

# **A co-created landslide mobile application: lessons learned**

**Prof Bruce D Malamud**  
Director & Wilson Chair of Hazard and Risk  
Institute of Hazard, Risk and Resilience  
Durham University  
E-mail: [bruce.malamud@durham.ac.uk](mailto:bruce.malamud@durham.ac.uk)  
**27 January 2025**



- **Research grant on early warning of landslides in India (LANDSLIP).**
- **Five years (Nov 2016 to June 2022) £2.4m.**
- **Nine partners from India, UK, Italy.**
- **Today: Discuss one small part of grant—collection of landslide data via crowdsourcing Landslide Tracker methodology.**



**Landslide Multi-hazard Risk Assessment, Preparedness and Early Warning in South Asia: Integrating Meteorology, Landscape and Society (LANDSLIP)**

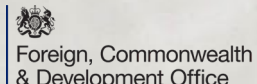


Foreign, Commonwealth & Development Office



- Present short video.
- Video 1: (5'11") Brief overview of the LANDSLIP project in India.
- Note different actors involved (government, academic, NGOs).

<https://youtu.be/qjnj2GKHUx8?si=QuuElr0UDdzk-4D0>





Landslide Multi-hazard Risk Assessment,  
Preparedness and Early Warning in South Asia:  
Integrating Meteorology, Landscape and Society  
(LANDSLIP)



Practical  
ACTION



Natural  
Environment  
Research Council



Foreign, Commonwealth  
& Development Office



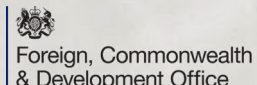
Science for  
Humanitarian  
Emergencies  
& Resilience



<https://youtu.be/qnj2GKHUx8?si=QuuElr0UDdzk-4D0> (5 min 11 sec)

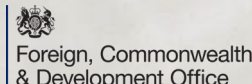
# Landslide Tracker

- As part of LANDSLIP, we developed a Landslide Tracker methodology to ‘crowd source’ local data.
  - First in **paper version**.
  - Then as **mobile app** and **web version**.
  - [As of 1/2025 app used in over 20 countries].



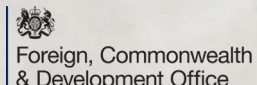
# Landslide Tracker (co-developing paper and app)

- **2019–2020: Over 40 meetings of 5–10 people at first physical then virtual meetings.**
  - King's College London (Bruce convened meetings)
  - Amrita University (led on software development),
  - Geological Survey of India (formed basis of some of the questions asked)
  - British Geological Survey
  - Practical Action (India branch)
  - NGOs: Save the Hills, Keystone Foundation (both trialling w. local volunteers).
- **2020–2021: Trialled over two monsoon seasons (>500 landslides recorded).**




# Landslide Tracker


- **Co-Developed all aspects of the landslide tracker methodology.**
  - **What were the needs (landslide location, time, size, impact).**
  - **Who would use it.**
  - **Simplicity/complexity of questions.**
  - **Different levels of users.**
  - **Graphics needed.**
  - **Ethics, security, anonymity, safety.**
  - **Who would collect the data/process data/see the data.**
  - **Trials/Training with local volunteers/government officials.**
  - **Legacy**



# Landslide Tracker (Paper Form)



## India Landslide Tracker Form



• Thank you for filling out this Landslide Tracker form from Geological Survey of India (GSI) and LANDSLIP project partners ([www.landslip.org](http://www.landslip.org))\*. An equivalent android app is available (Google Play, 'Landslide Tracker' by Amrita University).  
 • Information gathered here will help contribute to the India national landslide inventory. Your information will be added to an open access landslide database (without your name or other identifying information).  
 • This information will in the future be seen and accessed at the GSI portal [www.gsi.gov.in](http://www.gsi.gov.in).  
 • This landslide database will go a long way in enriching our understanding of landslide management in India and will help in evolving a useful, usable and credible landslide forecasting system, on a sound scientific basis.  
 • Filled form to be sent to: E-mail: [dir.ghrm.landslide@gsi.gov.in](mailto:dir.ghrm.landslide@gsi.gov.in); OR WhatsApp: 8794738224 & 9038849750  
**THINK SAFETY: Each time BEFORE you fill this form out, read carefully the SAFETY INSTRUCTIONS on p. 3.**

### 1. REPORTING DONE BY:

1a. Name:		1b. Mobile #:	
1c. Address:		1d. Email ID:	
1e. Reporting Date & Time while in Field		1f. Signature:	
1g. Record #: First three letters of District (e.g., DAR, NIL)/Last five digits of your mobile/Serial # of landslide you have tracked this year. (e.g., DAR/05132/003).			

