Chapter - VI
Landslides

CHAPTER VI

Landslides

The State had been experiencing a spurt in incidences of landslides since 2016, particularly in the Western Ghats. This could be traced to factors such as population growth, unchecked infrastructure development, changes in land cover and land use besides extreme rainfall induced by climate change.

Audit identified issues such as insufficient preparedness and commitment to landslide mitigation. The State Government delayed publishing the State Action Plan for Landslide Management until 2022. Discrepancies in hazard zonation maps, the absence of a landslide inventory, and non-deployment of necessary monitoring equipment highlighted a critical need for effective interventions, particularly in Kodagu district.

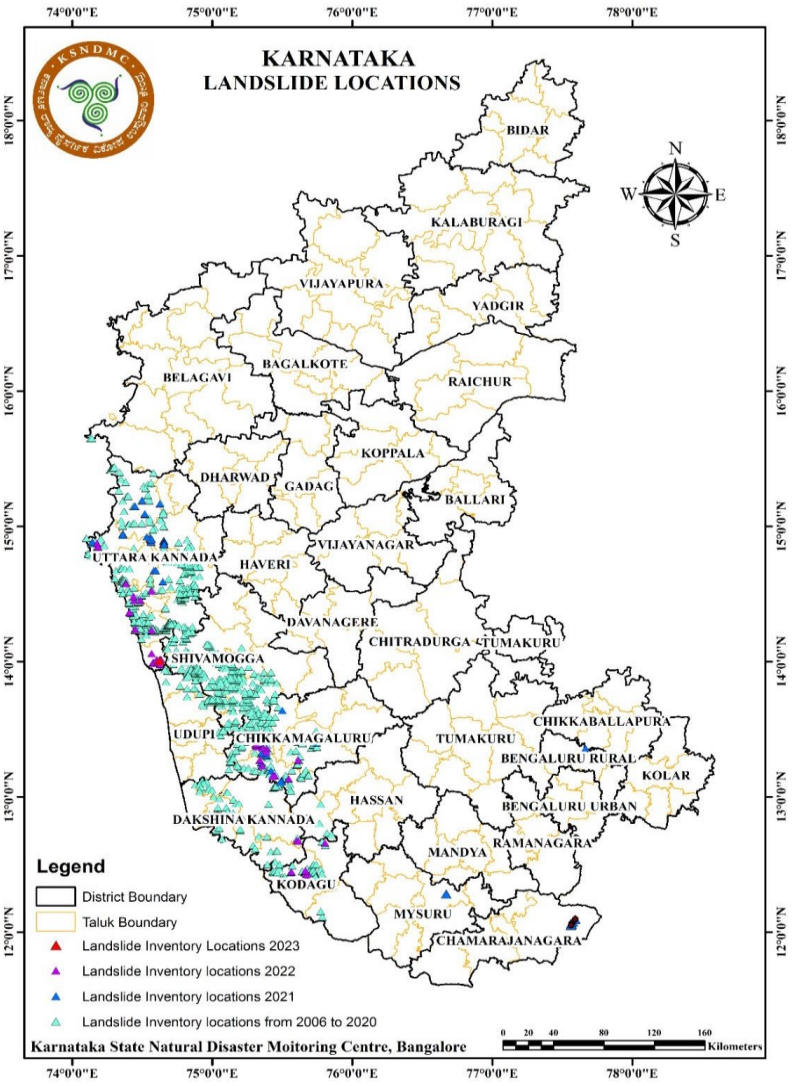
A separate case study on the Kodagu landslide events revealed a lack of guidelines or regulations for land use and cover to mitigate the hazard. Systemic lapses in government monitoring were evident in incidents like the collapsed retaining wall at the Deputy Commissioner's office in Madikeri. Unauthorized constructions were regularized, and agricultural land continued to be converted for commercial uses, highlighting inadequacies in disaster-resilient infrastructure planning and execution.

Landslide hazards rank high among hydrogeological hazards because they pose a threat to life and livelihood ranging from disruptions of normal activities to widespread loss of life, and property, and destruction in large parts of mountainous regions. The primary causes of landslides are forces due to geology, weathering, water content, vegetation, slope angles, human activities, *etc*.

