



**भारत सरकार
GOVERNMENT OF INDIA**

**समझौता ज्ञापन
Memorandum of Understanding between**

**भारतीय भूवैज्ञानिक सर्वेक्षण
खान मंत्रालय, भारत सरकार**

**GEOLOGICAL SURVEY OF INDIA
MINISTRY OF MINES
GOVT. OF INDIA**

**एवं
and**

**कर्नाटक राज्य आपदा प्रबंधन प्राधिकरण
कर्नाटक सरकार
के मध्य**

**KARNATAKA STATE NATURAL DISASTER MONITORING CENTRE
GOVERNMENT OF KARNATAKA
Representing KARNATAKA STATE DISASTER MANAGEMENT AUTHORITY**

On

**भूस्खलन प्रारंभिक चेतावनी प्रणाली के कार्यान्वयन पर संस्थागत
सहयोग कार्यक्रम**

**Institutional Cooperation Programme on Implementation of Experimental
Landslide Forecasting System**

31st March 2023

31.3.23

Page | 1

Memorandum of Understanding on Implementation of Experimental Regional Landslide Forecasting System (LFS)

This Memorandum of Understanding hereinafter referred to as 'MoU' signed on this the 31st March, 2023 between The President of India acting through the Geological Survey of India, having office at 27, Jawaharlal Nehru Road, Kolkata 700016, an attached office of Ministry of Mines, Government of India (hereinafter referred to as 'GSI', which expression shall include, unless repugnant to the context or contrary to the meaning thereof, its successors or permitted assignees) on the FIRST PART.

AND

Karnataka State Natural Disaster Monitoring Centre, (Autonomous Body, affiliated to Department of Revenue (DM)) representing The Government of Karnataka, Karnataka State Disaster Management Authority (KSDMA) having office at Major Sandeep Unnikrishnan Road, Attur layout, Yelahanka Taluk, Bengaluru Urban Karnataka 560064 (hereinafter referred to as 'KSNDMC' which expression unless otherwise provided shall include its successors, representatives and assignees) on the OTHER PART.

GSI and KSNDMC (representing KSDMA) may at times be referred to individually as "Party" and collectively as the "Parties".

2. Preamble

WHEREAS:

GSI is a premier earth science organization under the Ministry of Mines engaged in fundamental and multi-disciplinary geoscientific activities in the country including the landslide studies. GSI, being the Nodal Agency of the country on landslide studies, has a mandate to develop and generate early warning for landslides. Since 2017 GSI has been involved in an international research program (LANDSLIP) for developing a prototype rainfall induced regional landslide early warning system (LEWS) for two test areas in India (i.e., Darjeeling and Nilgiris). The broad aim of LANDSLIP project was to develop a prototype landslide early warning system for spatial scales from slope (25 km²) to region (2000 km²) and temporal scales from a day to month. Currently, GSI is testing the regional LEWS developed in LANDSLIP in the above two test areas, and has also planned to extend similar endeavour in other landslide prone States in the country, including Karnataka. GSI also maintains the repository of landslide data, including seamless landslide susceptibility maps, inventory data and thematic attributes such as land use/land cover, slope forming material, lithology etc. of landslide prone areas in India including those of Karnataka.

AND WHEREAS,

KSNDMC (formerly known as Drought Monitoring Cell) has been responsible for providing Science & Technology(S&T) inputs for managing and mitigating natural disasters in Karnataka State. KSNDMC is engaged in number of activities related to synergizing S & T activities and providing a common platform for the response players in Disaster Management in Karnataka State. KSNDMC has installed a network of weather monitoring stations which comprises Solar Powered GPRS enabled Telemetric Weather Stations (TWS) at 747 Hoblis (~250 Sq km) and Telemetric Rain Gauge Stations (TRG) at all the 6000 Grampanchayaths (~25 Sq km). The data on Temperature, Relative Humidity, Wind Speed, Wind Direction, Rainfall Intensity and amount of Rainfall is being collected at every 15 minutes. The near-real time data collected through the network is being analysed, maps and reports generated at real time.



31.3.23



AND WHEREAS,

Both the Parties agree to undertake the following activities to achieve the overall objective of implementation of an experimental forecasting system for rainfall-induced landslides in Karnataka. Considering importance of societal nature of the issue, the financial aspects regarding the field and laboratory work will be met by the parties on their own.

