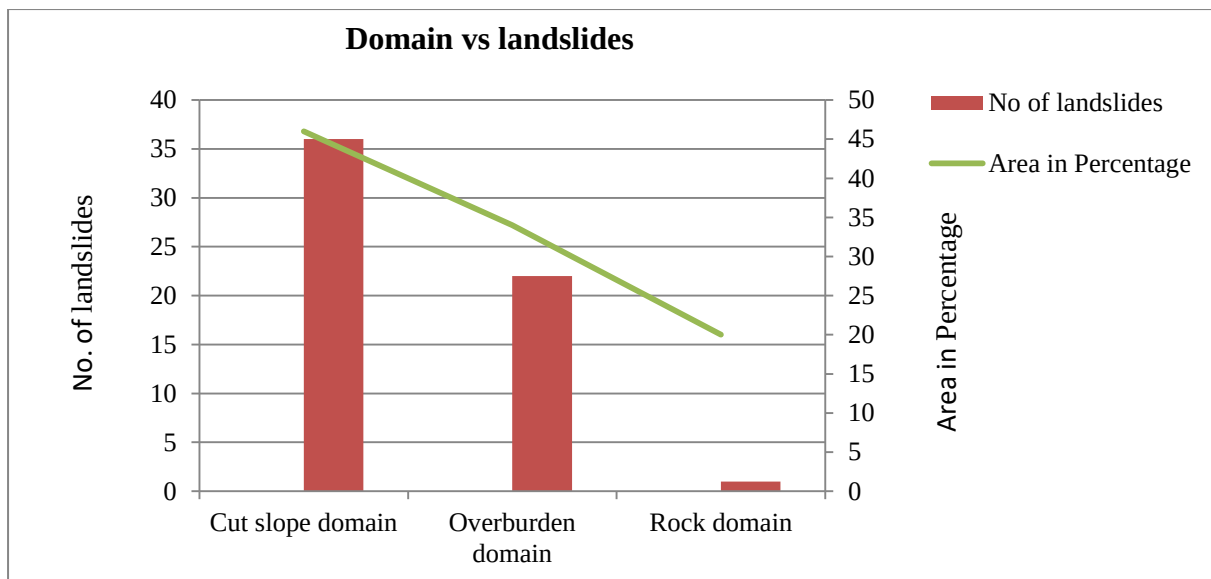


Fig 19: Domain map of the study area on (1:10,000 scale)



Graph 10: Landslide distribution over the Domain map

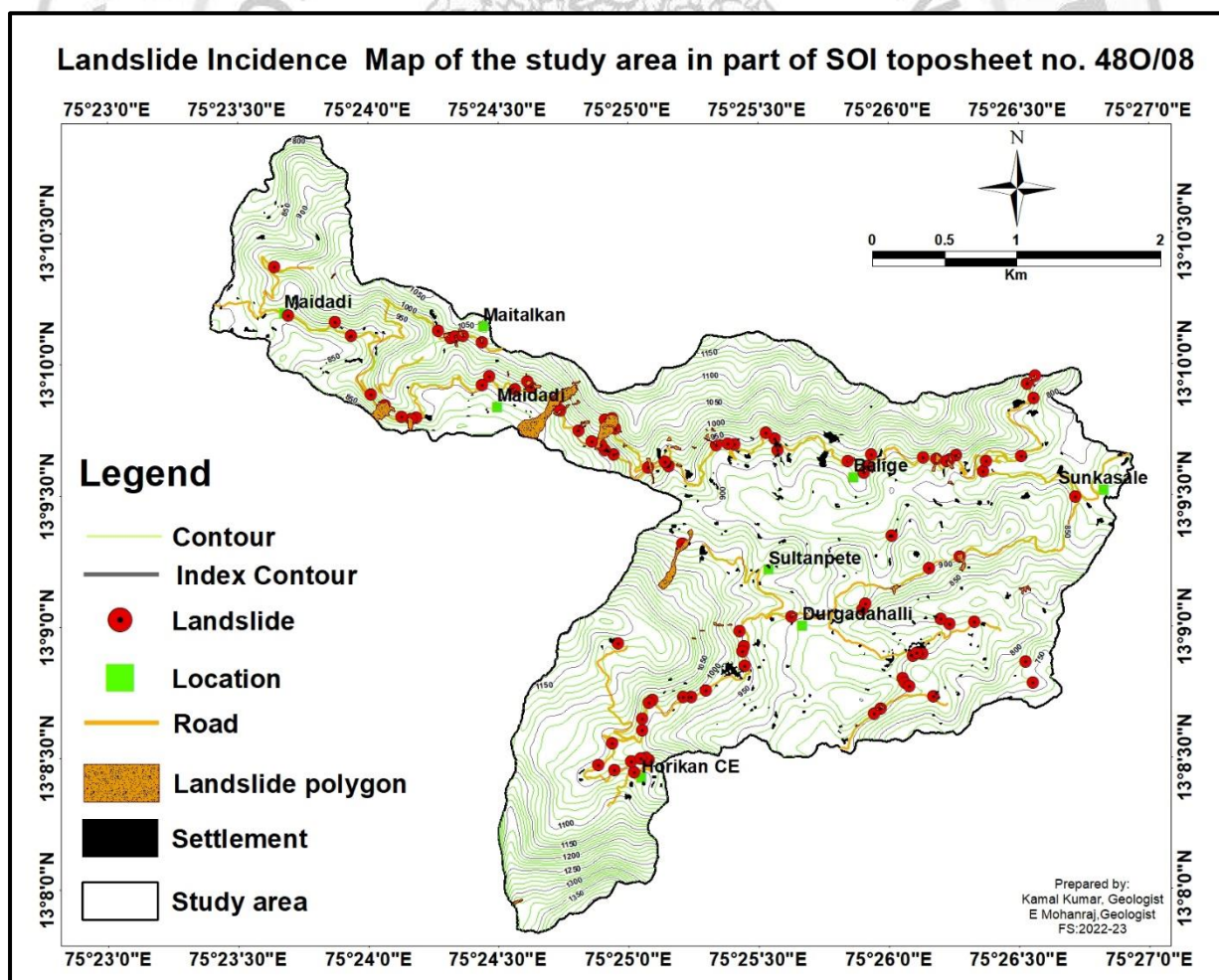


Fig 20: Landslide Incidence Map of the study area on (1:10,000 scale)

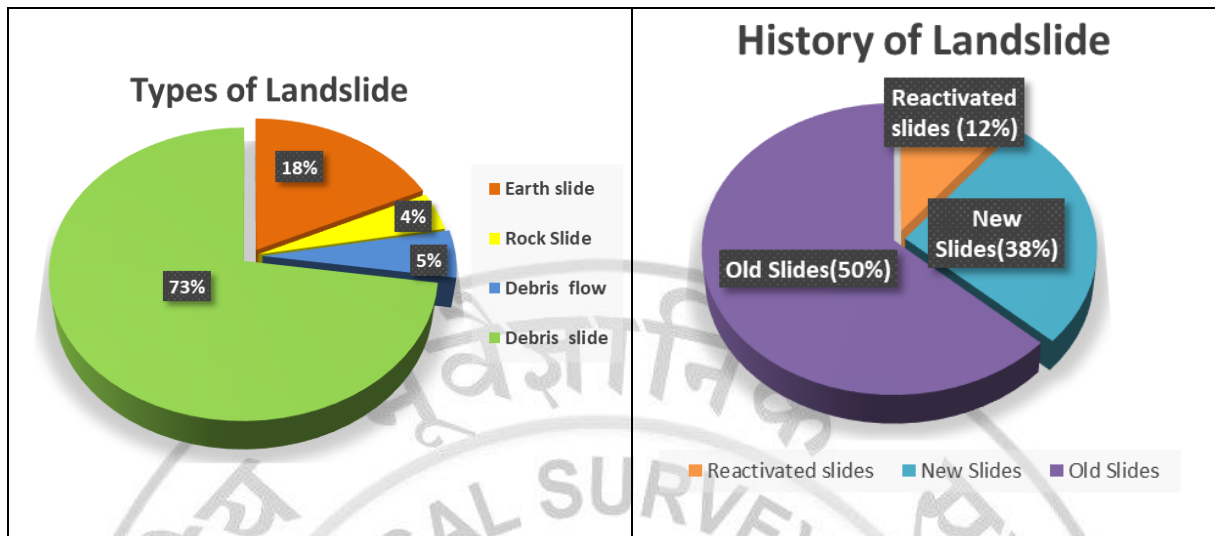


Fig 20(a): Landslide Incidence Map of the study area on (1:10,000 scale)

4.3 SAMPLING AND GEOTECHNICAL TESTING:

SAMPLING: The geotechnical maps play a vital role in determining the shear parameters of the slope-forming material. The spatial variability i.e. heterogeneity of soil can have a significant effect on slope stability. The geotechnical investigation includes field tests and laboratory testing of soil samples. The representative sampling is done on slope facets with similar slope morphometric parameters and similar overburden material type and at landslide zones and vulnerable hillslopes at different elevations to study the physical and mechanical properties of slope-forming material. For rock mass characterization 32 nos. of samples i.e. 32nos. of undisturbed soil were collected and analyzed by the geotechnical laboratory, SR for sample testing. Samples are widely distributed in all the available slope-forming material classes. The geotechnical soil sample results are attached in Annexure II. The sample location map on the facet Base Map is shown in Fig. 21.

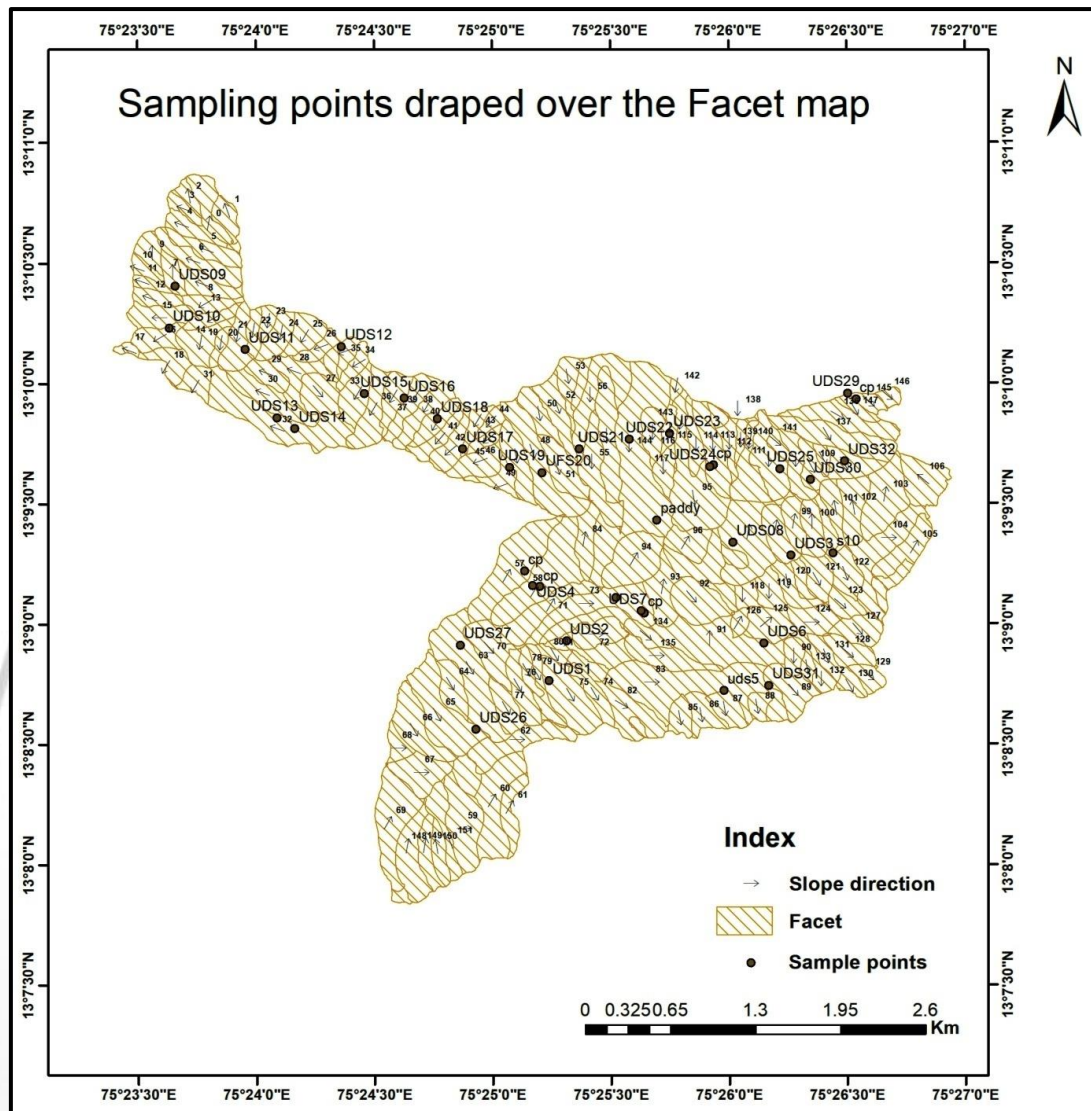


Fig 21: Sampling points draped over the facet map

SAMPLING METHODOLOGY:

i) Sampling is done by covering the entire variants of slope-forming material from varying elevations and is recorded on a base map sheet along with all observation/ field data location points. The samples are well distributed and preferably collected from undisturbed natural slopes.

ii) From the debris/ soil, area, a disturbed sample weighing 5 kg is collected from the natural slope in plastic bags. The collected samples are characterized in the field itself as per the standard classification of soil and also sample type as disturbed or undisturbed samples are collected. The undisturbed soil samples are collected in standard cylindrical tubes.

iii) The samples are collected from the debris/ soil horizon at ~0.5 m depth and after removing all roots etc. from the samples. The samples were collected in sealed plastic bags to keep natural moisture content intact.

iv) The geotechnical samples are collected from the field within a maximum span of 7 days to maintain natural moisture content. A total of 32 nos. of debris/soil samples are collected and samples are widely distributed in all the available debris/ soil types in each item.

v) Samples are collected in 100 mm diameter and 440 mm long steel tubes with cutting edge.

vi) After taking soil samples, both sides of the steel tube were covered with wax, and after, they were sealed in plastic to keep NMC intact.

ii) **Geotechnical testing:** The geotechnical sample testing was carried out in the Geotechnical laboratory, GSI, Hyderabad. The geotechnical tests for soil samples to be carried out are “qualitative grain size analysis”, “specific gravity”, “Bulk density”, “Density (dry)”, “Density (wet)”, “Porosity”, “Permeability”, “UCS”, “Free swell test”, “NMC”, “Liquid limit”, “Plastic limit”, “C” and “ ϕ ”. Schmidt’s hammer is used in the field for estimating UCS data for rock mass characterization. The geotechnical analytical results are attached for undisturbed soil samples in Annexure II.



Photo 3: Field photograph showing sample collection, packing, weighing, and sealing of cylinder sample tubes.

4.4 Post-field Derivative Maps: The post-field derivative maps are prepared for kinematic failure analysis in the rock. The post-field derivative maps (Slope forming material map, Regolith thickness map, Domain map classified into cut slope, rock domain & overburden domain) are prepared, whereas the geotechnical map is prepared for determining the shear strength of the material property. The major part of the study area is under the overburden domain. Whereas the geotechnical map is prepared for determining the shear strength of the material property. The major part of the study area is under the rock domain.

4.4.1 Geotechnical Map

A geotechnical map has been prepared based on the correlative matrix between the important parameters of shear strength i.e. cohesion and angle of internal friction. Based on the correlative matrix, we are defining/grading the soil values into Very poor, poor, fair, good and very good grades of rocks. This classification provides meaningful insight into the comprehensive strength parameters of the soil samples in a meaningful way. Cohesion and angle of internal friction are the important parameters that determine the shear strength of any slope-forming material. The other parameters involved in the Geotechnical analysis are Grain

size analysis, liquid limit, plastic limit, Plasticity index and Shrinkage limit. Apart from this specific gravity, moisture content, Density, dry density and void ratio

Cohesion	The angle of internal friction			
	>28	26-28	26-24	24-22.2
0.17-0.21	Fair	Fair	Poor	v. poor
0.21-0.24	Fair	Fair	Poor	Poor
0.24-0.27	Good	Good	Fair	Fair
>0.27	v. good	v. good	Good	Fair

Table 10: Cohesion versus angle of internal friction correlation matrix

The geotechnical analysis reveals that fine-grained and clay materials constitute a relatively small proportion compared to the coarse-grained soil mass in the area. The results also indicate that the geotechnical property values do not exhibit significant variations; they are quite consistent with similar properties, aligning with our expectations. Notably, the dominant failure mechanism in this area is debris flow, and as a result, the liquid limit of the materials plays a more critical role in influencing failures than any other geotechnical properties. It's important to note that the behavior of weathered materials varies from one location to another. On average, the liquid limit falls within the range of 40% to 45%, with a few exceptional values reaching up to 55%. Similarly, the plasticity index also exhibits some variability, ranging from 10% to 25%, among other properties.

Cohesion and angle of internal friction:

The cohesion values in the area range from a minimum of 0.17 to a maximum of 0.27, while the angle of internal friction varies between 22.2 and 28 degrees. A table illustrates the positive correlation between cohesion and the angle of internal friction, which are two critical factors determining the shear strength of the debris and soil materials in the overburden domain. The correlation matrix reveals the distribution of values between cohesion and the angle of internal friction. These values are categorized into classes such as very poor, poor, fair, good, and very good. When there is a positive correlation between low cohesion values and low friction values, it results in the gradability of overburden materials ranging from fair to poor. Similarly, a positive correlation between low cohesion and moderate friction values

yields a grade of rocks ranging from poor to fair. In cases where both cohesion and friction values are low, the gradability of rocks falls within the poor to very poor range. Conversely, the fair to a very good grade of materials cover the remaining area.

Landslide Analysis against the Geotechnical map shows that the maximum no. of slides has been documented on the fair grade of soils than the Good grade of shear strength materials.

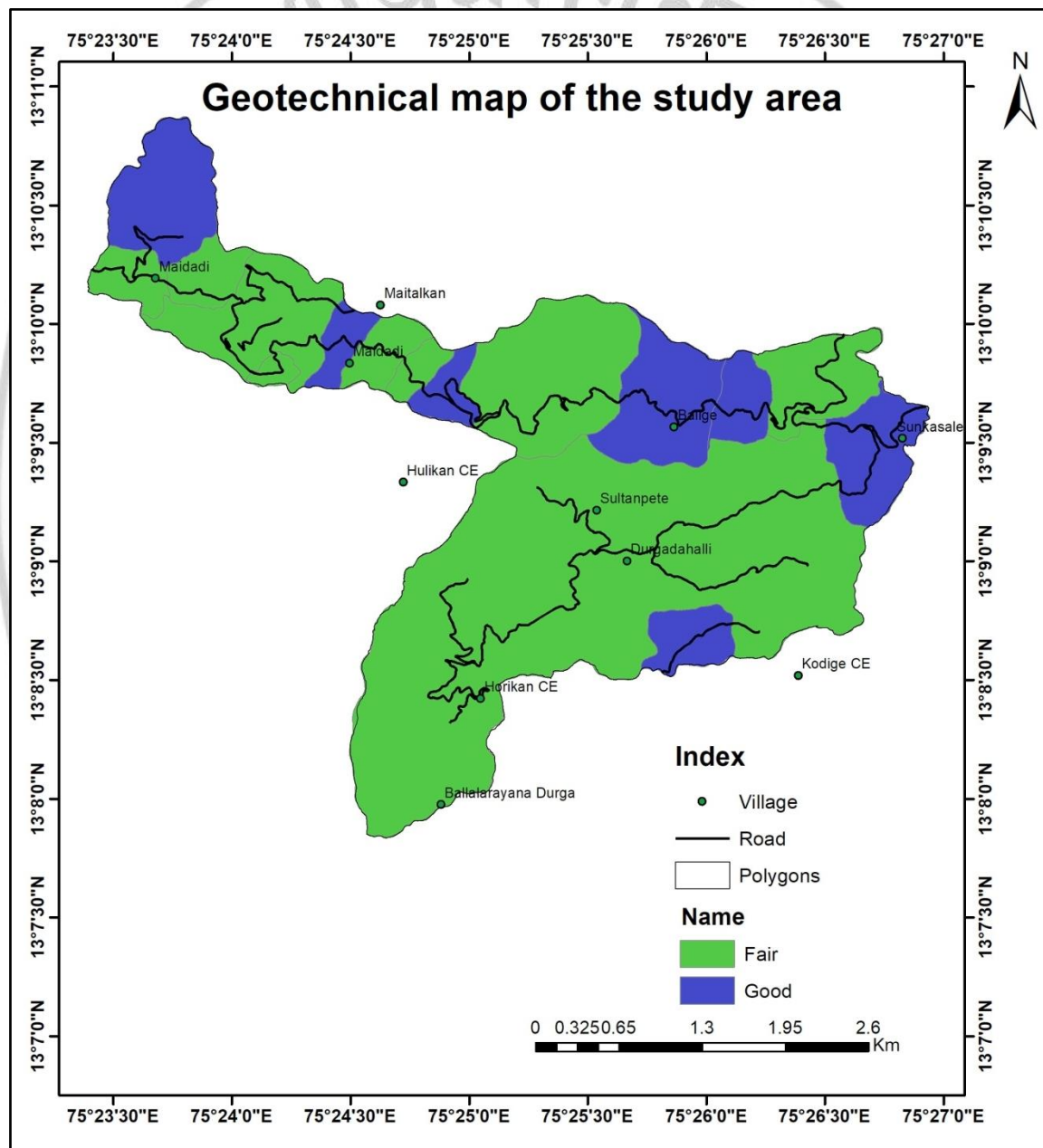
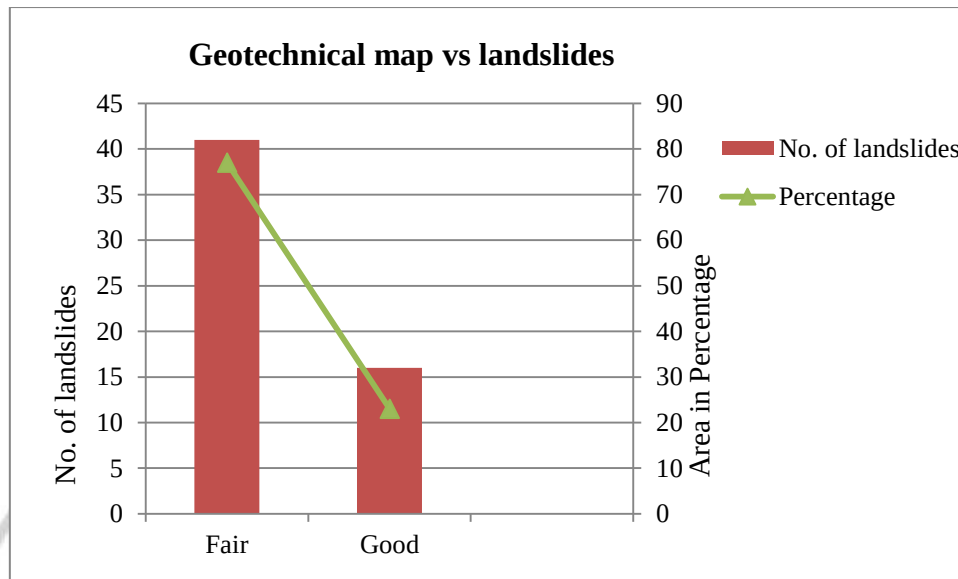


Fig 22: Geotechnical Map of the study area



Graph 11: Landslide distribution over the Geotechnical map

4.2.2 Kinematic slope failure-stereo plot Analysis: The orientation of the plane of discontinuity and cut-slope intersection, coupled with heavy spells of rainfall during monsoon months attributed to the cause of the failure. The kinematic failure for planar, wedge and toppling conditions is analysed in a stereo plot. Based on Joint sets and slope dip and dip direction, kinematic failure analysis and their critical intersection along the discontinuity plane is illustrated through steronet plot. Failed slopes conform to either single or a combination of several types of failures including rock fall, plane failure, wedge failure, toppling.

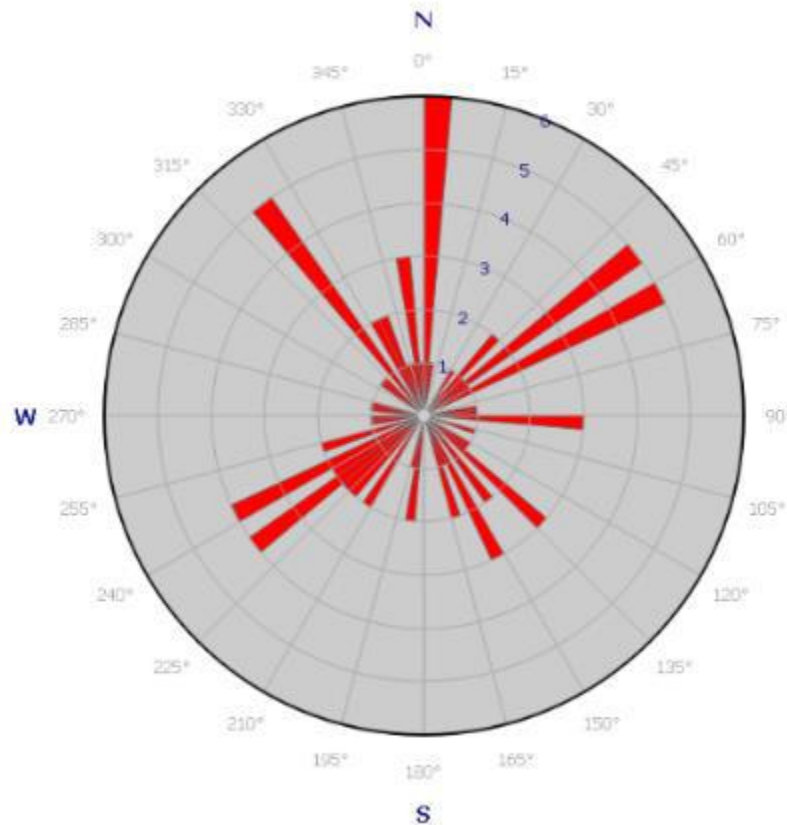


Figure 23: Joint planes plotted in the rose diagram to delineate the major discontinuity planes.

Out of the domains (Cut slope, overburden & rock domain) map we demarcated, the rock domain constitutes only 20% of the area. As the rock failures in this terrain are very less since most of the top sections are highly weathered and fragile in nature, moves to the debris part instead of rock failures. The upslopes of the unweathered rocks are mostly massive at places and the joint planes have been projected even to those areas too for the analysis. The major discontinuity planes fall along NE, and NW sectors and the bedding planes move from E-W to N-S directions. The kinematic analysis of the rock domain has been separated into northeastern, north, southeastern and southern sectors.

The NE sector kinematic analysis shows planar failures than the Wedge and Topple failures. The Northern sector also shows planar failures. SE sector shows Topple failures instead of planar failures. The southern sector displays planar failure.

