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Learning Sharing National Conference on Disaster Risk Reduction (NCDRR)

**Technical Session C: Understanding & Managing Disaster Risk**

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# Earthquake Risk Management in Nepal: Key Approaches and Lessons

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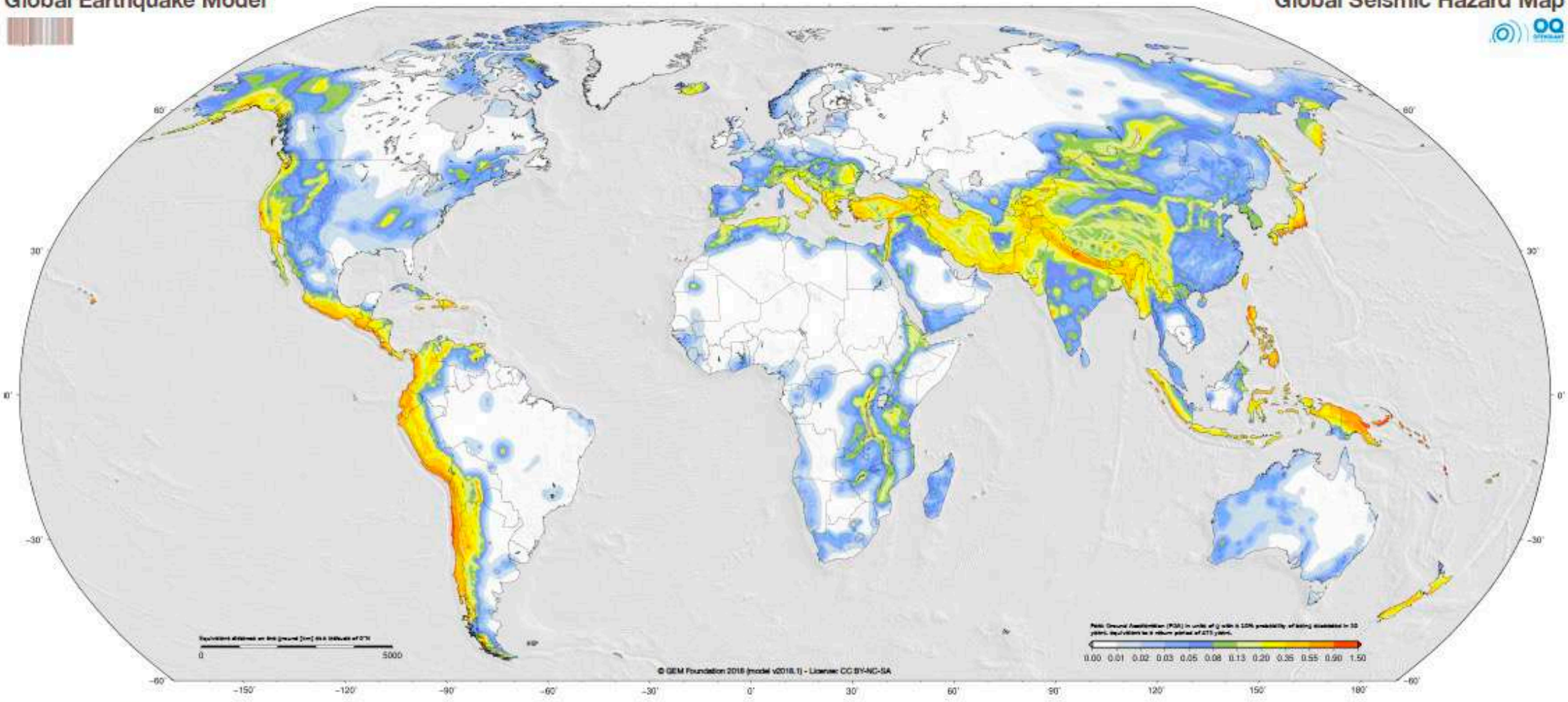
- Brief on Hazard Scenario of Nepal
- Key Approaches and Efforts in Last two and half decades
- Lessons
- Way Forward

# Global Earthquake Model

# Global Seismic Hazard Map




## Global Earthquake Model (GEM) Global Seismic Hazard Map

The Global Earthquake Model (GEM) Global Seismic Hazard Map (version 2018.1) depicts the geographic distribution of the Peak Ground Acceleration (PGA) with a 10% probability of being exceeded in 50 years, computed for reference rock conditions (shear wave velocity, $V_{S30}$, of 760-900 m/s). The map was created by collating maps computed using national and regional probabilistic seismic hazard models developed by various institutions and projects, and by GEM Foundation scientists. The OpenQuake engine, an open-source seismic hazard and risk calculation software developed principally by the GEM Foundation, was used to calculate the hazard values. A smoothing methodology was applied to homogenise hazard values along the model borders. The map is based on a database of hazard models (described using the OpenQuake engine data format (NRML)) those models originally implemented in other software formats were converted into NRML. While translating these models, various checks were performed to test the compatibility between the original results and the new results computed using the OpenQuake engine. Overall the differences between the original and translated model results are small, notwithstanding some diversity in modelling methodologies implemented in different hazard modelling software. The hazard areas in the map (e.g. Greenland) are currently not covered by a hazard model. The map and the underlying database of models are a dynamic framework, capable to incorporate newly released open models. Due to possible model limitations, regions portrayed with low hazard may still experience potentially damaging earthquakes. The GEM Foundation plans to release future updates of this map on a regular basis as new information becomes available. Technical details on the compilation of the hazard and risk maps and the underlying models are available at http://www.globalquakemodel.org/gem

### How to use and cite this work

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### Acknowledgements

This map is the result of a collaborative effort and extensively relies on the enthusiasm and commitment of various organisations and projects to openly share and collaborate. The creation of this map would not have been possible without the support provided by many public and private organisations during GEM's second implementation phase (2014-2018). These key contributions are profusely acknowledged. None of this would have been possible without the extensive support of all GEM Secretariat staff. The map was plotted using the Generic Mapping Tools software (Wessel et al., 2013).

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More information available at:
http://www.globalquakemodel.org/gem