3. Proposed Activities

During recent times, one of the major thrust areas in landslide risk reduction is the development of a Landslide Forecasting System (LFS) for a large area with inputs from static landslide susceptibility and hazard maps and dynamic short and long term rainfall forecasts. Thus, **the main objectives** of this MoU are as follows:

- 3.1. Institutional cooperation and collaboration for implementation/ validation of experimental Regional Forecast system for landslides for making it an operational model for Karnataka.
- 3.2. To develop a Standard Operating Procedure (SOP) for flow of information for dissemination of Landslide Forecasting forecast system.
- 3.3. To provide support for the development of Disaster Management plan for landslides

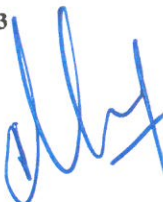
Responsibility of the parties to meet the objectives of the MoU is appended below:

4. Responsibility of KSNDMC

- 4.1. will provide daily rainfall data (project area) from all available rain gauges/AWS both historical and for the period of entire experimental stage and even later during operational stages.
- 4.2. will establish at least one rain gauge/ AWS wherever required for the experimental phase and augment daily rainfall data for development, evaluation and for operationalization of the LFS.
- 4.3. will provide landslide data through template provided by GSI for developing and validation of Landslide Forecasting System model for both experimental and operational stages
- 4.4. will provide weekly feedback/ ground condition on daily landslide occurrences, forecast bulletin after its issuance at experimental and onwards for making it for use during operational stages.
- 4.5. will provide GIS map for administrative boundary village/ ward/ Mauza/ block/ Subdivision/ District, including other physical feature data such as roads and other infrastructure locations for model preparation.
- 4.6. will provide up-to-date census information for risk and hazard analysis (both GIS-enabled data and attribute information).
- 4.7. will provide landslide damage data through Calamity Assessment or Village damage reports etc. on regular basis during testing of the Landslide Forecasting System.
- 4.8. will arrange to carry out landslide awareness programs for outreach down to Block and Gram Panchayat level as and when necessary.
- 4.9. will identify a nodal officer at State and District Level for coordination with GSI during validation of the model and implementation at operational stage later.
- 4.10. will identify and deploy People Centric Early Warning System later as necessary after operationalisation of the Regional Landslide Forecasting System in Karnataka for its effective utilisation on ground involving the community.



31.3.23



5. Responsibility of GSI

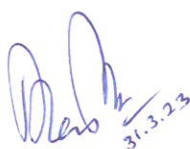
- 5.1. will provide technical support and back-up for implementing landslide training and awareness programs for outreach
- 5.2. will provide relevant landslide and thematic information for implementation of regional Landslide Forecasting System.
- 5.3. will carry out probabilistic rainfall threshold modelling for landslide initiation using the available data and will refine the model with new data acquired overtime with augmentation of AWS/rain gauges data from SDMA & landslide data from all sources.
- 5.4. will provide seamless landslide susceptibility map on 1:50,000 scale for all the hilly areas of Karnataka for using as input to LEWS.
- 5.5. will provide debris flow susceptibility map of Karnataka for using relevant input to develop LEWS.
- 5.6. will carry out analysis of landslide damage data for vulnerability mapping.
- 5.7. will collate and integrate multiple information (landslide hazard, weather forecast, and elements-at-risk) using relevant decision support system to develop LFS for Karnataka.
- 5.8. will provide daily experimental rainfall induced regional landslide forecast bulletin down to Block/ Sub-Taluk level in landslide prone districts of Karnataka to KSNDMC.
- 5.9. will carry out model testing and validation during experimental stage
- 5.10. will provide relevant technical input and support for deployment of People Centric Forecasting System.
- 5.11. will develop a Standard Operating Procedure for generating Landslide forecast Bulletin and dissemination for operational implementation.
- 5.12. will participate in the landslide awareness programs for outreach down to Block and Gram Panchayat level as and when necessary.