6.1 Karnataka State Landslide Hazard Profile

In the State, landslides affect at least 15 *per cent* of the total land area of Karnataka, mostly falling in the Western Ghat region which includes 29 taluks of seven districts *viz.,* Uttara Kannada, Shivamogga, Chikkamagaluru, Udupi, Dakshina Kannada, Kodagu and Hassan districts. Landslide vulnerability map of Karnataka, as mapped by KSNDMC is shown in **Chart 6.1.**

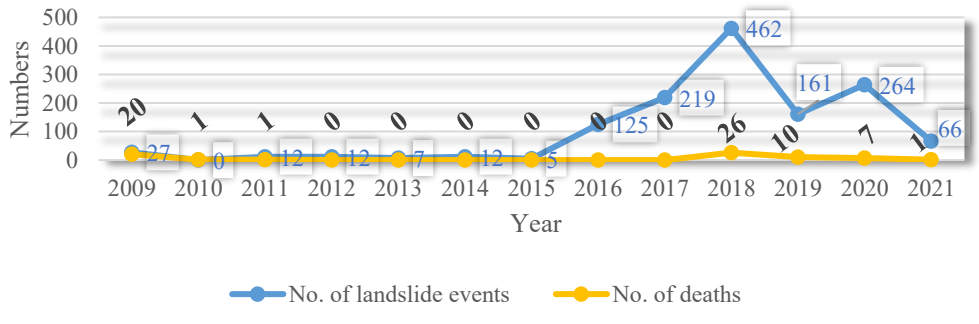
Chart 6.1: Landslide vulnerability map of Karnataka



Source: KSNDMC.

The landslides in the State had caused widespread damage and many casualties, together with significant economic losses and social disruption. The number of landslides and consequent human causalities recorded between the years 2009 and 2021 is shown in **Chart 6.2**.

Chart 6.2: Number of landslides and deaths in the State



Source: Karnataka State Action Plan: Management of Landslides-2022.

It can be seen that the landslide events have increased significantly since 2016. This can be attributed to the growth of population and consequent infrastructure development in violation of the zonal regulations together with the extreme rainfall events triggered due to climate change (as per GSI report). Deforestation is also a contributing factor to landslide. Among the test-checked districts, Dakshina Kannada and Kodagu were the most vulnerable and had been severely affected by landslides since the year 2018.

Illustrative photographs showing the intensity of destruction caused by landslides in various parts of the State are depicted in **Exhibit 6.1**.

Exhibit 6.1: Media reports showing the intensity of landslide destruction

Source: Media reports.

6.2 Landslide Impacts

Landslide hazards have both short-term and long-term impacts on society and the environment. The short-term impact accounts for the loss of life and property at the site and the long-term impact includes changes in the landscape that can be permanent, including the loss of cultivable land and the environmental impact in terms of erosion and soil loss, population shift and relocation of population and establishments. Like in any other disaster, the most affected by the landslides are the socio-economically weaker sections of the society who inhabit vulnerable areas.

Neither the data on expenditure incurred by the Government towards management of landslip hazards over the years nor the details of environmental damage and socio-economic impact thereon, on the farming community in particular, were available with the Government.

6.3 Preparedness towards Landslides

6.3.1 Landslide management framework

Landslides can be predicted, and the vulnerability to landslides, as well as the areas within landslide zones, can be clearly mapped out by land modelling utilizing remote sensing and Geographical Information System (GIS) technology. This information was deemed crucial for the provision of early warnings, the execution of evacuation exercises, and general preparedness. Thus, there was a need for a comprehensive Landslide Risk Management Strategy (LRMS) addressing all components of landslide disaster risk reduction and management, such as hazard mapping, regulations and policies, stabilization and mitigation of landslides, early warning systems, awareness programmes, capacity building, and training, among others.

Although the National Disaster Management Guidelines on the Management of Landslides and Snow Avalanches was formulated in 2009 and the specific National LRMS was introduced by NDMA in September 2019, the State published the Karnataka State Action Plan: Management of Landslides only in 2022.

The Government replied (August 2024) that the 'Karnataka State Action Plan: Management of Landslides' addressed all the components of landslides and action was being taken for monitoring rainfall in moderate to high-risk areas through rain gauge network of KSNDMC.

Reply is not convincing as significant gaps remain in its implementation. The State's response primarily focussed on rainfall monitoring without addressing broader preventive measures and community preparedness outlined in the plan. Further, the devices for monitoring rainfall as indicated in the previous chapters are largely non-functional.

6.3.2 Inappropriate landslide hazard zonation maps

The strategic document of NDMA recommended the preparation of Landslide Hazard Zonation maps at both macroscale and mesoscales (1:50000/25000 and 1:10000, respectively) employing advanced state-of-the-art tools such as Unmanned Aerial Vehicles (UAVs), Terrestrial Laser Scanners, and very high-resolution Earth Observation (EO) data.

As per the State Action Plan: Management of Landslides-2022, the State prepared the district-wise susceptibility maps, which are shown in **Appendix 6.1.** Audit observed that the test-checked districts of Dakshina Kannada and Kodagu possessed the zonation maps, which were prepared to adopt a scale of 1:325000 as against the envisaged scale of 1:10000. However, the period during which these maps were prepared was not on record and thus, audit could not ensure whether these maps were prepared by the district administration as a tool for preventive action against the landslides.

The Government replied (August 2024) that action would be taken to prepare the maps on a prescribed scale in consultation with GSI and other related departments/agencies.