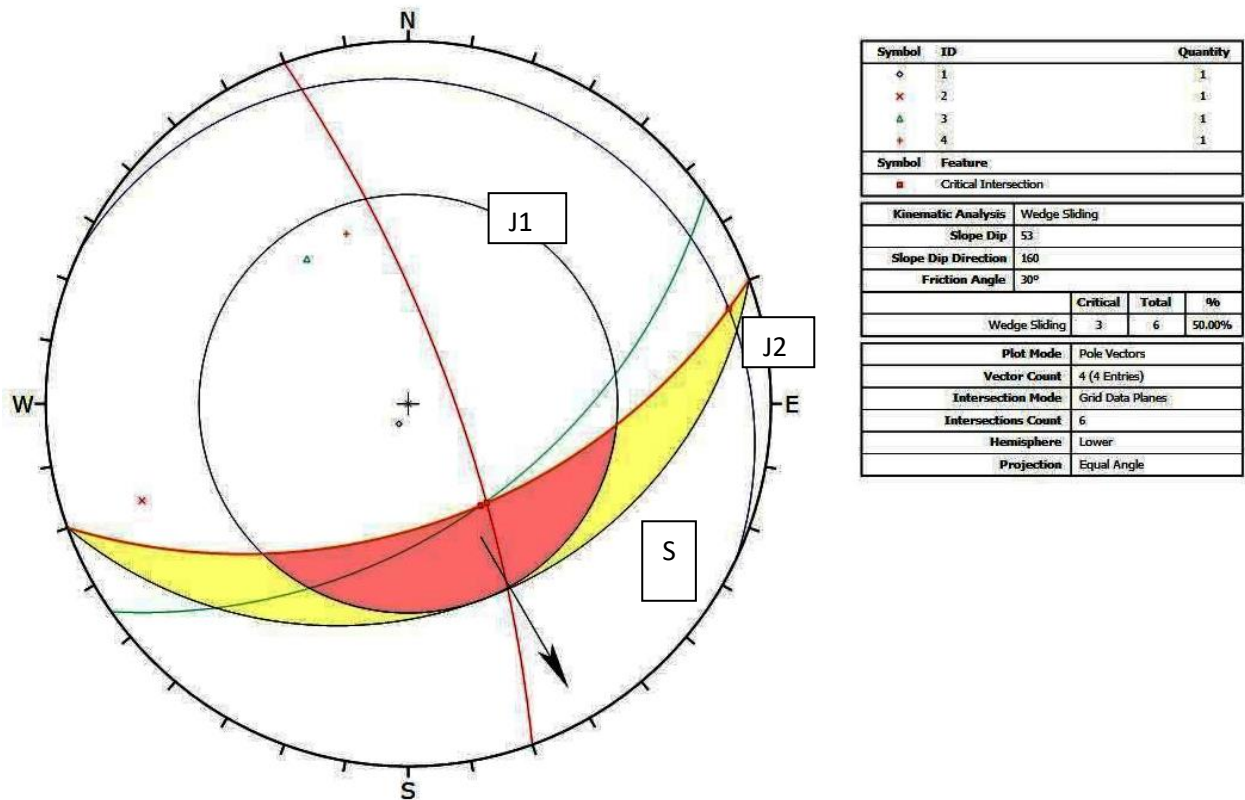


Figure 24: Kinematic analysis near Maidadi

Location:1

Bedding	7	335	
J1	76	70	13° 08' 46.1"
J2	52	145	75° 25' 17.9"
Slope	53	160	

Table 11: Structural data for Kinematic analysis near Maidadi

Here the kinematic analysis of the joints with the bedding shows the wedge failure which fails along South East direction. The pink zone shows the critical zone, where failure may happen.

Location: 2

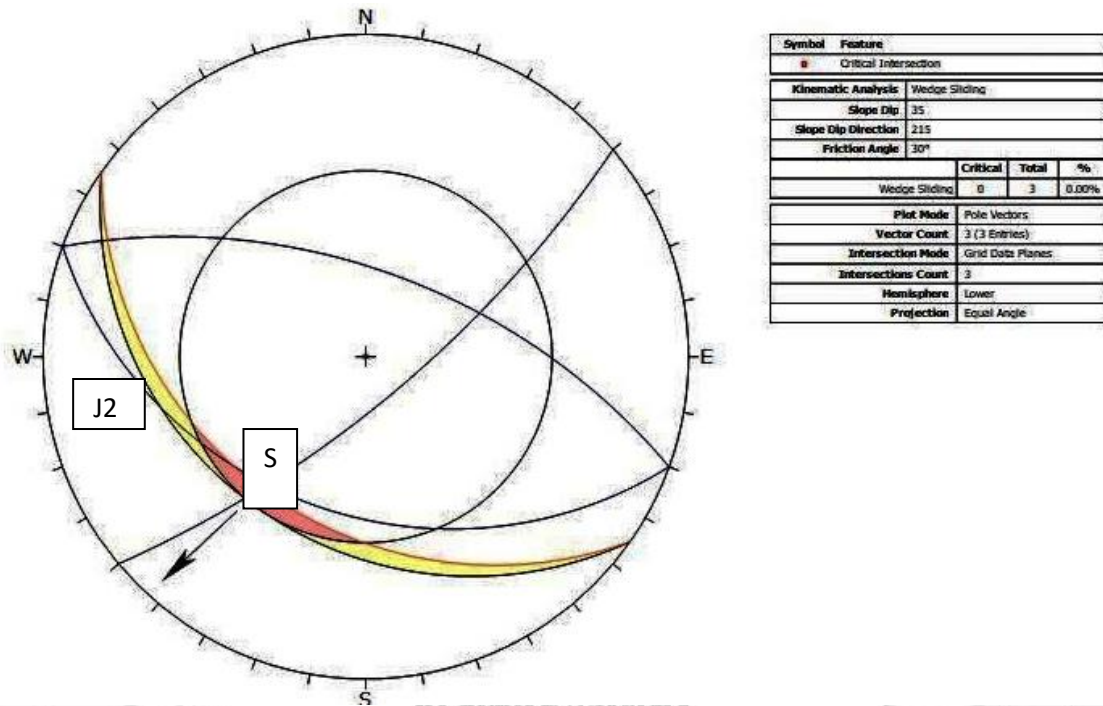


Figure 25: Kinematic analysis near Balige

The pink region shows the probable vulnerable zone. Here the kinematic analysis of these spot shows that only planar failure can take place towards SW directions, not a wedge; the plunge of the two joints are steeper than the slope.

Table 12: Structural data for Kinematic analysis near Balige

Bedding	60	20	13° 09' 49.4" 75° 24' 3.8"
J1	74	140	
J2	38	200	
Slope	35	215	

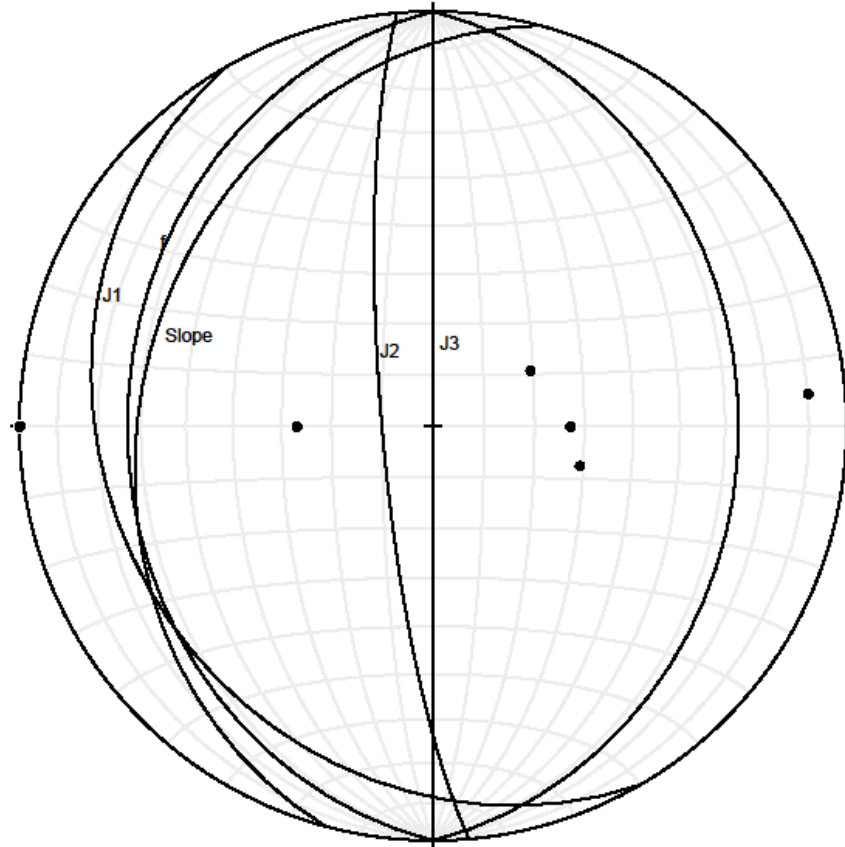


Fig 26: Kinematic analysis along the NE sector

The northeastern sector kinematic analysis shows planar failures than the Wedge and Topple failures.

Table 13: Structural data for the North Eastern sector

Bedding/J3	90	0	
J1	22	245	13° 10' 22.6"
J2	78	260	75° 23' 48.9"
Slope	35	255	

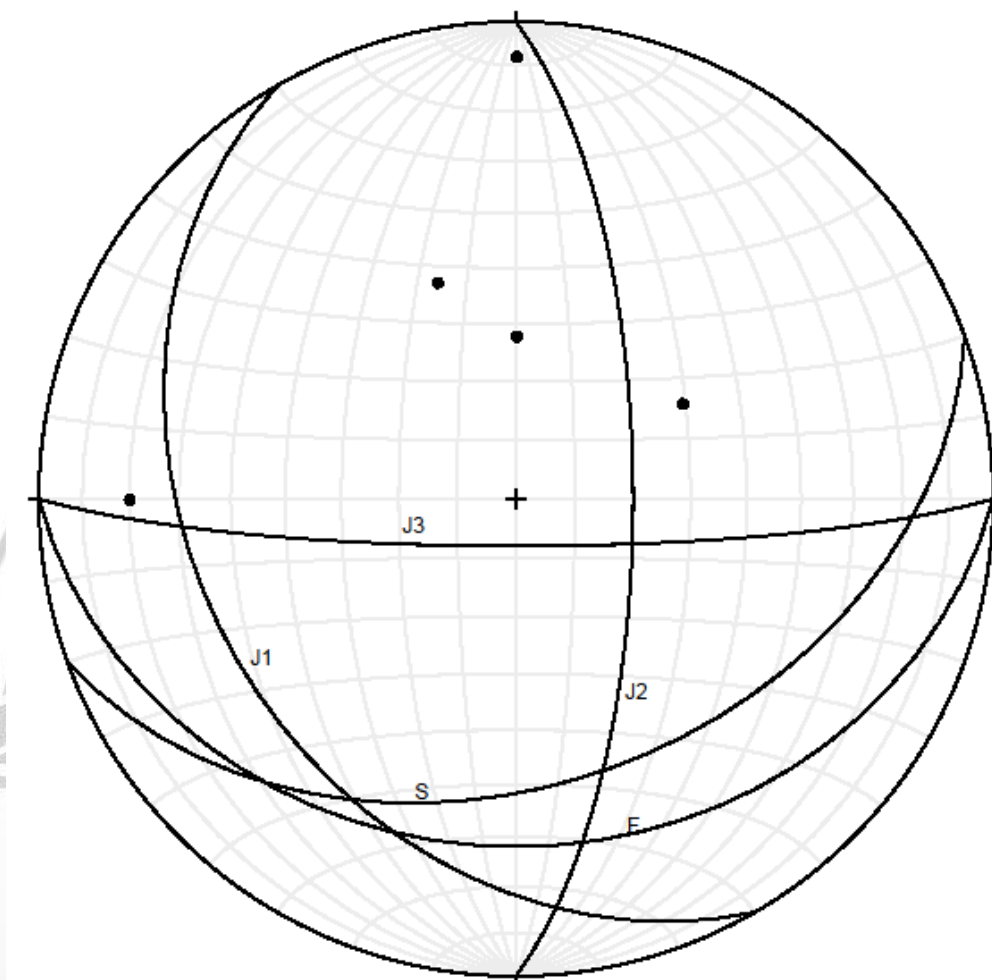


Fig 27: Kinematic analysis along the Northern sector

The northern sector also shows planar failures

Table 14: Structural data for the Northern sector

Bedding	82	180	13° 09' 37.9" 75° 26' 5.7"
J1	33	240	
J2	70	90	
Slope	40	165	

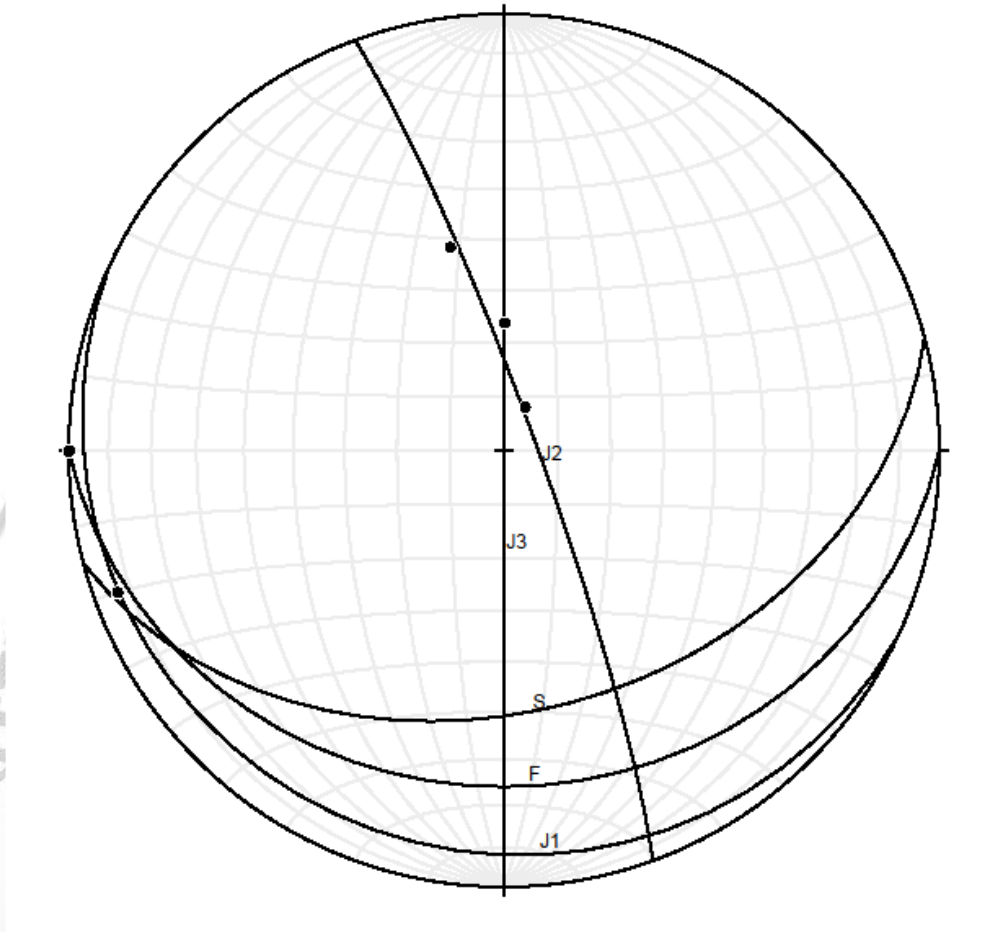


Fig 28: Kinematic analysis along the South eastern sector
South eastern sector shows topple failures instead of planar failures.

Table 15: Structural data for the South Eastern sector

Bedding/J3	90	0	
J1	10	180	13° 08' 43"
J2	65	55	
Slope	40	165	
			75° 26' 16"

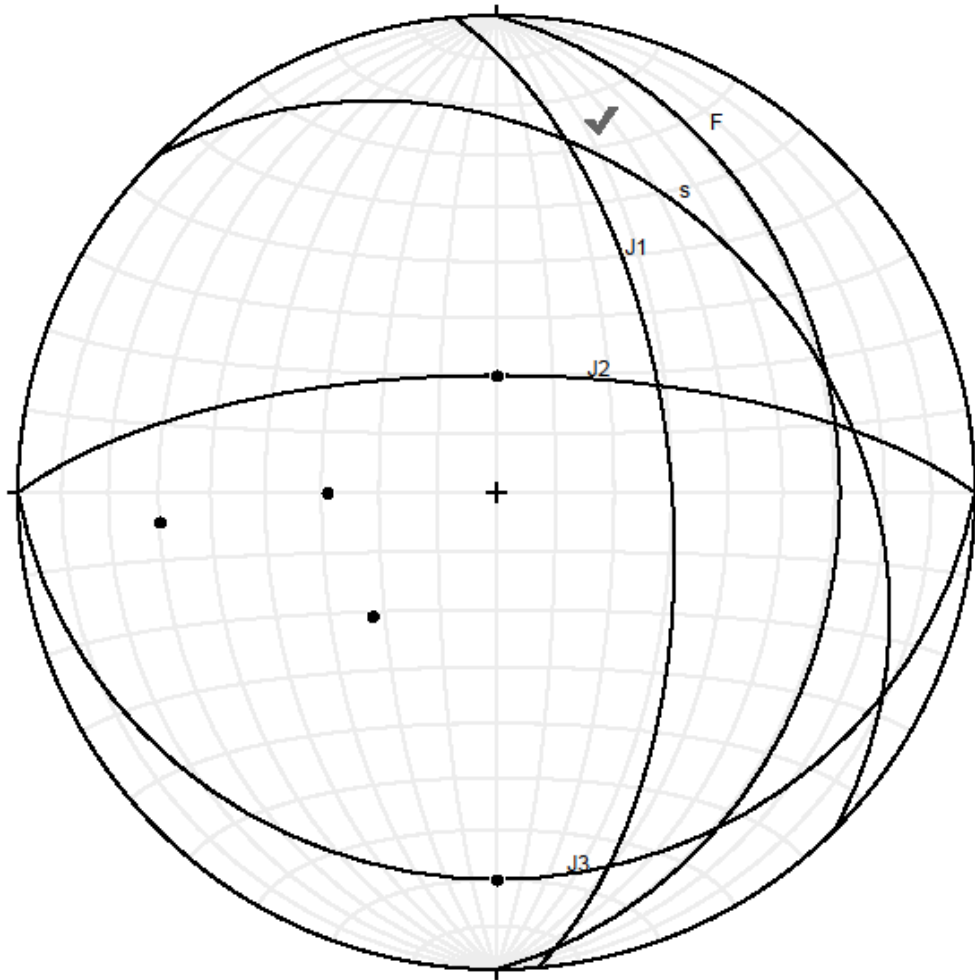


Fig 29: Kinematic analysis along the Southern sector

The southern sector displays planar failure

Table 16: Structural data for the Southern sector

Bedding/J3	22	180	
J1	66	65	13° 08' 7.8"
J2	78	360	75° 25' 7.7"
Sl ope	40	45	

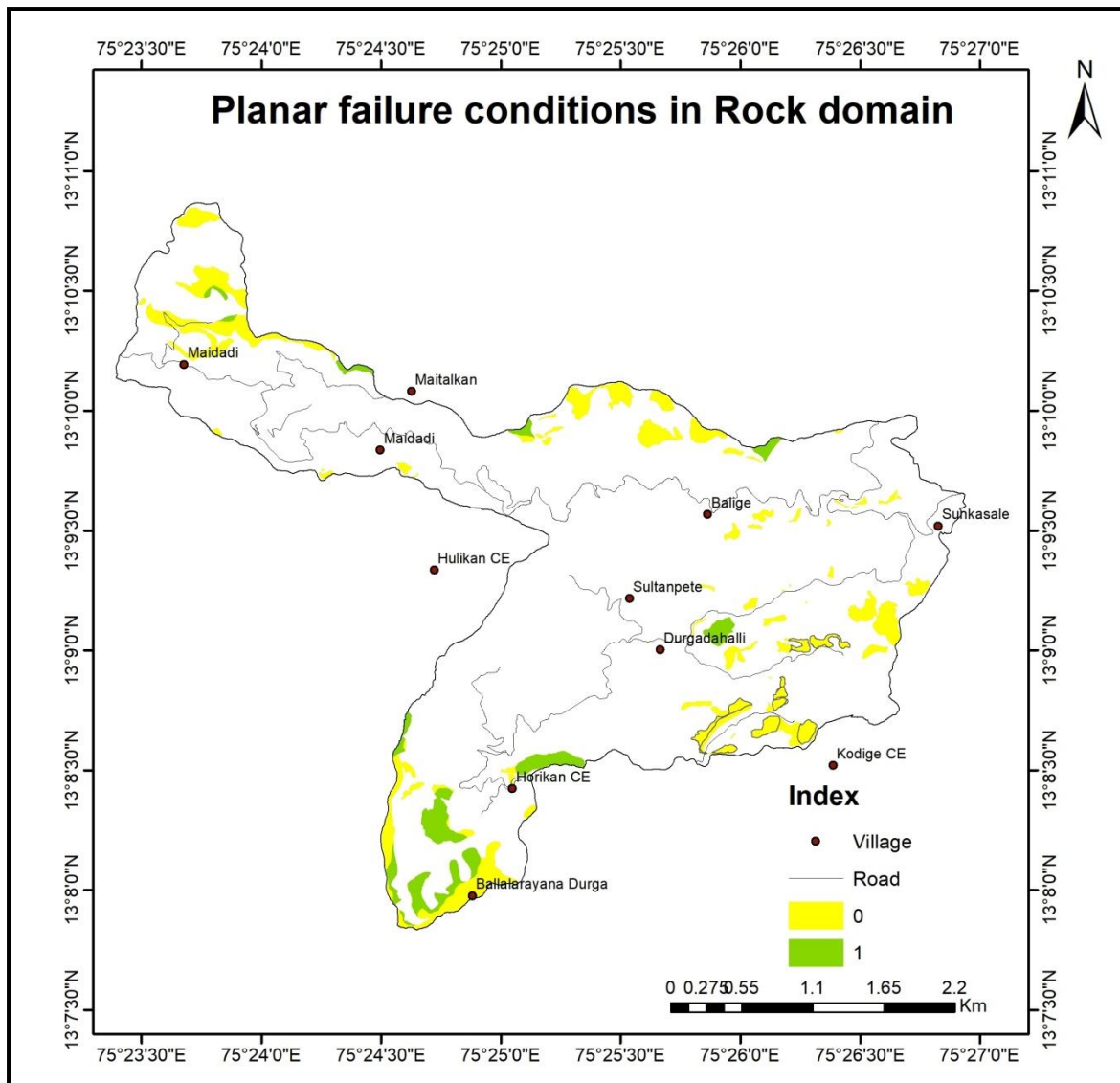


Figure 30: Planar failure conditions in the Rock Domain

As 0 in the index value indicates no failure and 1 indicates the above-said condition failure i.e. planar failure.

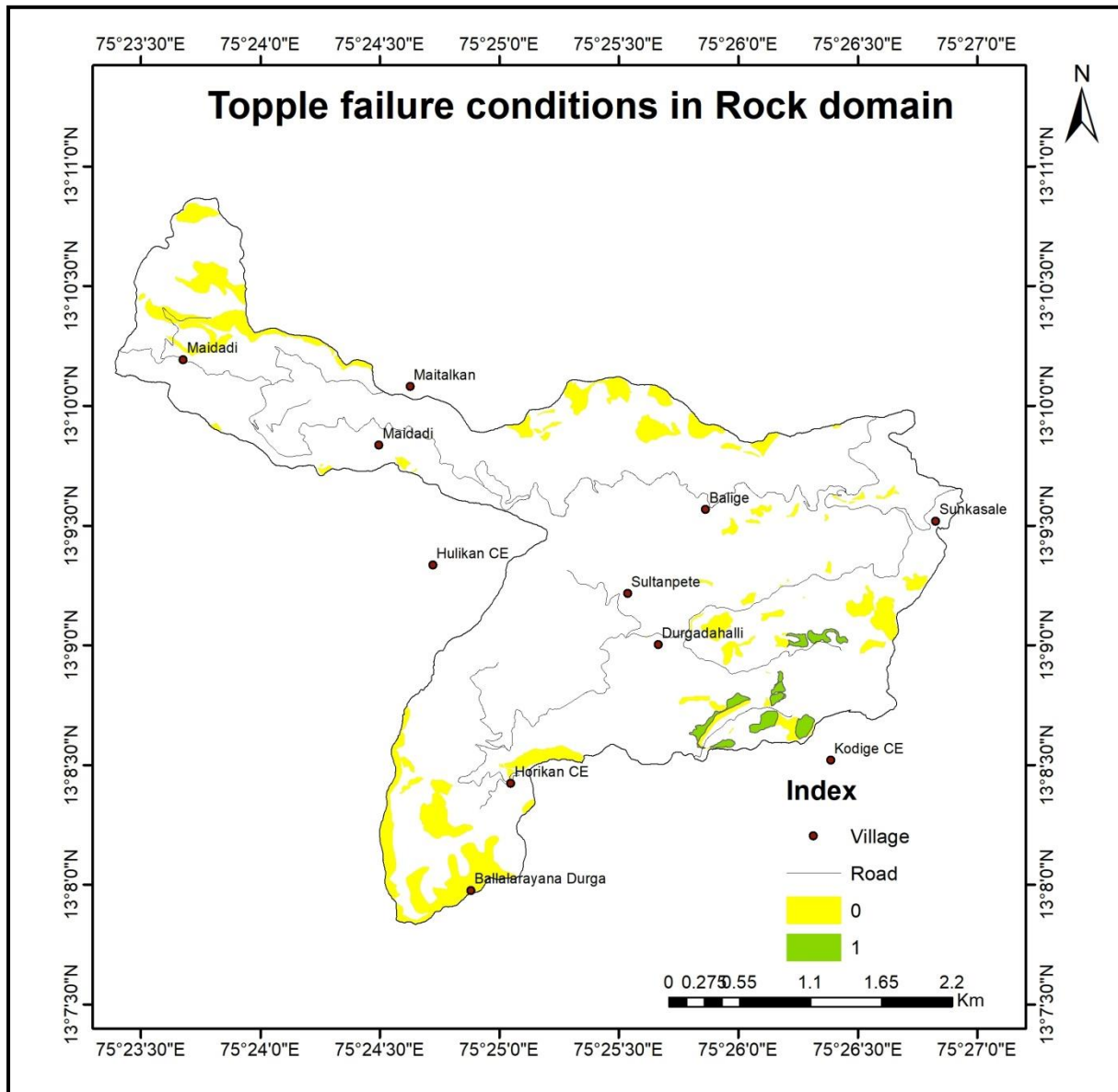


Fig 31: Topple failure conditions along the Rock domain.

