1 **Invited perspectives:**

2 **Mountain roads in Nepal at a new crossroads**

3 Dr. Karen Sudmeier-Rieux, Institute of Earth Sciences, Faculty of Geoscience and Environment,
4 University of Lausanne, Switzerland
5 Prof. Brian G. McAdoo, Yale-NUS College, Singapore
6 Mr. Sanjaya Devkota, Institute of Engineering, Tribhuvan University, Nepal
7 Mr. Purna Lal Chandra Rajbhandari, Independent, Kathmandu, Nepal
8 Mr. John Howell, Consultant, Living Resources Ltd., Devon, U.K.
9 Mr. Shuva Sharma, Scott Wilson Nepal Ltd., Kathmandu, Nepal

10

11 **Introduction – roads as vehicles of development?**

12 For the past two decades, development of the road network in Nepal has topped community and
13 government priorities, a trend likely to continue as the country transitions to a decentralized Federal
14 government (Rankin, 2017). In parallel, China's new Belt and Road Initiative (BRI) offers the promise of
15 investments in key infrastructure: expanding trunk roads, hydro-electricity, trade and development
16 (The Wire, 2017; The Economist, 2017). Yet as Nepal devolves significant power to local and Provincial
17 administrations, it is uncertain whether the newly formed local administrations will rise to the
18 challenge of establishing safeguards to ensure that promised benefits outweigh potential losses. We
19 suggest that the issue of poor roads in Nepal is a political, not a technical issue and one where better
20 service and less environmental damage could both be significantly addressed through improved
21 governance. This commentary points to the need for improved road governance based on research,
22 consultations and observations of road construction and associated landslides in Nepal and around the
23 world (e.g. Blaikie et al. 1980; Sidle et al., 2012; Jaboyedoff et al., 2016., Rankin, et al., 2017). It also
24 highlights the need for more scientific studies on the topic as most relevant publications emanated
25 from the grey literature, government publications or media articles.

26 Roads are globally accepted livelihoods links for communities in rural areas. By reducing travel time
27 on foot, opportunities are opened for quicker transportation of goods, better access to employment,
28 education and health (Hettige, 2006; Bryceson et al., 2008). Roads generally create direct and indirect
29 benefits to rural populations, directly through employment in constructing and maintaining them, and
30 in providing rural transportation services. Indirectly they provide opportunities for marketing goods
31 and services, flexibility for employment and roadside businesses, and for transporting agricultural
32 products to markets (Bryceson et al., 2008; Iimi et al., 2016). They can provide a safety net of sorts in
33 generating alternative livelihood opportunities, especially in circumstances where conditions for
34 agriculture are difficult. In general, connectivity is thus positively correlated with lower poverty rates
35 (Hettige, 2006; Iimi et al., 2016). Additionally, there are many non-monetary benefits of roads,
36 especially greater access for the poor to health and other public services, such as education, which can
37 significantly reduce vulnerability and even gender inequality (Starkey et al., 2013). In Nepal, roads are
38 also linked to the current boom in migration, facilitating easier mobility to both near and distant
39 migration destinations (Jaquet et al., 2015; Upreti and Shrestha, 2015). Finally, a robust road
40 infrastructure can provide vital corridors for evacuation and rescue in the aftermath of disaster.

41 However, benefits of roads need to be weighed alongside evidence that roads may benefit non-poor
42 households more, perhaps making development less even (Hettige, 2006). Furthermore, other
43 impacts, such as increased environmental hazards, pollution, crime and unwanted cultural influences
44 are often overlooked (Blaikie et al., 1976; Hettige, 2006; Jaboyedoff et al., 2016; Murton, 2016). This
45 manuscript builds on research and publications questioning the aspirations of the Government of

46 Nepal as early as the 1970s and 1980s. The Overseas Development Group at the University of East
47 Anglia pioneered studies to understand short-, medium- and long-term effects of road construction on
48 spatial and socio-economic inequality (Blaikie et al., 1976; Rankin et al., 2017). Blaikie et al. (1980)
49 revealed the inequalities created by road construction in Nepal, with loss of livelihoods for those
50 without possibilities to invest, and enhanced opportunities for those who could (Rankin et al., 2017).