### Sponsors and major contributors

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### Contributing models

## Global Earthquake Model (GEM) Foundation

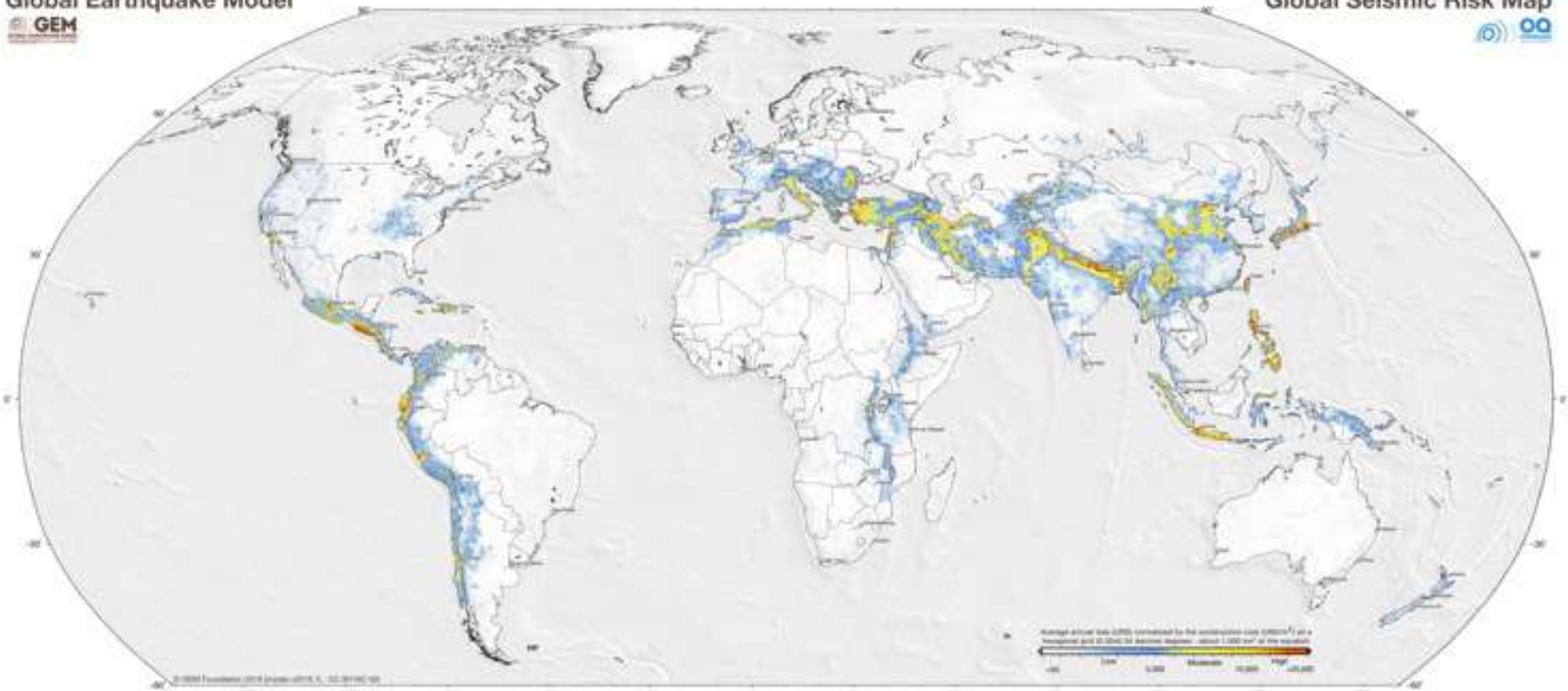
The GEM Global Seismic Hazard Map is a product of the GEM Foundation. Initiated by the OECD's Global Science Forum in 2006, GEM was formed in 2009 as a non-profit foundation in Pavia, Italy, funded through a public-private partnership with the vision to create a world that is resilient to earthquakes. Participants represent national research, applied science or disaster management institutions, the private sector and international organisations. GEM continues the tradition of the Global Seismic Hazard Assessment Program (GSHAP), which produced the first global seismic hazard map arising from a global collaborative effort of scientists in 1999 in support of the UN International Decade of Natural Disaster Reduction (IDNDR). GEM's collaborative network comprises more than 10 public and private institutions organised under more than 25 regional, national and multilateral projects. Observing its core values of collaboration, transparency, openness, credibility and serving the public good, the GEM initiative extends the scope of work of GSHAP to the risk domain, providing an institutional framework for continuous updates and widening direct applications to risk reduction and prevention projects. GEM's OpenQuake platform (platform.openquake.org) provides access to data, models, tools and software behind the maps. GEM's open-source OpenQuake engine enables probabilistic hazard and risk calculations worldwide and at all scales, from global down to regional, national, local, and site-specific in a single software package.
The Sendai Framework for Disaster Risk Reduction (SFDRR) calls for "decision-making on disaster risk reduction to be based on solid and openly accessible scientific work". GEM supports the SFDRR goals by constructing openly accessible products for hazard and risk assessment and capacity development for risk reduction projects. GEM also served as a baseline or exemplar for the development of a broader multi-hazard framework for risk assessment in support of a holistic and comprehensive approach to disaster risk reduction.

### Legal statements

Global Earthquake Model

GEM

# Global Seismic Risk Map



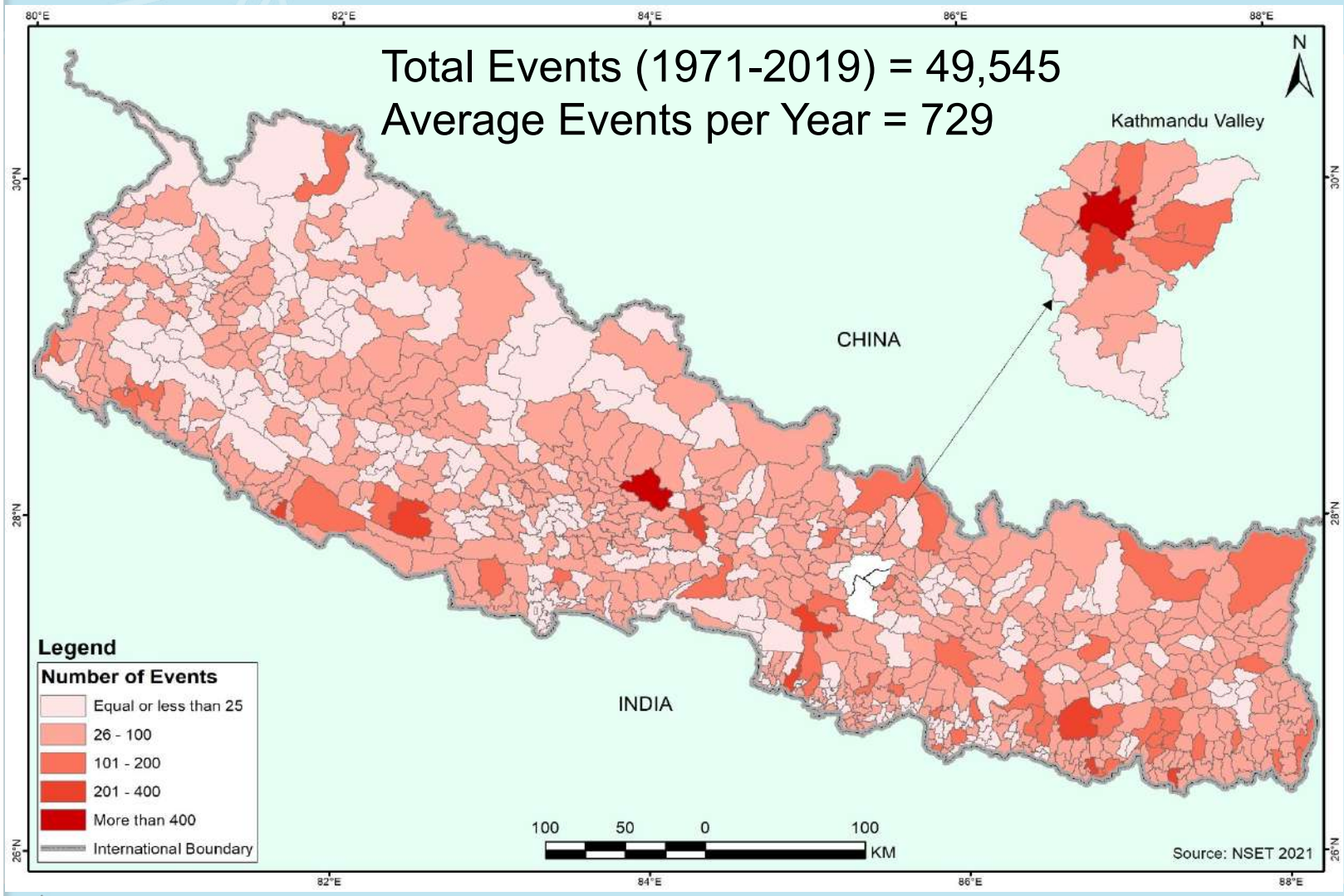
## Global Seismic Hazard Map

## Global Exposure Map

## Global Seismic Fatalities Map

Sponsors and major contributors

# Recorded Disaster Events in Nepal




Earthquake,
Flood,
Landslide,
Epidemic,
Fire, ….