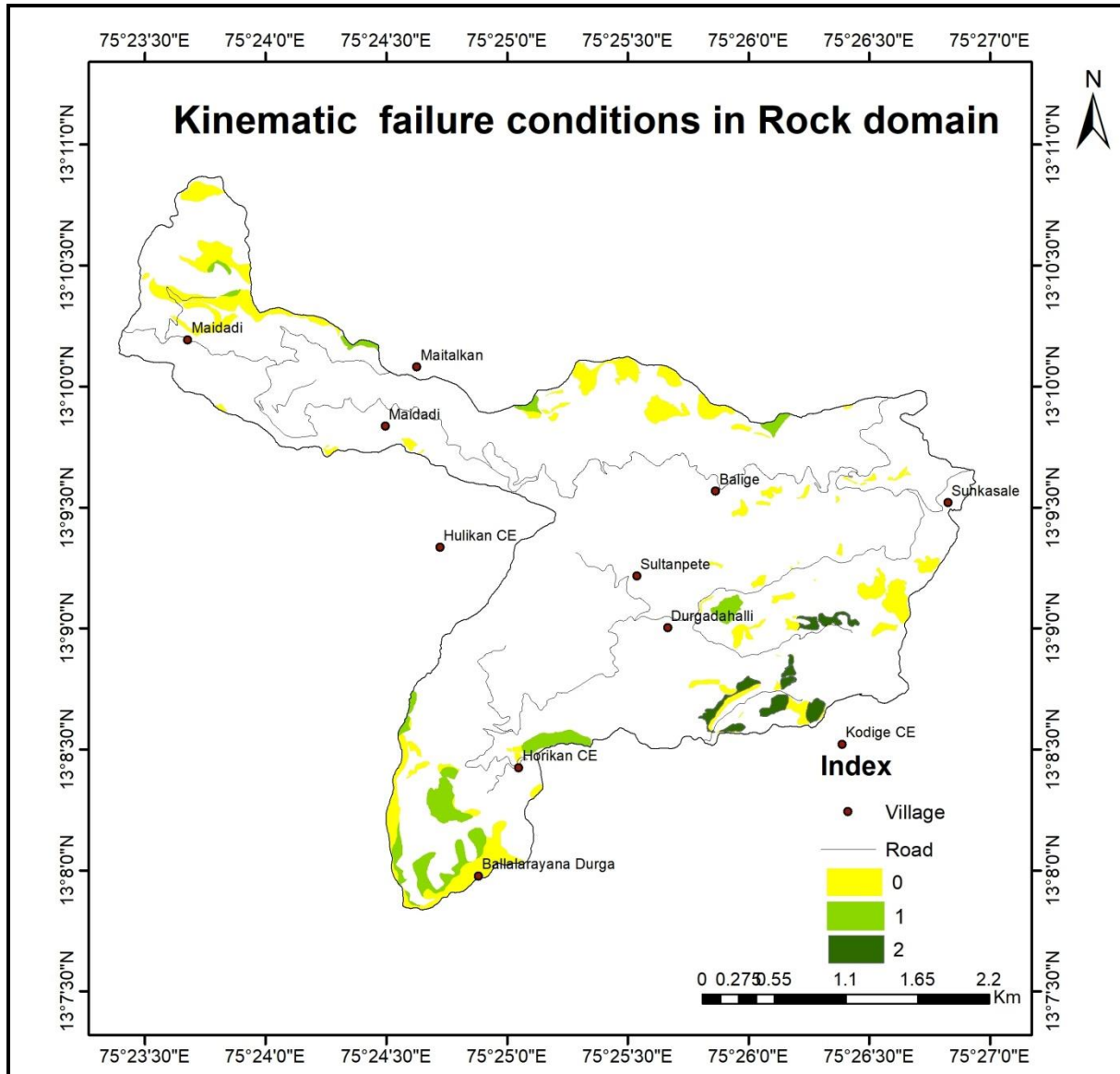


Fig 32: Kinematic failure conditions in the Rock domain.

The value of 1 indicates the chances of one set of failure conditions and the value of 2 indicates the probable chances of 2 conditions of failure is possible.

4.5 Rainfall Condition: The rainfall data available from rain gauge stations of different taluks in the Chikkamagaluru district were analysed. Based on daily rainfall recorded during the southwest monsoon season for the period between June to August 2019, the departure between the normal and actual rainfall conditions was studied. The antecedent rainfall events for the peak monsoon period are also analysed to determine the triggering factor for landslide initiation.

Cumulative Daily mean & Normal Rainfall (SW monsoon period: June-August 2019) in Chikkamagaluru District

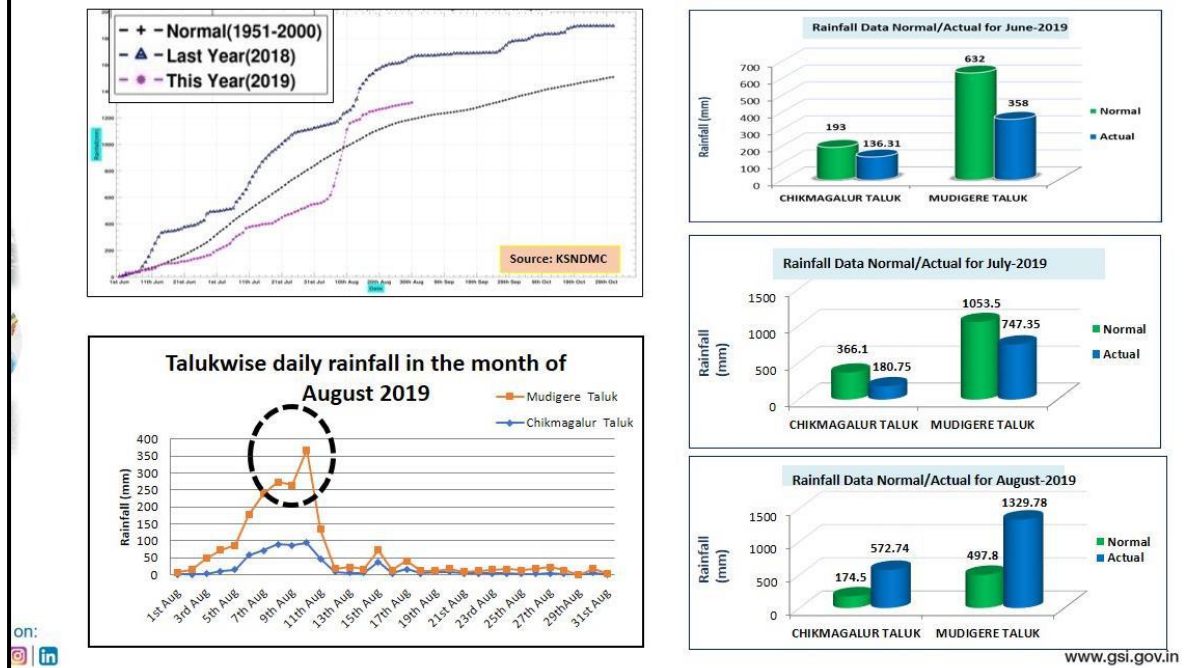
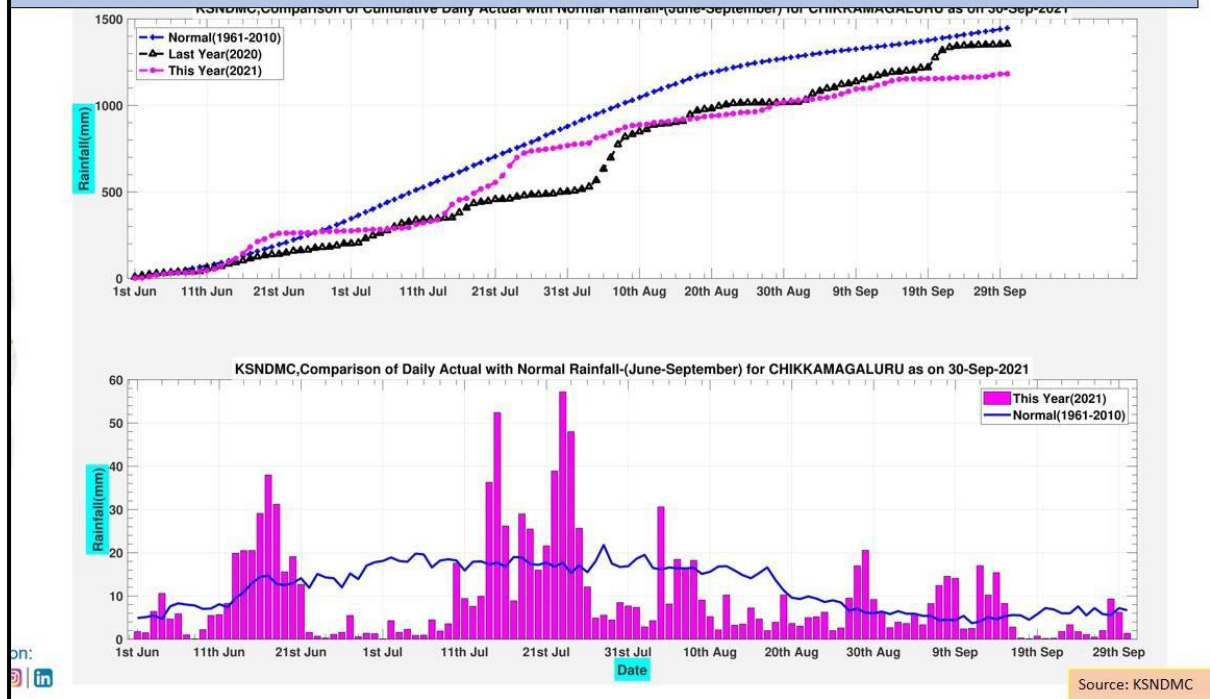
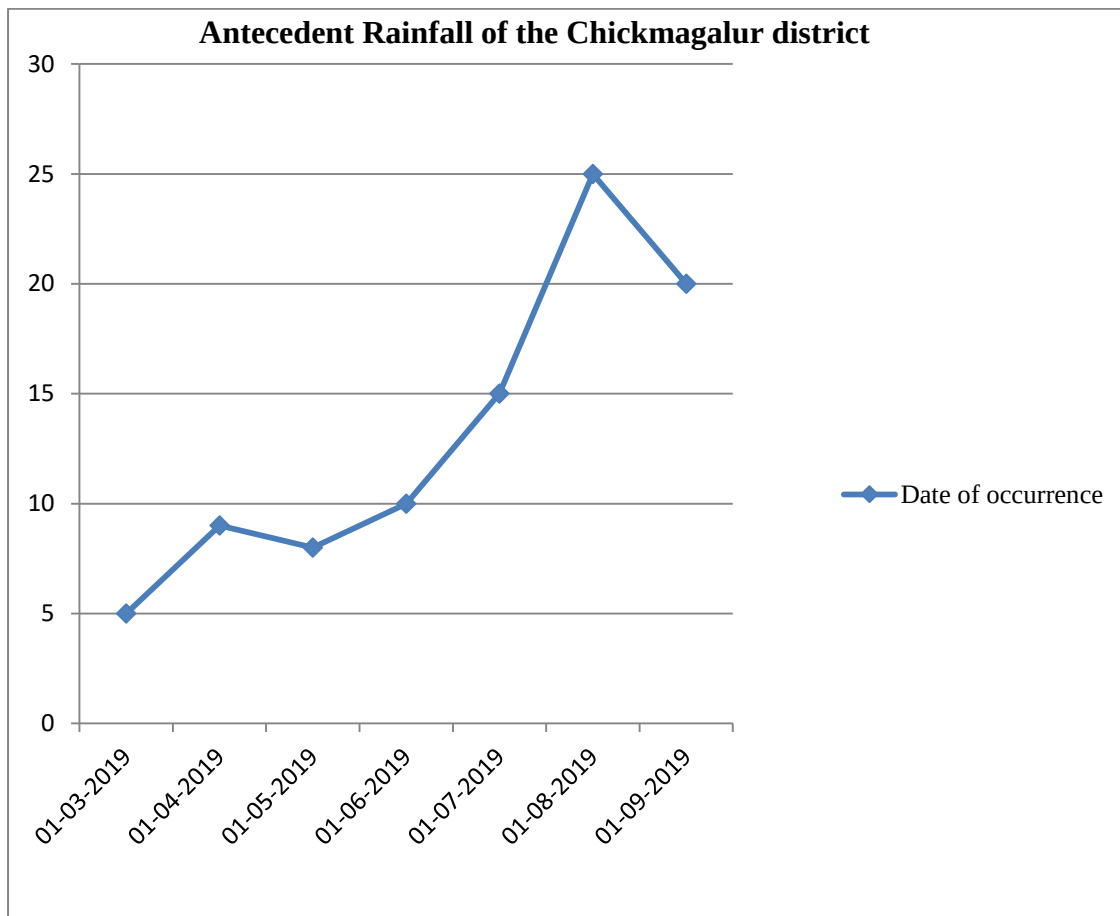


Figure 33: Rainfall distribution (Taluk wise)

Cumulative Daily mean & Normal Rainfall (SW monsoon period: June-Sep 2021) in Chikkamagaluru District



Graph 12: SW monsoon- Cumulative rainfall distribution



Graph 13: Antecedent rainfall of the Chickmagalur district

Antecedent rainfall of the study area analysis during the month of Aug-2019 peak rainfall dates with the millimeter precipitation has been depicted in the above diagram. During that particular week, the area received 70 inches of rainfall. During the 9th afternoon, all the major incidents happened. The major geomorphon units upslopes are concave in shape and the geomorphic pattern favours collecting more rainfall water from upslopes and concave geomorphon in turn collects more rainfall and the slope passes the collected water to the downslopes and thus the erosion occurs as debris flows.

CHAPTER 5

LANDSLIDE SUSCEPTIBILITY MAP

Domain-Based Landslide Susceptibility Map

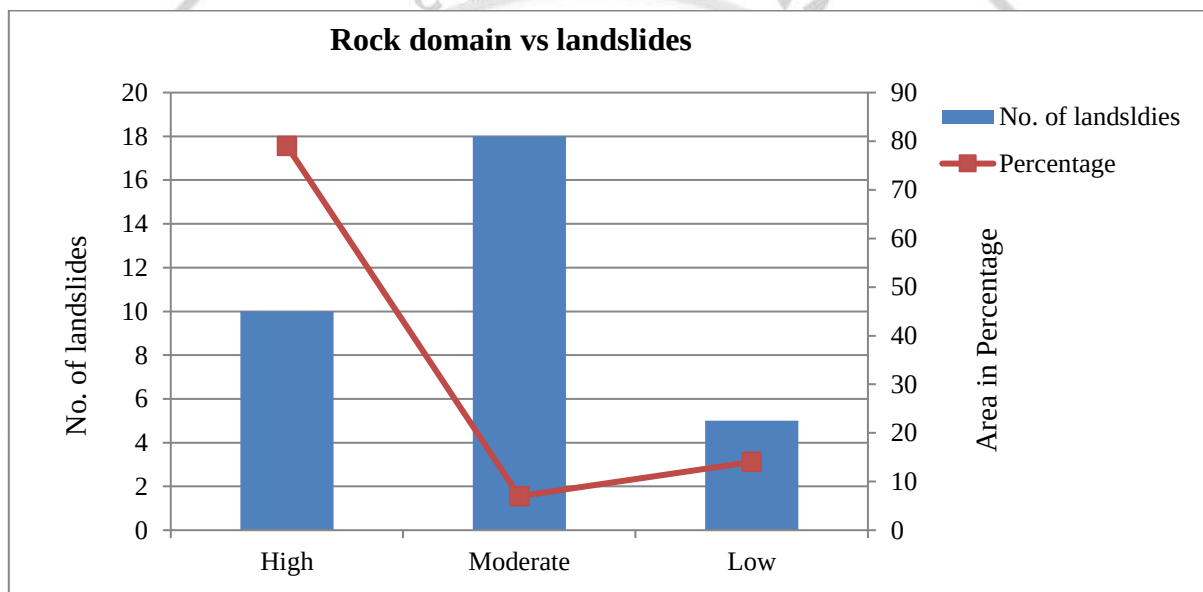
Landslide Susceptibility Map is generated on a priority basis using a terrain-specific heuristic knowledge-driven mathematical modelling method using a multi-class overlay index method in the GIS platform. The hill slopes are categorized as high, moderate, and low susceptible zones based on weightage and rating assigned to causative geofactors for each landslide failure domain through assigning and integrating Landslide susceptibility evaluation rating (TSER) to get final classified “Total estimated susceptibility values (TESV) to generate domain based landslide susceptibility map for delineating the probability of spatial occurrence of landslides and landslide susceptible zones.

In each failure domain, terrain-specific geofactors are identified and inter-predictor weights are assigned, and then selected predictors with their weights in a suitable susceptibility model like Weighted Multiclass Index Overlay are combined in the GIS platform. GIS-based modelling and integration of selected and weighted geofactor maps are generated separately for each landslide failure domain by assigning and integrating landslide susceptibility evaluation value to get the total estimated landslide susceptibility value for preparation of landslide susceptibility maps showing the varying degree of landslide susceptibility and validated with landslide inventory, and ground cracks.

The weighted summation of the thematic geofactor is carried out using the map algebra calculation tool in the ArcGIS platform. Since, the geofactor assemblages are failure domain-specific, initially different susceptibility maps specific to different failure domains are prepared and finally are combined as a “Combined Landslide Susceptibility” map and classified into three susceptibility classes (High, Moderate and Low) for easy comprehension and taking quick decision by stakeholders.

5.1.1 Landslide Susceptibility in Rock Domain: The landside susceptibility analysis is carried out by taking into consideration the kinematic analysis of the study area sector-wise accordingly.

The sector has been classified into the NW sector, northern sector, SE sector and Southern sector. The failure conditions such as planar, wedge and topple have been applied to find out the exact failure condition and the possible susceptible zones have been projected. The susceptible zones have been classified accordingly as per the kinematics assigned values/interpredictor weights.



Graph 14: Landslide distribution over the Rock Domain

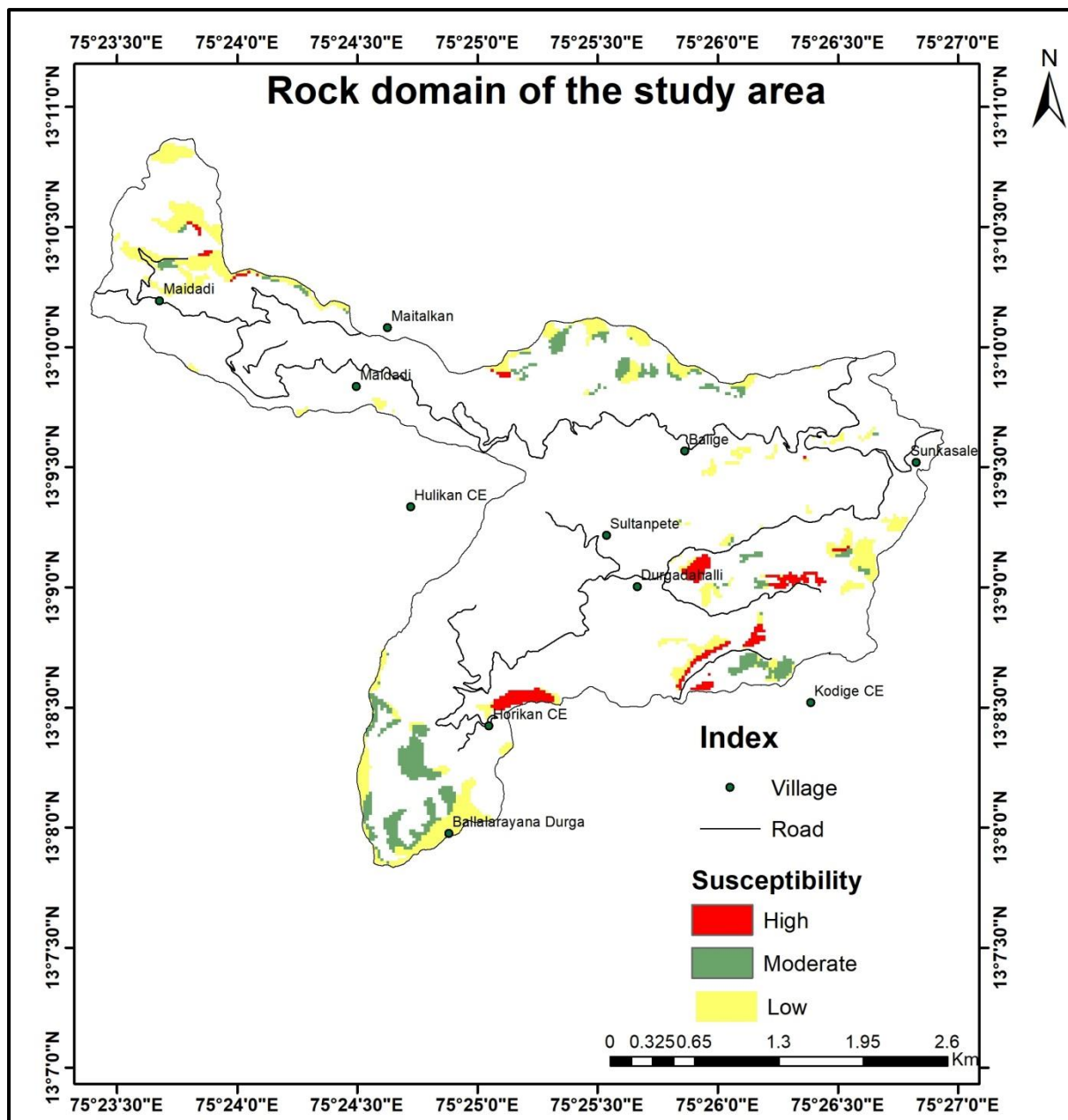


Fig 34: Rock domain map of the study area

Table 17: LSER values for the Overburden domain

Landform	LSER
Summit	0.2
Ridge	0.2
Shoulder	0.4
Spur	0.6
Slope	0.8
Hollow	1
Footslope	0.2
Valley	0.4
Geotechnical classes	LSER
Very good	0.2
Good	0.2
Fair	0.4
Poor	0.6
Very poor	1.0
SPI Classes	LSER
Very low erosion	0.1
Low erosion	0.1
Moderate erosion	0.2
Relative Relief classes	LSER
Low	0.4
Moderate	1
High	0.8
Slope angle class	LSER
0-10°	0
10°-20°	0.2
20°-30°	0.6
30°-40°	0.8
40°-50°	0.4
>50°	0.2

Table 18: TSEV values for the Overburden domain

Overburden domain	LSER
1. Stream Power Index	0.1
2. Landform	0.2
3. Relative Relief	0.3
4. Geotechnical map	0.1
5. Landuse/Landcover	0.1
6. Slope	0.2
Total Estimated Susceptibility Values (TSEV)	1.0

a). Overburden Domain: This domain is demarcated based on slope-forming material type in the overburden of soil and failure mechanism. The rock fragment and weathered rock with loose soil, 0.5m to 2m and >2m overburden on the rock are considered in the overburden domain. The overburden domain susceptibility map is prepared after taking into consideration landform units, Stream power index, Relative relief, and slope gradient as predisposing inherent geofactors that contribute to slope instability. In the overburden domain, 74% of the area falls in Low, 30% in High, and 30% in Moderate landslide susceptible zone. Here most of the major slides recorded are debris flow incidents along the 2nd order nalas along the Balige, Maidadi, and Maithalkan road stretches that come along the northern hill slopes of the study area and a major Hulikatte slide along the Southern hill slopes of the study area. Compared to the Southern part of the hill slopes the Northern part of the hill slopes have high Relative relief, the weathered overburden materials are more because of the sheared northern zone, the weathered units show disrupted, fragile units.

The overburden domain susceptibility map of the terrain is prepared by semi-heuristic data modelling technique, inter predictor weights for geofactor themes, and classes are assigned based on factors influencing slope stability condition. In the Debris/Earth failure domains, 60% of the area falls in Low, 20% in High, and 20% in Moderate landslide susceptible zone. Here the major controlling factors of the landslides in this terrain are Slope angle, Relative relief and stream power index & geomorphic units have themes has more influence.

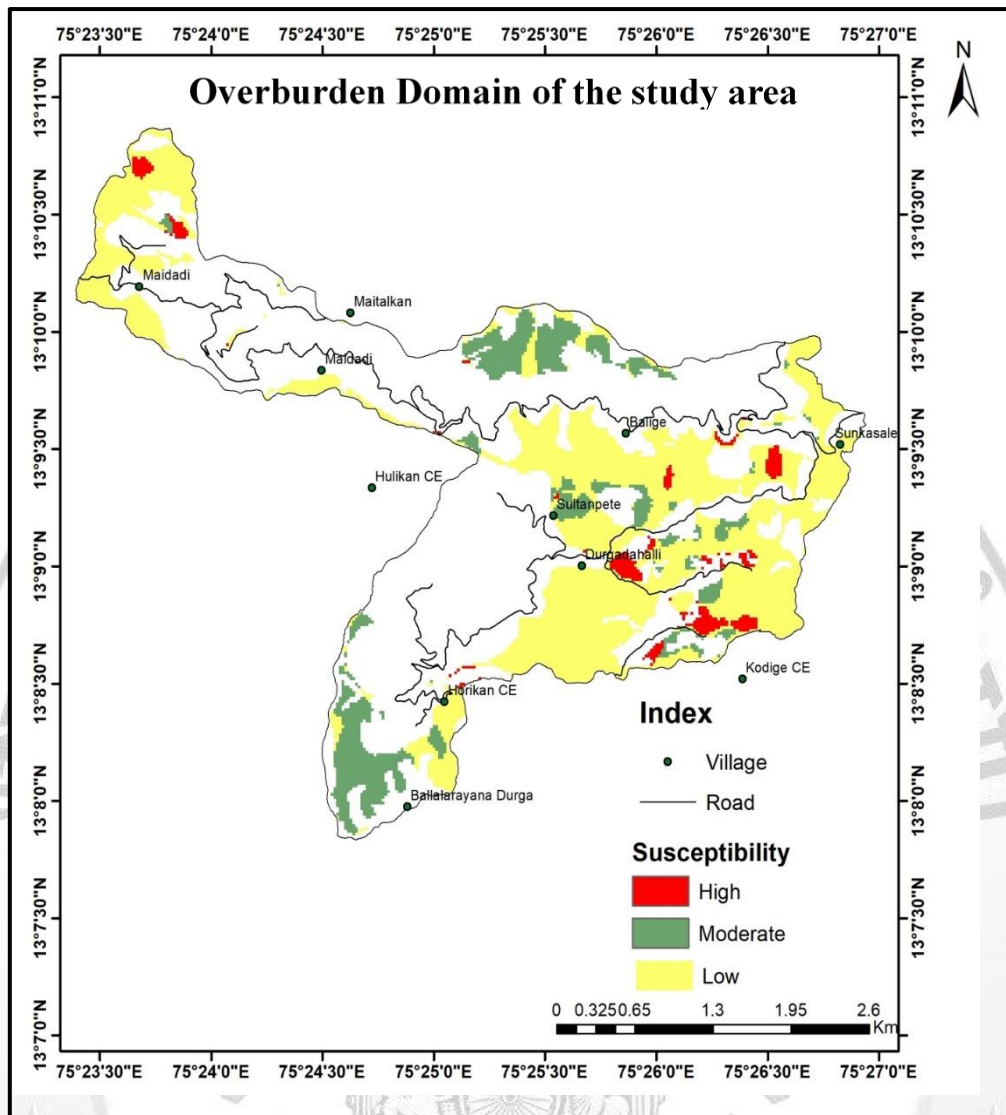
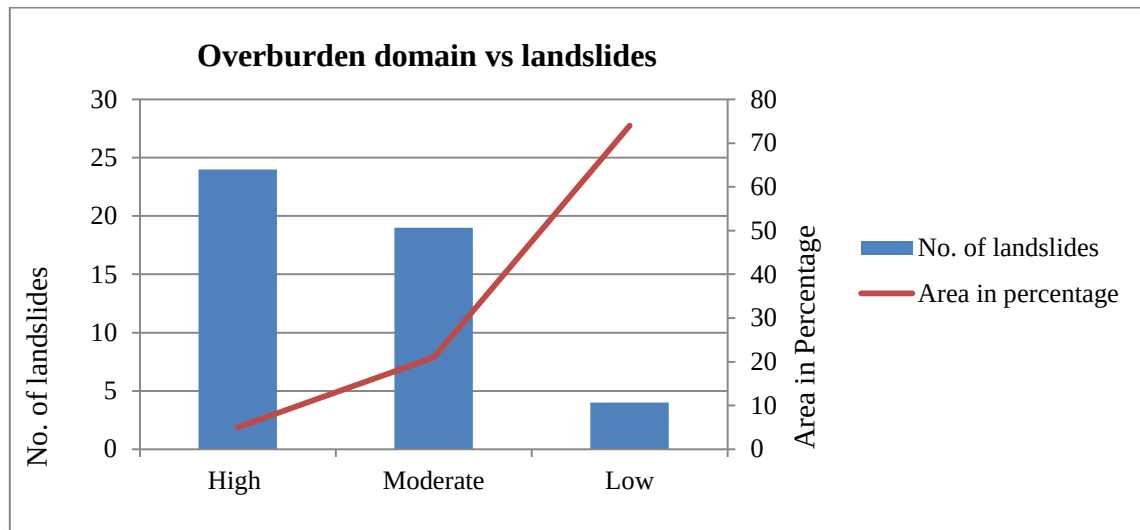


Figure 35: Overburden domain map of the study area

b). Landslide Susceptibility Evaluation Rating (LSER): Semi-quantitative heuristic method is used for the determination of domain-specific Landslide Susceptibility Map preparation. The Landslide Susceptibility Evaluation Rating and weights are assigned to geofactor classes and geofactor themes in each failure domain based on causative geofactors influencing landslides.