51 The work presented in this paper was conducted during the same period as the Laban (1979)
52 benchmark inventory of landslides in Nepal to document the number of landslides and their origin as
53 either natural or human-induced. Although roads represented a small proportion of total land area at
54 the time, Laban warned that as the road network continued to expand, the number of landslides will,
55 "increase drastically in the near future, especially if more careful construction methods are not
56 undertaken" (Laban, 1979: iv). Both research projects were widely influential and according to Rankin
57 et al (2017), the Blaikie et al (1976) study may have redirected domestic budgets and foreign aid
58 toward other rural development investments. However, this reprieve was soon to end with a greater
59 focus on connectivity in the 10th 5-year plan (2002-2007) and the boom in foreign investments in road
60 construction projects after 2008 and the end of the Maoist insurgency (Pokharel and Acharya, 2015).
61 The 11th plan (2007-2010) established the ambitious goal of constructing a road network throughout
62 the country whereby residents in the Hills should have a road available within four hours walking
63 distance and Terai residents within two hours (Pokharel and Acharya, 2015).

64

65 **Nepal's mountain roads – vehicles of disaster?**

66 Roads in Nepal are generally classified as national roads, (i.e. Strategic Road Network, SRN) under the
67 jurisdiction of the Department of Roads (DOR), or local roads (i.e. Local Road Network, LRN). The LRN
68 is comprised of District Road Core Network (DRCN) and Village Roads (VR) under the jurisdiction of the
69 Department of Local Infrastructure Development and Agricultural Roads (DOLIDAR) (Figure 1). Road
70 building started to gain momentum in Nepal with the advent of multi-party democracy in the early
71 1990s, intensified further after the Maoist insurgency ended in 2006 and continues to be one of the
72 country's main priorities (DOLIDAR, 2016a; Upreti and Shrestha, 2016).

73
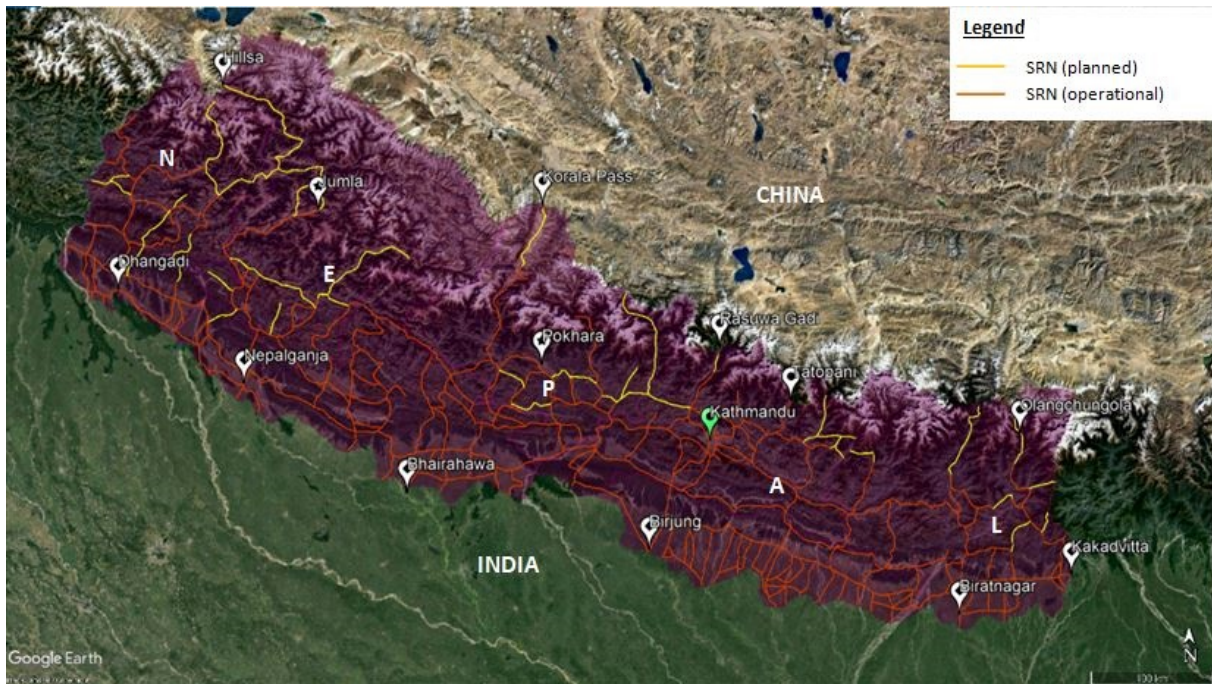
Figure 1. Nepal Provincial boundaries and national (SRN) road network highlighting existing and proposed roads, according to DOLIDAR (2016) and main current border crossings with China and India. As Provincial administrations are in the process of revising Master Plans to represent new administrative boundaries, there is opportunity to put in place governance mechanisms for improved road construction and maintenance. (Source: Modified from DOLIDAR, 2016, based on Google Earth imagery).