Hereby, I provide my consent to the information below being used by the National/State government organisations and LANDSLIP project partners for research and development purposes. (Tick box)  
 Hereby, I confirm that I have read and understood the Safety Measures for Landslide Tracking and COVID-19 described on Page 3. (Tick box)

### 2. LANDSLIDE OCCURRENCE: DATE & TIME

2a. When did the landslide occur? (Fill in date & time if known or tick box)	Date: (dd-mm-yy)	2b. How do you know this information? (Tick box and/or fill in 'other')	<input type="checkbox"/> I observed it
	Time: (hh:mm)		<input type="checkbox"/> A local contact told me
	<input type="checkbox"/> Roughly in last three days		<input type="checkbox"/> Social media
	<input type="checkbox"/> Roughly in last week		<input type="checkbox"/> News report
	<input type="checkbox"/> Probably older than a week		<input type="checkbox"/> Other (Fill in):
<input type="checkbox"/> I don't know			

### 3. LANDSLIDE LOCATION (Fill in as much information as you can)





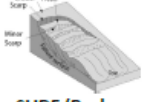
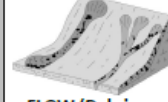



3a. District & Sub-Division/Taluka		3d. What prominent landmarks are near the landslide? (e.g., near Ram Temple at Gandhi Road, 50 m above Tata Tea Estate; below mountain railway line, next to Sharma tea shop, 100 metres north of Government school)
3b. Town/Municipality/Village panchayat		
3c. Coordinates, if known	Latitude: Longitude:	

3e. Where did landslide take place? (Tick all that apply)	<input type="checkbox"/> Near / on road	<input type="checkbox"/> Sparse Forest	<input type="checkbox"/> Tea Plantation	<input type="checkbox"/> Next to River
	<input type="checkbox"/> In Bstee / Gaon / town	<input type="checkbox"/> Dense Forest	<input type="checkbox"/> Other (Fill in):	

3f. Road Type? (Tick one)	<input type="checkbox"/> National highway	<input type="checkbox"/> Local paved road	3g. Landslide location relative to road? (Tick ALL that apply, e.g., 'on and above').	<input type="checkbox"/> Above the road	<input type="checkbox"/> On the road
	<input type="checkbox"/> State highway	<input type="checkbox"/> Local unpaved road		<input type="checkbox"/> Below the road	

3h. Any other relevant information to describe landslide location or environment (e.g., "I observed landslide from across valley, about 1 km north of me")

### 4. LANDSLIDE TYPE, SIZE & TRIGGER (Please consult pp. 3 to 4 for photograph examples)

4a. What is the landslide material? (Tick one)	<input type="checkbox"/>  ROCK	<input type="checkbox"/>  EARTH (SOIL)	<input type="checkbox"/>  DEBRIS (ROCK + SOIL)	<input type="checkbox"/> ? I don't know
4b. Which form (type) describes the landslide best? (Tick one)	<input type="checkbox"/>  FALL (Rock)	<input type="checkbox"/>  SLIDE (Rock or Debris or Earth)	<input type="checkbox"/>  FLOW (Debris or Earth)	<input type="checkbox"/> ? I don't know
4c. What is the size of the landslide? (Tick one)	<input type="checkbox"/>  SMALL (< 1 storey building [3 m])	<input type="checkbox"/>  MEDIUM (1-3 storey building [3-10 m])	<input type="checkbox"/>  LARGE (> 3 storey building >10 m])	<input type="checkbox"/> ? I don't know
4d. What triggered the landslide? (Tick ALL that apply)	<input type="checkbox"/> Rainfall	4e. How do you know this information on the trigger?	<input type="checkbox"/> I observed it	
	<input type="checkbox"/> Earthquake		<input type="checkbox"/> A local contact told me	
	<input type="checkbox"/> Other (Fill in)		<input type="checkbox"/> Social media	
	<input type="checkbox"/> I don't know		<input type="checkbox"/> News report	
4f. If rainfall trigger, what was average rainfall intensity?	<input type="checkbox"/> Drizzling (< 1 mm/day) (umbrella unnecessary)	4g. If rainfall trigger, how long did it rain?	<input type="checkbox"/> Half a day or less	
	<input type="checkbox"/> Slight (1-10 mm/day) (umbrella optional)		<input type="checkbox"/> Whole day	
	<input type="checkbox"/> Medium (11-25 mm/day) (rain accumulates)		<input type="checkbox"/> Few days to one week	
	<input type="checkbox"/> Heavy (>25 mm/day) (cloudburst, storm)		<input type="checkbox"/> A week or more	

### 5. LANDSLIDE DAMAGE & IMPACT (What can you see, and what do you know about from other sources?)


5a. Describe damages (including extent) YOU CAN SEE that landslide has caused. (E.g. death/injury to people and livestock, damage to dams/buildings/roads/railways).

