

## Biology teaching at IITs

Recently I attended a few meetings where strategies are being devised to introduce/augment biology teaching at the undergraduate level in IITs. In my opinion, this is one of the most important activities being spearheaded by the Department of Biotechnology, Government of India, which will have a long cascading effect within a decade or two. What is the underlying reason for this statement?

Internationally, more and more pure science and engineering graduates are opting for research in biology because of the immense challenge and potential it offers. In India too, new faculties are recruited in engineering sciences, who have tremendous interest in core biology or at the interfacial areas, and the number

would increase with time. It is true that many IITs have separate bioscience/bioengineering departments, and the quality of teachers and students is excellent. However, it needs to be stressed here that the biological sciences of the future must be inclusive and be accessible to best young minds of the country. The IIT undergraduate students should go through a rigorous training in any engineering branch of their choice, with core subjects like physics, chemistry, mathematics and biology as a new addition.

Engineers who switched to biology research at a later point in their career have done extremely well, but learned the subject by choice. Basic training during the initial undergraduate years would

certainly help and if 5–10% of these students like the subject and opt to do research in the field, it will be good for the country.

This would necessarily mean that the IIT entrance test will have a paper in biology, that in turn would motivate schools to have serious training in biology from an early period.

On the flipside, no matter how much one dislikes coaching centres, they are a reality now. Will they be then far away from biology training?

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## Anthropogenically induced mass movements along the Dharasu–Yamunotri route

Anthropogenic interference and consequent obliteration of landscape is presently the main triggering factor for large-scale landslides along the Dharasu–Yamunotri pilgrimage route in Uttarkashi District, Uttarakhand. This route is a part of the 160 km long Rishikesh–Yamunotri national highway (NH 94). To broaden the route, slope-cutting and blasting activities are being undertaken. This has resulted in a linear, active mass wasting zone (10–30 m wide) juxtaposing part of the highway (on the hillside) between the Dharasu bend and Pheri (Figure 1a). Here, boulders of phyllite and quartzite hang over the road, with their joint openings having widened due to repeated blasting.

The stretch between Barkot Dobata and Gangani has also developed a 10–20 m wide slope-cut zone juxtaposing the road from the hillside, with many new zones of mass movement (Figure 1b and c). Both Dharasu bend–Pheri and Barkot Dobata–Gangani stretches have become highly prone to landslides because a major portion of the slopes remains untreated after cutting. Construction of retaining walls and other

structural mitigation measures may take a few more years. Until then, these stretches will remain life-threatening corridors for pilgrims and local commuters.

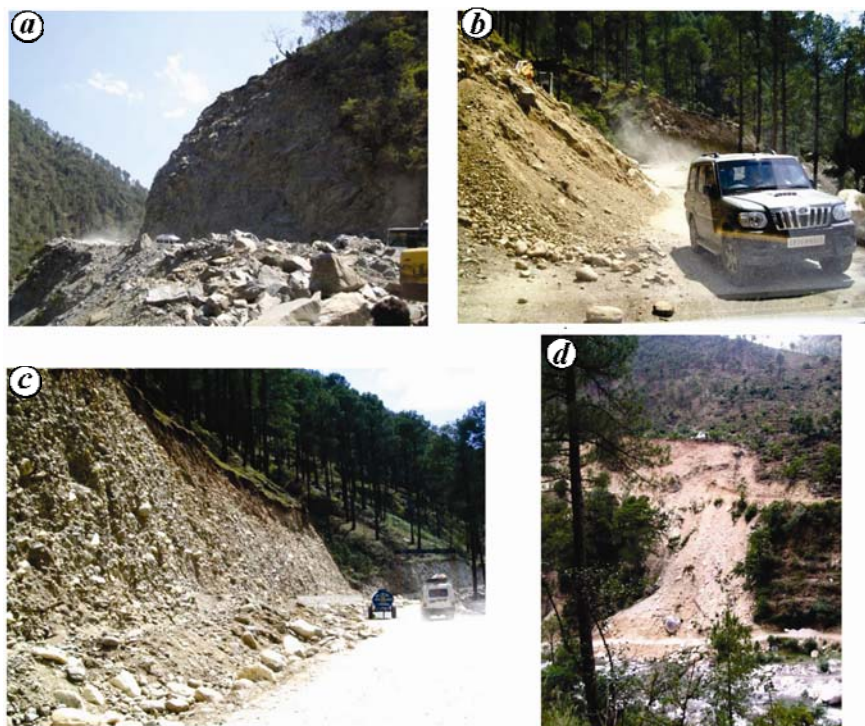
On the opposite bank of the Yamuna, opposite to Kharadi near Kishala, large-scale landslides have been triggered due to road-cutting and laying of tunnel pipes to supply water to the downstream power house (Figure 1d). A large slide has developed near Saina Chatti. Other active slide zones have developed across this highway near Banas and Phool Chatti–Janki Chatti. Some active rockfalls are noticed at Yamuna Chatti–Wazri and along the footpath at Janki Chatti–Yamunotri.