6. Joint Responsibility

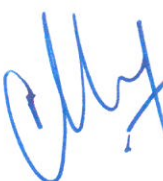
- 6.1. GSI and KSNDMC will jointly evaluate landslide forecast bulletin with ground information, including validation.
- 6.2. GSI and KSNDMC will jointly work on developing the mechanism for mutual data and also dissemination of LFS information.
- 6.3. GSI and KSNDMC will jointly develop SOP for Early action plan to be used by KSNDMC for Landslide Warning Forecast during actual operation.
- 6.4. GSI and KSNDMC will jointly conduct outreach programmes to create awareness as and when required. Geo-scientific data sharing with KSNDMC and GSI will be based on existing norms of both the parties.
- 6.5. Either of the Parties recognizes that the successful implementation of this MoU to the mutual satisfaction and benefit of both the Parties will require a significant degree of co-operation and good faith. The Parties resolve to act in good faith and in accordance with the spirit of this MoU to implement the provisions in accordance with the mutual desire and in the interest of both the Parties.

7. Institutional arrangements

- 7.1. The duration of this MoU will be for five (05) years after signing of MoU but can be extended as agreed upon by the Parties mutually. Development and Implementation of a Regional Landslide forecast system in Karnataka, to be taken up immediately under this MoU in phases. The operational phase will be assessed after validation and calibration of the model during these five years.
- 7.2. The facilities in the form of equipment and expertise from both the organizations will be utilized and extended to each other based on mutual agreement. The cost, if any, will be borne by the respective organisation.
- 7.3. KSNDMC and GSI will provide possible logistics respectively for their own staff for joint programme implementation initiatives based on mutual agreement. The cost, if any, will be borne by the respective organisation.
- 7.4. KSNDMC and GSI scientists will be mutually associated for increase in know-how and



31.3.23



- capacity building.
- 7.5. Other responsibilities that may emerge while implementing the collaborative programme will be mutually agreed upon by the parties.
- 7.6. While the parties agree to co-operate and otherwise act in good faith with the view to the successful implementation, there is no financial binding on either party.

8. Deliverables

- 8.1. Validation of a regional Forecasting System for rainfall-induced landslides for operational implementation of regional Landslide Forecasting System in Karnataka.
- 8.2. Technical report and Standard Operating Procedure for operational implementation.

9. Confidentiality

- 9.1. The experimental rainfall induced Landslide Forecast Bulletin will be for internal use of KSNDMC and line departments till such time it is validated and made operational. The same if operational will only be disseminated to wider audience, as decided by KSNDMC.
- 9.2. The Forecast bulletin will be part of validation purposes and research and will not be for any action till completion of validation phase, which may take 3-5 monsoon years.
- 9.3. Any use of trademarks and logos of the Parties would require specific agreement or prior written consent of the Parties.
- 9.4. The Parties undertake to (a) respect each other's intellectual property right, (b) not to infringe upon each other's intellectual property right without the prior written consent from the other Party, and (c) ensure the confidentiality within their respective organizations.

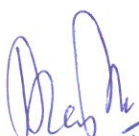
10. Notices

All notices, requests or other communications required or permitted to be given under this MoU shall be in writing, preferably in English and shall be delivered in person or by recognized courier service or facsimile, to following addresses or to the authorized persons of the Parties to be notified separately:

For KSNDMC (representing KSDMA) Director, Karnataka State Natural Disaster Monitoring Center, (Autonomous Body, affiliated to Department of Revenue(DM)), Govt. of Karnataka, Major Sandeep Unnikrishnan Road, Yelahanka, Bengaluru 560064 Phone: 08067355000 Email: dmc.kar@gmail.com	For GSI Director General, Geological Survey of India, 27, Jawaharlal Nehru Road, Kolkata- 700 016. Phone No: 033-22861676 Email: dg.gsi@gov.in
--	---

11. Force Majeure

In the event of either party being rendered unable by Force Majeure to perform any obligation required to be performed under this MoU, the relative obligation of the party affected by such Force Majeure, shall upon notification by the other party, be suspended for the period during


31.3.23



which the clause lasts. The term/expression Force Majeure shall include an act of nature, such as, earthquake, flood, inclement weather, pandemic, war, riot, sabotage and breakdown of law and order caused by terrorist's activities. The party affected shall send a notice in writing to this effect to the other party immediately but not later than one month of such occurrence.