5b. Describe damages you learned about from ANOTHER source:

5c. Who are these other sources of information? (Tick all that apply)

<input type="checkbox"/> A local contact	<input type="checkbox"/> News report	<input type="checkbox"/> Other (fill in):
<input type="checkbox"/> Social media		

### 6. ANY ADDITIONAL INFORMATION




Landslide overview from far away

**PHOTOGRAPHS**

Your photographs will help improve our understanding of the landslide. Therefore, we would like to ask you to make AT LEAST two photos from the landslide with:

- One or more photos showing surrounding of landslide, i.e with nearby villages, forests, and for scale houses, vehicles, etc.
- One or more detailed view on the whole landslide (please include IF SAFE a scale, e.g., a person/car in front [not on the landslide]).



Landslide more detailed view

**Please take a photo of this form and your two or more photos; send to the following:  
E-mail: [dir.ghrm.landslide@gsi.gov.in](mailto:dir.ghrm.landslide@gsi.gov.in) OR WhatsApp: 8794738224 & 9038849750**

See: [www.landslip.org](http://www.landslip.org) (Knowledge Products: Landslide Data) for a detailed discussion.



# Landslide Tracker (Paper Form)

## SAFETY INFORMATION

### IMPORTANT NOTE (PLEASE READ!)

#### Safety Measures for landslide tracking

- Stay away from the main landslide areas. There may be danger of additional slides. Do not go near unstable buildings and structures.
- Listen carefully for any unusual sounds such as boulders knocking together. This may indicate moving debris. Stay away from such places.
- Listen to the latest local radio or television news.
- Watch out for Whatsapp and other messages for the latest emergency information.
- Watch out for flooding which may occur after landslides. Keep away from streams and rivers.
- Please note that rescuers have priority of access to landslide sites.
- Always keep in mind your own safety and safety of others in landslide areas.
- If you notice something unusual in the landslide area, please notify local emergency authorities.

#### Safety measures for COVID-19

- Stay at home if you have fever or any other COVID-19 symptoms like coughing.
- Always follow instructions issued by local/State authorities for taking precautions while at home, in office or while on travel and during field visits
- Strictly follow all COVID-19 related safety measures such as hand sanitisation, social distancing and wearing masks all the times.



### C. Landslide Form (Type) (see Landslide Tracker Section 4b on p. 2).

- The term *landslide* encompasses events such as falls, topples, slides, spreads, and flows. Falls, slides and flows all occur in India (see Figure 2) with the most common slides (see Figure 3).

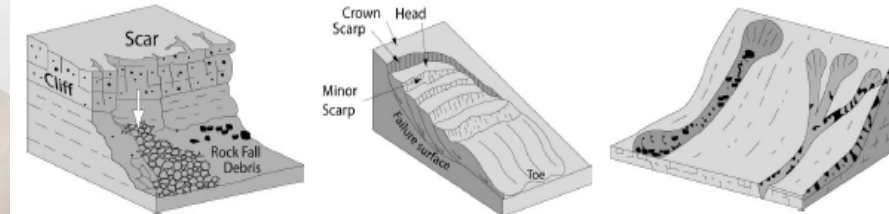


Figure 2. Representative drawings of falls, slides and flows (Source: British Geological Survey).

- Fall: Movement from a steep slope cliff or cliff, in a mixture of free-fall through the air, bouncing or rolling.
- Slide: Movement occurs along a distinctive surface.
- Flow: A slurry of rock and mud and a lot of water, moves like a liquid, sometimes at high speeds.