Graph 15: Landslide distribution over the Overburden domain map

c). Cut slope domain: The cut slope domain is demarcated almost all along the road cut of the study area along Balige & Durgdahalli areas, with the help of field mapping. Most of the Balige stretch seems to be highly vulnerable. The cut slope domain from the hill -ridge to the bottom of the bottom has been considered or the break of the slope from the road section to the bottom of the valley is considered for the susceptibility study. Most of the earlier failure events concentrated on the Balige, Maithalkhan and Kirugirullumane and maidai sides and their hill slopes, the hill attitude is trending Northwest direction and the slope is facing SSW to SW directions in general landslide.

Here to prepare the cutslope domain we integrate the geofactor maps such as the Slope angle map, Regolith thickness map, Geotechnical map and Relative relief map have been used to generate the classified cutslope domain map. Landslide susceptibility evaluation rating for each of the map classes and the respective weightages has been assigned as per the influencing factors inducing landslides which has been shown in the below table for your reference. The cut slope domain area is classified into high, moderate and low with a coverage percentage of 46%, 45% and 9% respectively.

Table 19: LSER values for the cut slope domain

Geotechnical classes	LSER
Very good	0.2
Good	0.2
Fair	0.4
Poor	0.6
Very poor	1.0
Relative Relief classes	LSER
Low	0.4
Moderate	1
High	0.8
Slope angle class	LSER
0-10°	0
10°-20°	0.2
20°-30°	0.6
30°-40°	0.8
40°-50°	0.4
>50°	0.2

Table 20: TSEV values for the cut slope domain

Cut Slope Domain	Weightage
1. Slope map	0.6
2. Relative relief map	0.2
3. Geotechnical map	0.1
4. Regolithness map	0.1
Total Estimated Susceptibility Values(TSEV)	1.0

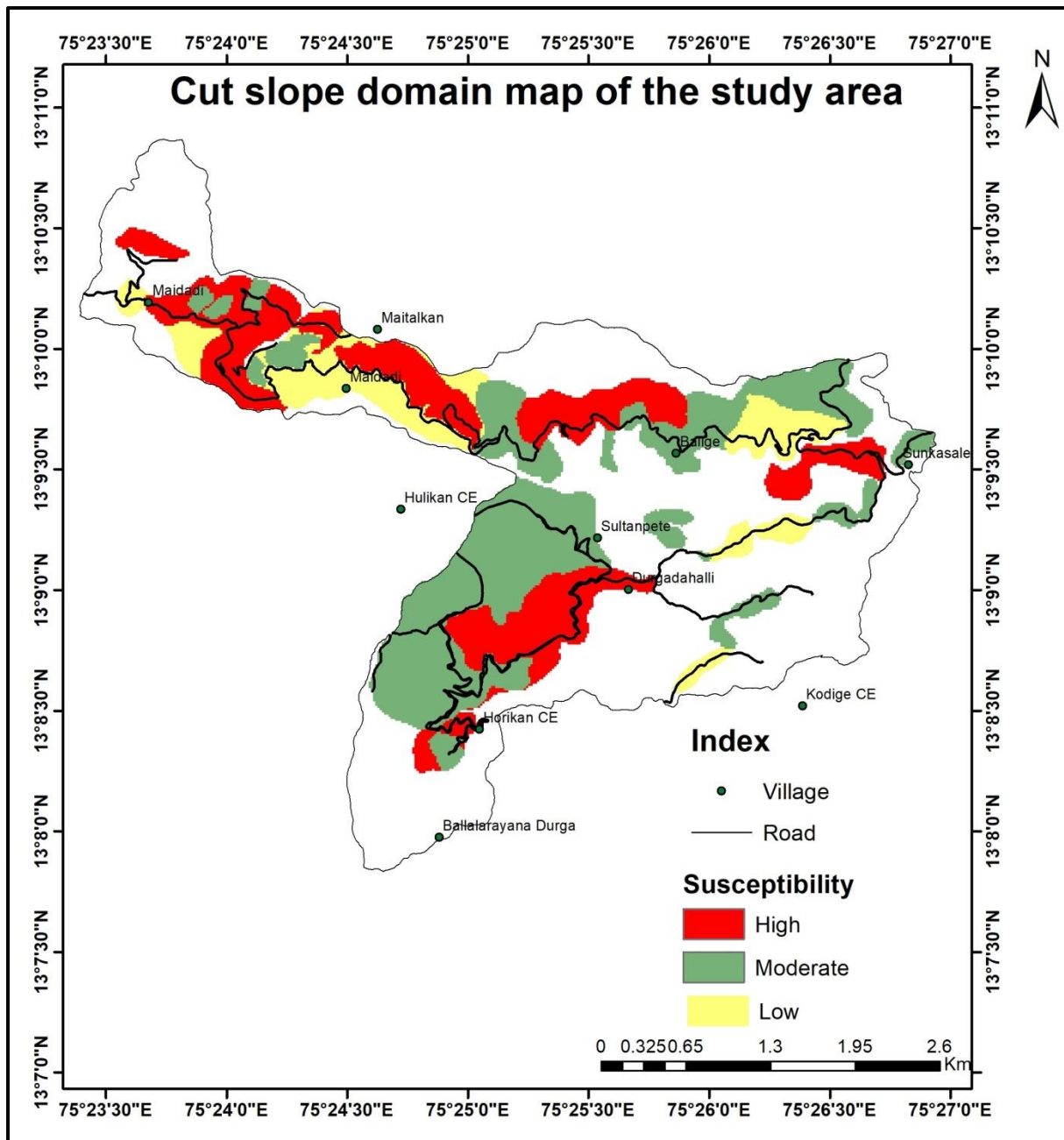
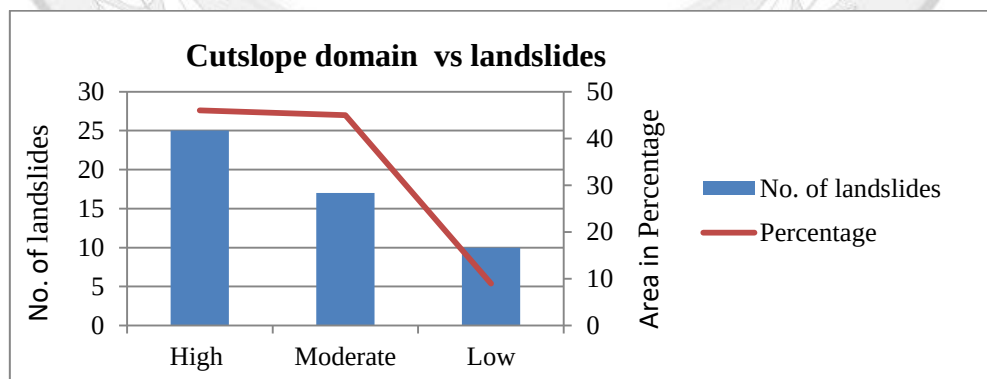


Figure 36: Cut slope domain map of the study area



Graph 1: Landslide distribution over the cut slope domain

5.1.3 Combined Landslide Susceptibility: All the landslide failure domain-based susceptibility map is prepared and integrated into the GIS platform to generate a combined landslide Susceptible Map. In the combined domain-based susceptibility map, 58% fall in Low, 28% in High, and 14% in Moderate landslide susceptible zone. About 46% of the landslides occurred in High susceptible zones, 17% fell in Low and 37% fell in Moderate landslide susceptible zones.

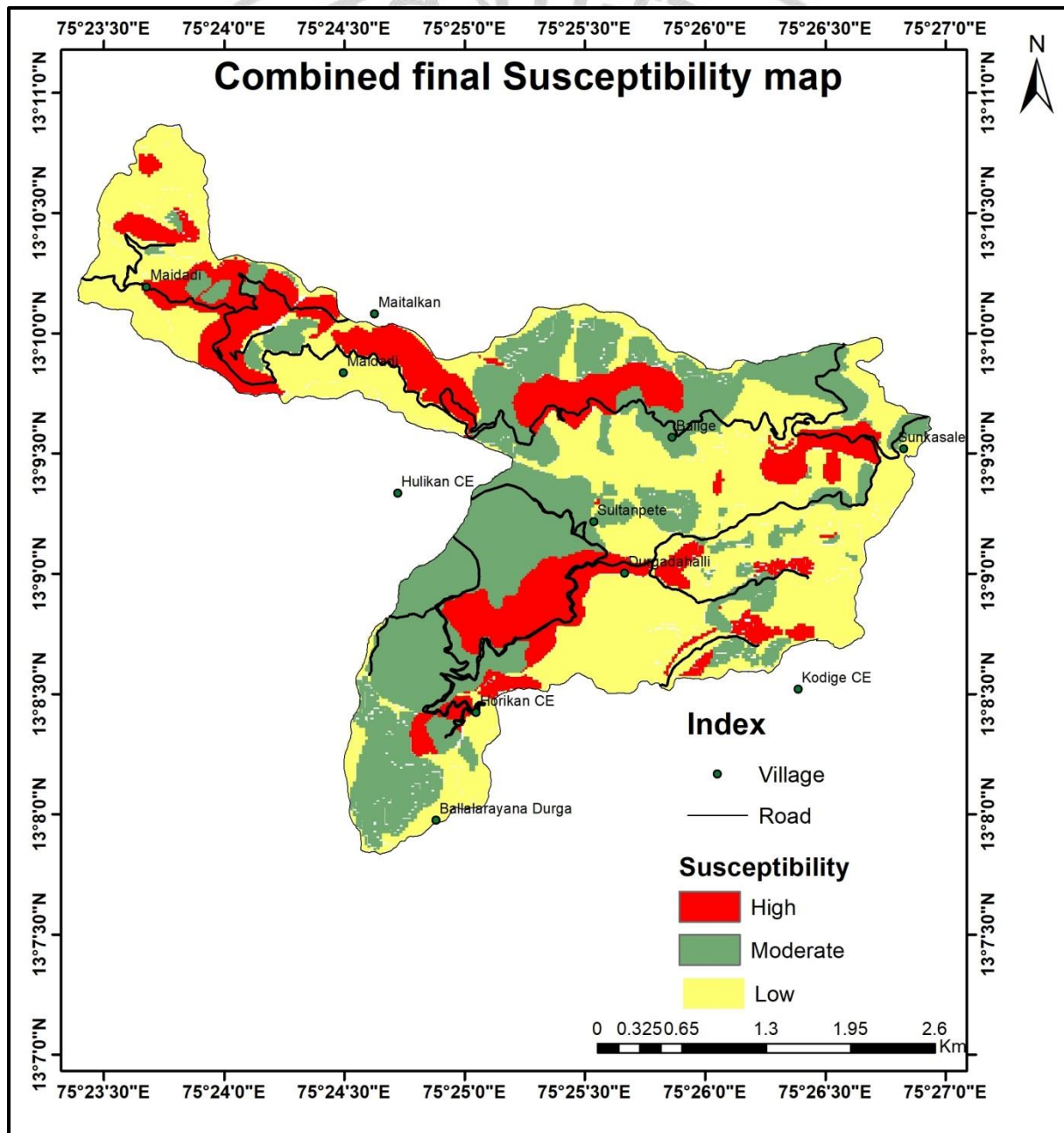
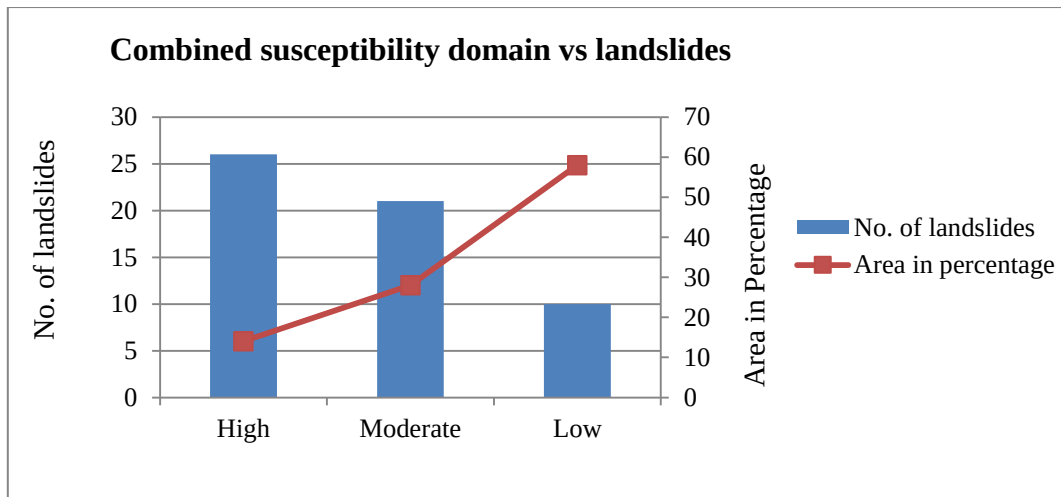


Fig 37: Combined Susceptibility map of the study area



Graph 2: Landslide distribution over the final susceptibility map

Validation of the Susceptibility map over landslides has been done as the above graph represents that the maximum number of landslides falls on high and moderate susceptible classes(>80%) than the low susceptible class.

CHAPTER 6

LANDSLIDE SUSCEPTIBILITY ANALYSIS

6.1 Landslide Incidences in Study Area:

Landslide inventory mapping plays a crucial role in the analysis of landslide susceptibility within the terrain. Understanding the mechanisms behind slope failures is essential for identifying the root causes of landslide initiation. The landslide inventory was compiled using data from GSI reports, literature, satellite imagery, multi-temporal Google Earth images, and field observations. A comprehensive field assessment was conducted to document both past and current landslide locations, resulting in the identification and recording of 95 landslides. These landslides were characterized by 42 geoparametric attributes, forming the basis of the landslide inventory database (refer to Annexure-I). The analysis also encompassed the examination of causative and triggering factors, failure mechanisms, damage and risk assessments, and recommended remedial and mitigation measures based on site-specific conditions. Out of the 95 recorded landslides, the final susceptibility assessment of the area revealed that 28% of the region is highly susceptible, with an additional 14% falling within the moderately susceptible zone, and 58% categorized as low susceptibility areas. The majority of the landslides occurred in the debris and earth domains. The spatial distribution of landslide occurrences indicates that most slope failures and landslides originated on hillslopes with gradients ranging between 25-35°, marking them as the most vulnerable areas. These landslides were primarily triggered by heavy and persistent rainfall during the 2019 Southwest monsoon season. Notably, areas such as Balige, the southeast of Hulikatte, and the Maidadi road section experienced a high incidence of landslide events.

Spatial distribution of Landslides: Most of the Balige & Kirugalamane stretch hill slopes seem to be severely affected by the landslide events. The major events are concentrated along this road stretch apart from one of the major events near the Hulikatte area where a big landslide destabilised the area and devastated the coffee and cardamom plantations. The major events come under the category of debris flow events along the 1st to 2nd order nalas.

These major events are distributed over the highly weathered metabasalts and Gneisses litho units.

Field Observation: On 2019 August 9th major events destabilised the hillslopes of Balige, Kirugilumane, Maithalkhan & Durghadahalli places of the study area. During that

particular week, the area receives 70 inches of rainfall which plays a major havoc to the disaster around those areas. Recalled by the locals that a similar major disaster took place 40 years ago. The majority of the study area hillslopes have been covered by moderate to highly weathered slope-forming materials mostly belonging to the metabasalts & gneisses etc. The Northern stretch of the Balige, Kirugilamane & Maidadi relative relief is high compared to the Southern sectors of Durgadhahalli & Rani Jheri areas. Most of the nalas got aggravated and the debris flow events occurred along major Northern portions mostly along the high relative relief places of the Balige stretch and some major events were recorded in the Southern parts of the study area. The weathered materials got saturated enough to lose cohesions for the heavy precipitation of that particular week.

6.1.2 Causative Geofactors & Triggering Factor:

Detailed field observations and assessments are essential for identifying all the causative factors that influence slope stability. These factors are determined based on a comprehensive evaluation of both inherent and external geofactors associated with landslides. The key factors governing slope stability include predisposing terrain conditions, such as landform units, slope morphometric parameters like slope gradient and relative relief, land use/land cover, drainage morphometric parameters, the influx of water and stream power erodibility index, hydro-geological settings (including the water condition of the slope), lithology, structural discontinuities, shear parameters (cohesion and frictional resistance), and the grain size of the materials that form the slope. In the prevailing geomorphic conditions, external factors that contribute to slope instability are primarily excessive and periodic heavy rainfall events. These rainfall events have triggered a significant number of landslides. When heavy rainfall occurs, it leads to a substantial increase in water flow within the watershed, causing abnormally high sub-surface water levels in all sub-basins. Consequently, under extreme hydrostatic stress, excess sub-surface water surpasses the carrying capacity, emerging on the surface. This emergence occurs through weaker planes and zones, often manifesting as springs with capillary action on the surface. These conditions ultimately lead to the occurrence of large landslides.

6.1.3 Susceptibility condition of the slope: The pre-disposing terrain condition i.e. landform units, slope morphometric parameters i.e. slope gradient, relative relief, land use/land cover, drainage morphometric parameters; the influx of water and steam power erodibility index,

hydro-geological setting, shear parameters (cohesion and frictional resistance), and grain size of the slope forming material are governing the slope stability condition. In the combined domain-based landslide susceptibility map The final susceptibility of the area shows that 30% area falls into a highly susceptible zone followed by a moderately susceptible zone covering 40% area and a low susceptible zone covering 25% of the study area that got triggered during heavy incessant rainfall event of August 2019 happened in Chikmagalur district of Karnataka.

6.1.4 RISK MANAGEMENT IN PROBABLE HIGH-RISK AREAS

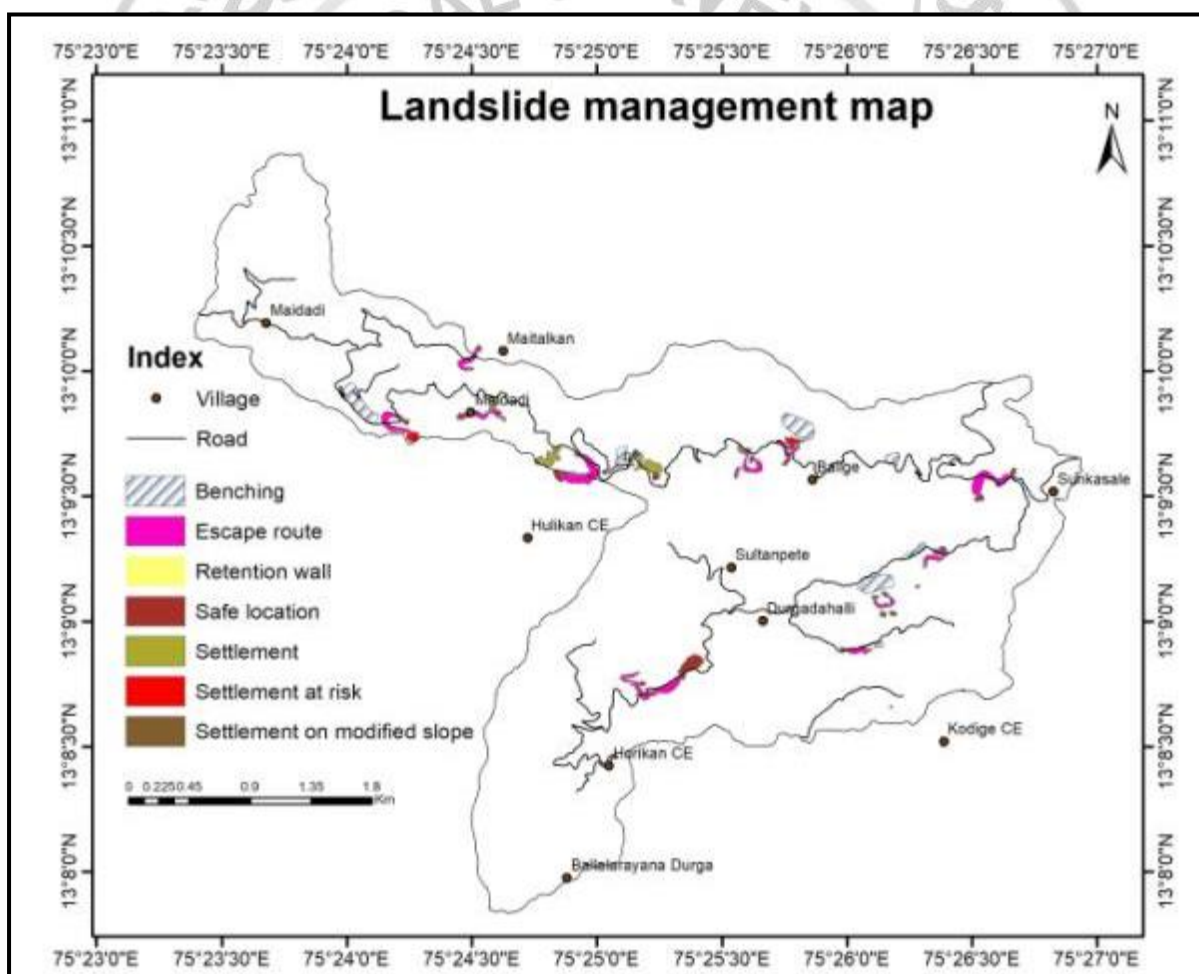


Fig 38: Landslide susceptibility management map

Landslide management map is a preparedness map for the decision makers during disasters, prepared by the experts of the geologists. The high-risk zones of the susceptible hill slopes may have a high probable chance of hitting/affecting the elements (either living or non-living) during the disasters (landslides) in the future providing safe escape routes and safe

shelters during heavy rainfall. Probable high-risk areas & Mitigation Measures a total of four areas are delineated as four areas have been identified as probable high-risk zones based on hazard elements and the potential for recurrent landslides during heavy rainfall events in landslide-susceptible areas. The table below presents the spatial distribution of these high-risk zones, accompanied by detailed scientific observations for effective disaster prevention, preparedness, and planning by the administrative authorities.

These measures are essential for reducing the risk of landslides and ensuring the safety of the affected areas and residents. Monitoring and early intervention during heavy rainy seasons are critical components of disaster preparedness and mitigation efforts.

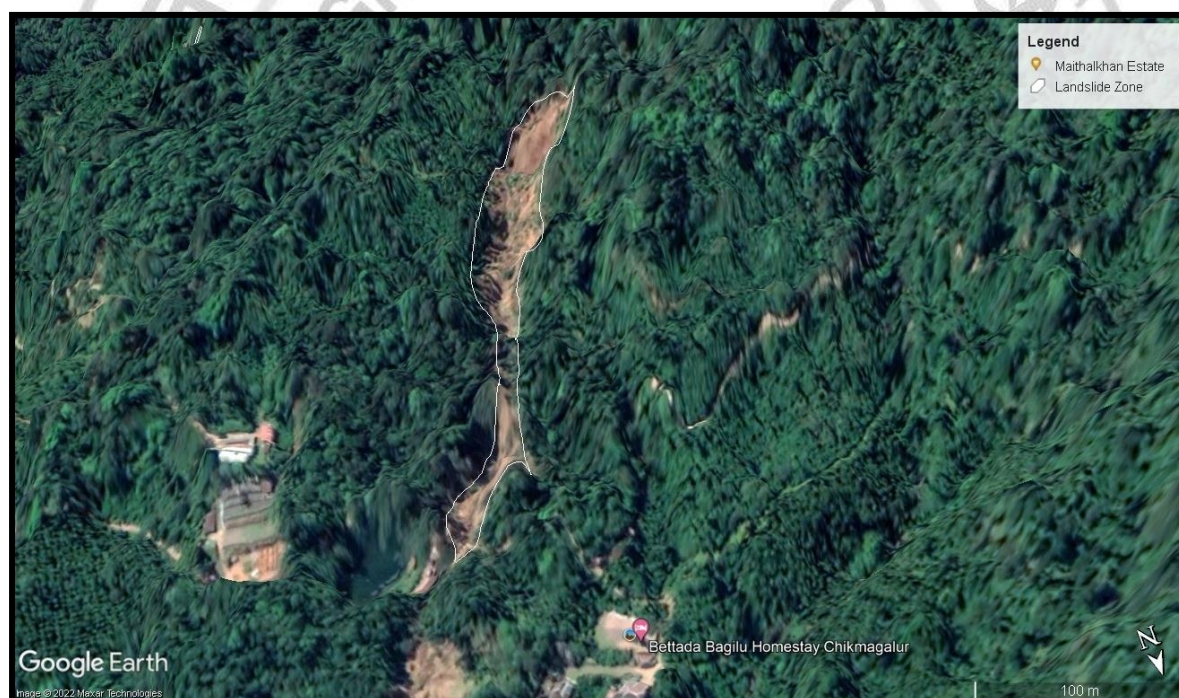


Figure 39: Major Hulikatte landslide from Google image

6.1.5 Probable high-risk areas & Mitigation Measures: A total of four areas are delineated as probable high-risk areas considering the hazard and associated risk elements on high landslide susceptible zones as well as the areas where the likelihood of recurrence of past landslide incidence is possible during heavy incessant rainfall events. The spatial distributions of high-risk zones are listed in the table below and related site-specific scientific observations are discussed in detail for effective disaster prevention, preparedness, and planning by the administrative authority.

Field Assessment of Identified Probable High-Risk Zones

In and around Lat: 13° 09' 47.45" & Long: 75°24' 9.44", This location is near Maidadi, where the major road got disrupted by the major slide and older big events also recorded nearby along the same hill slopes trending in NW-SE directions. The rock units are fragile, intersected by 2 sets of joints added with the foliation plane which may become another set of joints during kinematic analysis. The slope face faces towards the SW direction and the kinematic analysis shows planar failure.

Geogenic cause: The slope materials get disrupted by joints, fracture and become fragile as weathering progresses and the cut slope for the road cut disrupts the stability condition of the slope. During heavy rainfall time, the slope rock units lose their shear strength further with the influence of incoming water from the precipitation.

Easing of the slope by benches in a proper ratio and soil nailing can be tried with the help of civil engineers in Maidadi vulnerable stretches.

Geoscientific causes: The Kinematics study shows that the joint is not directly involved in wedge formation but dislocates the bonding between the rocks and forms the planar failure. The Steepness of the slope is high around 40° to 50° degrees approximately. The area is moderate to highly weathered in the state. The natural slope has been disrupted for road construction; the same slope has been trimmed for 3 roads at different elevation levels. Consequently, all the weakness/factors and the structural discontinuities with the added rainfall trigger increases the gravity pull of that particular slope facet reducing the shear strength and leading to failure. Even the Rock mass rating (RMR) value of the spot also yields us a poor grade.