Some prominent landslides in and around the Yamunotri shrine include the debris rockslide at Ghur Parav area of Yamunotri, the rockfall zone above Yamunotri temple (which has been treated a few years back), and a translational rockslide about 50 m upstream of Yamunotri temple on the left bank of the Yamuna. In the past, the majority of landslides in this area were triggered by geological or climatic factors, or by both. However, in the last couple of years, the anthropo-

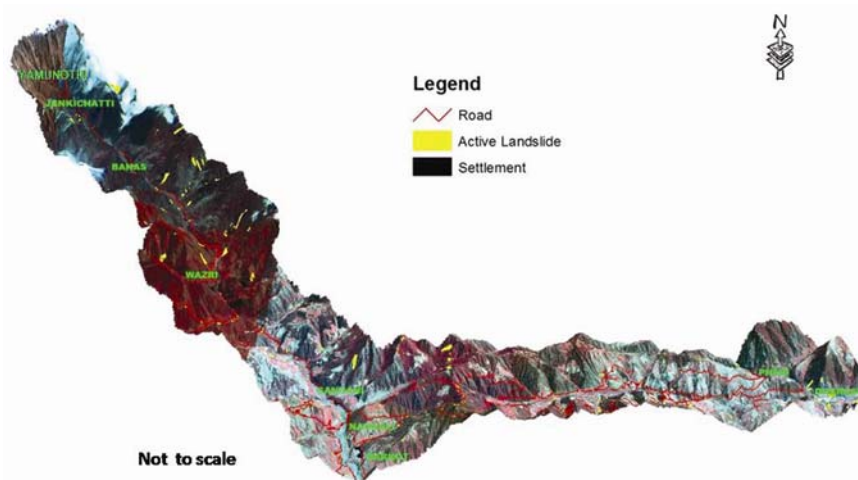
genic factor has become the primary triggering factor.

The entire area is geodynamically unstable, with fragile rocks and landforms traversed by a number of thrusts and faults; prominent among these are the North Almora Thrust, Main Central Thrust (MCT) and Vaikrita Thrust. The geological set-up is defined by the Lesser Himalayas and Higher Himalayas, separated by MCT that passes through Wazri. The Lesser Himalayan rocks of the area comprise phyllite, siltstone, quartzite, slate, quartz arenite and marble, whereas those of the Higher Himalayas include mylonitized quartzite, granite gneiss, green schist, metapelite and phyllitic quartzite<sup>1</sup>. The joints in these rocks are highly fractured; the rocks are even sheared and crushed in the proximity of faults and thrusts. Incised channels have given rise to narrow valleys, with steep valley walls (>45° slope at many places).

The hills of Dharasu–Yamunotri fall in the category of moderate–highly dissected denudostructural hills. Morainic ridges, colluvial and alluvial cones/fans and large, old slide zones – at many locations along or near the road – provide



**Figure 1.** Field view of anthropogenically induced mass movements. Near Dharasu bend (a), Naunali (upstream of Barkot Dobata) (b), Gangani (c) and Kishala (on the opposite bank of Yamuna) (d).



**Figure 2.** Digital elevation model of Dharasu–Yamunotri area.

unconsolidated material for slope failure, particularly when the angle of repose of these landforms is altered due to slope-cutting for road widening. The complex hydrology of the area is also an important triggering factor. Climatic factors

such as heavy rains and cloud-burst events in particular, in combination with geological factors, have primarily contributed to the problem of mass wasting.

Ever since the widening of this highway began a few years ago, the anthropogenic

obliteration coupled with geological and climatic factors has transformed many stretches into landslide-prone zones, and is posing geo-environmental problems (Figure 2). The Pathargad Reserve Forest at Barkot Dobata–Gangani and reserve forest at Dharasu bend–Pheri stretches are witnessing degradation. Furthermore, agriculture fields in the immediate downslope are also being rendered waste due to dumping of slope-cut debris. Consequently, some small drains across this highway are becoming over-filled; this may result in debris flow in the downstream area during heavy monsoon rains.

There is a need for urgent restorative measures along the Dharasu–Yamunotri corridor. The magnitude of mitigation measures should match the magnitude of landscape obliteration. More precisely, if two 12 km stretches are broadened every year through slope-cutting and blasting, the mitigation measures should also be completed by the next year. The cut-and-fill method of road-widening and construction is a more eco-friendly method compared to blasting. The higher cost of this method should not be an obstacle in preserving the natural land cover, in aiding landslide management, and in geo-environmental restoration of this region.

1. Biyani, A. K., In Proceedings of the National Seminar on Geodynamics and Environment Management in Himalaya (eds Nainwal, H. C. and Prasad, C.), H.N.B. Garhwal University, Srinagar, 2002, pp. 304–331.

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