29 Different types, All events Human Loss or Property Loss

# Continue existence of high hazard and risks

- **The hazard is still there**
- **We have high vulnerabilities (buildings, structures, urban planning), and lower level of preparedness**
  - We are continuously increasing the vulnerabilities
- **Hence, the risk is still very high, and risk in increasing day by day**

**Potential of large earthquakes - 2015 Earthquake was just an alarm**

**Potential of many day-to-day hazards**

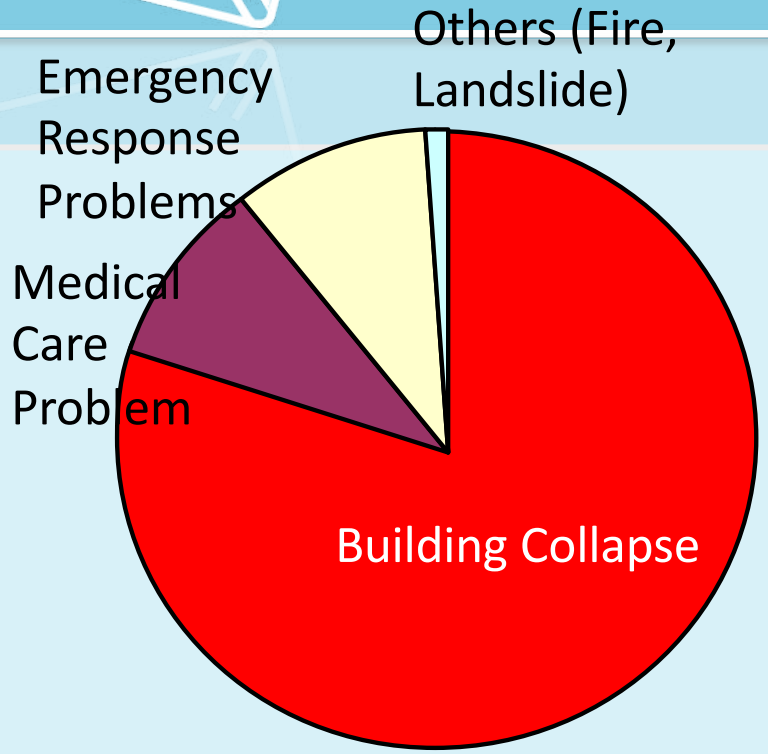
# Three Categories Vulnerability
## Anderson and Woodrow (1989)

- **Physical/material vulnerability**
  - inherent weakness of the built environment and lack of access to resources, especially of poor section of the population
- **Social/organizational vulnerability**
  - inherent weakness in the coping mechanism, lack of resiliency, lack of commitment, Policy and legal environment, Governance, Religious, Economic, health status
- **Attitudinal/motivational vulnerability**
  - fatalism, ignorance, low level of awareness

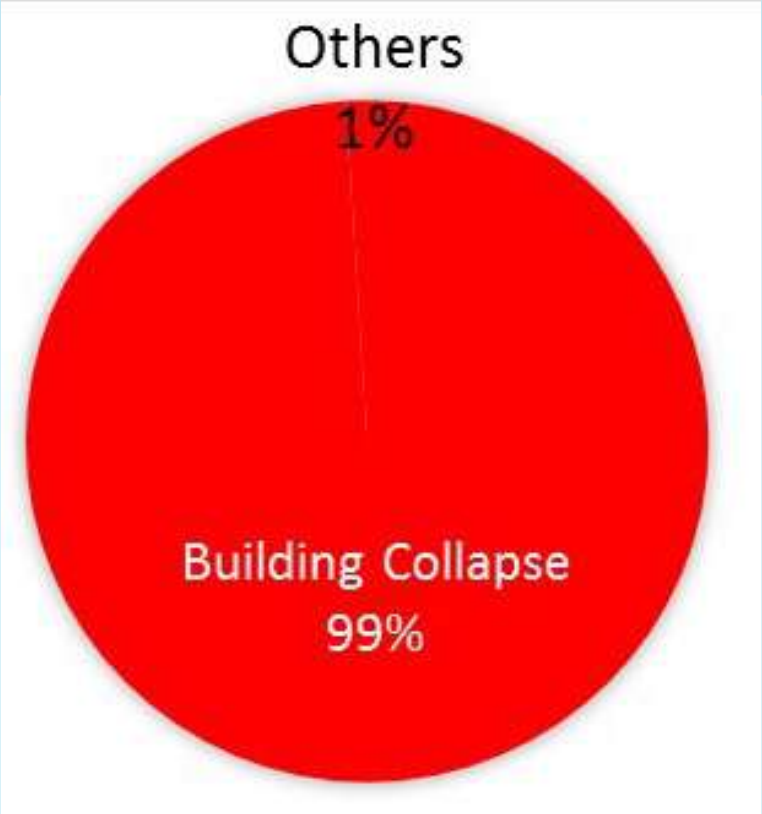
# Factors Contributing to Earthquake Vulnerability of Built Environment in developing Countries

- **Large Settlements already in Seismic Areas**
  - Poor buildings in terms of material strength, maintenance, age factors etc.
  - 50 million people in the urban settlements at the foot of the Himalayan Range (Bilham et al. 2001 )
  - Most of the people subject to such high level of vulnerability are unaware of the earthquake
- **Prevalence of Non-Engineered Constructions**
- **Erosion of the traditional wisdom in building construction**
  - Timber bands running all over the walls, wooden pins, very strict selection of quality materials, adequate thickness of the walls, and obviously high level of craftsmanship are regarded as the positive elements in old construction in Kathmandu Valley

# Sources of Earthquake Risk




(GESI, 2003)