6.3.3 Absence of landslide inventory

The preparatory measure for initiating preventive actions was to identify, map and list the landslides/landslips over a time series. The landslide inventories contain

basic information about landslides such as location, classification, morphology, volume, run-out distance, activity, and date of occurrence *etc*. Though the State had identified (2022) broad zones/locations and road sections vulnerable to landslides, the district authorities of the test-checked districts were not in possession of landslide inventory.

The absence of a defined framework and landslide inventory coupled with mapping with lesser resolution led to inadequate preparedness, and risk assessment ultimately exposing the vulnerable communities and infrastructure to danger.

The Government replied (August 2024) that the district authorities and KSNDMC would be instructed to compile data on landslide incidences as well as to prepare a detailed inventory to enable planning preparedness and mitigation measures. Further, though Government claimed to have possessed inventory of 1495 landslides in the State, the same was not furnished to audit.

6.3.4 Monitoring/Forecast Mechanism

Monitoring is an important component of landslide investigation/studies that includes the measurement and analysis of landslide dynamics as well as changes in the factors that cause landslides. Monitoring of landslides can be both surface and subsurface. The Government itself had accepted in the State Action Plan that landslide monitoring is generally not practised.

6.3.4.1 Failure to deploy scientific equipment

The primary geo-physical causes for any landslip are the formation of linear/vertical cracks or piping cavities, as shown in **Exhibit 6.2**, which may be natural or have occurred due to man-made activities.

Exhibit 6.2: Formation of linear/vertical cracks

Source: Photographs furnished by KSNDMC.

These fractures/cracks in the earth could be studied, analysed, and monitored by installing technologically available instruments like a Crack meter/Joint meter where the cracks are visually apparent, and Inclinometer/Piezometer/Tilt meter/ Borehole extensometer, *etc.*, where the subsurface deformation and depth of sliding is not apparent from surface measurements and visual observations.

Audit observed that the State Government/SDMA or the DDMAs did not initiate necessary action to adopt available technology and to install the forecast mechanism equipment in any of the hazard-vulnerable points/locations. Hence, there was no established procedure for forecasting this disaster in the State.

6.3.4.2 Early warning systems

Dissemination and communication mechanisms, as far as early warning systems are concerned, must be operational, robust, and available around the clock. These should be designed to meet the needs of a wide range of different threats and different user communities. The landslide risk management strategy also recommended Landslide Monitoring and Early Warning Systems[41], Stabilization and Mitigation of Landslides, and the creation of a Special Purpose Vehicle (SPV) for landslide management, capacity building, and awareness programs.

Audit observed that the State Government had not acted upon these recommendations. Thus, in the absence of advanced technological equipment and early warning systems, the Government/district authorities could not disseminate any alerts which exposed the local community to landslip hazards without a forecast mechanism.

The State Government stated (August 2024) that the GSI had pioneered early warning system for landslides in July 2024, which will be rolled over across the country in the next three months. Evidently, the early warning mechanism against landslides hazard was absent in the State. It is further stated that the KSNDMC had entered into a Memorandum of Understanding (MoU) with Geological Survey of India, Kolkata towards the development of an experimental rainfall threshold-based regional landslide forecasting system for Karnataka and soon after the project approval, actions will be taken to deploy scientific instruments. However, audit observed that although the MoU was entered into in March 2023, KSNDMC was not in possession of details of progress in this regard.

6.4 Mitigation Measures

Landslide hazard management involves measures taken to avoid or mitigate the risk posed by landslide hazards.

6.4.1 Absence of determined commitment towards risk reduction

Numerous studies, including those by the Geological Survey of India (GSI), have linked recurring and widespread landslides in Kodagu district since 2005 to various factors. These factors include transverse surface cracks resulting from increased pore water pressure due to heavy rainwater infiltration, slope cutting for road construction, anthropogenic factors intensified by heavy rainfall, unregulated habitation expansion disrupting the natural equilibrium, land modifications for agriculture and road development, extensive slope cutting along roads, structural modifications increasing susceptibility, destabilization due to slope toe removal, inadequate drainage leading to water seepage into joints and fractures, and poorly designed houses without basements.

Recommendations arising from these studies propose measures based on the specific causes of landslides. These measures include establishing proper drainage systems to manage slope water, constructing retaining walls, implementing inclined piles at slope toes, using stone pitching and gabions, employing biotechnical slope protection, and geometrically modifying slopes through grading and benching. Additional recommendations include planting stabilizing grass like

[41] Such as Rainfall Threshold-based Landslide Early Warning System, Ground Instrument-based Landslide Early Warning System, Seismicity-induced Landslide Early Warning System, *etc.*

vetiver, removing loose boulders, exercising caution in construction activities within high and moderate susceptibility zones, and conducting detailed site-specific studies before civil construction projects.