Twenty years ago, Nepal's road network was one of the smallest in the world with a road density for both SRN and LRN estimated at 13.7 km per 100 km^2 in 1998 (DOR, 2002; DOR, 2017). By 2016, it had increased to 49.6 km per 100km^2 and continues to increase at a very rapid pace (DOLIDAR, 2016a). The SRN expanded rapidly from 4,740 km (blacktop, gravel and earthen) in 1998 to 15,404 km in 2016 (DOLIDAR, 2016a). The LRN experienced a 1200 percent increase during this period, from 4,780 km in 1998 to 57,632 km in 2016 and are the most common roads in rural areas (DOLIDAR, 2016a).

In 2007, the country spent 5.2 percent of its national budget on roads, but by 2011/12 this figure had increased to 6.7 percent or an estimated 491.2 million USD (WB-GON, 2014). The estimated investment in the LRN was about 245.6 million USD (2011/12), of which 54 percent of the rural road budget originated from donors and 20 percent were soft loans to communities. Community contributions amounted to an estimated 12 percent of the total budget through their own savings and remittances, and earnings from community forestry (WB-GON, 2014; DOLIDAR, 2016b). This demonstrates the significance and priority given to roads and connectivity as a vector for economic development and population mobility.

Despite the budget and priority allocated to the road network, Nepal's mountain roads are in a treacherous state, subject to frequent rockfall, landslides and accidents (Singh, 2018; DoR, 2013a) (Figure 2). According to DoR (2013a), one of the main causes of road accidents is road design, including very steep gradients, lack of safety features and poor road conditions. Local road construction or so-called 'dozer roads' are most often initiated and constructed by bulldozer owners in collaboration with politicians at the request of communities, without basic grading or drainage (ITAD, 2017; Singh, 2018). The dozer roads are usually constructed or upgraded during the dry season. During the monsoon, road segments are frequently washed out because a majority of these roads lack proper engineering (WB-GON, 2013). Road failures are cleared up at high cost after the monsoon and the failure-and-clearance process is repeated for years until there is no loose soil to block roads (Leibundgut et al., 2016).

104 Environmental impacts include destroyed irrigation schemes, buried springs and contaminated water
105 supplies (Singh, 2018). Initial Environmental Examinations (IEE) to reduce environmental impacts are
106 usually required for local road construction but are rarely enforced (ITAD, 2017).