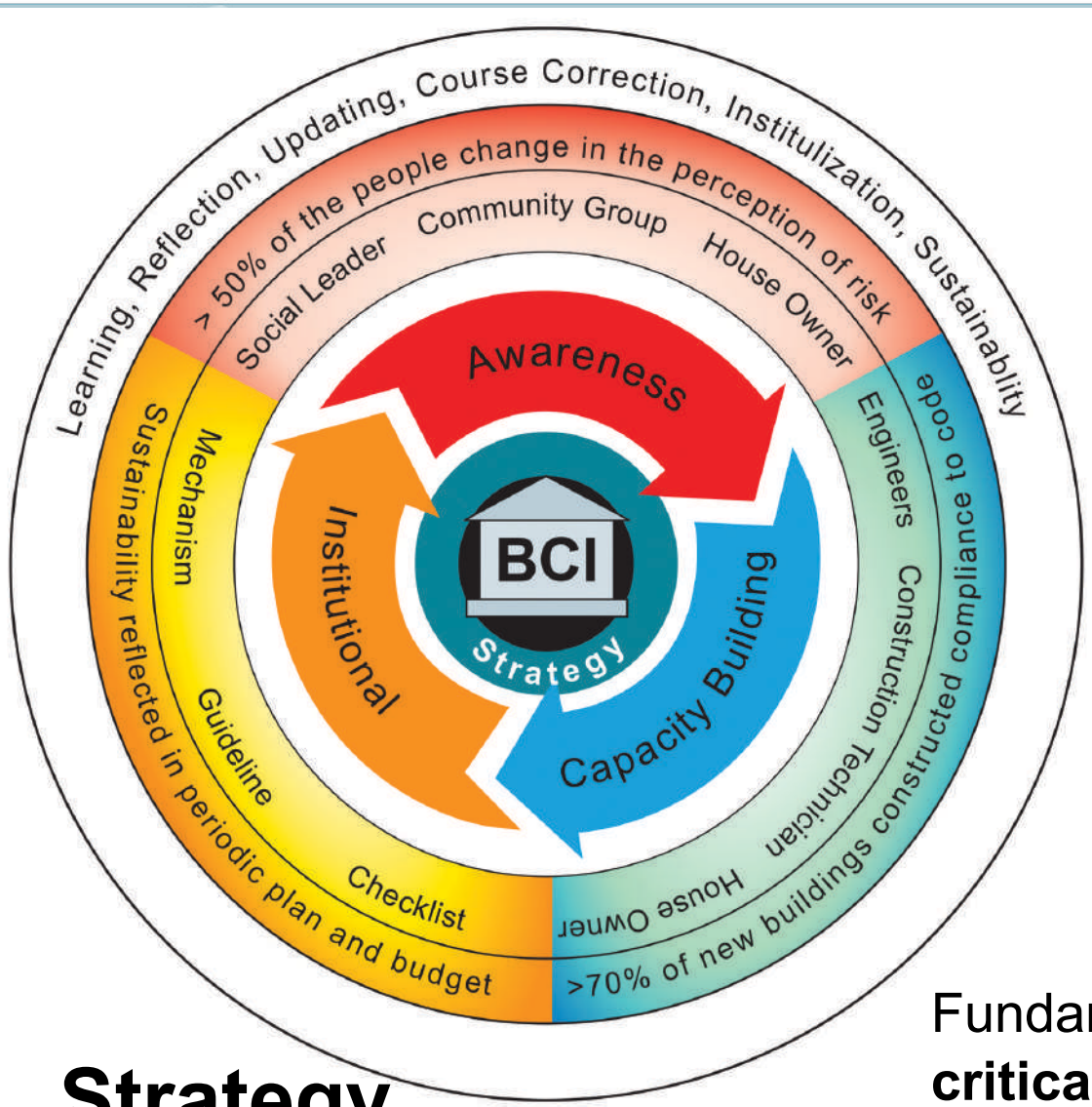



(April 25, 2015 Gorkha Earthquake)

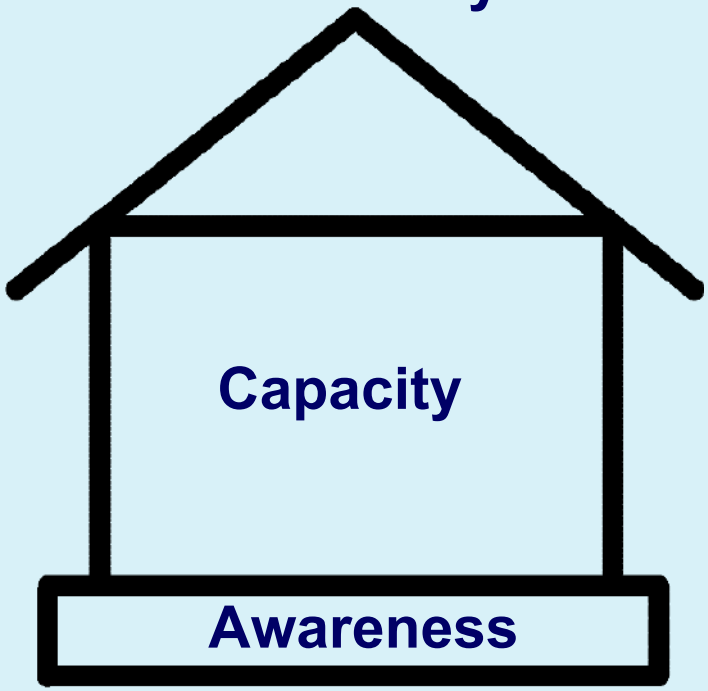
⇒ Only way of Reducing Casualty: Safe Buildings

⇒ Earthquake Risk Reduction

# Approach of Earthquake/Disaster Risk Reduction




**Strategy**




Fundamental is - **we need to reach to a critical mass/number of people**

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# Use of Innovative Tools on Awareness Raising

## Shake Table Demonstration for Awareness Raising


Seeing is Believing!

Shake Table Demonstration for awareness in schools and communities

**Award Winning Tool**

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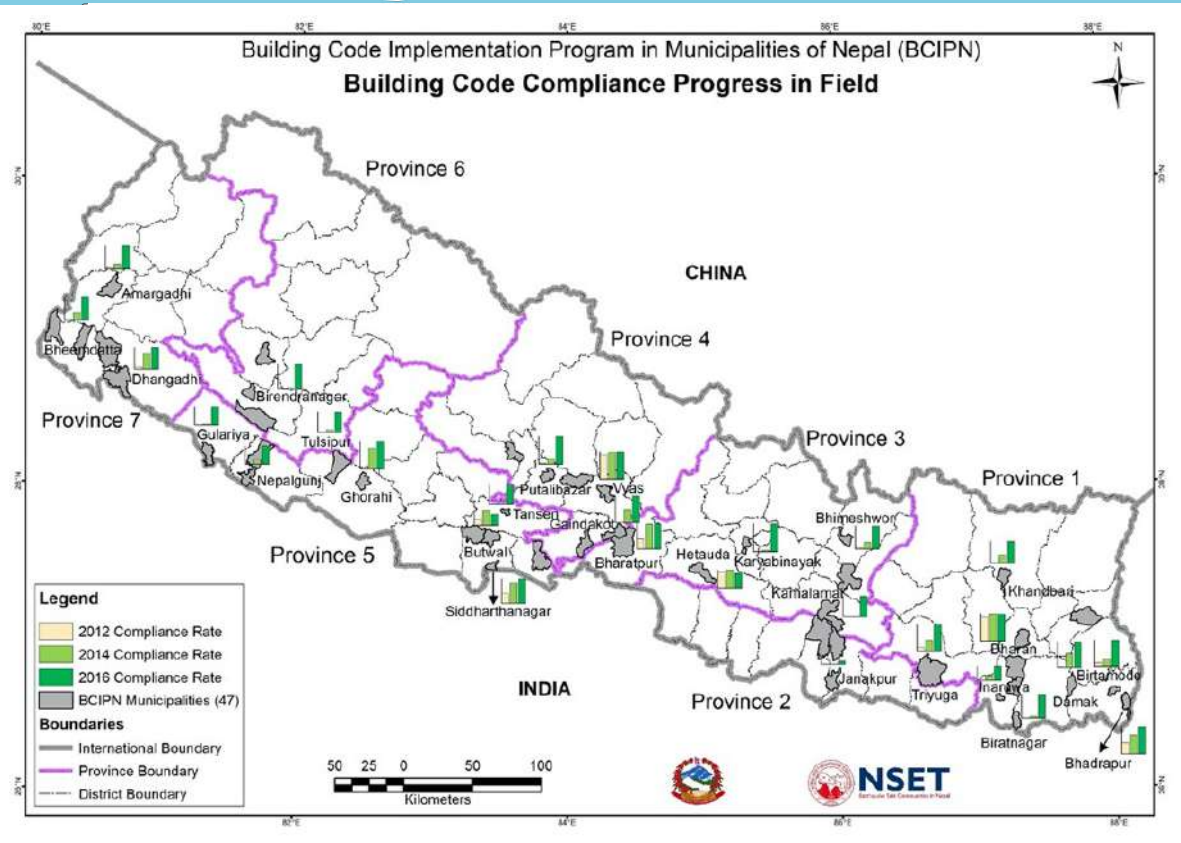
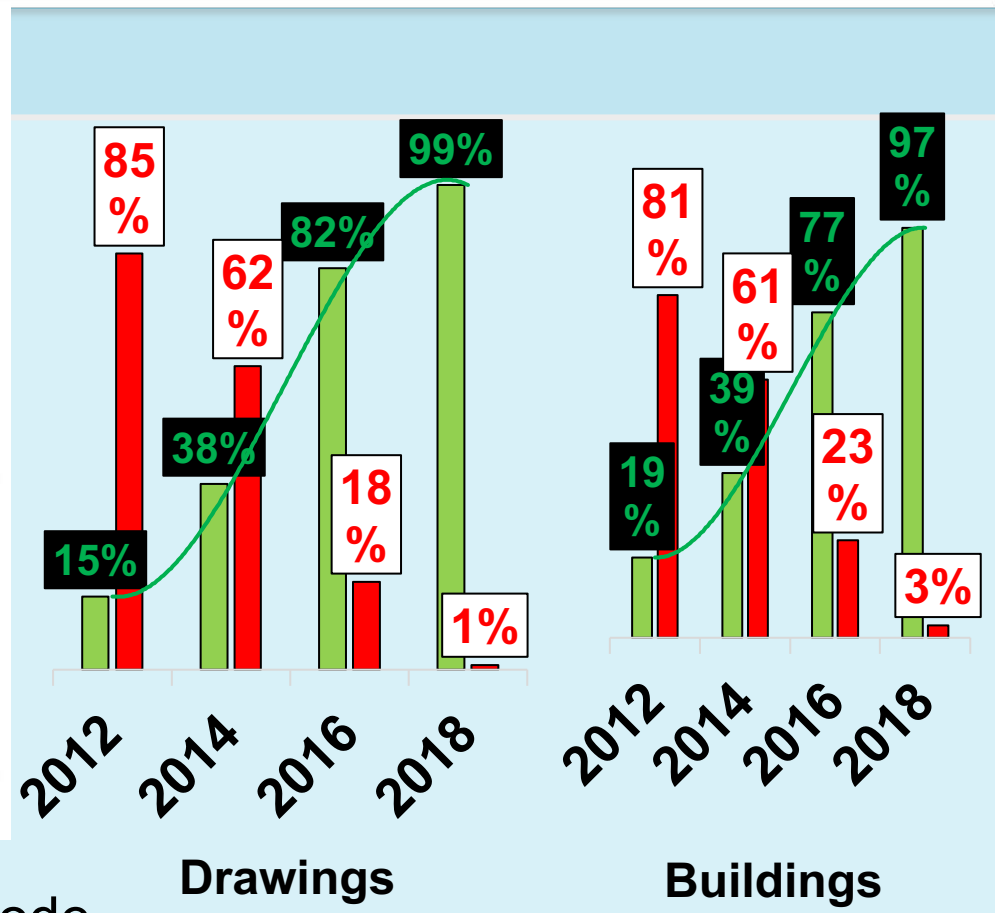
# Public Awareness: Key Component of All Programs