## ADDITIONAL INFORMATION

### LANDSLIDE Material, Form and Size

#### A. Introduction: What is a landslide?

- A landslide is a movement of a mass of rock, earth (soil) or debris (soil + rock) down a slope under the influence of gravity.
- The size of individual landslides ranges from metres squared to kilometres squared (about the size of sixty cricket fields!).
- The speed landslides travel at ranges from slow (millimetres per year) to very fast (e.g., 80 km per hour for debris flows).
- This additional information includes enlarged figures/photos from p. 2 of this Landslide Tracker form, along with some additional information for the following: landslide material (Section B), landslide form/type (Section C), landslide size (Section D), and further resources on landslide information (Section E).

#### B. Landslide Material (see Landslide Tracker Section 4a on p. 2).

- Landslide Material can be composed of rock or soil or a combination of rock + soil. See Figure 1.

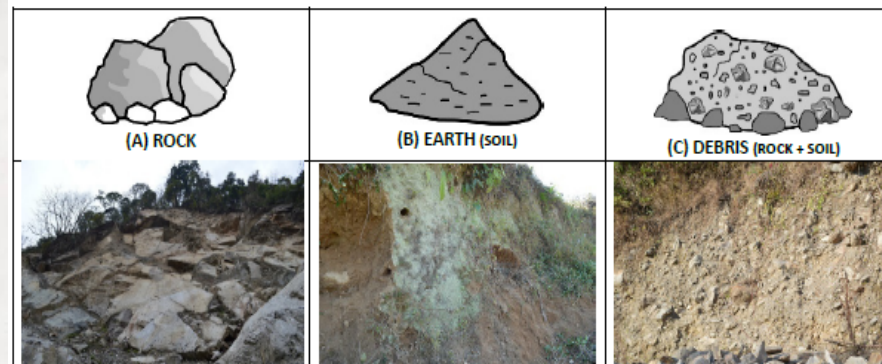


Figure 1. Representative drawings of rock, earth & debris, with examples from India (Photos: Christian Amhardt).

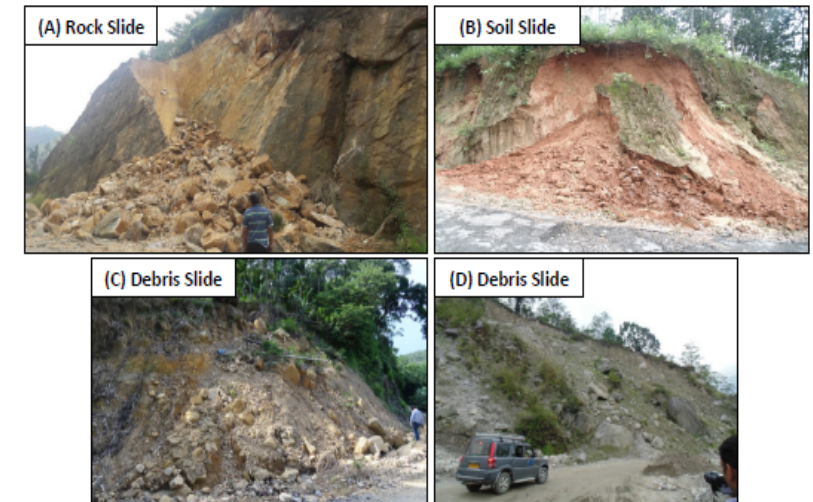


Figure 3. Four examples of Indian slides: (A) rock, (B) soil, (C) and (D) debris (Source: Geological Survey of India).

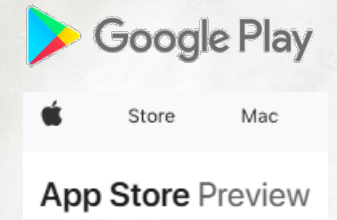
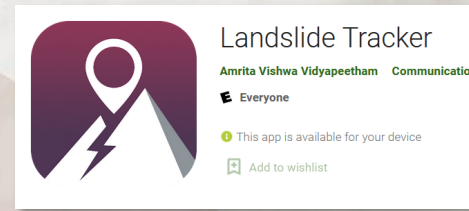
#### D. Landslide Size (see Landslide Tracker Section 4c on p. 2).