Recommendation: Earlier retaining structures have been constructed and they should have weep holes and proper monitoring of weep holes without choking of holes has to be taken care of periodically. The upslope has the chance of further reactivation. The upslope and the adjacent slopes can be eased, and slope gradation has to take place by making the benches in proper ratio and reducing the angle of the slope to near gentle. During monsoon seasons the upslopes have to be monitored for cracks, which are the initial signs of slope instability.

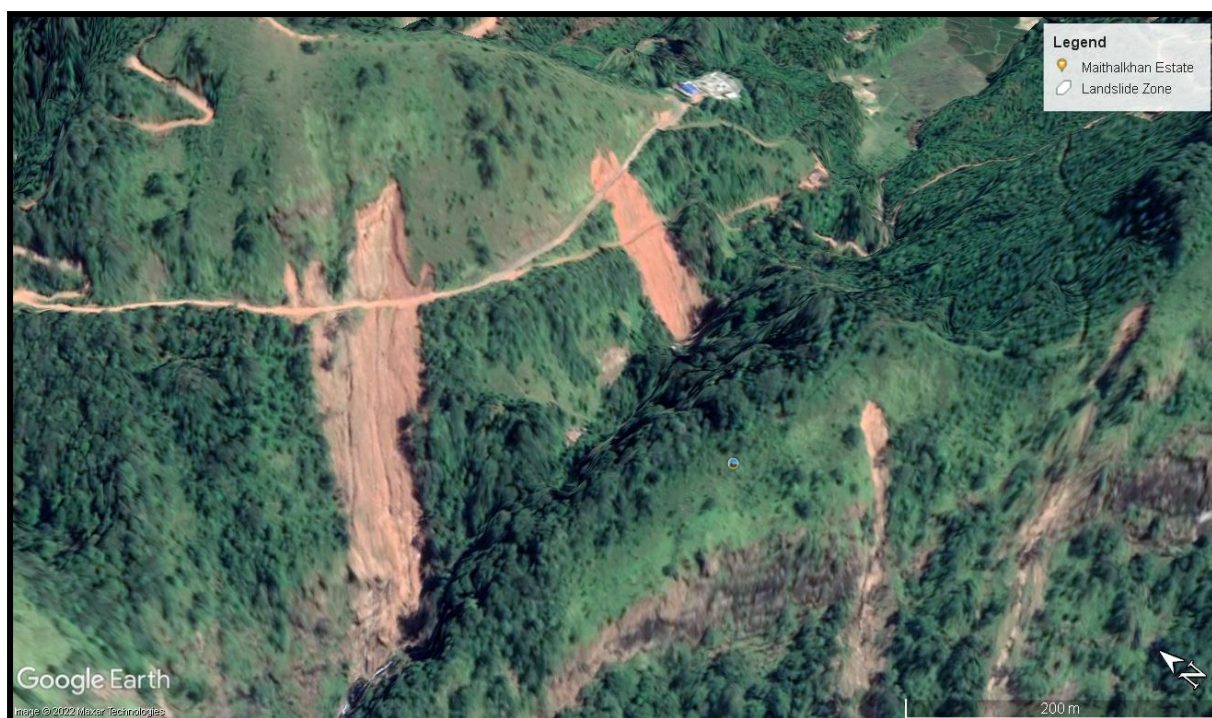


Fig 40: Landslide near Maidadi Estate



Photo 4: Major treated landslide near Maidadi estate

Location 2: Near Bombrakallu homestay the slope of this area is in vulnerable condition. On nearby sides, old slides have been recorded earlier. The house located on the nearby nala path where cracks have developed during heavy flood time indicates the movement of the slope and for every season the crack has increased. During heavy rainfall as well as flood time

people residing in that particular house should relocate to safe places and can come back after normality returns. Some kind of supporting structure is essential and drainage pipes to evacuate collected upslope and seepage water. The downslope of the cracked house slope can be benched and extra water can be removed safely. Gabbion walls can be placed along each bench to make the slope stable. The catchment area of the slope is massive and considering this fact the houses located at the downslopes have to be vacated during heavy to very rainfall conditions.

Geogenic cause: Here the upslope local basin is big where it can collect more water and channel everything through the same nala flowing in NNW-SSE directions. The slope geomorphon is moderate to steep in condition and the weathered materials are not stable and fragile in nature, on that slope. Kinematic analysis shows that two sets of joints, destabilize the slope units and thus form planar failure and the chances of retrogradation are possible and the adjacent sides of the slope condition are also not stable. RMR rating also yields a poor grade of rock strength. Finally, rainfall is the last triggering factor to initiate the movement. Overall, the whole area /facet appears to be a bit depressed part. A house was located where the slope looks like convex faceted here a small portion. Small-scale movements can be identified from the immediate upslopes of the house. The immediate upslopes are a bit steep slope compared to the other areas nearby.

The aspect of the steep slope is towards the Southern direction. A couple of houses are located here and there that are/ below the downslopes. The slope here is moderate to steep. The downslope geomorphon is concave shaped and a couple of houses may get affected if movement happens.

Recommendation: During heavy rainy seasons, the peoples staying at the downslopes of this section has to move to the safest place. Because the larger basin, in turn, collects more stream flow and the possibility of flooding chances is high, big boulders are dislocated and it has been identified on the earlier landslide zone during the fieldwork. So, if any movement starts then any chunks of boulder associated with the debris failure may create havoc at the downslopes. Preventive measures are better than other worst things to happen in future.



Fig 41: Bommarrakallu homestay and the vulnerable spots.



Photo 5: Cracks affected house near Bomarakallu homestay.



Photo 6: Bomarakallu homestay located at the cut section of the hill.

Location 3: In and around Lat: $13^{\circ} 09' 14.01''$ & Long: $75^{\circ}26'18.67''$, This location is towards the Durghadhalli roadside, here the slope is moderate to steep in section, and the thick patches of weathered section failed along the SW slope. The Slope aspect is towards the SW direction. Nearby, the natural failures have been noted on the right side of the demarcated zone.

Geogenic cause: here the upslope is less but the cut slope for house construction behaves very weakly. The slope-forming materials are completely weathered soil and even though they trimmed the slope, the holding capacity i.e. the cohesion becomes less due to heavy rains and a flow of water along the slope.

Recommendation: Cemented drainage pipes are the best way to stop water erosion and slope gradation by making benches in a proper ratio, if needed soil nailing can be tried. Based on civil engineers' suggestions. A proper retaining wall structure with weep holes further arrest the movement of downslopes which in turn stabilizes the slope in one way. Vetiver grasses and tree plants can be grown on the edges of the slopes to arrest erosion.

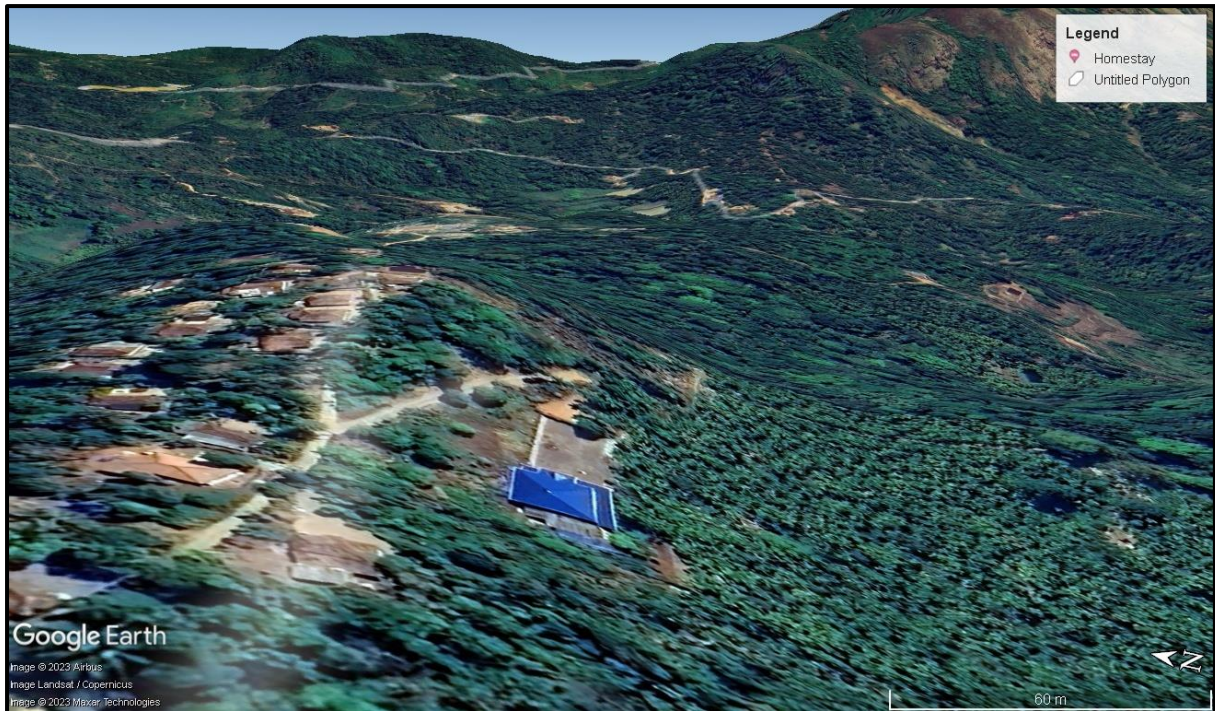


Figure 42: Overview of Durgadhahalli vulnerable spot around the blue house.



Photo 7: Landslide susceptible zone near Durghadhahalli

Location 4: Hulikatte to Rani-Jheri route:

The exact area with a Lat: 13° 09' 9.05" & Long: 75° 25' 29.35" that we have a long upslope where a considerable amount of rainwater gets collected and gushes through this sport only.

The average slope angle ranges from 35°-40° degrees facing towards NE directions. The road stretch connects the village to the rest of the places and the houses are located at the downslopes, supposing a failure happens on the upslopes, these spots which are located below may get affected.

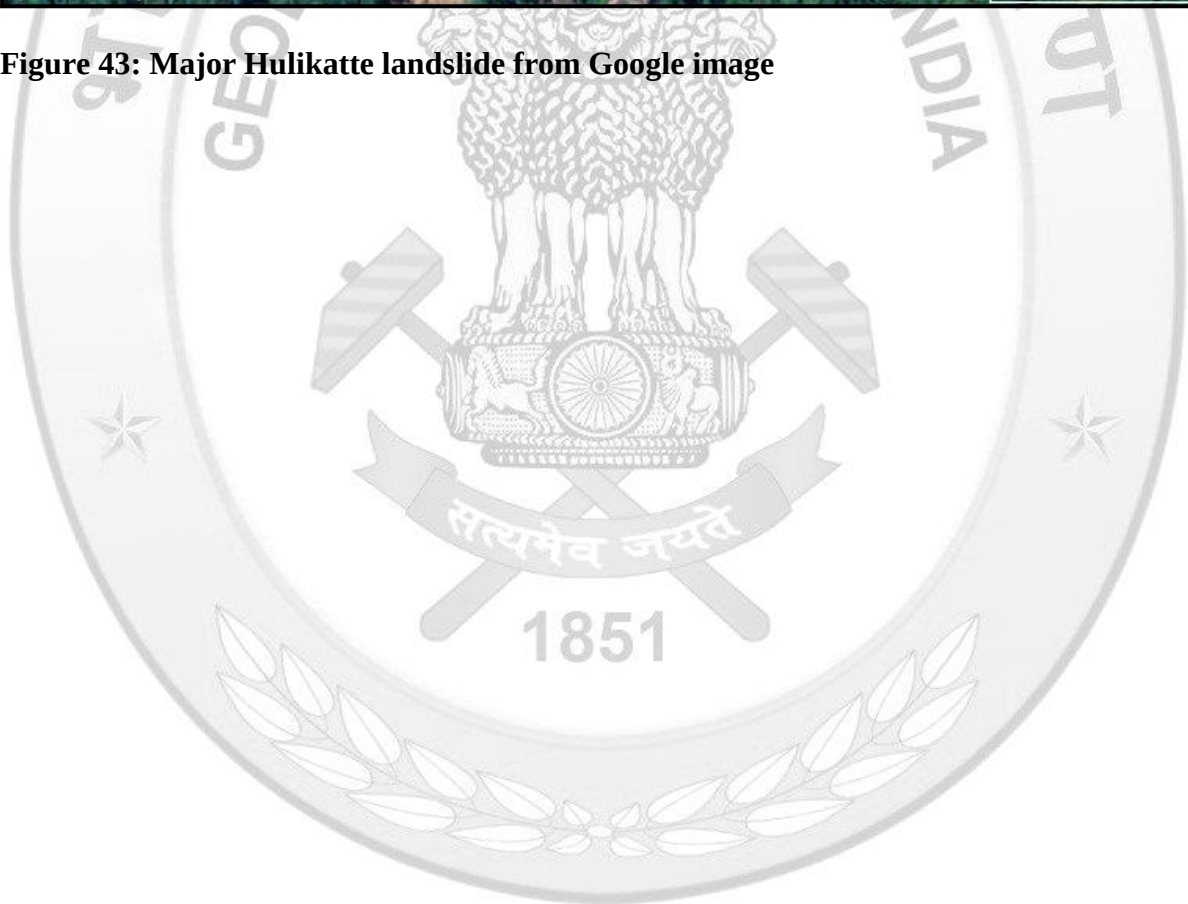
Geogenic cause: The slope geomorphon is moderate to steep in condition and the weathered materials are not stable on that slope. Kinematic analysis shows that two sets of joints, destabilize the slope units and thus form planar failure and the chances of retrogradation are possible and the adjacent sides of the slope condition are also not stable. RMR rating also yields a poor grade of rock strength. Finally, rainfall is the last triggering factor to initiate the movement.

Recommendation: During heavy rainy seasons the peoples staying at the down slopes of this section has to move to the safest place. Because big boulders are dislocated and it has been identified in the earlier landslide zone during the fieldwork. So if any movement starts then any chunks of boulder associated with the debris failure may create havoc at the down slopes. Preventive measures are better than, other worst things to happen in future.

Near Hulikatte Landslide: It is a big landslide and the chance of retrogradation is high. Here the slope angle ranges from about 30° to 32° degrees approximately as per the Google Earth calculations. From the drainage map and as per the landowner's observation, a nala was flowing earlier at this place and the whole area has been cultivated. During the 2019- 20 rainfall, a subsidence has been noticed. Further, there was appearance and disappearance of Nala were noticed during the peak season of rainfall. Particularly a nala only flows during the rainy season. During that week, the area received 70 inches of rainfall. During the 9th afternoon incident happened. The upslopes are concave in shape and the geomorphic pattern favours collecting more rainfall water from the upslopes and concave geomorphon(hollow unit) in turn collects more rainfall and the slope passes the collected water to the downslopes and the erosion occurs similarly to debris flows. Here the slope aspect faces towards the NE direction.



Figure 43: Major Hulikatte landslide from Google image



CHAPTER 7

CONCLUSION AND RECOMMENDATIONS

In accordance with FS: 2022-23, a Meso-scale (1:10,000) landslide susceptibility mapping project covering 12.4 sq. km in the Chikkamagaluru district, Karnataka, was conducted. The project involved assigning heuristic knowledge-driven inter-predictor weights to assess the level of influence of various factors and generate susceptibility maps. Pre-field geofactor maps, including land use and land cover (LULC), slope-forming material (SFM), and regolith thickness, were prepared from Google Earth imagery and validated in the field. Additionally, domain-specific maps were created, such as the cut slope, overburden, and rock domains, to generate the final combined susceptibility map.

From August 6th to 9th, heavy rainfall occurred saturating the surface and subsurface systems, making the area highly susceptible to debris flows. The northern part of the study area experienced intense shearing, leading to most landslide events, with a significant incident on the afternoon and night of August 9th. Approximately 70 inches of rainfall during that week significantly contributed to destabilizing the highly weathered slope units. Interestingly, the local community reported a similar incident in 1961, and it has recurred.

Regarding the susceptibility map, out of 95 recorded landslides, the final assessment showed that 14% of the area is highly susceptible, 28% moderately susceptible, and 58% low susceptibility. Most landslides occurred in the cut slope and overburden domains. Notable high-incidence areas included Balige, southeast of Hulikatte, Maidadi Road, and the Maithalkan estate road.

The landslide incidence in the study area revealed a correlation with younger-order streams, where around 86% of landslides occurred near 1st and 2nd-order streams. Subsurface groundwater, combined with surface water systems, played a role in triggering debris flow failures. Landslides were concentrated in areas with high relative relief (47-61) and slopes of 20-40 degrees. Slope and hollow geomorphic units accounted for over 89% of landslides, with the spur unit having only 9%. Additionally, regolith thickness of 0.5 to 2 meters and soil/overburden units recorded more landslide events. Highly weathered metabasalt and gneissic rocks were prone to landslides.

Overall, these landslide incidences provide valuable insights into delineating high, moderate, and low susceptibility zones based on local topography and rainfall triggers. Four areas are identified as probable high-risk zones considering hazard elements and the likelihood of recurrence during heavy rainfall events: Maidadi road stretch, Bommarakallu homestay location, Durdghahalli, and Hulikatte to Rani-Jehri route.

Recommendations:

- ✚ The hamlet located before Abkikallu homestay is vulnerable based on its history of previous major events. Implementing upslope benching and installing proper culverts where needed is advisable. In cases of heavy to very heavy rainy seasons, residents in this area should prepare for evacuation to nearby safe locations.
- ✚ Consider soil nailing with the assistance of civil engineers to reinforce vulnerable road stretches in Maidadi and in proximity to the Durgadhahalli sites.
- ✚ The slope near Bombrakallu homestay exhibits vulnerability. Recommended measures include benching the downslope of the damaged house and ensuring the safe removal of excess water. Installing gabion walls along each bench can enhance slope stability. Given the substantial catchment area of the slope, evacuating houses located downstream during periods of heavy to very heavy rainfall is advisable for safety.
- ✚ The slope near the Bombrakallu homestay exhibits vulnerability. Recommended measures include benching the downslope of the damaged house and ensuring the safe removal of excess water. Installing gabion walls along each bench can enhance slope stability. Given the substantial catchment area of the slope, evacuating houses located downstream during periods of heavy to very heavy rainfall is advisable for safety.

LOCALITY INDEX

Locality	Latitude	Longitude	TS.No
Balige	13° 9' 33.969" N	75° 25' 51.841" E	48O/08
Durgadhahalli	13°08'59.06"N	75°25'47.10"E	48O/08
Hulikatte	13°09'18.94"N	75°25'17.03"E	48O/08
Horikan CE	13° 8' 25.366" N	75° 25' 2.924" E	48O/08
Maidadi	13°09'53.19"N	75°24' 1.42"E	48O/08
Maitalkan	13° 10' 8.594" N	75° 24' 26.540" E	48O/08
Sunkasale	13°09'29.99"N	75°26' 48.53"E	48O/08

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1. Tanvi Gupta and Sunandan Basu, Geologists, 2019: Marco Scale (1:50,000) Landslide Susceptibility Mapping in parts of Toposheet No. 48O/07 AND 48O/08, Chikmagalur and Dakshin Kannada districts, Karnataka.
2. Kapil Singh, Geologist & Kamal Kumar, Geologist, 2019: A note on the post-disaster investigation of landslide Occurrences in Chikmagalur and Mudigere taluks, Chikmagalur district, Karnataka, Dated 27th August 2019.
3. Maruthi K.V and Mishra A.K; Landslide inventory along NH & SH of ghat roads in Chikmagalur, Coorg, Dakshina Kannada, Udupi and Shimoga districts, Karnataka. (Progress report of FS 2009 – 10).
4. Mishra A.K; Pradhan U.P and Maruthi K.V; Landslide hazard zonation on macro scale of Charmudi ghat section from Charmudi to Kotigehara, Kotigehara to Kalasa and Sakleshpur to Uppinangadi in Dakshin Kannada and Chikmagalur districts, Karnataka. (Progress report of FS 2008 – 09 and 2009 – 10).
5. Disaster Management Plan (DDMP) for Chikmagalur district, 2019-20.
6. Standard Operating Procedure (SOP) for Meso scale (1:10,000/ 5000) Landslide Susceptibility Mapping, 2021.

42-Point Geo parametric data sheet

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/01
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Balige village
6	NH/SH/Locality	Balige village road
7	Latitude	13°09'39.00"
8	Longitude	75°26'15.7"
9	Length	~35m
10	Width	~35m
11	Height	~12m
12	Area	~1225m ²
13	Depth	~<5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Advancing
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	2019
24	Geomorphology	Moderately dissected slope
25	Geology	Banded Magnetite quartzite
26	Structure	-
27	Landuse/ Land cover	Coffee plantation with HHP
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to pore water pressure increases and also toe erosion by stream, unplanned cutting of slope.
37	Remedial measures	Slope easing & deep root plantation required, remove the debris materials from the slope.
38	Remarks, if any	-

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Extensive cut slope has been made for road construction without proper remedy. Due to extensive rainfall as a triggering factor material moved towards downside.
41	Date of Reporting	26/10/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/02
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Balige road
6	NH/SH/Locality	Balige road
7	Latitude	13°09'38.09"
8	Longitude	75°26'14.1"
9	Length	~40m
10	Width	~25m
11	Height	~8m
12	Area	~1000m ²
13	Depth	~<5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Coffee plantation with HHP
28	Hydrological condition	Wet

29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Balige village road was damaged
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Anthropogenic activities (unplanned cutting of slope)
37	Remedial measures	Slope grading, at down slope deep root plantation are required and retaining structure are suggested.
38	Remarks, if any	At down slope a retaining wall has constructed for toe support after 2019 landslide event in this area.
39	Photos, Sketch of Plan & section of the slide	
40	Summary/Abstract	Due to Anthropogenic activities like unplanned cutting of slope causes planar failure triggered by rain. Slope grading, at down slope deep root plantation are required and retaining structure are suggested. Soil piping have also observed. At down slope a retaining wall has already constructed for toe support after 2019 landslide event in this area.
41	Date of Reporting	26/10/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/03
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Near Balige
6	NH/SH/Locality	Balige road
7	Latitude	13°09'37.7"
8	Longitude	75°26'13.4"
9	Length	~80m
10	Width	~25m
11	Height	~50m
12	Area	~2000m ²

13	Depth	~<5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Coffee plantation with HHP
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Anthropogenic activities (unplanned cutting of slope)
37	Remedial measures	Retaining structure has suggested
38	Remarks, if any	Remedies has already provide after landslide incidence in 2019.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Retaining wall has already constructed for toe support after 2019 landslide event in this area.
41	Date of Reporting	27/10/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/04
2	State	Karnataka
3	District	Ckikkamagaluru

4	Toposheet	48O/08
5	Name of the slide	Balige
6	NH/SH/Locality	Balige road
7	Latitude	13°09'38.2"
8	Longitude	75°26'11.1"
9	Length	~90m
10	Width	~25m
11	Height	~75m
12	Area	~2250m ²
13	Depth	~4m
14	Volume	9000m ³
15	Run out distance	-
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Suspended
20	Distribution	Advancing
21	Style	Single
22	Failure mechanism	Deep planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	J1:70/64-170, J2: 140/72-230
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Flowing
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Increasing of Pore water pressure and reduction of strength on supersaturation, Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	At upslope side slope easing & benching should be done and retaining structure are also required.
38	Remarks, if any	A retaining wall has constructed after 2019 landslide incidence.

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Due to increasing of Pore water pressure and reduction of strength on supersaturation, Anthropogenic activities which is unplanned cutting of slope. At upslope side slope easing & benching should be done and retaining structure are also required. A retaining wall (20 m length) has constructed after 2019 landslide incidence.
41	Date of Reporting	27/10/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/05
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Balige
6	NH/SH/Locality	Balige road
7	Latitude	13°09'38.5"
8	Longitude	75°26'8.0"
9	Length	~20m
10	Width	~15m
11	Height	~10m
12	Area	~300m ²
13	Depth	~<5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Banded magnetite quartzite

26	Structure	J1:15/80-120, J2: 50/80-140
27	Landuse/ Land cover	Mixed jungle and at downslope Coffee plantation
28	Hydrological condition	Flowing
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Slope easing and deep root plantations are suggested
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Due to increasing of pore water pressure and reduction of strength on supersaturation, anthropogenic activities which is unplanned cutting of slope.
41	Date of Reporting	27/10/2022
42	Landslide Category	III

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/06
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Balige Estate
6	NH/SH/Locality	Balige Road
7	Latitude	13°09'39.2"
8	Longitude	75°25'56.1"
9	Length	~25m
10	Width	~30m

11	Height	~15m
12	Area	~750m ²
13	Depth	~<5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Dormant
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow planar
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Flowing
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture land
36	Geo-scientific Causes	Planar failure due to Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Slope grading and line drainage are required.
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Planar failure due to anthropogenic activities which is unplanned cutting of slope. Slope grading and line drainage are required.

41	Date of Reporting	27/10/2022
42	Landslide Category	III

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/07
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Balige estate
6	NH/SH/Locality	Balige road
7	Latitude	13°09'36.5"
8	Longitude	75°25'55.3"
9	Length	~100m
10	Width	~30m
11	Height	~90m
12	Area	~3000m ²
13	Depth	~<5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow rotational failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Coffee plantation with HHP.
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road connecting Balige was damaged.
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Increasing of Pore water pressure and reduction of strength on supersaturation, Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	During 2019 event Retaining wall has constructed at down slope.
38	Remarks, if any	At downside slope plantation is required.