# Building Code Implementation: Journey from Awareness to Institutionalization




- Around 60 municipalities only with proper code compliance system
- Need to reach to all 753 local governments
- **Retrofitting of existing vulnerable buildings**

Total no. of assessed drawings : 5796

Total no. of assessed buildings : 5045

# School Earthquake Safety Program; School to Resilience Community

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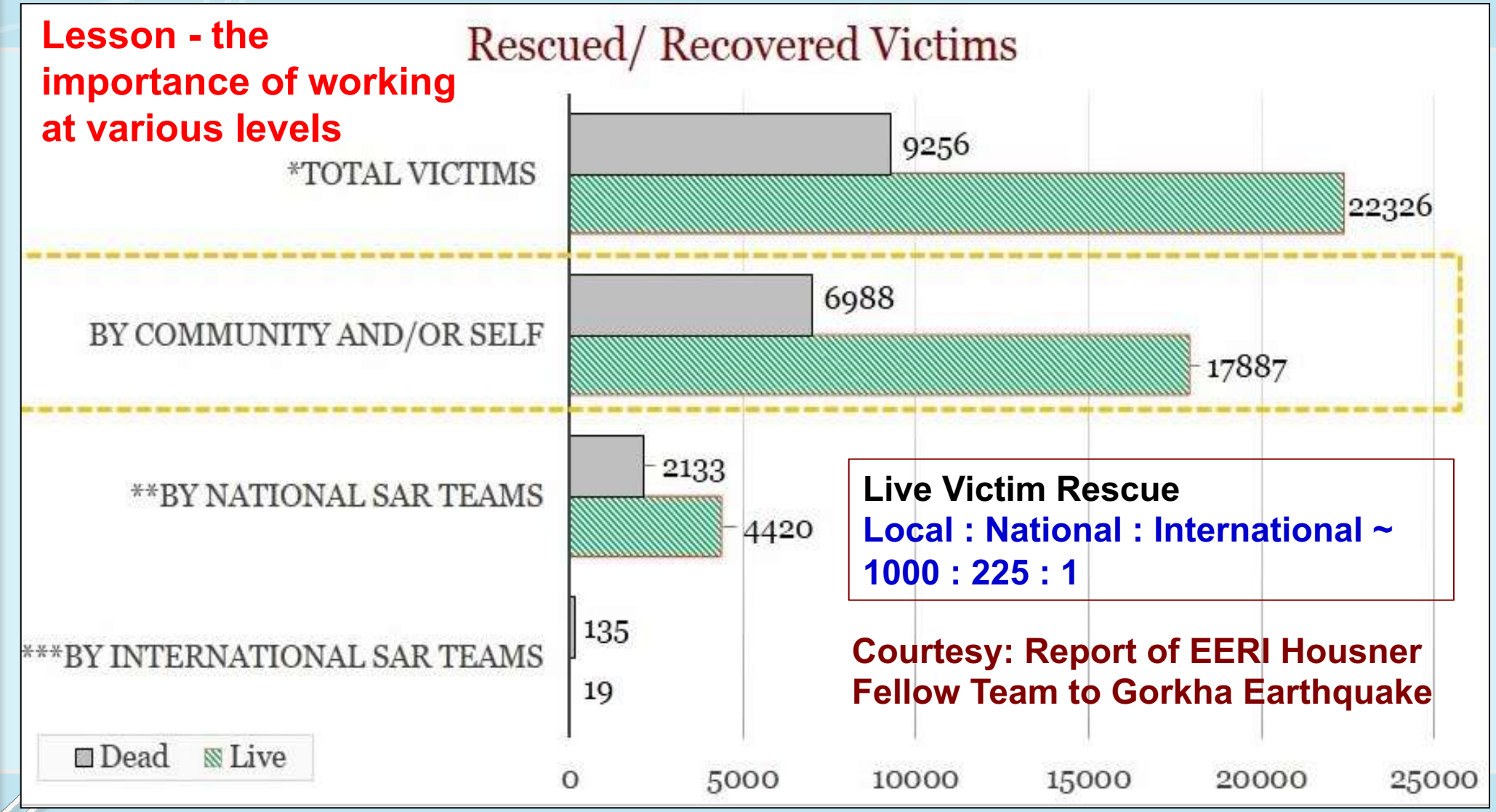
Approaches:

- School Retrofitting
- Mason Training
- Training of Teachers and Students
- Community Awareness, Engagement
- Involvement of Government/Institutionalization

**Less than 1,000 school buildings retrofitted so far**

# Improving Emergency Response Capacity; 2015 Search and Rescue

**Lesson - the importance of working at various levels**




**Live Victim Rescue**
**Local : National : International ~ 1000 : 225 : 1**

**Courtesy: Report of EERI Housner Fellow Team to Gorkha Earthquake**

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# Core Emergency Response Training Courses under PEER

Community Action for Disaster Response (CADRE)

Collapsed Structure Search and Rescue (CSSR)

Medical First Responder (MFR)

Hospital Preparedness for Emergencies (HOPE)

Swift Water Rescue (SWR)

**PEER Graduates so far**
**~ 2,400**
**Instructors ~ 600**

**Equivalent community level training courses are to be massively conducted**
**BEMR, CSAR, DAT etc.**

# Prepositioning Emergency Supplies

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| Emergency supplies |  |  |  |  |
|---|---|---|---|---|
| | **Go Bag (Earthquake Go Bag)** | **HH Kit (Household Emergency Kit)** | **CSAR (Community Search and Rescue)** | **PPERS (Pre-positioned Emergency Rescue Store)** |
| **What?** | A bag with emergency supplies which lets an individual survive for at least 3 days during an emergency. | A rescue box around with 25 various rescue items in different numbers as per need | A container around with 72 various rescue items in different numbers as per need | A large container around with 100 various rescue items in large numbers. |
| **For Whom?** | Individual purpose | One Family | Neighborhood/ small community/Institution | Larger Community/ ward |

# Earthquake Reconstruction to Resilience Building

## Lessons and Good Practices of Reconstruction – Need to go throughout the country


- 2,700 Engineers Trained (100% targeted completed)
- More than 16,000 Masons
- More 400 Social Mobilizers
- More than 900 New Masons (through OJT)
- More than 50,000 Houses made safer (in 4 districts)
- Influence and contribution in making all reconstructed houses safe (more than 80% compliant)

# Scientific Collaboration for the Multi-Hazard Risk Reduction

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**Risk-Informed Landslide Management in Nepal's Hill Areas; प्रतिबद्ध**

## Principal Objective:

To increase the resilience of communities in rural hill areas of Nepal through the effective mitigation and management of landslides.

