



Geo-Hazards and Mountain Road Development in Nepal: Understanding the Science-Policy-Governance Interface

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The foothills of Nepalese Himalayas located in the neotectonic mountain environment are among some of the most unstable and geomorphologically dynamic landscapes in the world. Young fold mountains in this region are characterized by complex tectonics that influence the occurrence of earthquakes, while climatic processes such as intense orographic rainfall often dictate the occurrence of floods and landslides. Development of linear infrastructures, such as roads, in mountainous terrain characterized by high relief and orogeny is considerably challenging where the complexity of landscape in steep and irregular topography, difficult ground conditions and weak geology, presents engineers and planners with numerous difficulties to construct and maintain mountain roads. Whilst application of engineering geology, geomorphic interpretation of terrain in terms of physiography and hydrology, and identification of geo-hazards along the road corridor is critical for long term operation of mountain roads, low-cost arterial roads in the Himalayan foothills generally fail to incorporate standard road slope engineering structures. This research provides unique insights on policy and governance issues in developing mountainous countries such as Nepal, where achieving a sound balance between sustainability and affordability is a major challenge for road construction. Road development in Nepal is a complex issue where socio-economic and political factors influence the budget allocation for road construction in rural hilly areas. Moreover, most mountain roads are constructed without any geological or geo-technical site investigations due to rampant corruption and lack of adequate engineering supervision. Despite having good examples of rural road construction practices such as the Dharan-Dhankuta Road in Eastern Nepal where comprehensive terrain-evaluation methods and geo-technical surveys led to an improved understanding of road construction, learnings from this project have not informed other road development schemes in Nepal. Geomorphological surveys and robust geo-hazard assessments that factor the spatial and temporal dimensions of the seismic, fluvial and sediment hazards along the road corridor are critical for sustainable development of mountain roads. However, scientific and technical research studies seldom inform mountain road development primarily due to lack of co-ordination between the respective government agencies, access to journal papers in developing countries and unwillingness to adopt novel interventions in rural road construction practices. These challenges are further exacerbated by weak governance and lack of proper policy enforcement that often leads to construction of poorly engineered roads, thereby increasing the risk of rural infrastructural damage from geo-hazards. Though there exists a disconnect between the science-policy-governance interface where information on geo-hazards is neglected in mountain road development due to lack of scientific research and government apathy, there is an opportunity to spur dialogue and sensitize these issues via trans-disciplinary approaches on disaster risk management.