

Indian national agenda for landslide disaster mitigation: challenges and recommendations

Facing the challenges of the Indian landslides

Apropos highlighting the challenges of the devastating Indian landslides¹, the next logical step was to evolve Indian national agenda for landslide disaster mitigation and arrive at a set of concrete recommendations based on collective wisdom, at the highest level of expertise. The Indian National Academy of Engineering (INAE) took *suo moto* cognizance of the sad ground reality that at a time when India is on the fast track of development, disasters due to landslides, among others, are frustrating the progress especially because our track record of managing landslides is disappointing, the associated engineering practices are unremarkable, the existing institutional mechanisms appear dysfunctional, the culture of safety is on the decline, and worst of all, the frequency, intensity, damage potential and the devastating impact of landslides are on the increase, accentuated by extreme weather events, unregulated urbanization and non-engineered construction.

INAE, after a series of nationwide consultations, convened a round-table meeting of landslide experts on 11 May 2015 in New Delhi. The recommendations of the round table, presented here, are the essence of the detailed recommendations posted on the INAE homepage. There is the unanimous view that a pro-active strategic and determined approach, with a strong *political and administrative will*, can put us back on the path to safety because, unlike earthquakes and tsunamis, most landslides are predictable, preventable and controllable, if managed with appropriate interventions of S&T.

Recommendations

Establish a National Centre for Landslide Management

An autonomous and empowered National Centre for Landslide Management (NCLM) should be created by the Government of India very early for focused, coordinated and holistic attention on

landslide mitigation and management. Its need is greater than ever before because the existing institutional mechanisms have fallen short of delivery all these years and their mere reorganization or strengthening will not suffice. The proposed centre should play the role as an apex national institution for landslide management and be accountable to the nation.

Prepare multi-tier, dynamic and holistic short-, medium- and long-term landslide management plans

Prepare short (0–3 years), medium (3–10 years) and long-term (10–20 years) landslide management plans at the national, state and district levels in the multi-hazard context, through multi-disciplinary teams, within one year. The plans should, *inter alia*, address the present and the emerging challenges, and provide strategies for coordinated action, and for large-scale promotion of sound engineering practices. These plans must be dynamic in nature. A standing order should be issued to ensure their regular updating, reaffirmation and re-notification.

Launch a national programme to control major landslides

A time-bound national programme for controlling all major landslides should be undertaken, for which, (i) a National Task Force of expert professionals should be constituted, (ii) appropriate agencies, institutions and teams should be identified, shortlisted and mandated to implement the programme in a phased manner, (iii) rational criteria to classify an individual landslide as minor, medium or major should be prescribed at the outset for uniform adoption and (iv) adequate funding should be provided through national landslide management projects or by one-time funding from the Central Government. The 'Best Practice' examples and success stories of landslide control and management should be nationally recognized, rewarded and widely disseminated.

Fortify landslide management

For all ongoing and new development projects involving landslide risk management, the project construction and the corrective action for countering the construction-related, visible or anticipated slope failures and environmental damage before, during or after the construction stage, ought to be considered in design as its inseparable parts. This could be achieved by discontinuing the conventional practice of reflecting costs of corrective actions as separate budget items, by recourse to sound engineering design practices and by creating innovative techno-legal and techno-financial enabling environment. Adequate budget for the above purpose, including the maintenance costs, must be sanctioned as a package; all major landslide projects should pass through a mandatory peer-review by independent panels of experts with particular reference to technical merit, financial viability, speed effectiveness, eco-friendliness and accountability.

Ensure that DPRs are eco-friendly and techno-economically sound

Detailed project reports (DPRs), being of critical importance, remove systemic deficiencies and introduce sound engineering practices to ensure expertise in engineering geology, hydro-geology and geotechnology, quality and cost-based selection (QCBS) process instead of awarding work on least cost basis, objectively estimated time allocation for preparation of a DPR (and its scrutiny vis-à-vis the prescribed guidelines), stringent scrutiny of the vendors, independent peer-review of DPRs of all major projects and periodic surprise audit of ongoing projects. Accreditation of consultancy firms, capacity building of technical agencies within the Government, strengthening of the institutional arrangements for vetting and approvals of DPRs, a third party inspection and audit, disaster impact assessment of all major projects, and permitting mid-course modification of ongoing sanctioned works (in tune with the new information that gets exposed

as the work progresses) lie at the heart of the recommendation.