107

108 **Figure 2. Local road, Lower Mustang District, Province 4, Nepal. Credit: Rajbhandari, 2016.**

109

110 Such rapid and ineffective road construction throughout the country, but particularly in the middle hill
111 and mountain areas, is placing increasing pressure on fragile ecosystems, wasting government
112 resources and increasing risk to road passengers and roadside dwellers (DoR, 2013a; Singh, 2018).
113 Studies have demonstrated that roads are one of the greatest anthropogenic drivers of environmental
114 degradation, erosion and landslides in Nepal (Petley et al., 2007; Leibundgut et al., 2016; Froude and
115 Petley, 2018; McAdoo et al., 2018; Vuilliez et al. 2018). This situation is worsening due to the
116 intensifying rainfall during the monsoon, largely attributed to climate change (Petley et al., 2007; Bharti
117 et al., 2016; Devkota et al. 2018; Froude and Petley, 2018), which has led to a greater occurrence of
118 landslides, especially in the middle hills (McAdoo et al., 2018). The possibility of an earthquake of even
119 greater magnitude than the 2015 Gorkha earthquake (M 7.8) raises concerns about poorly designed
120 roads increasing the likelihood of catastrophic landslides (Singh, 2018).

121

122 **Nepal at a governance crossroads**

123 Nepal has a range of acts, regulations, guidelines and directives that require proper road engineering
124 practices, various levels of environmental assessments and approval. However, while funded by
125 government budgets, a majority of local roads do not follow established government practices (ITAD,
126 2017). Hence, although the legal framework for ensuring proper governance of infrastructure
127 development is well developed with public bodies to monitor and enforce governance, the lack of
128 political will and consensus among political leaders has undermined the impact of these bodies (WB-
129 GoN, 2013).

130 As the country shifts decision-making to the Provinces, it is unclear how management of roads will be
131 affected among the main actors such as DOR, DoLIDAR, and rural and urban Municipalities.
132 Institutional roles are shifting under on-going reforms, with executive authority over local
133 infrastructure development being transferred from district level authorities (District Technical Officer)
134 to Provincial Public Works Departments, which are supposed to coordinate with central level ministries
135 and departments (ITAD, 2017). At the time of printing, it is not yet clear which administrative body
136 will have oversight of road policies and alignment of policies between Provinces. The risk is that the
137 few gains that had been achieved over the past decade, including a greater emphasis on regular
138 maintenance of roads, become completely diluted (ITAD, 2017).

139 Another development which may affect the type and pace of road construction in Nepal is China's Belt
140 and Road Initiative (BRI). In May 2017, Nepal became a signatory to the BRI with the promise of
141 expanding several trunk roads in order to foster new trade and economic benefits (The Economist,
142 2017). This new "Silk Road" will develop a trade and infrastructure network from China towards the
143 west and south including countries in Central and South Asia and Eastern Europe.

144 The BRI has for now elicited more questions than answers, including: which roads will be expanded,
145 will it link rural mountain communities to greater economic development opportunities, better health
146 care and education options, and increased social networks; or will the BRI trunk roads spawn more of
147 the poorly engineered local roads with their demonstrated low cost-effectiveness and high
148 environmental impacts? Without adequate controls and support, rural villages can be expected to tie
149 into these trunk roads by expanding the network of poorly-constructed local roads, with ensuing
150 environmental, economic and human risks associated with roadside erosion and slope failures that
151 damage both the roads and the neighboring productive land.

152 Despite this bleak picture, Nepal has the governance systems in place to resolve the problem if it
153 chooses to do so. Numerous technical manuals and departmental guidelines provide the basis for good
154 alignment determination, careful engineering, the stabilization of incipient landslides in slopes and the
155 prevention of erosion through the use of bio-engineering (e.g., Deoja, 1994; DOR, 2013b). Nepal has
156 been a world leader in the past and government agencies such as DOR and DOLIDAR all have cadres of
157 highly trained engineers and bio-engineers who could fulfill the required technical functions
158 satisfactorily if directed properly (WB-GON, 2013; ITAD, 2017).