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Increasing of Pore water pressure and reduction of strength on supersaturation, Anthropogenic activities which is unplanned cutting of slope. During 2019 event Retaining wall has constructed at down slope. At downside slope plantation is required.
41	Date of Reporting	28/10/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/08
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Balige
6	NH/SH/Locality	Balige road
7	Latitude	13°09'35.17"
8	Longitude	75°25'54.33"
9	Length	~35m
10	Width	~20m
11	Height	~30m
12	Area	~700m ²
13	Depth	~<5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Planar failure

23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Coffee plantation (HHP)
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture land
36	Geo-scientific Causes	Planar failure, Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	During 2019 event road was damaged and Retaining wall has constructed at down slope.
38	Remarks, if any	Presently it is in stable condition.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Planar failure, Anthropogenic activities which is unplanned cutting of slope. During 2019 event road was damaged and Retaining wall has constructed at down slope. Presently it is in stable condition.
41	Date of Reporting	27/10/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/09
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Balige
6	NH/SH/Locality	Balige road
7	Latitude	13°09'37.80"
8	Longitude	75°25'50.72"
9	Length	~50m

10	Width	~50m
11	Height	~40m
12	Area	~2500m ²
13	Depth	~4m
14	Volume	10000m ³
15	Run out distance	-
16	Type of Material	Soil
17	Type of movement	Slide
18	Rate of movement	Very rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Multiple
22	Failure mechanism	Deep planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Shared Granite Gneiss, quartz vein
26	Structure	Shear sense indicator are present.
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Flowing
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Road
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Due to intense rainfall in 2019 the entire area was badly affected by many landslides. Along flowing stream landslide occurred.
37	Remedial measures	Retaining wall has constructed at down side of the slope which is 40-50 m in length and 7-8 m in height.
38	Remarks, if any	Remedial measures already present.
39	Photos. Sketch of Plan & section of the slide	

40	Summary/Abstract	Due to intense rainfall in 2019 the entire area was badly affected by many landslides. Along flowing stream landslide occurred. Remedial measures provided after 2019 landslide incidence.
41	Date of Reporting	28/10/2022
42	Landslide Category	I

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/10
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Balige
6	NH/SH/Locality	Balige road
7	Latitude	13°09'42.89"
8	Longitude	75°25'33.92"
9	Length	~200m
10	Width	~20m
11	Height	~80m
12	Area	~4000m ²
13	Depth	~5m
14	Volume	20000m ³
15	Run out distance	50
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow rotational failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Flowing
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Increasing of Pore water pressure and reduction of strength on supersaturation, Anthropogenic activities which is unplanned

		cutting of slope.
37	Remedial measures	Slope grading and road drainage are required
38	Remarks, if any	Adjacent to the landslide buffer one residential house is situated which is not safe to live during intense rainfall.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Increasing of Pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. Slope grading and road drainage are required Adjacent to the landslide buffer one residential house is situated which is not safe to live during intense rainfall.
41	Date of Reporting	28/10/2022
42	Landslide Category	I

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/11
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Balige
6	NH/SH/Locality	Metaled road connected to Balige village
7	Latitude	13°09'44.14"
8	Longitude	75°25'31.8"
9	Length	~100m
10	Width	~30m
11	Height	~75m
12	Area	~3000m ²
13	Depth	~5m
14	Volume	15000m ³
15	Run out distance	-
16	Type of Material	Debris

17	Type of movement	Slide
18	Rate of movement	Very Rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow rotational failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Flowing
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Increasing of Pore water pressure and reduction of strength on supersaturation, Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Benching should be done. Relocate the settlements during intense rainfall. This place is not suitable for residential purpose during monsoon period.
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Extensive cut slope made for road construction. Downside of the nala few houses are present. During monsoon or heavy rain this place is not safe for stay.
41	Date of Reporting	28/10/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/12
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Balige
6	NH/SH/Locality	Balige road
7	Latitude	13°09'41.6"
8	Longitude	75°25'24.6"
9	Length	~10m
10	Width	~15m
11	Height	~8m
12	Area	~150m ²
13	Depth	~<5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Multiple
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Coffee plantation with arecanut
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture area
36	Geo-scientific Causes	Planar failure due to Increasing of Pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Slope grading and deep root plantation are recommended.
38	Remarks, if any	

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Extensive cut slope made for road construction. At downside slope few residential house is situated. Slope grading and deep root plantation are recommended. Proper drainage management are suggested at this site.
41	Date of Reporting	28/10/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/13
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Balige
6	NH/SH/Locality	Balige road
7	Latitude	13°09'41.68"
8	Longitude	75°25'23.01"
9	Length	~50m
10	Width	~30m
11	Height	~40m
12	Area	~1500m ²
13	Depth	~<5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow Planar failure

23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Highly sheared Granite Gneiss, Micaceous band
26	Structure	-
27	Landuse/ Land cover	Moderate vegetation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture land
36	Geo-scientific Causes	Planar failure due to Increasing of Pore water pressure and reduction of strength on supersaturation, Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Slope easing and retaining wall are required at down side of the road.
38	Remarks, if any	Retaining wall are present which is partially damaged, repairing should be done. At upslope side benching are required.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Towards slope one homestay is present and one higher order stream is flowing adjacent to the landslide. Retaining wall are present which is partially damaged, repairing should be done. At upslope side benching are required.
41	Date of Reporting	28/10/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/14
2	State	Karnataka
3	District	Ckikkamagaluru

4	Toposheet	48O/08
5	Name of the slide	Balige
6	NH/SH/Locality	Balige road
7	Latitude	13°09'41.4''
8	Longitude	75°25'20.35''
9	Length	~120m
10	Width	~30m
11	Height	~100m
12	Area	~3600m ²
13	Depth	~5m
14	Volume	~18000m ³
15	Run out distance	-
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Dormant(old scar)
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Deep rotational failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Granite Gneiss
26	Structure	-
27	Landuse/ Land cover	Thick vegetation and at downside of slope coffee plantation
28	Hydrological condition	Flowing
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Retaining wall and drainage management have suggested.
38	Remarks, if any	Remedial measures already given.

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. After the 2019 landslide event remedial measures are already present.
41	Date of Reporting	28/10/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/15
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Balige
6	NH/SH/Locality	Balige road
7	Latitude	13°09'36.60"
8	Longitude	75°25'9.43"
9	Length	~25m
10	Width	~20m
11	Height	~15m
12	Area	~500m ²
13	Depth	~<5m
14	Volume	-

15	Run out distance	-
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Granite Gneiss
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Flowing
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to Increasing of Pore water pressure and reduction of strength on supersaturation, Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Cracks should be filled and the house is not safe during monsoon. It is at risk.
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Near Giri Sri homestay one residential house is present which is at risk during intense rainfall. Cracks has already developed in house wall. Adjacent to this house 4 more residential houses are situated. These house should be relocate during rainy season. The house owner name is Mr. Rukumayya.

41	Date of Reporting	28/10/2022
42	Landslide Category	I

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/16
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Balige (Kate Makki)
6	NH/SH/Locality	Balige village
7	Latitude	13°09'37.72"
8	Longitude	75°25'8.57"
9	Length	~50m
10	Width	~20m
11	Height	~30m
12	Area	~100m ²
13	Depth	~<5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Moving
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Granite gneiss
26	Structure	-
27	Landuse/ Land cover	SMS & Coffee plantation with mixed jungle.
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	-
36	Geo-scientific Causes	Due to unplanned cutting and construction (homestay) without any proper remedies below one house is present. There is no proper drainage management, water is flowing from the downslope house and road which is increasing soil erosion. Towards flowing direction of rain water one house is situated which have cracks and land subsidence. That house is not

		suitable for living during rainy season.
37	Remedial measures	Residential house is present which is at risk during intense rainfall. Cracks has already developed in house wall. This house should be relocate as it is at risk.
38	Remarks, if any	Owner name: Mr. Kadiya
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Due to unplanned cutting and construction (homestay) without any proper remedies below one house is present. There is no proper drainage management, water is flowing from the downslope house and road which is increasing soil erosion. Towards flowing direction of rain water one house is situated which have cracks and land subsidence. That house is not suitable for living during rainy season.
41	Date of Reporting	30/10/2022
42	Landslide Category	I

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/17
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Balige
6	NH/SH/Locality	Balige road
7	Latitude	13°09'36.26"
8	Longitude	75°25'4.73"
9	Length	~110m

10	Width	~80m
11	Height	~30m
12	Area	~8800m ²
13	Depth	~5m
14	Volume	70400m ³
15	Run out distance	-
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Very Rapid
19	Activity	Suspended
20	Distribution	Moving
21	Style	Single
22	Failure mechanism	Deep rotational failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Granite gneiss
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Flowing
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Benching required, deep root plantation should be done, drainage with proper culvert required at downslope.
38	Remarks, if any	Downside of road retaining structure should be constructed for road safety.

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	At the crown part one kutcha road has constructed and disturbed the natural slope with unplanned cutting. The overburden material is present. During intense rainfall, there are favorable condition for planar failure due to increasing of pore water pressure and reduction of strength on supersaturation of highly weathered material present at upslope and downslope.
41	Date of Reporting	30/10/2022
42	Landslide Category	I

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/18
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Balige
6	NH/SH/Locality	Balige road
7	Latitude	13°09'39.40"
8	Longitude	75°24'56.66"
9	Length	~40m
10	Width	~35m
11	Height	~30m
12	Area	~1400m ²
13	Depth	~<5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Rapid

19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Multiple
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Granite Gneiss
26	Structure	-
27	Landuse/ Land cover	Coffee plantation with arecanut
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Retaining structure & benching required. Drainage with proper culvert required at downslope.
38	Remarks, if any	After 2019 landslide remedial measures have already provided at this site.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	At this site stream is present. Landslide occurred along the stream towards downside of the slope. Debris material is weathered rock. After 2019 landslide event remedial measures have already provided at this site.
41	Date of Reporting	30/10/2022

42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/19
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Balige
6	NH/SH/Locality	Balige road
7	Latitude	13°09'40.33"
8	Longitude	75°24'54.65"
9	Length	~90m
10	Width	~30m
11	Height	~70m
12	Area	~2700m ²
13	Depth	~<5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris
17	Type of movement	Falls
18	Rate of movement	Very Rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Granite Gneiss
26	Structure	-
27	Landuse/ Land cover	Coffee plantation with moderate vegetation
28	Hydrological condition	Flowing
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture area
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Proper drainage management are required at this place. Landslide occurred along the stream, after the erosion the stream

		path widened and discharge of water also will be more during rainy season.
38	Remarks, if any	100 m ahead one SMS at risk which have developed cracks. House owner is Mr. Ashok.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	On road side small dimension stream is flowing, during rainy season half of stream water flowing in stream and half of water flowing towards house which is constructed below the stream and the house is not safe during intense rain.
41	Date of Reporting	30/10/2022
42	Landslide Category	I

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/20
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Balige
6	NH/SH/Locality	Balige road
7	Latitude	13°09'41.5"
8	Longitude	75°24'53.8"
9	Length	~10m
10	Width	~20m
11	Height	~8m
12	Area	~200m ²
13	Depth	~<5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Suspended

20	Distribution	Widening
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Benching should be required
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	At this site upslope and downside coffee plantations are present. Highly weathered zone. Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
41	Date of Reporting	30/10/2022
42	Landslide Category	III

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/21
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Balige
6	NH/SH/Locality	Balige road
7	Latitude	13°09'42.25"
8	Longitude	75°24'51.73"
9	Length	~20m
10	Width	~20m
11	Height	~18m
12	Area	~400m ²
13	Depth	~<5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Granite gneiss
26	Structure	--
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Benching & slope easing should be required.
38	Remarks, if any	

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. Benching & slope easing should be required.
41	Date of Reporting	31/10/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/22
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Balige
6	NH/SH/Locality	Balige road
7	Latitude	13°09'44.75"
8	Longitude	75°24'48.63"
9	Length	~40m
10	Width	~30m
11	Height	~30m
12	Area	~1200m ²
13	Depth	~<5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Multiple
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt

26	Structure	
27	Landuse/ Land cover	Coffee plantation with high height plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Slope grading and plantation of deep root trees.
38	Remarks, if any	Due to stream erosion slide occurred along stream due to intense rain. Downside of the road toe erosion by stream.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Due to stream erosion slide occurred along stream triggered by intense rain. Downside of the road toe erosion by stream. Retaining wall is already constructed it should be monitored during monsoon. Culvert is provided but it should be channelized and proper maintenance should be required before monsoon. After 2019 landslide event retaining wall has already provided at this site.
41	Date of Reporting	31/10/2022
42	Landslide Category	III

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/23
2	State	Karnataka

3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Balige
6	NH/SH/Locality	Balige road
7	Latitude	13°09'49.38"
8	Longitude	75°24'44.50"
9	Length	~80m
10	Width	~25m
11	Height	~70m
12	Area	~2000m ²
13	Depth	~5m
14	Volume	10000m ³
15	Run out distance	-
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Benching & proper drainage required
38	Remarks, if any	

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Along the stream landslide occurred due to intense rainfall. The area is fully weathered and converted into thick pile of overburden material. Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
41	Date of Reporting	31/10/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/24
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Balige
6	NH/SH/Locality	Balige road
7	Latitude	13°09'51.78"
8	Longitude	75°24'43.59"
9	Length	~200m
10	Width	~40m
11	Height	~120m
12	Area	~8000m ²
13	Depth	~>5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Multiple
22	Failure mechanism	Shallow planar failure

23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Mylonite with quartz vein , garnet is also present
26	Structure	-
27	Landuse/ Land cover	Moderate vegetation
28	Hydrological condition	Flowing
29	Triggering Factor	Anthropogenic factors like road cutting
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Toppling & wedge failure due to intersection of joints and day lighted slope. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Drainage along with culvert present and retaining wall is also present.
38	Remarks, if any	Remove the dislodge boulders from upslope.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Rocks deformed by shear deformation. Toppling & wedge failure due to intersection of joints and day lighted slope. Anthropogenic activities which is unplanned cutting of slope.
41	Date of Reporting	01/11/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/25
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Maidadi
6	NH/SH/Locality	Kirgalmene, Maidadi road
7	Latitude	13°09'54.73"
8	Longitude	75°24'37.63"
9	Length	~10m

10	Width	~20m
11	Height	~8m
12	Area	~200m ²
13	Depth	~<5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Multiple
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Coffee plantation with moderate vegetation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Barren and downside coffee plantation
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Higher order stream is flowing near slide. Drainage and retaining wall is already constructed after landslide event in 2019.
38	Remarks, if any	

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	In adjacent area at upslope rock is exposed which is massive metabasalt exposure. Stream is flowing and there are no settlements in nearby. Multiple old scar of rock slide is present. Higher order stream is flowing near slide. Drainage and retaining wall is already constructed after landslide event in 2019.
41	Date of Reporting	01/11/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/26
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Maidadi
6	NH/SH/Locality	Maidadi road
7	Latitude	13°09'56.0"
8	Longitude	75°24'36.9"
9	Length	~15m
10	Width	~25m
11	Height	~12m
12	Area	~375m ²
13	Depth	~<5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Suspended

20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Old landslide scar.
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. Presently this is stable.
41	Date of Reporting	01/11/2022
42	Landslide Category	III

No	Field	Description
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1	Slide No (LS .No.)	KAR/CHK/2022/27
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Maidadi
6	NH/SH/Locality	Maidadi road
7	Latitude	13°09'54.23"
8	Longitude	75°24'33.94"
9	Length	~20m
10	Width	~30m
11	Height	~15m
12	Area	~600m ²
13	Depth	~<5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Coffee plantation with high height plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation.
37	Remedial measures	Slope benching and one retaining wall is required as one settlement on modified slope is present.
38	Remarks, if any	

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Slope benching and one retaining structure is required as one settlement on modified slope is present.
41	Date of Reporting	02/11/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/28
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Kirgalmene
6	NH/SH/Locality	Kirgalmene
7	Latitude	13°09'57.16"
8	Longitude	75°24'28.08"
9	Length	~50m
10	Width	~35m
11	Height	~30m
12	Area	~1750m ²
13	Depth	~<5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Soil
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Dormant
20	Distribution	Retrogressive
21	Style	Single

22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Flowing
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Slope benching and drainage with culvert is required.
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	The area is fully weathered and have thick pile of overburdened material. Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. Slope benching and drainage with culvert is required.
41	Date of Reporting	03/11/2022
42	Landslide Category	III

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/29

2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Kirgalmame
6	NH/SH/Locality	-
7	Latitude	13°09'55.30"
8	Longitude	75°24'26.42"
9	Length	~10m
10	Width	~15m
11	Height	~10m
12	Area	~150m ²
13	Depth	~<5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Thick vegetation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Slope grading is suggested.
38	Remarks, if any	Downside of the road one house is situated in the valley.

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	The site is moderately weathered. Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. Downside of the road one house is situated in the valley.
41	Date of Reporting	03/11/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/30
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Maidadi
6	NH/SH/Locality	Maidadi road
7	Latitude	13°09'47.89"
8	Longitude	75°24'11.26"
9	Length	~12m
10	Width	~20m
11	Height	~10m
12	Area	~240m ²
13	Depth	~<5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Retrogressive

21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Lowely dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Upslope forest land and downside of the road is private land.
28	Hydrological condition	Dry
29	Triggering Factor	Anthropogenic factor like road cutting
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Slope easing is required..
38	Remarks, if any	Extensive cut slope has converted into landslide.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	At upslope sparse vegetation is present and the area comes under government forest land. Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. Extensive cut slope has converted into landslide.
41	Date of Reporting	03/11/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/31
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Maidadi
6	NH/SH/Locality	Maidadi road
7	Latitude	13°09'47.51"
8	Longitude	75°24'09.94"
9	Length	~50m
10	Width	~35m
11	Height	~45m
12	Area	~1750m ²
13	Depth	~2m
14	Volume	3500m ³
15	Run out distance	-
16	Type of Material	Rock
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Dry
29	Triggering Factor	Anthropogenic factor like road cutting.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Slope easing and retaining wall should be constructed at toe level with proper dimension with weep holes. Upslope line drainage are recommended.
38	Remarks, if any	Retaining wall under construction at toe level. Downside higher order stream is flowing.

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. Slope easing and retaining wall should be constructed at toe level with proper dimension with weep holes. Upslope line drainage are recommended. Retaining wall under construction at toe level. Downside higher order stream is flowing.
41	Date of Reporting	04/11/2022
42	Landslide Category	I

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/32
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Maidadi
6	NH/SH/Locality	Maidadi road
7	Latitude	13°09'48.0"
8	Longitude	75°24'07.9"
9	Length	~15m
10	Width	~20m
11	Height	~10m
12	Area	~300m ²
13	Depth	~2m

14	Volume	~600m ³
15	Run out distance	-
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Dry
29	Triggering Factor	Anthropogenic factor like road cutting.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Slope easing and retaining structure should be constructed at toe level with proper dimension with weep holes. Upslope proper drainage are recommended.
38	Remarks, if any	Retaining wall under construction at toe level. Downside higher order stream is flowing.
39	Photos. Sketch of Plan & section of the slide	

40	Summary/Abstract	Slope easing and retaining wall should be constructed at toe level with proper dimension with weep holes. Upslope proper drainage are recommended. Retaining wall under construction at toe level. Downside higher order stream is flowing.
41	Date of Reporting	04/11/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/33
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Maidadi
6	NH/SH/Locality	Maidadi road
7	Latitude	13°09'50.7"
8	Longitude	75°24'04"
9	Length	~70m
10	Width	~60m
11	Height	~65m
12	Area	~4200m ²
13	Depth	~>5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Rock
17	Type of movement	Falls
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Multiple
22	Failure mechanism	Deep planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Sparse vegetation
28	Hydrological condition	Wet
29	Triggering Factor	Anthropogenic factor like road cutting.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic

		activities which is unplanned cutting of slope.
37	Remedial measures	Remove the debris from slope. Slope easing and downside of the road drainage is recommended for road safety.
38	Remarks, if any	Remedial measure are required.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. Remove the debris from slope, Slope easing. Downside of the road drainage is recommended. For road safety remedial measure are required.
41	Date of Reporting	04/11/2022
42	Landslide Category	I

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/34
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Maidadi
6	NH/SH/Locality	Maidadi road
7	Latitude	13°09'53.2"
8	Longitude	75°24'0.8"
9	Length	~15m
10	Width	~20m
11	Height	~12m
12	Area	~300m ²
13	Depth	~2m
14	Volume	~600m ³
15	Run out distance	-

16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Sparse vegetation
28	Hydrological condition	Wet
29	Triggering Factor	Anthropogenic factor like road cutting.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	Road
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Slope easing and drainage is recommended.
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. Slope easing & drainage is recommended.
41	Date of Reporting	08/11/2022

42	Landslide Category	II
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No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/35
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Maidadi 2
6	NH/SH/Locality	Maidadi road
7	Latitude	13°10'06.53"
8	Longitude	75°23'56.21"
9	Length	~12m
10	Width	~20m
11	Height	~10m
12	Area	~240m ²
13	Depth	~1m
14	Volume	240m ³
15	Run out distance	-
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Moderate vegetation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Slope benching and drainage at toe level is recommended.
38	Remarks, if any	Retaining wall under construction at toe level. Downside higher order stream is flowing.

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	For house construction extensive cut slope made at downside and presently slumping is observed near boundary wall. Slope benching and drainage at toe level is recommended.
41	Date of Reporting	09/11/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/36
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Maidadi 2
6	NH/SH/Locality	Maidadi road
7	Latitude	13°10'09.6"
8	Longitude	75°23'52.5"
9	Length	~20m
10	Width	~22m
11	Height	~18m
12	Area	~440m ²
13	Depth	~1m
14	Volume	440m ³
15	Run out distance	-
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single

22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Thick vegetation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Down side of the road landslide occurred which is initiated from top of the hill. Retaining structure required from the toe level.
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Toe erosion by stream causes landslide. At Upslope and downslope remedies are required. Stream is flowing, so to avoid toe erosion proper culvert is required for flowing stream.
41	Date of Reporting	09/11/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/37
2	State	Karnataka

3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Maidadi 2
6	NH/SH/Locality	Maidadi road
7	Latitude	13°10'11.22"
8	Longitude	75°23'41.74"
9	Length	~14m
10	Width	~40m
11	Height	~12m
12	Area	~560m ²
13	Depth	~1m
14	Volume	560m ³
15	Run out distance	-
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Widening
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Moderate vegetation
28	Hydrological condition	Wet
29	Triggering Factor	Anthropogenic factor like road cutting.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Slope benching and proper drainage is recommended.
38	Remarks, if any	

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Upslope sparse vegetation and in valley portion moderate vegetation. Drainage has given which is earthen cemented drainage is required.
41	Date of Reporting	10/11/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/38
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Maidadi 2
6	NH/SH/Locality	Maidadi road
7	Latitude	13°10'22.31"
8	Longitude	75°23'38.53"
9	Length	~25m
10	Width	~50m
11	Height	~20m
12	Area	~1250m ²
13	Depth	~1m
14	Volume	1250m ³
15	Run out distance	-
16	Type of Material	Rock
17	Type of movement	Falls
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Widening
21	Style	Multiple
22	Failure mechanism	Shallow planar failure

23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Banded magnetite quartzite
26	Structure	-
27	Landuse/ Land cover	Sparse vegetation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	Road
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Slope benching & drainage has recommended.
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. Slope benching & drainage has recommended.
41	Date of Reporting	11/11/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/39
2	State	Karnataka

3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Sunkasale
6	NH/SH/Locality	Durgadhahalli Road
7	Latitude	13°9'29.54"
8	Longitude	75°26'43.14"
9	Length	~10m
10	Width	~15m
11	Height	~8m
12	Area	~150m ²
13	Depth	~1m
14	Volume	150m ³
15	Run out distance	-
16	Type of Material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Coffee plantation with hhp
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Slope benching & drainage has recommended.
38	Remarks, if any	

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. Slope benching & drainage has recommended.
41	Date of Reporting	11/11/22
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/40
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Durgadhahalli
6	NH/SH/Locality	Durgadhahalli Road
7	Latitude	13°9'15.91"
8	Longitude	75°26'16.40"
9	Length	~10m
10	Width	~45m
11	Height	~70m
12	Area	~450m ²
13	Depth	~1m
14	Volume	~450m ³
15	Run out distance	-
16	Type of Material	Debris
17	Type of movement	Flow
18	Rate of movement	Extremely rapid
19	Activity	Active
20	Distribution	Widening
21	Style	Single

22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	Road was washed off.
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Slope angle should be proper maintaining of slope during road cut. Vertical cut should be avoided. Drainage are required to free flow of water. Downside on landslide plantation are suggested. Benching should be done.
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Down side of the slide one residential house is situated which is adjacent to the runout path. During heavy rainfall the house is not safe for living.
41	Date of Reporting	12/11/2022
42	Landslide Category	I

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/41
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Durgadhahalli
6	NH/SH/Locality	Durgadhahalli Road
7	Latitude	13°9'13.18"
8	Longitude	75°26'09.38"
9	Length	~12m
10	Width	~100m
11	Height	~10m
12	Area	~1200m ²
13	Depth	~1m
14	Volume	~1200m ³
15	Run out distance	-
16	Type of Material	Earth slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Widening
21	Style	Multiple
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	Road was damaged
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Drainage are required to free flow of water. Benching should be done.
38	Remarks, if any	

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	The rain water is directly flowing from slope to the road. The path of rain water is diverted by manmade pipe. At this site proper drainage is required. Adjacent to the site multiple small slump are also present.
41	Date of Reporting	12/11/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/42
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Durgadhahalli
6	NH/SH/Locality	Durgadhahalli Road
7	Latitude	13°9'3.81"
8	Longitude	75°25'54.02"
9	Length	~40m
10	Width	~20m
11	Height	~35m
12	Area	~800m ²
13	Depth	~<5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Earth slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Moving

21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Granite gneiss
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	Road was damaged
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Benching should be done
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Anthropogenic activities which is unplanned cutting of slope. For remedial measure benching should be done.
41	Date of Reporting	12/11/2022
42	Landslide Category	III

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/43
2	State	Karnataka
3	District	Ckikkamagaluru

4	Toposheet	48O/08
5	Name of the slide	Durgadhahalli
6	NH/SH/Locality	Durgadhahalli Road
7	Latitude	13°9'05.21"
8	Longitude	75°25'54.75"
9	Length	~55m
10	Width	~20m
11	Height	~45m
12	Area	~1110m ²
13	Depth	~<5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Earth slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Moving
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Granite gneiss
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Deep root plantations & benching should be done.
38	Remarks, if any	

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Both side of the slope coffee plantation are present. The rock is completely weathered and converted into overburden material. Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. Deep root plantations & benching should be done.
41	Date of Reporting	14/11/2022
42	Landslide Category	III

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/44
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Durgadhahalli
6	NH/SH/Locality	Durgadhahalli Road
7	Latitude	13°9'2.28"
8	Longitude	75°25'37.66"
9	Length	~20m
10	Width	~50m
11	Height	~18m
12	Area	~100m ²
13	Depth	~1m
14	Volume	~100m ³
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active

20	Distribution	Widening
21	Style	Multiple
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Granite gneiss
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Drainage are required to free flow of water & benching should be done.
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	The overburden thickness is 3-4m. The rock which is fully weathered and producing loose soil with sandy portion is high. The cohesive strength is less. Extensive cut slope failed and landslide occurred.
41	Date of Reporting	14/11/2022
42	Landslide Category	III

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/45
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Hebarngudi
6	NH/SH/Locality	Hebarngudi
7	Latitude	13°9'18.93"
8	Longitude	75°25'12.57"
9	Length	~150m
10	Width	~35m
11	Height	~80m
12	Area	~5250m ²
13	Depth	~5m
14	Volume	~26250m ³
15	Run out distance	-
16	Type of Material	Debris Flow
17	Type of movement	Flow
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Moving
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Granite gneiss
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	Labours quarter was damaged.
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Drainage with culvert is required & deep root plantations has suggested.
38	Remarks, if any	

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Large debris flow occurred in 2019 in coffee plantation. Stream is flowing in the runout path continuously and there is no culvert. In the vicinity of the landslide one residential house is situated.
41	Date of Reporting	14/11/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/46
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Durgadhahalli
6	NH/SH/Locality	Durgadhahalli Road
7	Latitude	13°8'59.02"
8	Longitude	75°25'25.64"
9	Length	~100m
10	Width	~75m
11	Height	~145m
12	Area	~7500m ²
13	Depth	~>5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Suspended
20	Distribution	Retrogressive

21	Style	Multiple
22	Failure mechanism	Deep planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Granite gneiss
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Slope grading and increase of deep root plantation. Drainage is required to free flow of water.
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Deep rotational debris slide in coffee plantation along the road side multiple scar is present. Gulley erosion and rill wash is also observed.
41	Date of Reporting	14/11/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/47
2	State	Karnataka
3	District	Ckikkamagaluru

4	Toposheet	48O/08
5	Name of the slide	Durgadhahalli
6	NH/SH/Locality	Durgadhahalli Road
7	Latitude	13°8'55.52"
8	Longitude	75°25'26.74"
9	Length	~20m
10	Width	~45m
11	Height	~18m
12	Area	~900m ²
13	Depth	~<5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Earth slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Widening
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Granite gneiss
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Drainage are required to free flow of water. Benching should be done.
38	Remarks, if any	

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. Drainage are required to free flow of water& benching should be done.
41	Date of Reporting	15/11/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/48
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Durgadhahalli
6	NH/SH/Locality	Durgadhahalli Road
7	Latitude	13°8'54.34"
8	Longitude	75°25'26.26"
9	Length	~18m
10	Width	~50m
11	Height	~15m
12	Area	~900m ²
13	Depth	~2m
14	Volume	~1800m ³
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Widening
21	Style	Multiple

22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Granite gneiss
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Drainage are required to free flow of water, benching should be done & deep root plantation are suggested.
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. Drainage are required to free flow of water, benching should be done & deep root plantation are suggested.
41	Date of Reporting	15/11/2022
42	Landslide Category	II

No	Field	Description
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1	Slide No (LS .No.)	KAR/CHK/2022/49
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Durgadhahalli
6	NH/SH/Locality	Durgadhahalli Road
7	Latitude	13°8'50.94"
8	Longitude	75°25'26.76"
9	Length	~18m
10	Width	~40m
11	Height	~16m
12	Area	~720m ²
13	Depth	~4m
14	Volume	~2880m ³
15	Run out distance	-
16	Type of Material	Earth slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Multiple
22	Failure mechanism	Shallow rotational failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Granite gneiss
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Drainage are required to free flow of water, benching should be done & deep root plantation are suggested.
38	Remarks, if any	

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. Drainage are required to free flow of water, benching should be done & deep root plantation are suggested.
41	Date of Reporting	15/11/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/50
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Durgadhahalli
6	NH/SH/Locality	-
7	Latitude	13°8'45.34"
8	Longitude	75°25'17.82"
9	Length	~150m
10	Width	~80m
11	Height	~80m
12	Area	~12300m ²
13	Depth	~>5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Suspended
20	Distribution	Retrogressive

21	Style	Multiple
22	Failure mechanism	Deep rotational failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Granite gneiss
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	-
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Drainage with culvert is required& deep root plantations are suggested.
38	Remarks, if any	Post disaster study has been done in 2019 for this landslide.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Large debris slide occurred in 2019. One acre Coffee plantation was affected by this slide. The land owner is Mr. DV Subraya of this property.
41	Date of Reporting	15/11/2022
42	Landslide Category	I

No	Field	Description
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1	Slide No (LS .No.)	KAR/CHK/2022/51
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Durgadhahalli
6	NH/SH/Locality	Durgadhahalli road
7	Latitude	13°8'43.90"
8	Longitude	75°25'14.44"
9	Length	~40m
10	Width	~35m
11	Height	~35m
12	Area	~1400m ²
13	Depth	~4m
14	Volume	~5600m ³
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabaslt
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Yes
32	Livestock loss	Nil
33	Communication	-
34	Infrastructure	The shop and house of Mr. M.K. Anil Kumar was completely damaged.
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Slope Benching & drainage with culvert required.
38	Remarks, if any	This site is not safe for any construction for future.