Insist on cost-benefit analysis of technological options

The engineering solution to a landslide problem, finally picked for adoption out of a plethora of technological possibilities, must necessarily pass through comparative evaluation of all options, ensuring that, as far as possible, the technologies deployed are eco-friendly. All DPRs should mandatorily include an exclusive chapter on positive and negative impacts of the finally selected design with cost-benefit analysis (CBA). Landslide management policy must encourage and reward innovation in investigation, design and plan implementation. Every completed project in landslide-prone areas must leave behind a set of indicators by which the efficacy of control measures and safety of the area could be monitored beyond the construction phase for early warning, and for feedback to designers and disaster managers.

Connection landslide investigation with landslide management

For all major landslide projects, a thorough geotechnical investigation should be a mandatory pre-requisite to planning and design of landslide control measures. Guidelines to professionals at national, state and district levels must underscore this requirement, provide for multi-disciplinary team-building and promote the observational method of design and construction in geotechnical engineering practice. The handicap of shortage of trained professionals in the fields of engineering geology and geotechnology should be overcome, and every landslide-prone state must identify and adopt at least one knowledge institution with expertise in engineering geological and geotechnical investigations and adequately equip it to undertake scientific investigations of landslides, and train professionals. Quality assurance of landslide investigations being critical to design of landslide control measures, all

major landslide investigation reports should be subject to independent peer reviews, to be facilitated by NCLM.

Give impetus to development projects in landslide-prone areas by organizing regular joint crash programmes for senior professionals, development planners and decision makers.

Promote community-centric early warning

A task force of eminent experts (an engineering geologist and a geotechnical engineer included) should be given the responsibility of preparing a state-of-the-art report on early warning systems (EWS) for Indian landslides. The report highlighting the early warning initiatives in India should be placed on the net for soliciting comments and thereafter deciding on the way forward. The terms of reference of the task force should include: (i) articulating the national vision based on felt needs and fullest appreciation of the global state-of-the-art in early warning against landslides; (ii) pinpointing of the deficiencies of ongoing initiatives and the lessons learned; (iii) suggesting mechanisms for spreading the culture of prevention and early warning; (iv) cataloguing of national priorities; and (v) preparation of guidelines on community-centric, user-friendly EWS against landslides. The central and state governments should create at least one pace-setting example of early warning installation against landslides in each of the landslide-prone states in the next couple of years. Early warning thresholds in a given hazardous area should undergo a rigorous scrutiny by an independent team of experts before their adoption for use. Communities should be made fully aware of their expected roles and responsibilities, they being the first to respond in the times of crisis.

Review and revise NDMA guidelines and landslide related BIS codes

The critical reviews, *inter alia*, must analyse deficiencies of the NDMA guidelines on management of landslides and

snow avalanche and those of the landslide-related BIS codes, standards and guidelines and examine why these have failed to make an impact on the national scene. The Government of India should consider granting one-time funding for BIS to fast track this work and write new codes in the gap areas, in close consultation with NCLM, National Institute of Disaster Management and other knowledge institutions. Landslide disasters occur many a time because of the non-engineered or illegal constructions. Law should enable enforcing the guidelines and codes with clearly defined unethical, immoral and illegal boundaries on the acts of omission and commission, beyond which the promoters of such actions would be made liable, held accountable by law and brought to justice.

Accord the highest priority to R&D

Some of the suggested topics of priority in R&D are: (i) earthquake-induced landslides; (ii) role of extreme weather events in landslide studies; (iii) approaches to landslide risk and damage assessment; (iv) development of innovative technologies for effective utilization of landslide debris and other wastes; and (v) unfolding of fundamental mechanisms of the most problematic Indian landslides.

Prepare monographs on landslide disasters

Government and funding agencies should pro-actively invite proposals from well-established teams of experts and assign projects for writing comprehensive monographs on select landslide tragedies. Scientific documentation and publication of peer-reviewed monographs should be encouraged and funded.

1. Bhandari, R. K., *Curr. Sci.*, 2013, **105**(5), 563–564.

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