159 However, these abilities are currently ignored in the interest of political expediency and a misplaced
160 public perception that quickly opened roads are a panacea for socio-economic development.
161 Institutions were established to regulate road construction. The Environmental Protection Council was
162 formerly established under the Chairmanship of the Prime Minister to monitor environmental impacts
163 and to regulate the environmental and social impact assessment legal instruments (GON, 1997), but
164 became an ineffective facade. The Department of Roads' Geo-environmental and Social Unit is also
165 not serving its function. Finally, political influence has overrun any efforts to instill checks and balances
166 (ITAD, 2017), notably by the Commission for Investigation of Abuse and Authority, which was created
167 to highlight cases of poor governance.

168 Yet with the revision of ministerial portfolios in 2018, the re-organized Ministry of Forests and
169 Environment has an opportunity to ensure that statutory environmental safeguards are met by those
170 government units that will be responsible for administering road development. Newly formed
171 Provincial administrations are now tasked with revising their Master Plans and have the opportunity
172 to develop action plans to strengthen governance bodies, increase transparency and enforce
173 regulations.

174

Conclusions

On the surface, roads are vital livelihood links for rural populations for improved access to markets, health care, education, employment and migration. Mobility is increased, rural populations can develop greater resilience to harsh environmental conditions, and there are possibilities of new economic opportunities, ultimately reducing economic vulnerability. However, mountain roads, especially when poorly constructed, present particular challenges of sustainability, risk and governance (Sidle and Ziegler, 2012). Hence, the full benefits of such roads in mountainous areas should be questioned.

Finally, the issue of poorly designed and risk-filled roads in Nepal, is a political, rather than technical issue. As Nepal moves towards greater decentralization of power, there is considerable opportunity for its local and national administrations to turn the tide toward safer and more sustainable road development. The two new major drivers of road development in Nepal – decentralization of power and the BRI – could be harnessed to change road construction from the current trajectory of environmental disaster to vectors for development. The high environmental and maintenance costs of haphazard 'dozer roads' could be significantly reduced if government policies were enforced to achieve well-established road engineering designs, including basic standards of road grading, alignment, drainage and bio-engineering. Nepal is at a new crossroads with fresh opportunities to rein in the "dozer road" constructors, but this will require concerted effort and considerably more political will power than has been demonstrated over the last decade.

Acknowledgements

The authors would like to thank Prof. Michel Jaboyedoff, Faculty of Geosciences and Environment, Institute of Earth Sciences at the University of Lausanne, the Ecosystems Protecting Infrastructure and Communities (EPIC) project, managed by the International Union for Conservation of Nature, funded by the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) 2012-2017, for contributing toward this research along with funding from Yale-NUS College's Centre for International and Professional Experience. We also thank anonymous reviewers and the guest editor for suggestions which significantly improved this manuscript.

References

Bharti, V., Singh, C., Ettema, J. and T.A.R. Turkington: Spatiotemporal characteristics of extreme rainfall events over the Northwest Himalaya using satellite data. International Journal of Climatology, 36(12), 3949–3962. https://doi.org/10.1002/joc.4605. 2016.

Bryceson DF, Bradbury A, Bradbury T.:Roads to poverty reduction? Exploring rural roads' impact on mobility in Africa and Asia. Development Policy Review 26 (4): 459-482. 2008.

Blaikie, P., Cameron, J., Feldman, D., Fournier, A. and D. Seddon.: The Effects of Roads in West Central Nepal. 3 Vols. Norwich: Overseas Development Group, University of East Anglia. pp. 1255–1270. 1976.