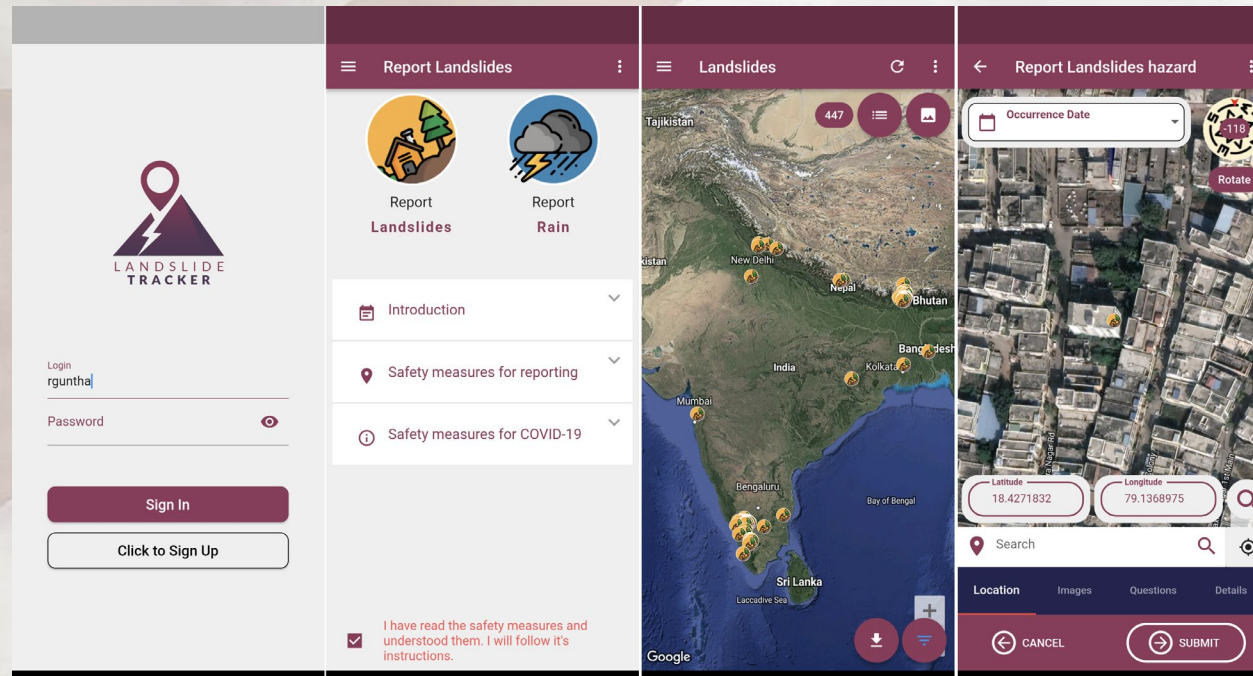
Figure 4. Three Indian landslides of different sizes (Source: Keystone Foundation and Geological Survey of India).

See: [www.landslip.org](http://www.landslip.org) (Knowledge Products: Landslide Data) for a detailed discussion.

# Landslide Tracker App




Free app available

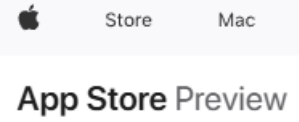


See: [www.landslip.org](http://www.landslip.org) (Knowledge Products: Landslide Data) for a detailed discussion.