## Specific Objective:

Local disaster risk management in Nepal's highly- exposed rural hill areas will be strengthened through participatory risk- informed landslide management.

Live Demonstration

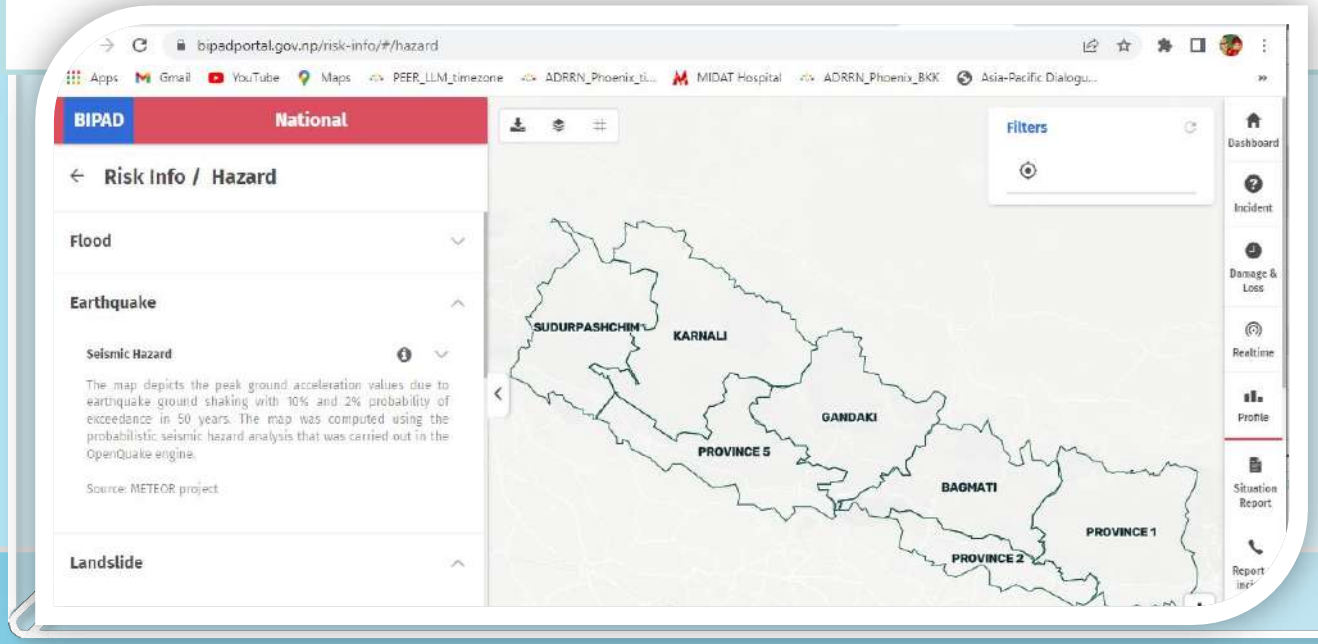
Interaction with Local Authorities: collaboration and cooperation

Community Engagement; Participatory 3D Mapping

# Scientific Collaboration for the Multi-Hazard Risk Reduction

## METEOR

- Delivery and use of open-source national-scale exposure datasets for multiple hazard analysis by Nepal, Tanzania and Global stakeholders
- Innovative methodology for exposure development with EO-based imagery to identify development patterns of buildings and use stratified sampling to characterise building pattern
  - EO and detailed field observation building characteristics for distribution of building types
- Create open protocols to develop critical exposure information from EO data
  - Uptake to develop critical exposure information from EO data




Contribution on National Disaster Database: BIPAD Portal

https://bipadportal.gov.np/risk-info/#/hazard

# SAFER : Seismic Safety and Resilience of Schools in Nepal

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A holistic and multi-disciplinary program for improving the earthquake-related safety of school buildings and the resilience of educational communities in Nepal.

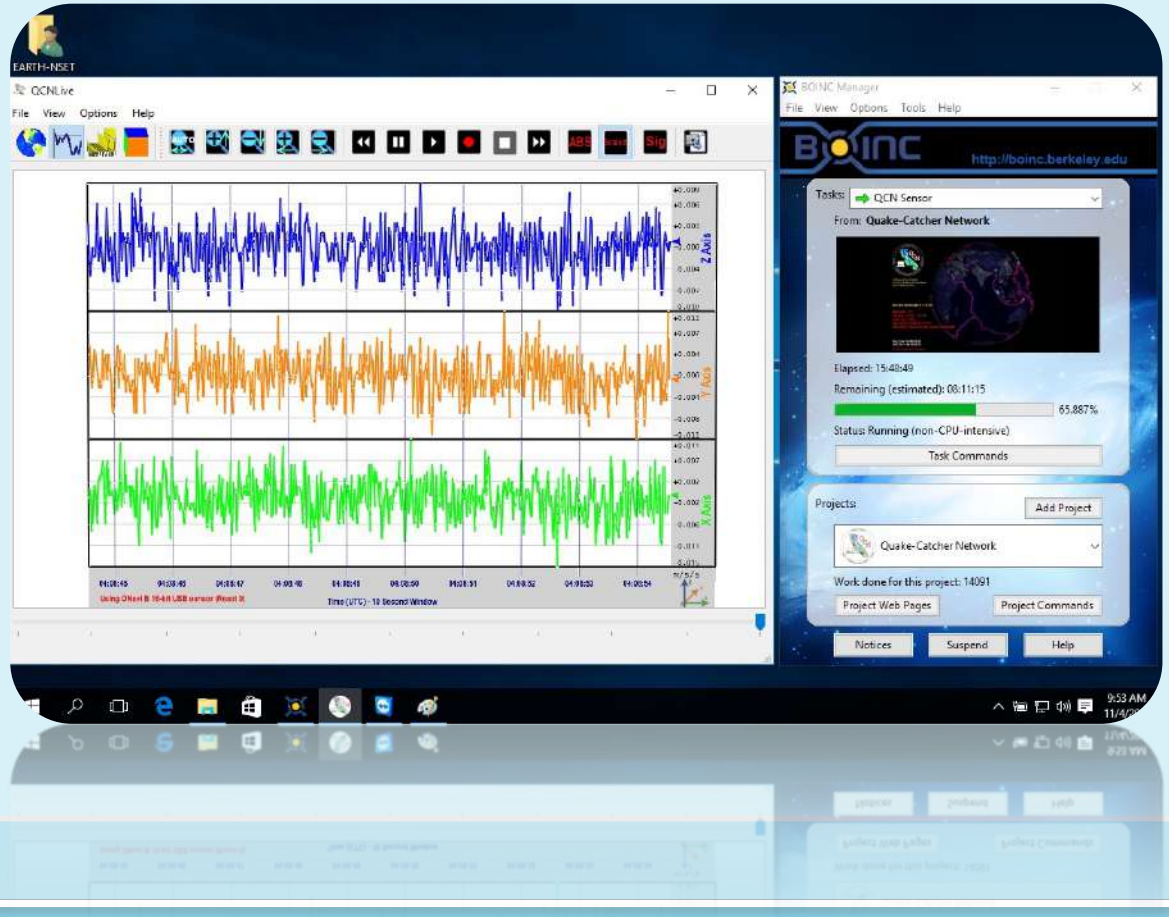
**Experimental Lateral Load tests for Unretrofitted and Retrofitted stone in mud masonry walls with Welded Wire Mesh (Jan, 2020)**