Blaikie, P., Cameron, J. D. Seddon. : Nepal in Crisis: Growth and Stagnation at the Periphery. Contributions to Nepalese Studies.. Tribhuvan University, Nepal Vol. VIII, No. 1. 1980

Deoja, B.B.: Sustainable approaches to the construction of roads and other infrastructure in the Hindu Kush-Himalayas, International Centre for Integrated Mountain Development (ICIMOD) Occasional paper, 24, Kathmandu:ICIMOD, 70pp. http://lib.icimod.org/record/24785/files/attachment_366.pdf. 1994

Devkota, S. Shakya, NM, Sudmeier-Rieux, K. Jaboyedoff, M. Van Westen, C. McAdoo, B.G., Adhikari, A.:

Development of Monsoonal Rainfall Intensity-Duration-Frequency (IDF) Curves and Empirical Model for Data-scarce Situations: The Case of Central-Western Hills of Nepal, Hydrology 2018, 5, 27; doi:10.3390/hydrology5020027. 2018.

DOLIDAR [Department of Local Infrastructure Development and Agricultural Roads]: Statistics of Local Road Network (SLRN) 2016. Government of Nepal. Ministry of Physical Infrastructure & Transport. Babarmahal: DOLIDAR, 534 pp. http://rapnepal.com/sites/default/files/report-publication/statistics_of_loacl_road_network_slrn_2016.pdf. 2016a.

DOLIDAR [Department of Local Infrastructure Development and Agricultural Roads]: Road Maintenance Groups Guidelines. Ministry of Federal Affairs and Local Development, Department of Local Infrastructure Development and Agricultural Roads (DOLIDAR). Kathmandu: GoN. 48pp. http://www.oit.org/wcmsp5/groups/public/---asia/---ro-bangkok/---ilo-kathmandu/documents/webpage/wcms_562124.pdf. 2016b.

DOR [Department of Roads]: National Transportation Policy Ministry of Physical Planning and Works, 2058 (2001/2002). Kathmandu: DOR, 15 pp. http://dor.gov.np/home/circular/force/national-transport-policy-2058. 2002.

DOR [Department of Roads]: Nepal Road Standard 2070, Government of Nepal, Ministry of Physical Infrastructure and Transport, Department of Roads, Planning and Design Branch, Road and Traffic Unit, Kathmandu: DoR, 55 pp. http://kec.edu.np/wp-content/uploads/2017/06/Nepal-Road-Standard-2070-1.pdf. 2013a.

DOR [Department of Roads]: Status Paper on Road Safety in Nepal, Europe-Asia Road Safety Forum and the 67th Session of the Working Party of UNECE, New Delhii, India 4-6 December, 2013. Kathmandu: GoN. 26pp. https://www.flagship2.nrrc.org.np/sites/default/files/knowledge/Status%20Paper%20on%20Road%20Safety%20in%20Nepal%20-%20Dep%20of%20Roads%20-%202013.pdf 2013b.

DOR [Department of Roads]: Road Network Data, Government of Nepal, Department of Roads: Kathmandu: DoR, 17pp. http://www.dor.gov.np/home Last accessed July 15, 2017.

GoN [Government of Nepal] Environmental Protection Act (1997). Government of Nepal. http://doenv.gov.np/files/download/environment-protection-act,%202053%20(1997).pdf 1997.

Froude, M.J. and Petley, D.: Global fatal landslide occurrence from 2004 to 2016, Natural 429 Hazards and Earth System Sciences, 2161-2181, 2018. Haigh, M.J., Rawat, J.S., Bartarya, S.K.: Environmental correlations of landslide frequency along new highways in the Himalaya: preliminary results. Catena, 15, 539—553. 1988.

Hettige, H.: Whether the poor benefit from rural roads depends on the contextual situation as well as the assets they hold. Manila: Asian Development Bank, 101pp. https://www.adb.org/sites/default/files/publication/29406/when-rural-roads-benefit-poor.pdf 2006.

ITAD: Rural Access Programme Phase 3. Monitoring, Evaluation and Learning Component Review of Rural Roads Maintenance Planning In Nepal, Brighton: ITAD, 20 pp. November, 2017. http://itad.com/reports/nepal-rural-access-programme-monitoring-evaluation-and-learning-component-reality-check-approach-baseline-report/ 2017.