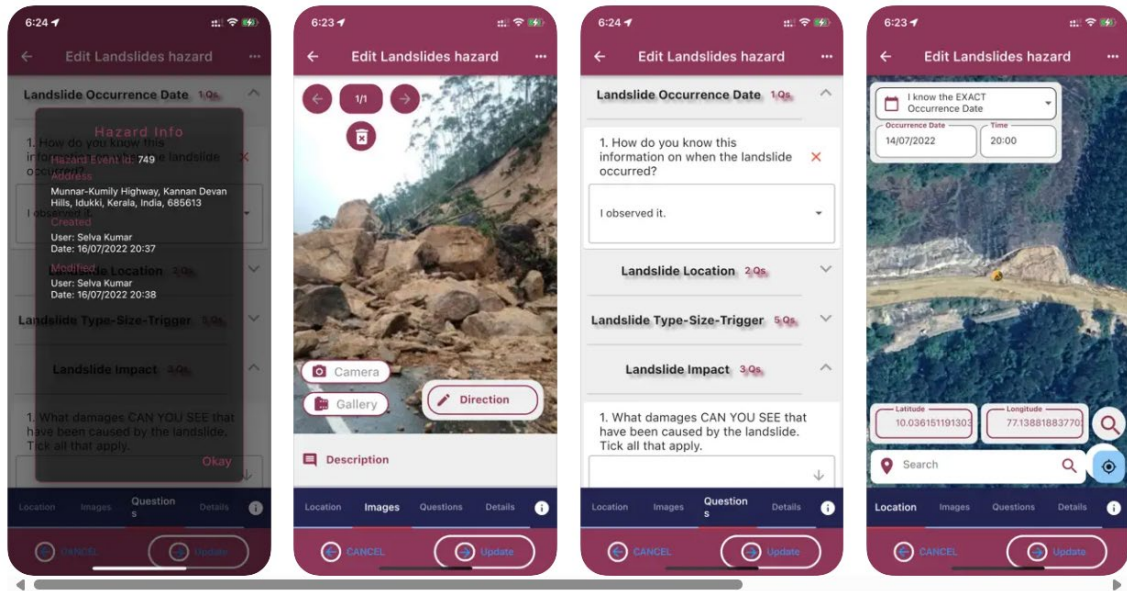
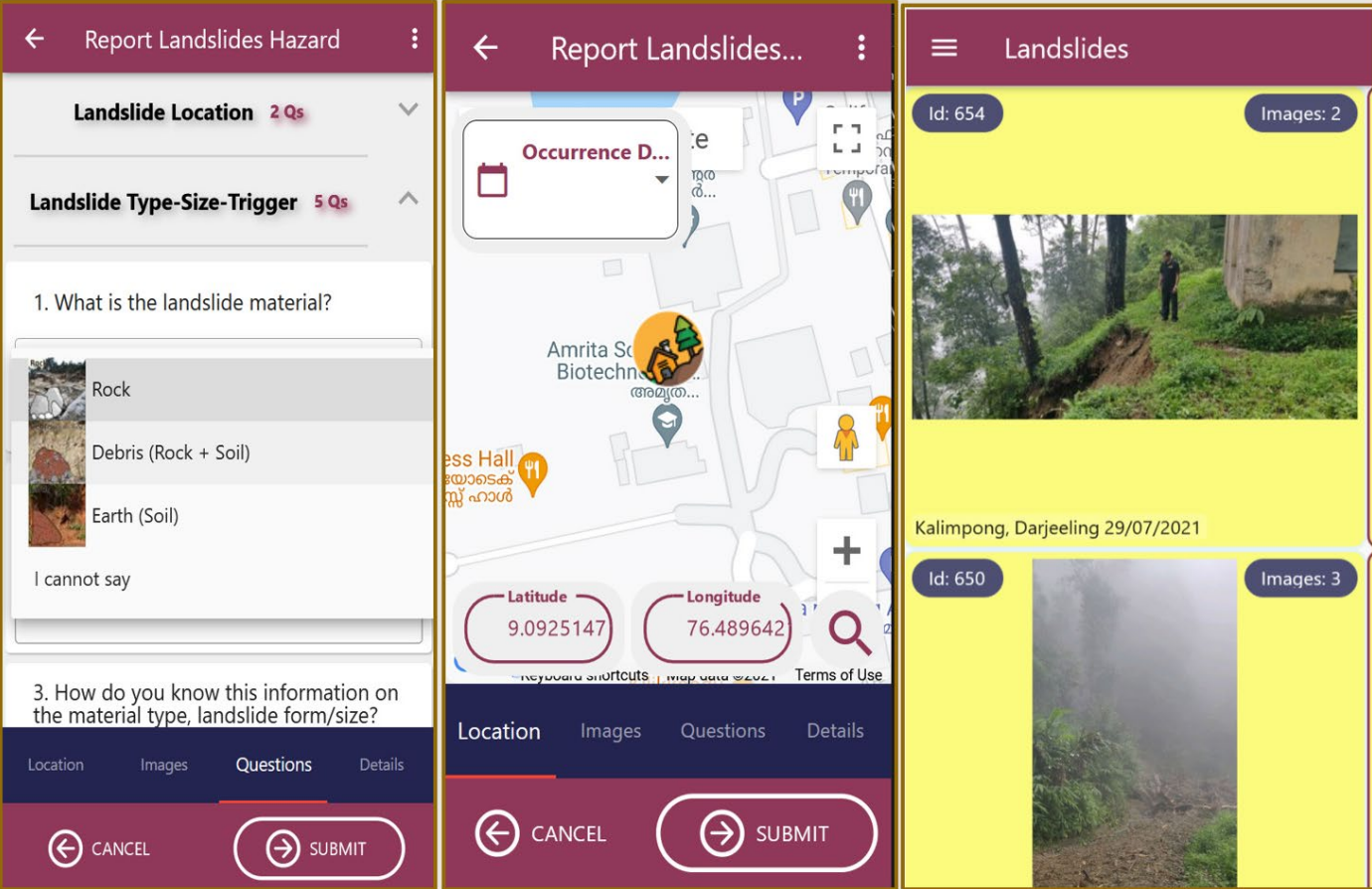
# Landslide Tracker App



Landslide Tracker  
Amrita Vishwa Vidyapeetham Communication  
Everyone  
This app is available for your device  
Add to wishlist



Free app available



See: [www.landslip.org](http://www.landslip.org) (Knowledge Products: Landslide Data) for a detailed discussion.