However, the State Government had not taken proactive steps to address the findings and recommendations from these studies. The DCs of Dakshina Kannada and Kodagu districts which were affected by the recurrent landslides replied that either structural or non-structural measures were not taken prior to devastation and action had been initiated in this regard only after 2018-19.

6.4.2 Laxity in implementation

Furthermore, a study report titled "Landslides in Coorg District of Karnataka State," published in the International Journal of Innovative Research in Science, Engineering, and Technology (Vol. 5, Issue 6, June 2016), emphasized the role of land use and human activities, specifically slope excavation being the contributory factor for landslides besides climatic conditions. Nevertheless, the State Government and the State Disaster Management Authority (SDMA) did not impose restrictions on infrastructure, human, or commercial activities that contributed to the destruction of natural geographical conditions, thereby neglecting preventive measures. Additionally, no efforts were made to conduct risk analysis and assessment.

The GSI in its reports on Kodagu landslides recommended to avoid vertical cut slopes as it unstabilises the slope and insert horizontal perforated pipes into the slopes which will act as weep-holes in the vertical slopes. Audit team conducted (June-July 2023) joint physical verification of selected reachable locations and stretches of roads affected by landslides under Kodagu and Dakshina Kannada districts and observed the following:

- The works executed towards repairs and restoration of roads were inappropriate as the authorities were still resorting to steep vertical cut formation along the roads, exposing the road and the terrain for possible landslips (**Exhibit 6.3(a)**).
- Retention walls constructed to arrest further landslips were without weep hole facility and hence, were fraught with the risk of washing off the structure due to infiltration during excessive rainfall incidents (**Exhibit 6.3(b)**).

Exhibit 6.3(a) **Exhibit 6.3(b)**

Source: Joint Physical Verification.

- Stabilization works were not taken up in landslide locations despite the visual appearance of huge natural drainage cavity (**Exhibit 6.4**).

Exhibit 6.4: Landslide location with natural drainage cavity

Monnangeri II

Monnangeri II

Source: Joint Physical Verification.

- Proper drainage facilities were not provided to either new or restored road works.
- Action was not taken by the State/District authorities to install early warning equipment.
- State/district administration had neither restricted land conversions nor construction of houses unscientifically and without approval. Instead, compensation at higher rates was paid in case of damage to such houses due to landslips.

The State Government stated (August 2024) that action had already been initiated to implement the recommendations of the study teams and that district administrations vulnerable to hazards had submitted various proposals for the management of landslides. However, neither the details of the action initiated to implement the recommendations nor the proposals submitted by the districts were furnished to audit. Timelines to implement the proposals are also needed to be factored to counter the increasing incidence of landslides.

6.5 Landslides in Kodagu – A Case Study

Kodagu witnessed major flood-cum-landslide events during the year 2018-19 which was very devastating as nearly as 20 lives were lost and many properties were damaged. After the devastation, the State Government/district administration requested the Geological Survey of India (GSI) to conduct a post-disaster investigation of landslides that occurred in Kodagu district. The GSI submitted its detailed investigation report in October 2019.

The major causal factors for slope failures reported by GSI (which studied around 105 landslides and subsidence) included geological lineaments, lithological factors, modification of the natural slopes, high angle (vertical or near vertical) slope cut for road construction, rapid modification for construction of infrastructure like houses, hotels, homestays, *etc.*, large scale slope modification for plantations (especially coffee), blockage of natural drainages, creation of water tanks, ponds throughout plantation estates modifying the actual slope, *etc*.

The report also highlighted the absence of guidelines or land use/land cover regulations to monitor land use pattern and recommended a wide range of measures for arresting/mitigating the landslide hazard. However, the State/district administration did not comprehensively act on the recommendations (March 2024) and could not mitigate landslide hazard.

Consequently, the State Government appointed (April 2020) a High-Power Committee headed by the Chairman, Karnataka Biodiversity Board, Bengaluru to study landslides in Karnataka. The committee submitted its report in March 2021. The High-Power Committee also attributed the severe landslides in the districts under western ghats to slope modification by human interference, drastic change in land use/land cover, manmade loss of vegetation, natural drainage blockage, forest land conversion, *etc*. The Committee, *inter alia,* recommended streamlining and strengthening ground-level institutional framework, possessing geo-referenced landslide inventory and landslide susceptibility maps, landslide risk analysis and management plan, developing a Comprehensive Landslide Prevention and Mitigation Plan (CLPMP), framing a well-defined land use policy, prevention of illegal roadside and forest encroachment for commercial activities, *etc*.

Further, KSNDMC in consultation with the experts from Amrita Vishwa Vidyapeetham, Kerala, jointly investigated[42] (May-June 2022) the landslides and recommended measures to monitor and mitigate the landslide and related multi-hazard disasters. The study team, after detailed field verification, noted heavy rainfall in a short span of time, presence of tectonic lineaments, construction of houses and disturbance to the natural course of ephemeral drainages, changes in hill-slope agriculture patterns (such as coffee and rubber plantations), inappropriate ways of interfering with hill-slope formations *etc*.