12. Arbitration

Except as otherwise provided elsewhere in the MoU, in the event of any dispute or difference relating to, arising from or connected with the MoU, such dispute or difference shall be mutually discussed between the parties and will be finalized to the satisfaction of both the parties. Any officer in the rank of Secretary, Govt. of India as agreed upon between GSI and KSNDMC (representing KSDMA) will be the Arbitrator for this MoU.

13. Amendments or Modifications

This MoU hereto is the Parties' understanding relating to the subject matter herein. It supersedes all prior or contemporaneous oral or written communications, proposals and representations with respect to its subject matter. Either Party can terminate this MoU at any time by serving one-month notice to the other Party.

14. Publication

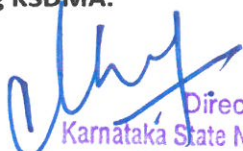
Any publication, document and/or paper arising out of joint work conducted by the participants pursuant to this MoU will be jointly owned. The use of the name, logo and/or official emblem of the participants on any publication document and/or paper will require prior permission of the both the participants. It may however be ensured that the official emblem and logo is not misused.

IN WITNESS WHERE OF the Parties hereto have duly executed this MoU on the 31st day of March
Two Thousand and Twenty Three.

By signing this MoU,

I also confirm that I am authorised to sign on behalf of and under order of Karnataka represented by Karnataka State Natural Disaster Monitoring Centre (KSNDMC) representing KSDMA.

Name:


Director
Karnataka State Natural Disaster
Monitoring Centre
Bangalore

Designation:

Address:

Karnataka State Natural Disaster Monitoring Center, (Autonomous Body, affiliated to Department of Revenue(DM)), Govt. of Karnataka, Major Sandeep Unnikrishnan Road, Yelahanka, Bengaluru 560064
Email: dmc.kar@gmail.com

By signing this MoU,

I also confirm that I am authorised to sign on behalf of and under order of President of India represented by Geological Survey of India (GSI)

Name:


31.3.2023

Designation:

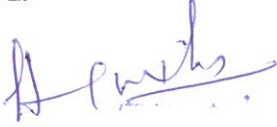
डॉ. पी. के सिंह / Dr. P. K. Singh

Address: उपमहानिदेशक, मिशन-IVए/Deputy Director General, Mission-IVA
भारतीय भूवैज्ञानिक सर्वेक्षण/Geological Survey of India
केन्द्रीय मुख्यालय, कोलकाता/Central Headquarters, Kolkata
27, Jawaharlal Nehru Road,
Kolkata – 700016
Phone No: 033-22861676
Email: dg.gsi@gov.in

In the presence of

In the presence of

Witness 1.



Signature:

Name: S. JAGADEESH
Designation/Address: Karnataka State Natural Disaster Monitoring Centre
Major Sandeep Unnikrishnan Road,
Near Attur Layout, Yelahanka,
BANGALORE - 560 064.
Phone : 080-67355000
Fax : 080-67355198

Witness 2.

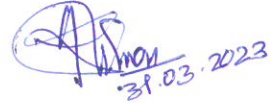


Signature:

Name: Dr. Ramesh Dheepal

Designation/Address: J.S.O
Karnataka State Natural Disaster Monitoring Centre
Major Sandeep Unnikrishnan Road,
Near Attur Layout, Yelahanka,
BANGALORE - 560 064.
Phone : 080-67355000
Fax : 080-67355198

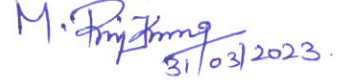
Witness 1.



Signature:

Name: अक्षय कुमार मिश्र
Designation/Address: KSHAYA KUMAR MISHRA
निदेशक/Director
भारतीय भूवैज्ञानिक सर्वेक्षण
Geological Survey of India
भारत सरकार/Govt. of India

Witness 2.



Signature:

Name: राजकुमार. एम/Rajkumar M
वरिष्ठ भूवैज्ञानिक/Sr. Geologist
केंद्रीय मुख्यालय, कोलकाता/Central Headquarters, Kolkata
भारतीय भूवैज्ञानिक सर्वेक्षण/Geological Survey of India
Designation/Address: खान मंत्रालय/Ministry of Mines