# Landslide Tracker Web

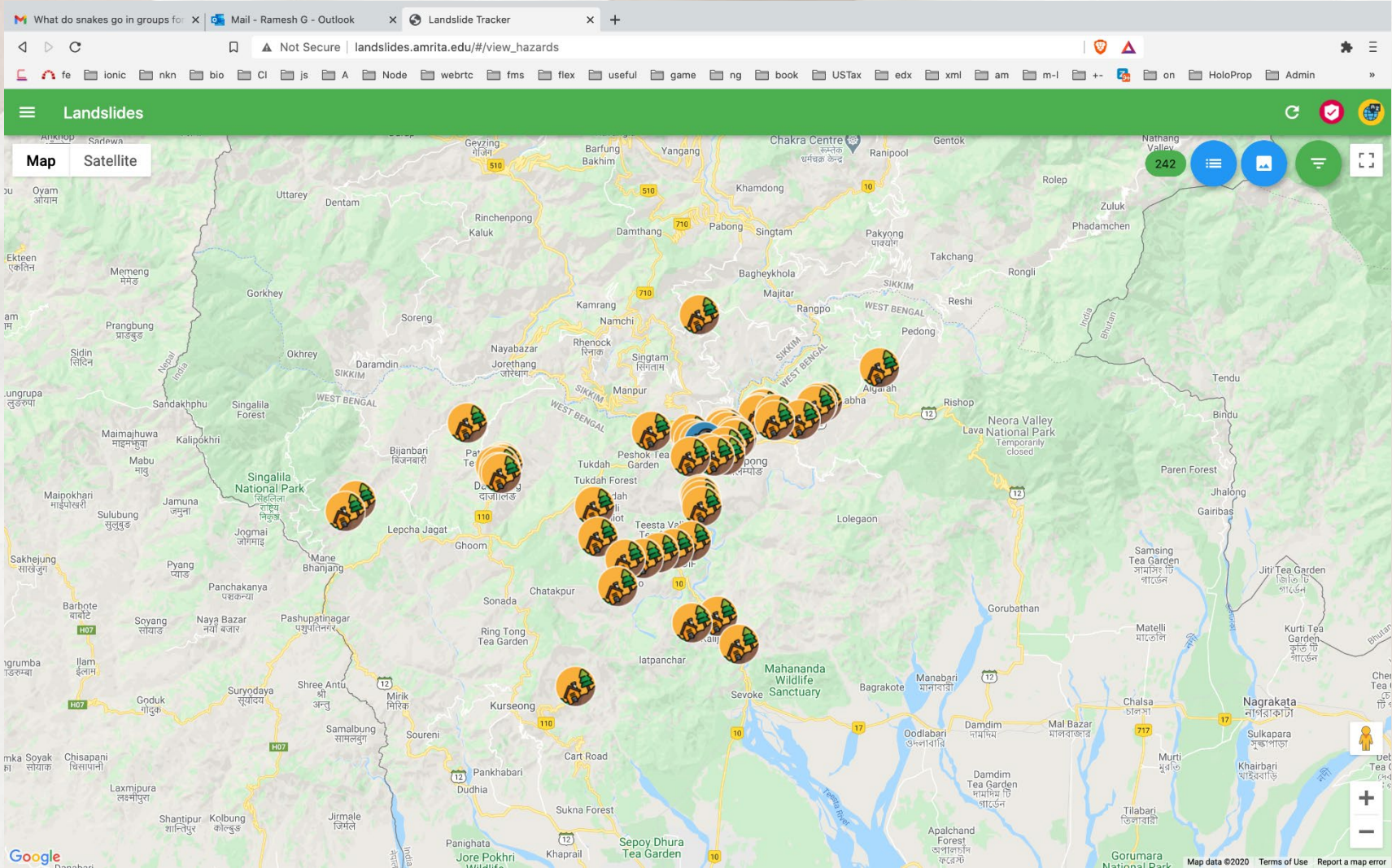
<https://landslides.amrita.edu>



LANDSLIDE TRACKER

Click to Sign In

Click to Sign Up



# Landslide Tracker

- **Video 2: (3'30") Discussion of the landslide tracker presented in 2022 by two of the four other key people working with me.**
  - **Ramesh Guntha (Amrita University; Software Engineer overseeing project)**
  - **Christian Arnhardt (British Geological Survey; Engineering Geologist)**
  - [https://youtu.be/JHFYfXoWShQ?si=5agw\\_a\\_Kr2S\\_Y8a](https://youtu.be/JHFYfXoWShQ?si=5agw_a_Kr2S_Y8a)

## 2. Landslide Data



[www.landslip.org](http://www.landslip.org)

Grant Dates: 1 November 2016 to 30 June 2022  
Grant Numbers: NE/P000681/1 and NE/P000649/1



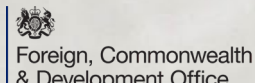
Ramesh Guntha  
(Amrita Vishwa Vidyapeetham)

Full screen (f)

<https://youtu.be/JHFYfXoWShQ?si=ONZyBkBuZiZzK3Bz>

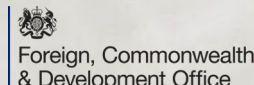
# Co-Developed Landslide Tracker Strengths

- **Detailed enhancement** of the Geological Survey of India's **national landslide inventory** with **data sourced by local actors**.
- **Immediate upload of data** to the cloud,
- Collection of a **large amount of crowd-sourced landslide-related data** in a **systematic and structured way**.
- A **methodology** designed in **joint cooperation between national government agencies, NGOs, local communities and academic institutions**.
- **Near real-time collection of landslide data** that might otherwise be erased from the record.



# Co-Developed Landslide Tracker Items to Consider

- **Different funding/branding/publicity/operational priorities of the different groups involved: government, academic, local community, NGOs.**
- **Legacy.** Who will **pay for and maintain the app** once it is operational (different priorities of government vs. academics).
- **Branding of the app** (again, different priorities of government vs academics).
- **Where data is stored and who has access to it (and how)** before, during and after any **quality control**.