Despite these remedial reports, the Government/district administration did not initiate adequate measures towards mitigating hazards of landslides as discussed in successive paragraphs.

6.5.1 District Land conversions - Disaster Risk Evaluation and Land management

In the aftermath of the devastating landslides and based on the inputs of GSI, the Government imposed (November 2018) ban on land conversion from agricultural to non-agricultural purposes in Kodagu district. However, the State Government modified (May 2019) the order lifting the ban on land conversions and allowed conversions for residential purposes up to an extent of 15 to 20 cents. As per this order, the following conditions were to be followed during land conversions for the proposed place which is:

- other than non-stable area/zones notified by GSI;
- located more than 10 meters from the river channels;
- avoiding steep slopes and valleys;
- at a place far from 2018 monsoon landslide-hit areas.

The State Government further modified (June 2020) the order and allowed land conversions for all including commercial purposes. A technical committee including a GSI scientist (later replaced by Scientists of Department of Mines and Geology, Madikeri) was empanelled for scrutiny and the same conditions stipulated in May 2019 were reiterated.

The status of land conversions during the years 2018-19 to 2022-23 in Kodagu district is shown in **Table 6.1**.

[42] Multi-disciplinary Landslide Post-Disaster Assessment and Action Plan for Kodagu District.

Table 6.1: Status of land conversions during the years 2018-19 to 2022-23

Year	Applications received	Conversions approved	Rejected	Percentage of approval
2019	1,247	541	706	43
2020	1,365	935	430	68
2021	1,223	903	320	74
2022	2,717	1,914	803	70
2023 (up to June)	463	315	148	68

Source: Information furnished by DC, Kodagu.

The data presented in the table clearly indicates an upward trend in the number of conversions and approval of applications each year.

Audit extracted the details of 207 conversion cases[43] from the '*Bhoomi'* database to check whether the areas proposed for conversion were forming part of the vulnerable zones. Audit observed that the survey number-wise landslide risk information in the district was absent. In the absence of critical granular level information, particularly relating to disaster-prone villages identified by GSI, audit could not ascertain whether the lands sought for conversion were in the landslide-prone zone or not.

The Department of Mines and Geology, which was technically responsible for site-specific investigations for land conversions had its own challenges. It lacked the necessary instruments, laboratory facilities, and experts to conduct geotechnical studies. The non-availability of technical data such as slope maps, landslide susceptibility maps, soil type maps, digitized toposheets and software hampered its effective functioning. Moreover, the geologists were to conduct site inspections and prepare the technical report as per the 18-point check list devised by GSI.

Audit reviewed the geologist reports for 20 out of 207 cases selected at random and noticed that the opinion/input provided against crucial parameters was either general or not site-specific. The Department of Mines and Geology stated (September 2023) that it had only two geologists and one vehicle to cover all the five taluks of the district in addition to their regular duties and the number of land conversion applications being received is increasing at a higher pace. It further stated that the department was not trained on the aspects of landslide study, terrain evaluation with respect to urbanisation and recommendation for land conversion from agriculture to non-agricultural activities. Further in the absence of the required maps, it could not ascertain the exact vulnerability of the area which applied for conversion and hence, the report was prepared based only on superficial observations. Thus, the geologists were unable to prepare the technical report for controlling unscientific constructions and ensuring proper land use management to mitigate future disasters.

The report, however, contained the details of past landslide history, the elements at risk and the final remarks which provided an insight for the Committee to decide the suitability of the proposed land for conversion. A few examples from the 18-point checklist (which are only illustrative and not comprehensive) are given in **Table 6.2** :

[43] Extent of land converted in excess of one acre was selected.