# USGS and NSET Collaboration
# N-SHAKE

**N**epal
**S**haking
**H**azard
**A**ssessment of
**K**athmandu &
**E**nvironment

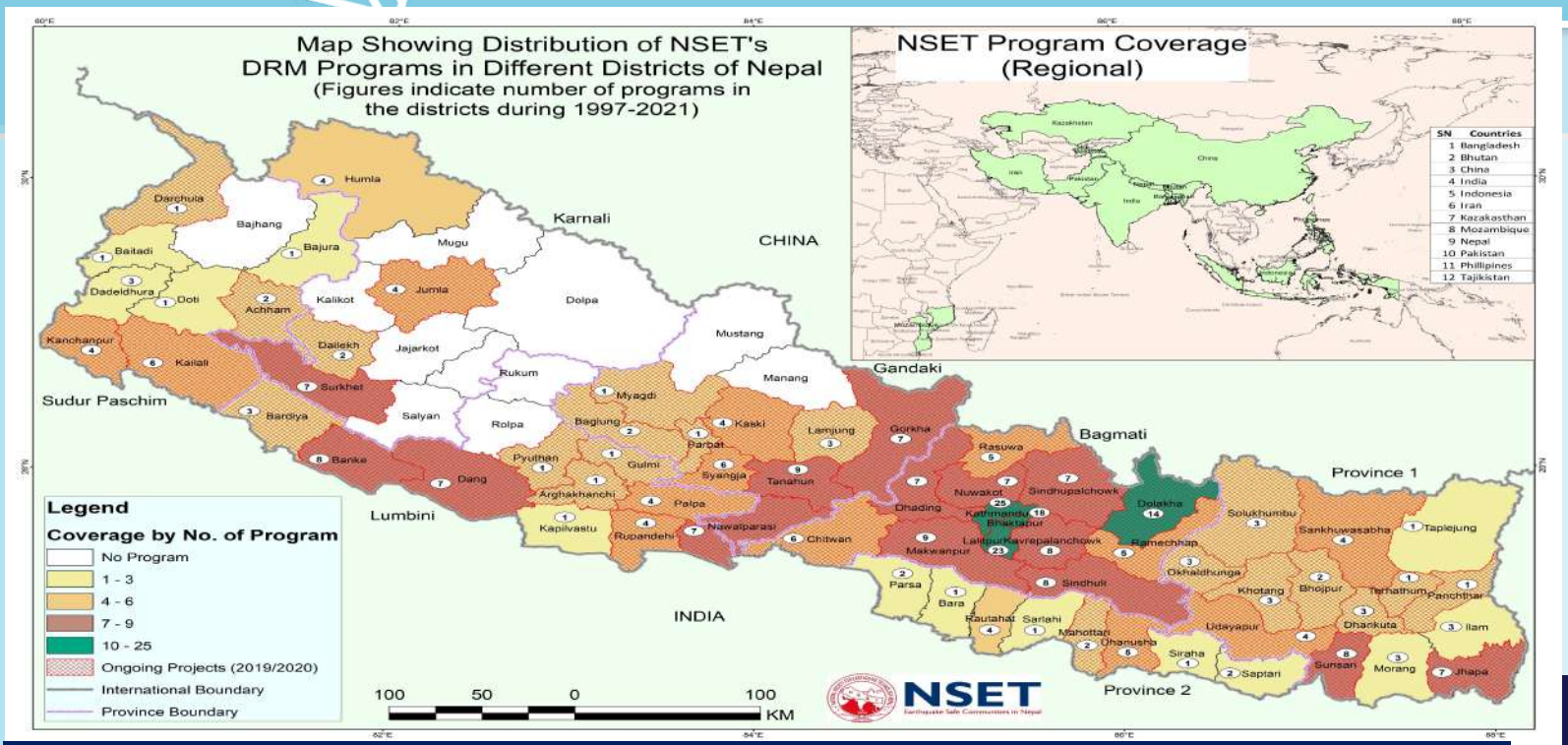
- A collaborative Scientific Study of Earthquake Hazard
- Network of low-cost accelerometers and few Net-Quakes
- Capacity Enhancement of Nepalese professionals

Installation work



# Achievement of last Two and Half Decades Effort

## All OUR WORK for Achieving VISION & MISSION




### Cumulative 1994-2021

96 National

12 Regional

108 Total Projects

100 Completed

8 Ongoing

10,482 (2020-2021)
**813,578 (1994-2021)**

**प्रत्यक्ष लाभग्राही**
**Direct Participants**

600,916 (2020-2021)
**4,665,071(1994-2021)**

**अप्रत्यक्ष लाभग्राही**
**Indirect Participants**

### Status of Ongoing Projects in NSET

4 National Projects

8 Total Ongoing Projects

4 Regional Projects

Oct 2020-Sept 2021

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# Orientations on Disaster Safety and Safer Construction

## Number of People Provided with Orientations on Disaster Safety and Safer Construction

**333,003**
Students and Teachers provided with the Orientation

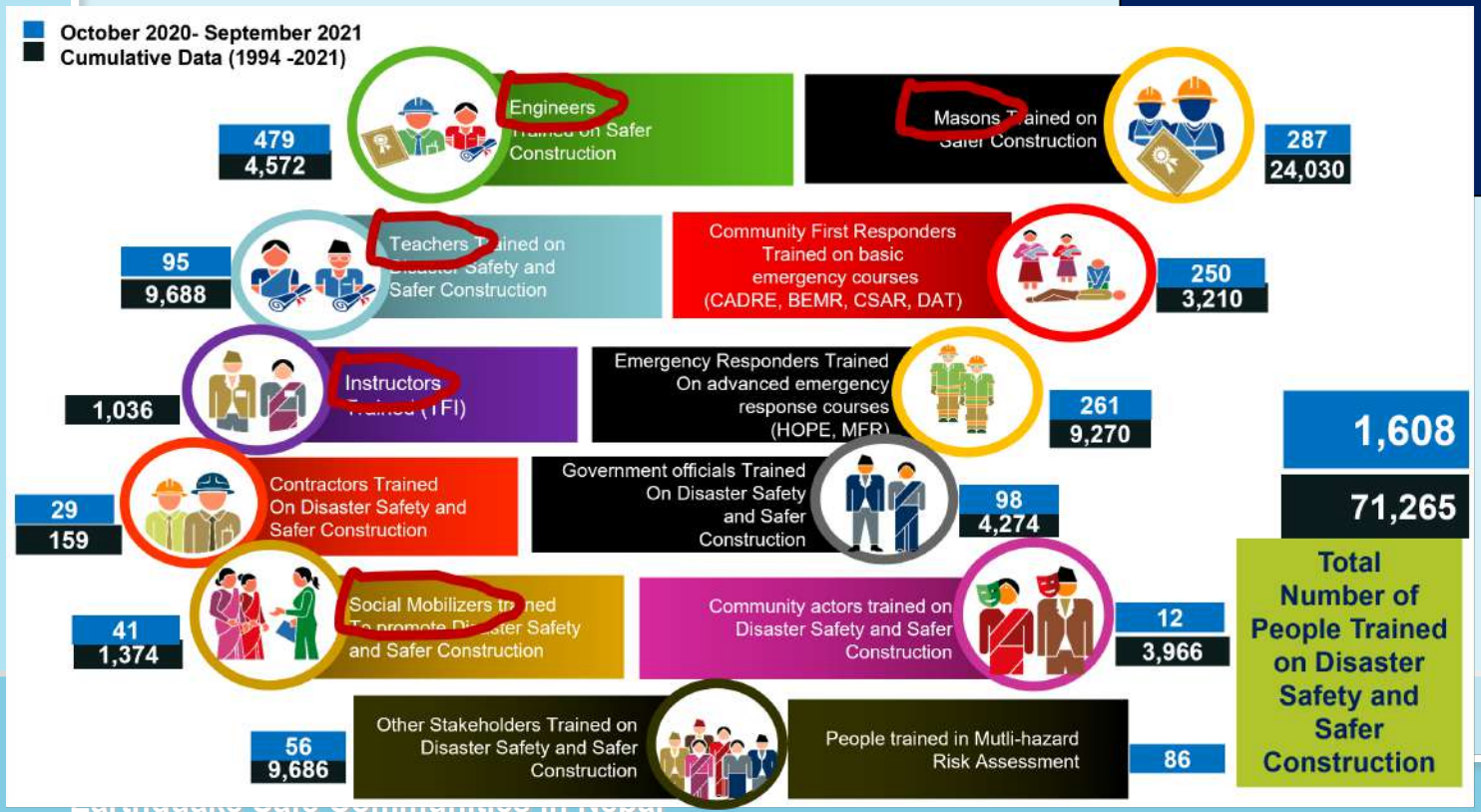
**7,009**
**360,460**
Community People provided with Orientation