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. Slope Benching & drainage with culvert required. This site is not safe for any construction for future.
41	Date of Reporting	16/11/2022
42	Landslide Category	I

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/52
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Durgadhahalli
6	NH/SH/Locality	Durgadhahalli road
7	Latitude	13°8'43.90"
8	Longitude	75°25'12.68"
9	Length	~35m
10	Width	~30m
11	Height	~30m
12	Area	~1050m ²
13	Depth	~2m
14	Volume	~2100m ³
15	Run out distance	-
16	Type of Material	Debris flow
17	Type of movement	Flow
18	Rate of movement	Rapid
19	Activity	Active

20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Granite gneiss.
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Yes
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Compound wall for road is required & drainage with culvert required.
38	Remarks, if any	This site is at risk for any construction for future.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Along the stream debris slide has occurred due to which present culvert is choked which should be clean. Adjacent to stream one SMS is present which is at risk. This site is not safe in monsoon.
41	Date of Reporting	16/11/2022
42	Landslide Category	I

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/53
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Durgadhahalli
6	NH/SH/Locality	Durgadhahalli road
7	Latitude	13°8'43.35"
8	Longitude	75°25'5.65"
9	Length	~50m
10	Width	~45m
11	Height	~40m
12	Area	~2250m ²
13	Depth	~2m
14	Volume	~4500m ³
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Multiple
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Drainage with culvert required& slope benching and deep root plantations are suggested.
38	Remarks, if any	

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. Drainage with culvert required & slope benching and deep root plantations are suggested.
41	Date of Reporting	16/11/2022
42	Landslide Category	II

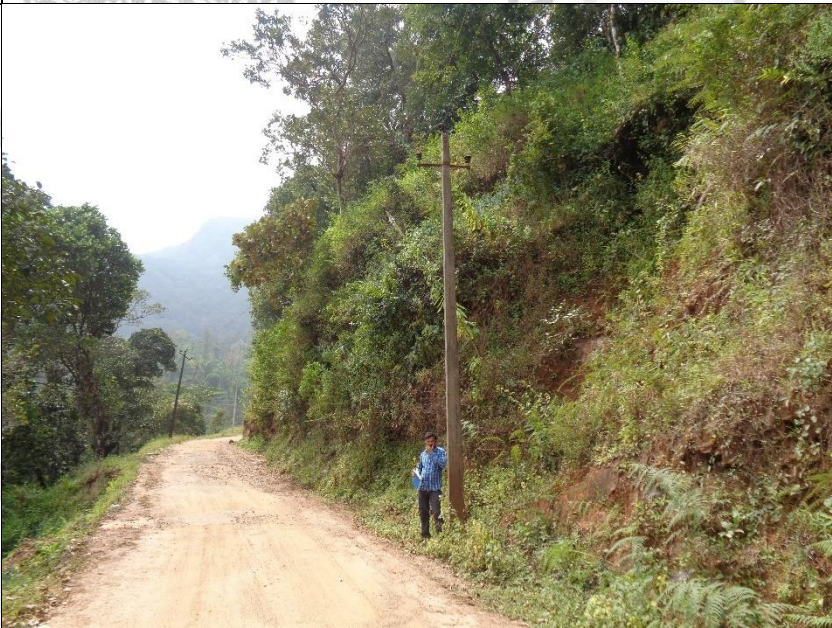
No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/54
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Durgadhahalli
6	NH/SH/Locality	Durgadhahalli road
7	Latitude	13°8'42.64"
8	Longitude	75°25'04.67"
9	Length	~12m
10	Width	~25m
11	Height	~10m
12	Area	~300m ²
13	Depth	~2m
14	Volume	~600m ³
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Widening

21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Moderate vegetation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Drainage with culvert required. Slope benching and deep root plantations are suggested.
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Extensive cut slope failed and landslide occurred. Adjacent to the site Extensive cut slope is present which is made for road construction and material is continuously falling from cut slope.
41	Date of Reporting	17/11/2022
42	Landslide Category	I

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/55
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Durgadhahalli
6	NH/SH/Locality	Durgadhahalli road
7	Latitude	13°8'39.03"
8	Longitude	75°25'3.20"
9	Length	~60m
10	Width	~40m
11	Height	~30m
12	Area	~2400m ²
13	Depth	~1-2m
14	Volume	~2400m ³
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Suspended
20	Distribution	Moving
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Thick vegetation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Drainage with culvert required & deep root plantations are suggested.
38	Remarks, if any	

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. Drainage with culvert required. Deep root plantations are suggested.
41	Date of Reporting	17/10/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/56
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Durgadhahalli
6	NH/SH/Locality	Durgadhahalli road
7	Latitude	13°8'36.35"
8	Longitude	75°25'3.13"
9	Length	~75m
10	Width	~50m
11	Height	~65m
12	Area	~3750m ²
13	Depth	~1-2m
14	Volume	~7500m ³
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Extremely Rapid
19	Activity	Active
20	Distribution	Moving
21	Style	Multiple

22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Thick vegetation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Road was damaged
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Downside of slope retaining structure are required. Drainage management along the road side. Upslope slope grading is required.
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. Downside of slope retaining structure are required. Drainage management along the road side. Upslope slope grading required.
41	Date of Reporting	17/10/2022
42	Landslide Category	I

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/57
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Durgadhahalli
6	NH/SH/Locality	Durgadhahalli road
7	Latitude	13°8'56.12"
8	Longitude	75°24'57.67"
9	Length	~10m
10	Width	~40m
11	Height	~8m
12	Area	~400m ²
13	Depth	~<1m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Widening
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Thick vegetation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Retaining structure required for temple safety. Benching required. Drainage should be made along the temple boundary to avoid the water percolation within the area.
38	Remarks, if any	

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	The overburden material thickness is 4-5 meter. The rock is highly weathered. Retaining structure required for temple safety. Benching required. Drainage should be made along the temple boundary to avoid the water percolation within the area.
41	Date of Reporting	18/10/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/58
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Horikon estate
6	NH/SH/Locality	Horikon estate road
7	Latitude	13°8'33.43"
8	Longitude	75°24'56.24"
9	Length	~10m
10	Width	~40m
11	Height	~10m
12	Area	~400m ²
13	Depth	~1m
14	Volume	~400m ³
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Suspended
20	Distribution	Widening

21	Style	Multiple
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Thick vegetation
28	Hydrological condition	Wet
29	Triggering Factor	Anthropogenic factor like road cutting.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Benching should be done.
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. Benching should be done.
41	Date of Reporting	18/11/2022
42	Landslide Category	III

No	Field	Description
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1	Slide No (LS .No.)	KAR/CHK/2022/59
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Horikon estate
6	NH/SH/Locality	Horikon estate road
7	Latitude	13°8'28.4"
8	Longitude	75°24'53.0"
9	Length	~25m
10	Width	~35m
11	Height	~15m
12	Area	~875m ²
13	Depth	~2m
14	Volume	~1750m ³
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Multiple
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Thick vegetation
28	Hydrological condition	Wet
29	Triggering Factor	Anthropogenic factor like road cutting.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Benching should be done & deep root plantations are suggested.
38	Remarks, if any	

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. Benching should be done & deep root plantations are suggested.
41	Date of Reporting	18/11/2022
42	Landslide Category	III

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/60
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Horikon estate
6	NH/SH/Locality	Horikon estate road
7	Latitude	13°8'27.2"
8	Longitude	75°24'56.7"
9	Length	~60m
10	Width	~55m
11	Height	~55m
12	Area	~m2
13	Depth	~2m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Moving
21	Style	Single

22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Thick vegetation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall and anthropogenic factor like road cutting.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Deep root plantation at downside as this site is falling in coffee estate so risk element is only agriculture land.
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. Deep root plantation at downside as this site is falling in coffee estate so risk element is only agriculture land.
41	Date of Reporting	18/11/2022
42	Landslide Category	III

No	Field	Description
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1	Slide No (LS .No.)	KAR/CHK/2022/61
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Horikon estate
6	NH/SH/Locality	Horikon estate road
7	Latitude	13°8'26.7"
8	Longitude	75°25'01.4"
9	Length	~40m
10	Width	~35m
11	Height	~35m
12	Area	~1400m ²
13	Depth	~1m
14	Volume	~1400m ³
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Widening
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	6 August 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Moderate vegetation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall and anthropogenic factor like road cutting.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Deep root plantation at downside as this site. Slope benching has suggested.
38	Remarks, if any	

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. Deep root plantation at downside as this site. Slope benching has suggested.
41	Date of Reporting	18/11/2022
42	Landslide Category	III

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/62
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Horikon estate
6	NH/SH/Locality	Horikon estate road
7	Latitude	13°8'29.3"
8	Longitude	75°25'0.62"
9	Length	~12m
10	Width	~50m
11	Height	~10m
12	Area	~600m ²
13	Depth	~1m
14	Volume	~600m ³
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Widening

21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	2022
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Thick vegetation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall and anthropogenic factor like road cutting.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Deep root plantation at downside as this site. Slope benching has suggested.
38	Remarks, if any	This is private property of Tripathi group
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	The katcha road is going to newly constructed homestay is the risk element as it is private coffee estate.
41	Date of Reporting	18/11/2022
42	Landslide Category	III

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/63
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08

5	Name of the slide	Horikon estate
6	NH/SH/Locality	Horikon estate road
7	Latitude	13°8'29.5"
8	Longitude	75°25'04.7"
9	Length	~50m
10	Width	~40m
11	Height	~45m
12	Area	~2000m ²
13	Depth	~<1m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Widening
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	2022
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Thick vegetation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall and anthropogenic factor like road cutting.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Deep root plantation at this site. Slope benching & drainage management is required.
38	Remarks, if any	This is private property of Tripathi group

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	The katcha road is going to newly constructed homestay is the risk element as it is private property.
41	Date of Reporting	18/11/2022
42	Landslide Category	I

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/64
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Horikon estate
6	NH/SH/Locality	Horikon estate road
7	Latitude	13°8'30.0"
8	Longitude	75°25'04.1"
9	Length	~50m
10	Width	~30m
11	Height	~45m
12	Area	~1500m ²
13	Depth	~2m
14	Volume	~3000m ³
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Moving
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	2022

24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Thick vegetation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall and anthropogenic factor like road cutting.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Slope benching & drainage management is required.
38	Remarks, if any	This is private property of Tripathi group
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	The original slope cut for making road and due to intense rain cut slope failed. Slope benching & drainage management is required. This is private property of Tripathi group.
41	Date of Reporting	18/11/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/65
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Horikon estate
6	NH/SH/Locality	Horikon estate road
7	Latitude	13°8'29.9"

8	Longitude	75°25'02.8"
9	Length	~45m
10	Width	~25m
11	Height	~40m
12	Area	~1125m ²
13	Depth	~<5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Moving
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	2022
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Thick vegetation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall and anthropogenic factor like road cutting.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Deep root plantation at this site, slope benching & drainage management is required.
38	Remarks, if any	This is private property of Tripathi group

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Road cut without any planned and cut slope made which is falling towards the steep slope. Downside stream is also flowing. Deep root plantation at this site, slope benching & drainage management is required.
41	Date of Reporting	18/11/2022
42	Landslide Category	I

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/66
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Durgdhahalli
6	NH/SH/Locality	Durgdhahalli road
7	Latitude	13°8'48.18"
8	Longitude	75°26'03.22"
9	Length	~55m
10	Width	~20m
11	Height	~48m
12	Area	~1100m ²
13	Depth	~<1m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Moving
21	Style	Single

22	Failure mechanism	Shallow planar failure
23	History	2022
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall and anthropogenic factor like road cutting.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Road was damaged
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Slope benching & drainage management has suggested.
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Anthropogenic activities which is unplanned cutting of slope. Slope benching & drainage management required.
41	Date of Reporting	22/11/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/67
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Durgdhahalli
6	NH/SH/Locality	Kodige fall road

7	Latitude	13°8'47.16"
8	Longitude	75°26'3.82"
9	Length	~90m
10	Width	~25m
11	Height	~80m
12	Area	~2250m ²
13	Depth	~1m
14	Volume	~2250m ³
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Moving
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	2022
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall and anthropogenic factor like road cutting.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Road was damaged
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Anthropogenic activities which is unplanned cutting of slope. Vertical cut made for road.
37	Remedial measures	Slope benching & drainage management is required.
38	Remarks, if any	

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Anthropogenic activities which is unplanned cutting of slope. Vertical cut made for road. Slope benching & drainage management. At down side steep slope and stream is flowing.
41	Date of Reporting	22/11/2022
42	Landslide Category	I

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/68
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Durgdhahalli
6	NH/SH/Locality	Kodige fall road
7	Latitude	13°8'46.24"
8	Longitude	75°26'04.77"
9	Length	~95m
10	Width	~25m
11	Height	~90m
12	Area	~2375m ²
13	Depth	~1m
14	Volume	~2375m ³
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Moving
21	Style	Single
22	Failure mechanism	Shallow planar failure

23	History	August,2019
24	Geomorphology	Moderately dissected slope
25	Geology	Granite gneiss
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall and anthropogenic factor like road cutting.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Road was damaged
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Anthropogenic activities which is unplanned cutting of slope. Vertical cut made for road.
37	Remedial measures	Slope benching & slope should be filled with sand bag for temporarily before monsoon & drainage management is required.
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Anthropogenic activities which is unplanned cutting of slope. Vertical cut made for road. Slope benching & slope should be filled with sand bag for temporarily before monsoon & drainage management is required.
41	Date of Reporting	22/11/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/69
2	State	Karnataka

3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Durgdhahalli
6	NH/SH/Locality	Durgdhahalli
7	Latitude	13°8'41.13"
8	Longitude	75°25'58.21"
9	Length	~100m
10	Width	~50m
11	Height	~75m
12	Area	~5000m ²
13	Depth	~3m
14	Volume	~15000m ³
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Moving
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	August,2019
24	Geomorphology	Moderately dissected slope
25	Geology	Granite gneiss
26	Structure	-
27	Landuse/ Land cover	Mixed jungle
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall and anthropogenic factor like road cutting.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Road was damaged
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Anthropogenic activities which is unplanned cutting of slope. Vertical cut made for road.
37	Remedial measures	Slope benching, slope should be filled with sand bag for temporarily before monsoon & drainage management is required.
38	Remarks, if any	

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	At downside steep slope is present. Anthropogenic activities which is unplanned cutting of slope. Vertical cut made for road. Slope benching, slope should be filled with sand bag for temporarily before monsoon & drainage management is required.
41	Date of Reporting	22/11/2022
42	Landslide Category	I

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/70
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Durgdhahalli
6	NH/SH/Locality	Durgdhahalli road
7	Latitude	13°8'40.12"
8	Longitude	75°25'56.70"
9	Length	~60m
10	Width	~25m
11	Height	~55m
12	Area	~1500m ²
13	Depth	~3m
14	Volume	~4500m ³
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Moving

21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	August, 2019
24	Geomorphology	Moderately dissected slope
25	Geology	Granite gneiss
26	Structure	-
27	Landuse/ Land cover	Mixed jungle
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall and anthropogenic factor like road cutting.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Road was damaged
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Slope benching, slope should be filled with sand bag for temporarily before monsoon & drainage management is required.
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Anthropogenic activities which is unplanned cutting of slope. Vertical cut made for road. Slope benching, slope should be filled with sand bag for temporarily before monsoon & drainage management is required.
41	Date of Reporting	22/11/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/71
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Kodige
6	NH/SH/Locality	Kodige road
7	Latitude	13°8'44.02"
8	Longitude	75°26'10.37"
9	Length	~18m
10	Width	~35m
11	Height	~15m
12	Area	~630m ²
13	Depth	~3m
14	Volume	~1890m ³
15	Run out distance	-
16	Type of Material	Earth slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Widening
21	Style	Multiple
22	Failure mechanism	Shallow planar failure
23	History	August,2019
24	Geomorphology	Moderately dissected slope
25	Geology	Granite gneiss
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall and anthropogenic factor like road cutting.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. Vertical cut made for road.
37	Remedial measures	Slope benching, retaining structure & drainage management is required.
38	Remarks, if any	

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Cut slope made for settlement on modified slope which failed. After changing the location for house construction again failed the material behind the wall.
41	Date of Reporting	24/11/2022
42	Landslide Category	I

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/72
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Durgdhahalli
6	NH/SH/Locality	Durgdhahalli road
7	Latitude	13°8'53.74"
8	Longitude	75°26'07.77"
9	Length	~100m
10	Width	~30m
11	Height	~75m
12	Area	~3000m ²
13	Depth	~>5m
14	Volume	~15000m ³
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Extremely Rapid
19	Activity	Suspended
20	Distribution	Moving
21	Style	Single
22	Failure mechanism	Shallow planar failure

23	History	2019
24	Geomorphology	Moderately dissected slope
25	Geology	Granite gneiss
26	Structure	-
27	Landuse/ Land cover	Coffee plantation with high height plantations
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall and anthropogenic factor like road cutting.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Forest
36	Geo-scientific Causes	Cut slope made for road and house construction. Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Back filling for road safety, deep root plantations, slope benching & drainage management are required.
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Cut slope made for road and house construction. All the catchment water of nearby area directly flowing to the same place. There is missing of proper rainwater drainage management.
41	Date of Reporting	24/11/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/73

2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Durgdhahalli
6	NH/SH/Locality	Durgdhahalli road
7	Latitude	13°8'53.23"
8	Longitude	75°26'05.67"
9	Length	~22m
10	Width	~25m
11	Height	~18m
12	Area	~550m ²
13	Depth	~<2m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Widening
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	2019
24	Geomorphology	Moderately dissected slope
25	Geology	Granite gneiss
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall and anthropogenic factor like road cutting.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Cut slope made for road and house construction. Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Drainage management at upslope, benching required behind the house& retaining wall with weep hole is required.
38	Remarks, if any	

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	At this site upslope and downside water is flowing and passes through the residential house. Drainage management is required. This is due to unplanned cutting of slope. The house owner name is Mr. Chandra Gowda in which house two member is residing.
41	Date of Reporting	24/11/2022
42	Landslide Category	I

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/74
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Durghahalli
6	NH/SH/Locality	Durghahalli road
7	Latitude	13°8'53.94"
8	Longitude	75°26'06.47"
9	Length	~20m
10	Width	~20m
11	Height	~18m
12	Area	~400m ²
13	Depth	~1-2m
14	Volume	~400m ³
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Extremely Rapid
19	Activity	Active
20	Distribution	Widening

21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	2019
24	Geomorphology	Moderately dissected slope
25	Geology	Granite gneiss(fully weathered)
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall and anthropogenic factor like road cutting.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. Vertical cut made for road.
37	Remedial measures	Drainage management at upslope & retaining wall with weep hole is required.
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Anthropogenic activities which is unplanned cutting of slope. Vertical cut made for road. Drainage management at upslope& retaining wall with weep hole is required.
41	Date of Reporting	27/11/2022
42	Landslide Category	I

No	Field	Description
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1	Slide No (LS .No.)	KAR/CHK/2022/75
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Durgdhahalli
6	NH/SH/Locality	Durgdhahalli road
7	Latitude	13°9'00.92"
8	Longitude	75°26'19.75"
9	Length	~45m
10	Width	~20m
11	Height	~40m
12	Area	~900m ²
13	Depth	~1-2m
14	Volume	~900m ³
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Extremely Rapid
19	Activity	Reactivated
20	Distribution	Widening
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	2019
24	Geomorphology	Lowly dissected slope
25	Geology	Granite gneiss(fully weathered)
26	Structure	-
27	Landuse/ Land cover	Mixed plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall and anthropogenic factor like road cutting.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Back filling required.
38	Remarks, if any	

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. Back filling required.
41	Date of Reporting	25/11/2022
42	Landslide Category	III

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/76
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Durgdhahalli
6	NH/SH/Locality	Durgdhahalli road
7	Latitude	13°9'00.48"
8	Longitude	75°26'14.12"
9	Length	~65m
10	Width	~60m
11	Height	~55m
12	Area	~3900m ²
13	Depth	~5m
14	Volume	~19500m ³
15	Run out distance	-
16	Type of Material	Earth slide
17	Type of movement	Slide
18	Rate of movement	Extremely Rapid
19	Activity	Active
20	Distribution	Widening
21	Style	Multiple

22	Failure mechanism	Shallow planar failure
23	History	2019
24	Geomorphology	Moderately dissected slope
25	Geology	Granite gneiss(fully weathered)
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall and anthropogenic factor like road cutting.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope.
37	Remedial measures	Deep root plantation are required.
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	The landslide occurred within coffee estate as there is no risk element apart from agriculture land. Deep root plantation are required.
41	Date of Reporting	25/11/2022
42	Landslide Category	III

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/77
2	State	Karnataka
3	District	Ckikkamagaluru

4	Toposheet	48O/08
5	Name of the slide	Durgdhahalli
6	NH/SH/Locality	Durgdhahalli road
7	Latitude	13°9'01.65"
8	Longitude	75°26'12.06"
9	Length	~45m
10	Width	~25m
11	Height	~35m
12	Area	~1125m ²
13	Depth	~2m
14	Volume	~2250m ³
15	Run out distance	-
16	Type of Material	Earth slide
17	Type of movement	Slide
18	Rate of movement	Extremely Rapid
19	Activity	Active
20	Distribution	Widening
21	Style	Multiple
22	Failure mechanism	Shallow planar failure
23	History	2019
24	Geomorphology	Moderately dissected slope
25	Geology	Granite gneiss(fully weathered)
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall and anthropogenic factor like road cutting.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Cut slope made for house construction.
37	Remedial measures	Benching&Retaining structure for the house safety are required.
38	Remarks, if any	

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Erosion by flowing stream and leads to failed the upslope material. Landslide occurred in coffee estate and road is connected to two residential house. In one house slumping has been observed. This site has soil piping, rill wash and gulley erosion in cut slope.
41	Date of Reporting	25/11/2022
42	Landslide Category	I

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/78
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Madhugundi
6	NH/SH/Locality	-
7	Latitude	13°08'51.97"
8	Longitude	75°26'31.58"
9	Length	~110m
10	Width	~35m
11	Height	~80m
12	Area	~3850m ²
13	Depth	~>5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Earth slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Retrogressive

21	Style	Single
22	Failure mechanism	Deep rotational failure
23	History	2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt (fully weathered)
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Due to intense rain landslide occurred, increased pore water pressure reduction of strength of super saturation.
37	Remedial measures	Deep root plantations and slope grading is required.
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Due to increased pore water pressure and reduction of strength of super saturation landslide occurred in coffee plantation area. There is only risk element is agriculture land. Soil thickness at this place is more than 8 meter. There are no settlements at down side.
41	Date of Reporting	26/11/2022
42	Landslide Category	III

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/79

2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Madhugundi
6	NH/SH/Locality	-
7	Latitude	13°08'47.01"
8	Longitude	75°26'33.24"
9	Length	~60m
10	Width	~50m
11	Height	~50m
12	Area	~3000m ²
13	Depth	~2m
14	Volume	~6000m ³
15	Run out distance	-
16	Type of Material	Earth slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Multiple
22	Failure mechanism	Shallow rotational failure
23	History	2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt (fully weathered)
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Due to intense rain landslide occurred, increased pore water pressure reduction of strength of super saturation.
37	Remedial measures	Deep root plantations and slope grading is required.
38	Remarks, if any	

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Due to increased pore water pressure and reduction of strength of super saturation landslide occurred in coffee plantation area. There is only risk element is agriculture land. Soil thickness at this place is more than 8 meter. There are no settlements are down side.
41	Date of Reporting	26/11/2022
42	Landslide Category	III

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/80
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Sunkaksale
6	NH/SH/Locality	Kalasa road
7	Latitude	13°9'35.33"
8	Longitude	75°26'21.92"
9	Length	~50m
10	Width	~50m
11	Height	~35m
12	Area	~2500m ²
13	Depth	~>5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Earth slide
17	Type of movement	Slide
18	Rate of movement	Extremely Rapid
19	Activity	Active
20	Distribution	Widening

21	Style	Multiple
22	Failure mechanism	Deep rotational failure
23	History	2019
24	Geomorphology	Moderately dissected slope
25	Geology	Granite gneiss(fully weathered)
26	Structure	-
27	Landuse/ Land cover	High height plantation
28	Hydrological condition	Wet
29	Triggering Factor	Anthropogenic factor like road cutting.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. Vertical cut made for road.
37	Remedial measures	Benching and slope grading & drainage with culvert is required.
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	The extensive cut slope made for road cut the slope is steep and downside near the landslide flank stream is flowing. This site have soil thickness is 8m and rock is fully weathered and converted into thick pile of over burden materials.
41	Date of Reporting	27/11/2022
42	Landslide Category	I

No	Field	Description
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1	Slide No (LS .No.)	KAR/CHK/2022/81
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Sunkaksale
6	NH/SH/Locality	Kalasa road
7	Latitude	13°9'37.71"
8	Longitude	75°26'22.62"
9	Length	~20m
10	Width	~25m
11	Height	~15m
12	Area	~500m ²
13	Depth	~3m
14	Volume	~1500m ³
15	Run out distance	-
16	Type of Material	Earth slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Widening
21	Style	Single
22	Failure mechanism	Shallow rotational failure
23	History	2019
24	Geomorphology	Moderately dissected slope
25	Geology	Granite gneiss(fully weathered)
26	Structure	-
27	Landuse/ Land cover	Coffee plantation with High height plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall in mm.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Road was damaged and repaired.
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. Vertical cut made for road.
37	Remedial measures	Upslope grading is required & drainage with culvert is required.
38	Remarks, if any	