- **How the data will be used** by local communities vs. national level (e.g., combining with other types of landslide data and incorporating into landslide modelling).



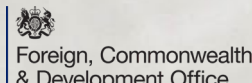


# Further sources of information

- **LANDSLIP Project** (2021). *LANDSLIP Knowledge Product: Landslide Data*. British Geological Survey, OR/21/068. Accessible at [www.landslip.org/outputs/globalknowledgeproducts.html](http://www.landslip.org/outputs/globalknowledgeproducts.html). [Last accessed 25 January 2025]
- **Amrita University and the LANDSLIP consortium** (2022) *Landslide Tracker* [Online] Available at [Google Play](https://play.google.com/store/apps/details?id=com.landslip), [Apple App Store](https://apps.apple.com/uk/app/landslide-tracker/id1544444444) and web (<https://landslides.amrita.edu>) [Last accessed 1 July 2022]

## Additional reading:

- **Bee, E.J. and Budimir, M.** (2019) The use of social media in natural hazard early warning Systems. Science for Humanitarian Emergencies and Resilience (SHEAR) Knowledge Piece. Available at: <https://nora.nerc.ac.uk/id/eprint/525003/> [Accessed 23 January 2025].
- **Paul, J.D., Bee, E. and Budimir, M.** 2021. Mobile phone technologies for disaster risk reduction. *Climate Risk Management*, 32, 100296. [doi.org/10.1016/j.crm.2021.100296](https://doi.org/10.1016/j.crm.2021.100296).
- **Hognogi, G.G., Meltzer, M., Alexandrescu, F. and Ștefănescu, L.** (2023) The role of citizen science mobile apps in facilitating a contemporary digital agora. *Humanities and Social Sciences Communications*, 10(1), pp.1-16. [doi.org/10.1057/s41599-023-02358-7](https://doi.org/10.1057/s41599-023-02358-7).



# **A co-created landslide mobile application: lessons learned**

**Prof Bruce D Malamud**  
Director & Wilson Chair of Hazard and Risk  
Institute of Hazard, Risk and Resilience  
Durham University  
E-mail: [bruce.malamud@durham.ac.uk](mailto:bruce.malamud@durham.ac.uk)  
**27 January 2025**