Table 6.2: Illustrative details of past landslide history in Kodagu district

Details of land converted	Parameter for evaluation as recommended by GSI	Remarks of the geologist
Sy no. 216/20 – Katageri village, Sampaje hobli, Madikeri taluk - 1 acre for commercial purpose	Element at Risk	Houses are present in both upslope and downslope area
	Excavation	Required as per construction plan
	Old landslide history	There was history of landslide occurrences within an area of 198 meters
	Final remarks	40 degrees slope towards west direction. In the case of multi-storeyed buildings, it is suggested to conduct geotechnical studies to mitigate structural failures. A layout plan of the applied area is to be obtained by the applicant and the same is to be approved by the concerned authority adhering to standard building guidelines. Since a major part of the area lies in hilly terrain, the selection of sites and development of buildings in hilly areas may be done as per the Indian Standard Guidelines IS 14243 (Part-2):1995.
Sy No.393/1- Kedemalluru village, Virajpet taluk – 6.06 acre for commercial	Element at Risk	No major structure is found in upslope or down slope area
	Excavation	Excavation is required as per the construction plan
	Old landslide history	There was a massive landslide in Thora village in August 2019 which is at a distance of 2.9 kms from the proposed place of conversion.
	Final remarks	The area is a sloppy terrain with 20-to-25-degree angle towards west direction. Suitable precautionary measures should be taken during construction without much land deformation.
Sy No. 115/19 Katageri village, Sampaje hobli, Madikeri taluk – 8 acre - Commercial	Element at Risk	No major infrastructure is present in upslope and downslope area.
	Excavation	Required as per the construction plan
	Old landslide history	There was a landslide at Talathmane which is 1.6 kms from the proposed conversion land
	Final remarks	Since a major part of the applied area lies in a hilly terrain, selection of site and development of buildings in hilly areas may be done as per the Indian Standard Guidelines.
Sy No. 2/11 – 1 acre and 2/12- 1 acre. Bettageri village, Ammathi hobli, Virajpet taluk – 2 acres for commercial purpose	Element at Risk	Buildings are present at downslope side
	Excavation	Required as per construction plan
	Final remarks	The area in the west direction is at a slope of 40 to 45 degrees. Since the applied area lies in a hilly terrain, selection of site and development of buildings in hilly areas may be done as per the Indian Standard Guidelines

In all the above cases, the committee responsible for assessing and approving the land conversions accorded approval for conversion of lands from agricultural to non-agricultural, mainly for commercial purposes, overlooking the report of the geologist. Other than the geologist, the role of the other members of the technical committee was only to verify the completeness of documentation to issue NOCs.

Audit also noticed that the Tahsildars/Village accountants/Revenue Inspectors were certifying that the four conditions stipulated in the orders of May 2019 and June 2020 were complied with, though the first condition of ascertaining the stability of the area was not within the purview of their competency as it was a technical parameter.

On the other hand, the role of the town planning department in the technical committee was not established in the examined land conversion files. There was a shortage of technical personnel in the town planning department and city municipal council, both of which were connected to post-land conversion activities. There were only two members present out of the 10 sanctioned posts in each of the institutions.

Furthermore, the procedure for geotechnical and structural evaluation of buildings as per Indian Standard Guidelines, was not clearly defined. Specific guidelines and bylaws related to safety in building construction were found to be absent, particularly after the 2018 landslides.

During review of the 20 test-checked files, audit observed two instances wherein the land that already had structures built on it was submitted for conversion from agriculture to non-agriculture purposes. The Committee approved the conversions in both cases after levying penalty.

It is, therefore, apparent from the above observations that structures were being constructed unauthorisedly without being monitored by the respective authorities, which could disturb the stability of the slopes leading to landslips. Thus, the conversions in the district were approved disregarding the primary purpose of protecting the district from future disasters. Blatant disregard of guidelines while approving conversion of land use is an invitation for further disasters and landslides. The State Government needs to focus on such conversions and reverse such incorrect conversions.

The State Government stated (August 2024) that departments concerned have been asked to regulate construction in the landslide prone area as per the existing rules, regulations and laws. The reply highlights the lack of coordination among the departments in mitigating landslide hazards.

6.5.2 Proposed corrective measures not taken up in landslide affected Bhagamandala

Talakaveri or Talacauvery is the source of the river Kaveri located on Brahmagiri hills near Bhagamandala in Kodagu district. In August 2020, there was a massive landslide along the approach road to Talacauvery temple involving both human and property loss in this hazardous event. Even before this dreaded calamity, the GSI had conducted studies in the year 2019 and indicated the causative factors of a possible landslide in future. One of the stated factors was *"the presence of forest trenches on upslope, parallel to ground crack, facilitate water logging and subsurface infiltration during monsoon season. The ground cracks and contour trenches observed on the slope acted as pathway for water infiltration resulting in increased hydrostatic pressure and reduced shear strength. Brahmagiri hills, as observed, are dissected with road cuts, forest trenches and settlements making the slopes vulnerable".*

Based on these observations, GSI recommended to take up following precautions to avoid any further eventualities in future.

i) Appropriately designed retaining structures of suitable height with firm foundations are to be erected from road level for checking slope failures.

ii) There should be a proper and adequate drainage system.

iii) Any trenches or cracks, if present on the slope should be monitored and filled up with impervious material and planting of deep-rooted plants or vetiver grass.

The GSI also opined that Brahmagiri Hills is a potential risk zone due to intense human activities. Since this area witnessed multiple reactivations of slides from past years, it was not advisable to rehabilitate this landslide-affected zone till the slope is stabilized to the best possible extent.