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	The extensive cut slope made for road cut the slope is steep and downside near the landslide flank stream is flowing. Upslope grading is required & drainage with culvert is required.
41	Date of Reporting	27/11/2022
42	Landslide Category	I

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/82
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Sunkaksale
6	NH/SH/Locality	Kalasa road
7	Latitude	13°9'57.22"
8	Longitude	75°26'33.96"
9	Length	~20m
10	Width	~45m
11	Height	~15m
12	Area	~900m ²
13	Depth	~4m
14	Volume	~3600m ³
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Widening
21	Style	Single

22	Failure mechanism	Shallow rotational failure
23	History	2019
24	Geomorphology	Moderately dissected slope
25	Geology	Granite gneiss
26	Structure	-
27	Landuse/ Land cover	Coffee plantation with High height plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall in mm.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Road was damaged and repaired.
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. Vertical cut made for road.
37	Remedial measures	Slope grading is required & drainage with culvert is required.
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. Vertical cut made for road. Slope grading is required & drainage with culvert is required.
41	Date of Reporting	27/11/2022
42	Landslide Category	I

No	Field	Description
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1	Slide No (LS .No.)	KAR/CHK/2022/83
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Sunkaksale
6	NH/SH/Locality	Kalasa road
7	Latitude	13°9'55.35"
8	Longitude	75°26'32.06"
9	Length	~100m
10	Width	~35m
11	Height	~55.60m
12	Area	~3500m ²
13	Depth	~>10m
14	Volume	~35000m ³
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Suspended
20	Distribution	Retrogressive
21	Style	Multiple
22	Failure mechanism	Deep rotational failure
23	History	2019
24	Geomorphology	Moderately dissected slope
25	Geology	Granite gneiss
26	Structure	-
27	Landuse/ Land cover	Coffee plantation with High height plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall in mm.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Road was damaged and repaired.
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. Vertical cut made for road.
37	Remedial measures	Retaining wall already provide. Slope grading is required & drainage management is required.
38	Remarks, if any	

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Vertical cut made for road which triggered by intense rain. Retaining wall is already given after 2019 landslide incidence.
41	Date of Reporting	27/11/2022
42	Landslide Category	I

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/84
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Sunkaksale
6	NH/SH/Locality	Kalasa road
7	Latitude	13°9'38.88"
8	Longitude	75°26'30.62"
9	Length	~35m
10	Width	~60m
11	Height	~30m
12	Area	~2100m ²
13	Depth	~2m
14	Volume	~4200m ³
15	Run out distance	-
16	Type of Material	Earth slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Widening
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	2019

24	Geomorphology	Moderately dissected slope
25	Geology	Granite gneiss
26	Structure	-
27	Landuse/ Land cover	Coffee plantation with High height plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall in mm.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Road was damaged and repaired.
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. Vertical cut made for road.
37	Remedial measures	Slope benching is required & drainage management is required.
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Vertical cut made for road which triggered by intense rain. Slope benching is required & drainage management is required.
41	Date of Reporting	27/11/2022
42	Landslide Category	III

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/85
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08

5	Name of the slide	Sunkaksale
6	NH/SH/Locality	Kalasa road
7	Latitude	13°9'52.10"
8	Longitude	75°26'33.06"
9	Length	~16m
10	Width	~50m
11	Height	~15m
12	Area	~800m ²
13	Depth	~2m
14	Volume	~1600m ³
15	Run out distance	-
16	Type of Material	Earth slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Widening
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	2019
24	Geomorphology	Moderately dissected slope
25	Geology	Granite gneiss
26	Structure	-
27	Landuse/ Land cover	Coffee plantation with High height plantation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall in mm.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Planar failure due to increasing of pore water pressure and reduction of strength on supersaturation. Anthropogenic activities which is unplanned cutting of slope. Vertical cut made for road.
37	Remedial measures	Slope benching is required & gabion wall& Drainage management is required.
38	Remarks, if any	

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	In the valley portion stream is flowing and toe erosion by stream. Vertical cut made for road which triggered by intense rain.
41	Date of Reporting	27/11/2022
42	Landslide Category	I

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/86
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Maitalkhan coffee estate
6	NH/SH/Locality	Maitalkhan coffee estate road
7	Latitude	13°10'07.71"
8	Longitude	75°24'16.37"
9	Length	~12m
10	Width	~50m
11	Height	~11m
12	Area	~600m ²
13	Depth	~<5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Widening
21	Style	Single
22	Failure mechanism	Shallow planar failure

23	History	2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Thick vegetation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall in mm.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Anthropogenic activities which is unplanned cutting of slope. Vertical cut made for road.
37	Remedial measures	Slope benching is required & drainage management is required.
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	The slope cut to construct the road to connect homestay. Cut slope failed which triggered by heavy rain. Slope benching is required & drainage management is required.
41	Date of Reporting	05/12/2022
42	Landslide Category	I

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/87
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Maitalkhan coffee estate
6	NH/SH/Locality	Maitalkhan coffee estate road

7	Latitude	13°10'05.97"
8	Longitude	75°24'19.13"
9	Length	~50m
10	Width	~40m
11	Height	~45m
12	Area	~2000m ²
13	Depth	~<5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Widening
21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Sparse vegetation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall in mm.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Anthropogenic activities which is unplanned cutting of slope. Vertical cut made for road.
37	Remedial measures	Slope benching is required & drainage management is required
38	Remarks, if any	

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	The slope cut to construct the road. Cut slope failed which triggered by heavy rain. The landslide occurred within coffee estate. The risk element is agriculture land & the unmetalled road is the risk factor which connected to Maitalkhan coffee estate.
41	Date of Reporting	05/12/2022
42	Landslide Category	III

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/88
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Maitalkhan coffee estate
6	NH/SH/Locality	Maitalkhan coffee estate road
7	Latitude	13°10'06.37"
8	Longitude	75°24'20.18"
9	Length	~50m
10	Width	~25m
11	Height	~45m
12	Area	~1250m ²
13	Depth	~<5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Retrogressive

21	Style	Single
22	Failure mechanism	Shallow planar failure
23	History	2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Sparse vegetation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall in mm.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Anthropogenic activities which is unplanned cutting of slope. Vertical cut made for road.
37	Remedial measures	Slope benching is required, drainage management is required. Deep root plantations are suggested.
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	The slope cut to construct the road. Cut slope failed which triggered by heavy rain. The landslide occurred within coffee estate. The risk element is agriculture land & the unmetalled road is the risk factor which connected to Maitalkhan coffee estate. Slope benching is required, drainage management is required. Deep root plantations are suggested.
41	Date of Reporting	05/12/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/89
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Maitalkhan coffee estate
6	NH/SH/Locality	Maitalkhan coffee estate road
7	Latitude	13°10'06.47"
8	Longitude	75°24'22.11"
9	Length	~110m
10	Width	~50m
11	Height	~100m
12	Area	~5500m ²
13	Depth	~>5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Deep rotational failure
23	History	2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Sparse vegetation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall in mm.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Anthropogenic activities which is unplanned cutting of slope. Vertical cut made for road.
37	Remedial measures	Slope benching is required, drainage management is required & deep root plantation required.
38	Remarks, if any	

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	Anthropogenic activities which is unplanned cutting of slope. Vertical cut made for road. Slope benching is required, drainage management is required & deep root plantation required. The unmetalled road is the risk factor which connected to Maitalkhan coffee estate.
41	Date of Reporting	06/12/2022
42	Landslide Category	II

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/90
2	State	Karnataka
3	District	Chikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Maitalkhan
6	NH/SH/Locality	Maitalkhanestate road
7	Latitude	13°10'05.05"
8	Longitude	75°24'26.33"
9	Length	~45m
10	Width	~35m
11	Height	~30m
12	Area	~1575m ²
13	Depth	~<5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Retrogressive

21	Style	Single
22	Failure mechanism	Shallow rotational failure
23	History	2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Sparse vegetation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall in mm.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Anthropogenic activities which is unplanned cutting of slope. Vertical cut made for road.
37	Remedial measures	Slope benching is required & deep root plantation required.
38	Remarks, if any	The slide is falling within jungle.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	The landslide occurred within forest area as such there is no risk element. The unmetalled road is the risk factor which connected to Maitalkhan coffee estate. Due to unplanned cutting of slope landslide occurred. Slope benching is required & deep root plantation required. The slide is falling within jungle.
41	Date of Reporting	07/12/2022
42	Landslide Category	III

No	Field	Description
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1	Slide No (LS .No.)	KAR/CHK/2022/91
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Maidadi
6	NH/SH/Locality	Maidadi estate road
7	Latitude	13°09'47.18"
8	Longitude	75°24'54.66"
9	Length	~50m
10	Width	~20m
11	Height	~40m
12	Area	~100m ²
13	Depth	~>5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Moving
21	Style	Single
22	Failure mechanism	Shallow rotational failure
23	History	2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Sparse vegetation
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall in mm.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Anthropogenic activities which is unplanned cutting of slope. Vertical cut made for road.
37	Remedial measures	Slope benching is required & deep root plantation required.
38	Remarks, if any	

39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	The landslide occurred within forest area as such there is no risk element. Due to unplanned cutting of slope landslide occurred.
41	Date of Reporting	07/12/2022
42	Landslide Category	III

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/92
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Maidadi
6	NH/SH/Locality	Maidadi estate road
7	Latitude	13°09'47.56"
8	Longitude	75°24'56.46"
9	Length	~60m
10	Width	~20m
11	Height	~50m
12	Area	~120m ²
13	Depth	~>5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Moving
21	Style	Multiple
22	Failure mechanism	Shallow rotational failure
23	History	2019
24	Geomorphology	Moderately dissected slope

25	Geology	Garnet mica schist
26	Structure	-
27	Landuse/ Land cover	Thick forest at upslope and coffee plantation at downslope.
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall in mm.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Anthropogenic activities which is unplanned cutting of slope. Cut made for estate road (mud road).
37	Remedial measures	Slope benching is required.
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	The landslide occurred within forest area as such there is no risk element. Due to unplanned cutting of slope landslide occurred.
41	Date of Reporting	07/12/2022
42	Landslide Category	III

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/93
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Maidadi
6	NH/SH/Locality	Maidadi estate road
7	Latitude	13°09'45.33"
8	Longitude	75°24'57.04"
9	Length	~75m

10	Width	~25m
11	Height	~50m
12	Area	~1875m ²
13	Depth	~<5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris Flow
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Moving
21	Style	Multiple
22	Failure mechanism	Shallow rotational failure
23	History	2019
24	Geomorphology	Moderately dissected slope
25	Geology	Garnet mica schist
26	Structure	-
27	Landuse/ Land cover	Thick forest at upslope and coffee plantation at downslope
28	Hydrological condition	Wet
29	Triggering Factor	Rainfall in mm.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Anthropogenic activities which is unplanned cutting of slope. Cut made for estate road (mud road).
37	Remedial measures	Slope benching is required.
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	

40	Summary/Abstract	The landslide occurred within forest area as such there is no risk element. The risk element is agriculture land & the unmetalled road is the risk factor which connected to coffee estate. Due to unplanned cutting of slope landslide occurred.
41	Date of Reporting	07/12/2022
42	Landslide Category	III

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/94
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Durgadahalli
6	NH/SH/Locality	Durgadahalli village
7	Latitude	13°08'40.27"
8	Longitude	75°25'34.59"
9	Length	~15m
10	Width	~25m
11	Height	~12m
12	Area	~375m ²
13	Depth	~<5m
14	Volume	-
15	Run out distance	-
16	Type of Material	Debris Slide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow rotational failure
23	History	2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Flowing
29	Triggering Factor	Rainfall in mm.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Anthropogenic activities which is unplanned cutting of slope. Cut made for house construction.

37	Remedial measures	Slope benching is required. Drainage is required to avoid percolation of rain water within the foundation.
38	Remarks, if any	
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	The landslide occurred adjacent to the residential house. Stream is also flowing adjacent to the house. Wall cracks has also developed. The house is at risk during heavy rain.
41	Date of Reporting	10/12/2022
42	Landslide Category	I

No	Field	Description
1	Slide No (LS .No.)	KAR/CHK/2022/95
2	State	Karnataka
3	District	Ckikkamagaluru
4	Toposheet	48O/08
5	Name of the slide	Balige
6	NH/SH/Locality	Balige village
7	Latitude	13°09'20.67"
8	Longitude	75°26'00.78"
9	Length	~12m
10	Width	~38m
11	Height	~10m
12	Area	~456m ²
13	Depth	~<5m
14	Volume	-
15	Run out distance	-
16	Type of Material	EarthSlide
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Widening

21	Style	Single
22	Failure mechanism	Shallow rotational failure
23	History	2019
24	Geomorphology	Moderately dissected slope
25	Geology	Metabasalt
26	Structure	-
27	Landuse/ Land cover	Coffee plantation
28	Hydrological condition	Flowing
29	Triggering Factor	Rainfall in mm.
30	Death of persons	Nil
31	People affected	Nil
32	Livestock loss	Nil
33	Communication	Nil
34	Infrastructure	Nil
35	Agriculture/Forest/Barren	Agriculture
36	Geo-scientific Causes	Anthropogenic activities which is unplanned cutting of slope. Cut made for house construction.
37	Remedial measures	Slope benching is required. Drainage is required to avoid percolation of rain water within the foundation.
38	Remarks, if any	New house has been provide by DC office.
39	Photos. Sketch of Plan & section of the slide	
40	Summary/Abstract	The landslide occurred adjacent to the residential house. The house is at risk during heavy rain. Stream is also flowing adjacent to the house. New house site has been provide by DC office Ckikkamagaluru.
41	Date of Reporting	10/12/2022
42	Landslide Category	I

Geotechnical sample results for undisturbed soil samples

Tests Done: Moisture content, Specific gravity, Density, Dry Density, Void ratio, Porosity, Cohesion, Angle of Internal friction (Φ), Grain Size analysis.

F.S.Code No. & Title: M4LSSM/NC/SR/SU-KG/2022/42400
Meso Scale (1: 10,000) Landslide susceptibility mapping in Sunkasale Area, Chikkmangaluru Dist., Karnataka.

TEST RESULTS

Sr. No.	Sample Number/Code	Specific gravity	Moisture content %	Density gm/cm ³	Dry Density gm/cm ³	Void ratio (e)	Porosity (n)	Grain Size				Cohesion (C)	Angle of Internal friction (Φ)
								Gravel %	Sand %	Silt %	Clay %		
1	KAR/CHK/01	2.70	27.90	1.52	1.19	1.27	0.56	34.9	30.6	31.4	3.1	0.21	29.1
2	KAR/CHK/02	2.69	29.50	1.45	1.12	1.40	0.58	39.4	22.3	35.7	2.6	0.19	28.3
3	KAR/CHK/03	2.71	18.61	1.48	1.25	1.17	0.54	49.0	25.6	21.4	4.0	0.18	27.4
4	KAR/CHK/04	2.68	31.00	1.51	1.15	1.33	0.57	15.6	24.7	57.2	2.5	0.27	26.2
5	KAR/CHK/05	2.65	25.50	1.50	1.20	1.21	0.55	6.8	35.2	50.8	7.2	0.30	24.1
6	KAR/CHK/06	2.67	22.39	1.60	1.31	1.04	0.51	56.6	24.2	18.1	1.1	0.18	31.2
7	KAR/CHK/07	2.65	26.77	1.69	1.33	0.99	0.50	49.6	17.7	28.9	3.8	0.19	29.5
8	KAR/CHK/08	2.70	28.88	1.70	1.32	1.05	0.51	55.6	26.7	14.6	3.1	0.18	28.9
9	KAR/CHK/09	2.79	28.65	1.55	1.20	1.33	0.57	24.5	30.9	40.2	4.4	0.25	27.2
10	KAR/CHK/10	2.69	25.92	1.57	1.25	1.15	0.53	33.0	26.9	36.3	3.8	0.23	28.5
11	KAR/CHK/11	2.67	15.02	1.49	1.30	1.05	0.51	48.2	33.1	12.9	5.8	0.18	30.0
12	KAR/CHK/12	2.59	15.05	1.45	1.26	1.06	0.51	33.3	47.0	13.7	6.0	0.21	27.2
13	KAR/CHK/13	2.66	27.15	1.50	1.18	1.25	0.56	47.4	13.3	37.0	2.3	0.32	29.4
14	KAR/CHK/14	2.58	28.56	1.55	1.21	1.13	0.53	23.4	20.0	53.3	3.3	0.26	25.3
15	KAR/CHK/15	2.60	24.19	1.49	1.20	1.17	0.54	38.1	28.4	29.8	3.7	0.24	27.5

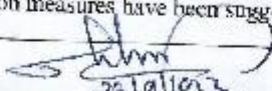
Sr. No.	Sample Number/Code	Specific gravity	Moisture content %	Density gm/cm ³	Dry Density gm/cm ³	Void ratio (e)	Porosity (n)	Grain Size				Cohesion (C)	Angle of Internal friction (Φ)
								Gravel %	Sand %	Silt %	Clay %		
16	KAR/CHK/16	2.63	16.10	1.46	1.26	1.09	0.52	17.8	29.8	50.1	2.3	0.26	26.5
17	KAR/CHK/17	2.65	22.72	1.51	1.23	1.15	0.53	23.3	19.4	53.8	3.5	0.24	27.1
18	KAR/CHK/18	2.58	13.46	1.53	1.35	0.91	0.48	10.2	44.5	42.1	3.2	0.32	22.5
19	KAR/CHK/19	2.67	25.72	1.49	1.19	1.24	0.55	69.9	9.4	17.6	3.1	0.17	30.7
20	KAR/CHK/20	2.69	12.84	1.47	1.30	1.07	0.52	48.1	31.3	19.1	1.5	0.19	29.1
21	KAR/CHK/21	2.65	29.13	1.50	1.16	1.28	0.56	4.1	44.4	45.0	6.5	0.31	23.4
22	KAR/CHK/22	2.64	21.37	1.52	1.25	1.11	0.53	9.6	36.7	47.6	6.1	0.30	24.5
23	KAR/CHK/23	2.62	26.76	1.55	1.22	1.15	0.53	23.5	26.3	43.6	6.6	0.26	26.1
24	KAR/CHK/24	2.59	21.99	1.51	1.24	1.09	0.52	5.3	48.8	39.4	6.5	0.30	26.3
25	KAR/CHK/25	2.60	18.61	1.56	1.32	0.97	0.49	28.7	26.1	39.3	5.9	0.28	27.1
26	KAR/CHK/26	2.64	16.92	1.62	1.39	0.90	0.47	57.7	18.2	16.5	7.6	0.20	29.3
27	KAR/CHK/27	2.60	26.27	1.63	1.29	1.02	0.50	46.5	18.2	31.3	4.0	0.21	28.9
28	KAR/CHK/28	2.58	31.39	1.59	1.21	1.13	0.53	15.6	20.6	56.3	7.5	0.29	23.1
29	KAR/CHK/29	2.65	17.32	1.51	1.29	1.05	0.51	21.9	31.8	39.7	6.6	0.25	24.5
30	KAR/CHK/30	2.63	30.20	1.54	1.18	1.23	0.55	19.3	14.1	56.5	10.1	0.27	22.2
31	KAR/CHK/31	2.52	16.27	1.60	1.38	0.83	0.45	60.4	22.5	11.9	5.2	0.19	29.5
32	KAR/CHK/32	2.69	18.31	1.63	1.38	0.95	0.49	44.6	8.8	44.4	2.2	0.21	28.3



Geological Survey of India

PROFORMA FOR WORK INPUT

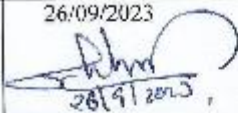
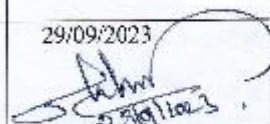
Title of Report:	Meso-scale (1:10,000) Landslide Susceptibility Mapping in Sunkasale area, Chikkmagaluru District, Karnataka.
Name of the author (s)	Kamal Kumar, Sr. Geologist & Mohan Raj, Sr. Geologist
1. Background of the Investigation" At whose instance or with what particular objective in view was the investigation undertaken.	The item was taken up as a one year (FS: 2022-23) standard project of GSI with the objective to prepare landslide susceptibility map (1:10,000 scale) of Virajpet area categorizing the hillslopes into three classes of susceptibility viz. Low, Moderate and High.
2. Whether the item of investigation was included in the approved programme for the year concerned. If so, particulars, such as Item No., page reference etc. may be given.	Yes, the item was included in the approved Annual Programme of GSI, SR with the Item code no. M4T.SSM/NC/SR/SU-KG/2022/42400, FS: 2022-23
3. Date of commencement of the investigation with month and year and exact number of days spent by the officer (s) in the field in connection with the investigation.	Field work for the item initiated on 21-08-2023. Kamal Kumar, Sr. Geologist- 102 days Mohan Raj, Sr. Geologist - 88 days
4. Brief comments by the Director/Supervisory officer on the conclusions and recommendations by the author(s) with suggestion for implementation of the same.	In compliance with FS: 2022-23, a Meso-scale landslide susceptibility mapping project was conducted in Chikkmagaluru district, Karnataka, focusing on identifying slope failure-prone areas and creating geofactor maps tailored to these domains. The study highlighted a history of shearing followed by brittle deformation and emphasized the role of joint sets in slope stability during infrastructure development. Debris flows emerged as a dominant landslide mechanism, particularly in high mountainous areas with heavy rainfall. The study underscores the need for proactive measures and engineering solutions to mitigate landslide risks and

	protect the region's inhabitants and infrastructure.
5. Please state specifically how the results of the investigation were achieved compared with the objective for which it was undertaken.	The landslide susceptibility map of the Sunkassale area, Chikmagalur District covering an approx. area of 12.4 sq. km was prepared following the landslide domain based mapping. The area has been classed as High, Moderate and Low susceptibility classes with identification of probable high risk areas. The causative factors have been studied and the mitigation measures have been suggested.
Place: Bangalore	Signature: 
Date: 29/09/2023	Name: R Sajeer
	Designation: Director
	Division: Engineering Geology and Landslide Division
	SU - Karnataka and Goa



Geological Survey of India
Data sheet on report movement in connection with its scrutiny

Project/Division:	MLSM/EG	FSP No:	M41.SSM/NC/SR/SU-KC/2022/42400	Mission:	IV
Title of the Project:	Meso-scale (1:10,000) Landslide Susceptibility Mapping in Sunkasale area, Chikkmagaluru District, Karnataka				
Name of author(s) 1. Kamal Kumar, Sr. Geologist 2. Mohan E Raj, Sr. Geologist	Date of submission of report to the Supervisory Officer:			30/06/2023	
	Signature of the senior most officer				
Name of Supervisory Officer 1. Dr. R.Sajeev, Director(G)	Date of receipt of report			30/06/2023	
	Date of completion of scrutiny			15/07/2023	
	Date of handing over report to the author after scrutiny Signature :			15/07/2023 	
Name of author(s) To whom the report has been handed over by the Supervisory officer 1. Kamal Kumar, Sr. Geologist 2. Mohan E Raj, Sr. Geologist	Date of receipt after scrutiny Signature :			15/07/2023	
	Date of resubmission Signature :			06/09/2023	
Supervisory officer 1. Dr. R.Sajeev, Director(G)	Date of receipt after modification			06/09/2023	
	Date of handing over the report to the Regional Mission Head Signature:			12/09/2023 	
Name of the Regional Mission Head/ Internal peer reviewer	Date of receipt of report			12/09/2023	
	Date of handing over the report after peer review to the Project Director Signature:			26/09/2023	

Name of Supervisory Officer 1. Dr. R.Sajeew, Director(G)	Date of receipt from the Regional Mission Head after peer review:	26/09/2023
	Date of handing over to author(s) Signature:	26/09/2023  26/9/2023
Name of author(s) 1. Kamal Kumar, Sr. Geologist 2. Mohan E Raj, Sr. Geologist	Date of receipt of report from Supervisory Officer	26/09/2023
	Date of handing over report after modification to Supervisory Officer: Signature: E. Mohanraj	29/09/2023
Name of Supervisory Officer 1. Dr. R.Sajeew, Director(G)	Date of receipt of report after modification from the author(s)	29/09/2023
	Date of handing over report to Regional Mission Head Signature:	29/09/2023  29/9/2023
Name of Regional Mission Head	Date of receipt of the report from the Project Director after modification	
	Date of handing over the report to the HOD of the region for approval Signature:	
Name of the HOD of the Region	Date of receipt of report for approval	
	Date of approval:	
	Date of sending back to Project Director Signature of the HOD:	
Name of the Project Director	Date of receipt of report after approval of HOD	
	Date of circulation of report Signature:	



**Geological Survey of India
Certificate of Quality of the report**

Project/Division: Engineering Geology and Landslide Division

FSP No. M4LSSM/NC/SR/SU-KG/2022/42400

Mission-IV

Title of the report: Meso-scale (1:10,000) Landslide Susceptibility Mapping in Sunkasale area, Chikkmagaluru District, Karnataka

Part-A

This is to certify that the following officer(s) have carried out the above mentioned FSP, and are responsible for collection of field data, carrying out the required laboratory analysis, compilation and synthesis of field data, coalition of the data and writing of the report as per the approved guidelines. The duration of field stay of each officer(s) is as against his/her name.

Name(s)/Designation of the Field Officer	Total field stay during the FSP (no. of days)	Signature with date
1. Kamal Kumar, Sr. Geologist	102 days	<i>Kamal Kumar</i>
2. E. Mohan Raj, Sr. Geologist	88 days	<i>E. Mohan Raj</i>

Part-B

This is to certify that drilling has been carried out and completed as per the table given below:

Drilling Unit No	Date of commencement of drilling	Date of completion of drilling	Name and Signature of the Director Drilling
1.			
2.			

Part-C

This is to certify that geophysical component of the item has been carried out as per the table given below:

Name(s)/Designation of Geophysist	Date of commencement of work	Date of completion of work	Signature with date of the Geophysist
1.			
2.			
Name and signature with date of the Director (Geophysics)			

Part-D

This is to certify that the chemical analysis of the geological samples has been carried out as per the table given below;

Name of Director in charge of the Chemical Lab	Dates of receipt of samples from the field officer/party	Date of providing complete analytical results to the field officer	Signature with date of the Director Chemistry

Part-E

This is to certify that the below mentioned Supervisory Officer(s) have supervised the above item and have provided guidance to the Field Officer(s). The number of inspection visits and total duration of field visits is as per the below table. It is also certified that the work carried out under the project is of high standards, the norms of field work, lab work etc. have been followed. It is also certified that thorough scrutiny of the report for maintaining the scientific contents and its Quality has been overseen.

Name(s)/Designation of the Supervisory Officer	No. of inspection visits made to the field area	Total no. of days spent on inspection visit	Signature with date
R. Sajeer, Director	05	NA	

Part-F

This is to certify that the report has been thoroughly scrutinized at the Regional Mission Head level. The scientific contents and the Quality of the report are certified. The report has been peer reviewed and the needful corrections have been attended to.

Name(s)/Designation of the Regional Mission Head	Signature with date

Part-G

This is to certify that the above report has been scrutinized at various levels and has also been peer reviewed. On being satisfied regarding the scientific contents and the Quality of the report, the undersigned has accorded approval for its circulation.

Name(s)/Designation of the Regional HoD	Signature with date



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