**7,009**
**693,463**
In Total

Oct 2020- Sep 2021

Cumulative Data (1994 -2021)

October 2020- September 2021
Cumulative Data (1994 -2021)

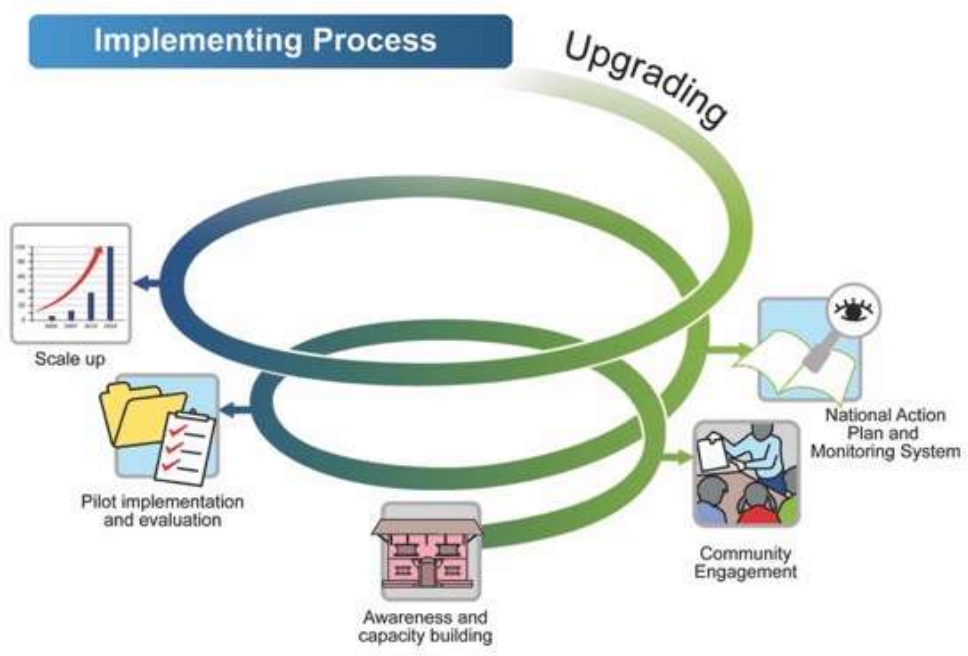



# Capacity Building on Disaster Safety and Safer Construction

# Lessons / Conclusions

- Continued and persistent long-term efforts
  - core - to establish the feasibility of disaster risk reduction and resilience
  - persistency in efforts
- Work with Champions
- Awareness – Capacity - Institutionalization
- Critical mass of people - Different Thresholds for Different Target Group
  - 30% People
  - 50% Masons/Engineers
  - 20% Municipalities

**There is No Short-cut! Organic Growth is Sustainable**



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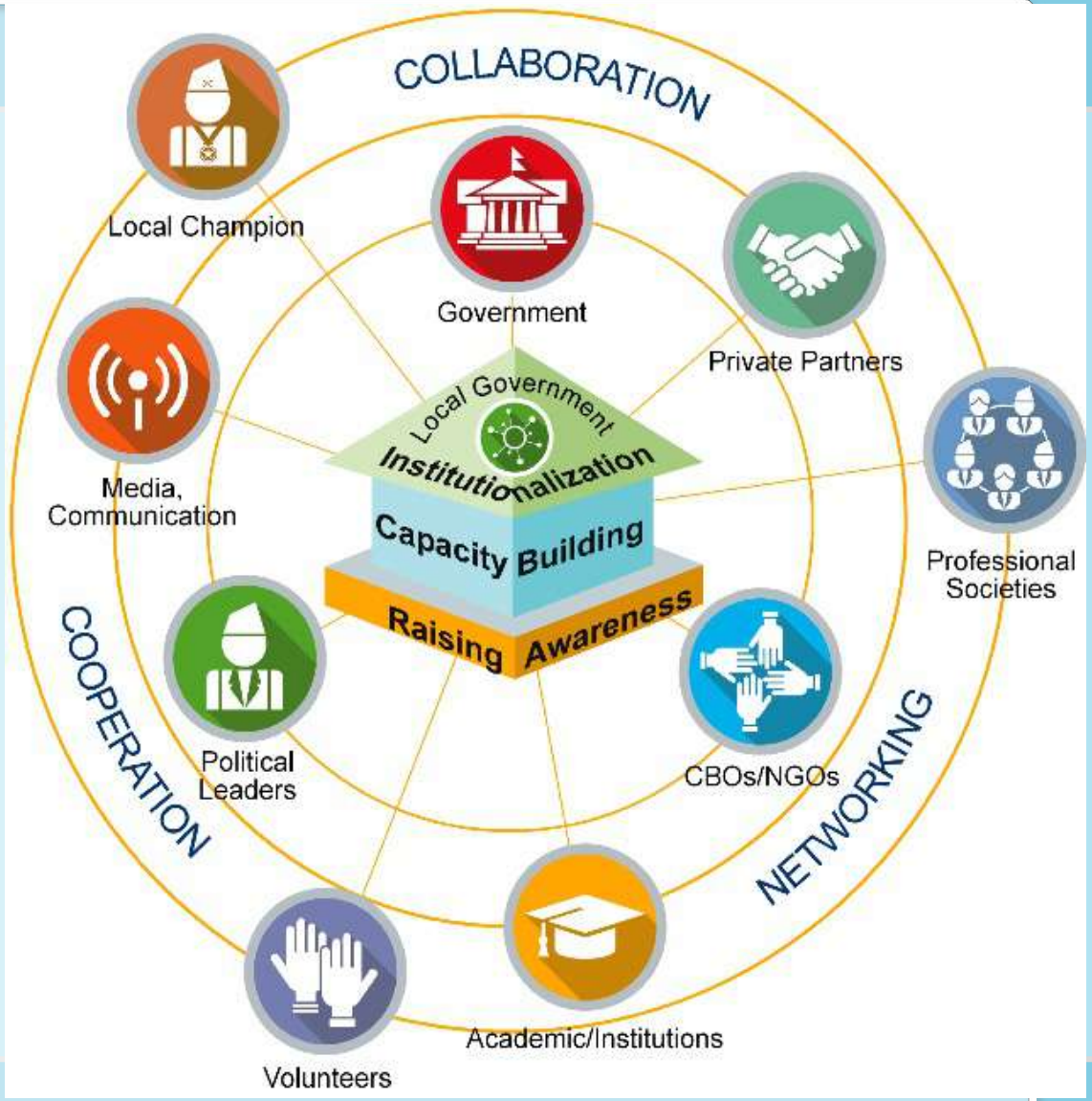
# Way forward

- **Consolidation and Standardization**
- **Scale-up of established methodologies and approaches**
- **Start work on new areas**
  - Critical infrastructures




# Thank You!