However, neither State Government nor district administration issued any circular/ instructions stipulating these recommendations of GSI for strict compliance by concerned departments for averting landslides. Further, the DC, Kodagu had convened (28 December 2020) a meeting to review the precautionary measures to be taken as recommended by GSI. The Assistant Conservator of Forest who was present in the meeting stated that a high-level committee of Forest department had inspected the landslide and provided its recommendations. The DC then addressed (29 December 2020) letters to the Principal Secretary, Forest, Ecology and Environment Department and Principal Chief Conservator of Forest, Bengaluru stating that there was the presence of forest trenches up to a depth of 3 km in the areas where the landslide occurred during February 2020 and requested to take up the precautionary activities as suggested by GSI.

The DC also instructed the Public Works department to prepare an action plan to take up the works such as construction of retaining walls, proper drainages and culverts in the landslide affected areas and directed that the works be completed before the onset of next monsoon i.e., by May/June 2021.

However, the details of works/precautionary activities taken up, if any, by the PWD or Forest Department on the instructions of DC were not forthcoming from records indicating lack of monitoring by the district administration to arrest further degradation of vulnerable locations.

The Government replied (August 2024) that the details would be furnished after seeking a report from DC, Kodagu. It may be noted that the draft report was submitted to the Government during November 2023 and the department had not yet sought the report/replies from the concerned authorities even as of August 2024. The reply evidences inaction by the nodal department towards mitigating the hazards of disasters and landslides, in particular.

Recommendation 15: The State Government should put in place a proper institutional framework integrating geo-referenced landslide inventory-cum-susceptibility maps, regulate landslide risk areas and develop a Comprehensive Landslide Prevention and Mitigation Plan to avoid geological disaster. The Government should also ensure thorough site assessments of land conversions and enforce zoning regulations.

6.5.3 Improper design resulted in failure of the retaining wall to the Deputy Commissioner office building complex

The Kodagu District Administrative Office complex at Madikeri houses the Office of the Deputy Commissioner and District Magistrate (DC), Kodagu and 19 other district level departments. The office complex was constructed by Karnataka

Housing Board during 2013-14 on a hillock which is a landslide-vulnerable zone (**Exhibit 6.5**). The threat perception to the building complex was high as a couple of landslides occurred on the Madikeri-Mangaluru Road adjacent to the building.

Exhibit 6.5: DC office complex situated on a hillock

Source: Media report

As a precautionary measure against probable landslips and consequent damage to the office building, the DC submitted (October 2016) a proposal to the State Government for construction of Terra Link and Reinforced Earth (RE) Retention Wall (for a length 140 mts and a height of 15 mts) and an approach road at a cost of ₹5.00 crore[44]. Audit observed that there was an inordinate delay in obtaining the approval of the Technical Advisory and Estimate Scrutiny Committee by the Public Works, Ports and Inland Division (PWPID) and the district administration and the State Government accorded administrative approval to the work during October 2018. However, funds for the work were not released.

Due to the efflux of time, the Executive Engineer, PWPID, Madikeri submitted (26 December 2018) a revised cost estimate of ₹7.00 crore for the work. The DC forwarded (January 2019) the revised estimate to the Government for approval and release of funds. The Government approved it in May 2019 and the work was put to tender (December 2019).

In the meantime, as no protection work had taken place more than three years after submitting the proposal, the land mass on the slope side of the building collapsed in August 2020 and the slid hillock portion was covered with plastic sheets to avoid further mud slide on to the adjacent highway.

Subsequently, the work was awarded (November 2020) to a contractor[45] for ₹7.58 crore (including GST) with a stipulation to complete the work within 11 months. Though the site was handed over to the contractor during December 2020, the designs for the construction of the wall and road were made available only during March 2021. However, the work was stopped (July 2021) for about five months due to heavy rain.

Verification of records showed that, while the work was resumed and fixing of the concrete panels of the RE wall was completed to a height of 14 meters, a few of the concrete panels of the wall got dislocated (first week of July 2022) and bulged

[44] Estimate prepared by Executive Engineer, PWPID based on the 2015-16 SR of Mangaluru circle.
[45] Sri UV Ramanjaneyulu of Sri Ayyappa Constructions, Hyderabad.

out posing danger of complete collapse of the wall and the hillock. The Superintending Engineer, Hassan Circle and the Chief Engineer, C and B (South), Bengaluru who inspected (07 and 08 July 2022) the work site attributed dislocation of the panels of RE wall to absence of a proper drainage facility alongside the worksite and consequent percolation of water/rainwater through the embankment abutting the RE wall (without any provision to drain out) hence they instructed covering the embankment with plastic sheets. The deformation of the wall panels increased day by day and was thus, supported with metallic structural measures and sandbags, as suggested by the engineers and experts.

To rectify the dislocation, all the concrete panels of the wall had been dismantled (December 2022) along with the embankment. Experts from IISc who inspected the worksite during May 2023 suggested a revised drawing and design for the work and the same was approved.

The work on which a total expenditure of ₹6.25 crore had been incurred and was scheduled for completion by November 2021, still remained incomplete even as of August 2023. Audit conducted a joint physical verification (August 2023) of the worksite and noticed that there was no progress in work since July 2022 and the entire work portion was covered with plastic covers to avoid further seepage due to monsoon rains (**Exhibit 6.6**).

Exhibit 6.6: Retention wall location covered with plastic sheets

Source: Photographs taken during JPV.

Thus, the office complex as well as the lives of the employees working therein were threatened due to the improper decision for construction of the District Administrative Office complex on a landslide vulnerable location without proper protection. The problem was exacerbated by the construction of a retention wall without drainage facility.

The above illustration also points to the negligent approach of the administration towards creation of a disaster resilience environment. The construction of a vital public office building on a sloppy hillock without adequate protection continuously exposes the life of government employees including the Chairperson of the DDMA (the DC) to the threat of landslides. The work which needed to be prioritised still languishes.

The State Government stated (August 2024) that reply would be submitted after getting a detailed report from DC, Kodagu.

Recommendation 16: The State Government should prepare a comprehensive landslide risk management strategy with zonal mapping and ensure landslide resilience in constructions through effective structural measures.

6.6 Relief and Rehabilitation/Reconstruction

As in other disasters, the State Government/district administrations paid relief compensation to the landslide affected population on the norms prescribed by the SDRF/NDRF along with additional assistance from the State Government. However, the details of expenditure towards compensation for landslides paid during the audit period were not forthcoming from records of the test-checked districts.

On an analysis of the data available on '*Parihara'* portal meant for payment of compensation for loss of crops, audit observed that a total sum of ₹6.23 crore had been paid towards crop loss due to landslides during the period from 2018-19 to 2021-22.

6.6.1 Construction and allotment of rehabilitation houses

Of the test-checked districts, the Kodagu district administration had initiated rehabilitation measures through construction of houses[46] (at different identified locations) for distribution to affected families who lost their houses in the devastative landslides during the years 2018-19 and 2019-20 as well as to those whose houses were in vulnerable locations.

A total of 730 beneficiaries were identified for allotment of houses under rehabilitation programme. The details of estimated outlay, agreement with entrusted agencies, agreed cost, expenditure incurred on construction, handing over of completed houses, *etc.*, were not made available to audit. Hence, audit could not ascertain the total expenditure incurred towards construction of rehabilitation houses in the district.

As per the available records, 666 houses were reportedly allotted to beneficiaries. The audit team conducted (20 June 2023) a joint physical inspection of houses constructed at Galibeedu and Jamburu locations along with the officials of district administration and illustrative photographs of the houses are shown in **Exhibit 6.7**.

Exhibit 6.7: Houses constructed at Galibeedu and Jamburu locations

Source: Photographs taken during joint physical inspection.

However, many houses in Galibeedu seemed unoccupied by the beneficiaries primarily due to insufficient transportation options and connectivity challenges.

[46] Funded by Government and Infosys foundation.

The Government did not offer any comments on the audit observation (August 2024).

6.6.2 Damaged houses/sites not taken over by district authorities

On allotment of a house to a beneficiary as part of rehabilitation, it was required for the district administration to immediately take over the possession/title of the damaged property, to desist the family of the beneficiary from further continuing in the same location and meet with any disaster later. Though the district/taluk administration had allotted new houses to the identified beneficiaries, it did not initiate any action to take possession of the properties in lieu of which the rehabilitated houses were allotted. This resulted in the beneficiary's holding possession of both the newly constructed house as well as the damaged house.

Audit conducted (September 2023) a joint physical examination of the damaged houses in Indiranagar and Chamundeswari nagar of Kodagu district where many houses were destroyed by landslides during 2018. The team noticed and interacted with three of the beneficiaries who continued to reside in the damaged houses endangering their lives even though they were allotted rehabilitated houses (H.nos. 10, 67 and 73) in Galibeedu.

Evidently, the district administration did not ensure that families shifted to the newly allotted houses from the distressed premises to avoid further loss of infrastructure and human lives due to any untoward happening. Further, the correspondence (February 2023) on record showed that the district administration had received complaints on illegal occupation of houses due to beneficiaries leasing/letting out the allotted new houses.

The Government did not offer any comments on the audit observation (August 2024).

6.6.3 Providing financial assistance without ensuring landslide resilient construction of houses

As a relief measure to the families of houses damaged due to landslides or the houses which were dangerously vulnerable to landslips, the State Government provided financial assistance of ₹9.85 lakh per house for reconstruction either in the same location or a different site belonging to the affected family.

Audit observed that 83 families in Kodagu had availed the benefit, of which 73 families had opted to construct the house on their original sites. Since the original sites were vulnerable to landslide disaster, the constructions taken up were to be landslide resilient. However, the district administration had neither insisted upon nor provided appropriate technical specifications for construction and thus, did not ensure that the houses constructed were landslide resilient and safe from further disasters.

The Government did not offer any comments on the audit observation (August 2024).