Iimi, A., Ahmed, F., Anderson, E.C., Diehl, A.S., Maiyo, L., Peralta-Quiros, T. Rao, S.K.: New Rural Access Index: Main Determinants and Correlations to Poverty. Transport and ICT Global Practice, The World Bank Group, November 2016, Policy Research Working Paper 7876. Washington D.C.: the World Bank, 18 pp. 2016. https://openknowledge.worldbank.org/handle/10986/25676 2016.

Jaquet, S., Schwilch, G., Hartung-Hofmann, F., Adhikari, A., Sudmeier-Rieux, K., Shrestha, G., et al.: Does outmigration lead to land degradation? Labour shortage and land management in a western Nepal watershed. Applied Geography, 62, 2015, 157–170. 2015.

Jaboyedoff, M . Michoud, C. Derron, M-H. Voumard, J. Leibundgut, G. Sudmeier-Rieux, K. Nadim, F. and E. Leroi: Human-induced landslides: toward the analysis of anthropogenic changes of the slope environment. Landslides and Engineered Slopes. Experience, Theory and Practice Proceedings of the 12th International Symposium on Landslides (Napoli, Italy, 12-19 June 2016) Edited by Stefano Aversa, Leonardo Cascini, Luciano Picarelli, and Claudio Scavia. 2016.

Laban, P.: Landslide occurrence in Nepal. Kathmandu: Integrated watershed management torrent control and Land use development project, Ministry of Forest, Department of Soil and Water Conservation and the Food and Agriculture Organisation. 1979.

274 Leibundgut, G., Sudmeier-Rieux, K. Devkota, S., Jaboyedoff, M., Derron, M-H., Penna, I. Nguyen, L. :
275 Rural earthen roads impact assessment in Phewa watershed, Western region, Nepal.
276 Geoenvironmental disasters 3 (13), 2016
277 McAdoo, B. Quak, M., Sudmeier-Rieux, K., Gnyawali, K., Adhikari, B., Devkota, S., Rajbhandari, P.: Roads and
278 landslides in Nepal: How development affects environmental risk.
279 Nat. Hazards Earth Syst. Sci., 18, 3203-3210, 2018 https://doi.org/10.5194/nhess-18-3203-2018
280 Murton, G.: A Himalayan Border Trilogy: The Political Economies of Transport Infrastructure and Disaster
281 Relief between China and Nepal. Cross-Currents: East Asian History and Culture Review E-Journal
282 No.18, March, 2016.
283 Petley, D., Hearn, G.J., Hart, A., Rosser, N., Dunning, S., Oven, K., Mitchell, W.: Trends in landslide occurrence in
284 Nepal. Nat Hazards, 43: p. 23–44. 2007.
285 Pokharel, R. and S.R. Acharya.: Sustainable Transport Development in Nepal: Challenges,
286 Opportunities and Strategies. Journal of the Eastern Asia Society for Transportation Studies, Vol.11,
287 2015.
288 Rankin, K.N., Sigdel, T.S, Rai, L. Kunwar, S. and P. Hamal.: Political Economies and Political Rationalities Of
289 Road Building In Nepal, Studies in Nepali History and Society 22(1): 43–84 June 2017
290 Sidle R.C. and Ziegler A.D.: The dilemma of mountain roads. Nature Geoscience, 5, 437-438. 2012.
291 Sidle, R. C., Ghestem, M., and A. Stokes.: Epic landslide erosion from mountain roads in Yunnan, China –
292 Challenges for sustainable development. Nat Hazards Earth Syst Sci 14, 3093-3104. 2012.
293 Singh, B.P.S.: From nowhere to nowhere. Haphazard road construction is ravaging the Nepali countryside.
294 Nepali Times, July 6, 2018. https://www.nepalitimes.com/banner/from-nowhere-to-nowhere/ 2018.
295 Starkey, P., Tumbahangfe, A., Sharma, S.: Building roads and improving livelihoods in Nepal, External
296 review of District Roads Support Project: Final Report. Swiss Agency for Development and Cooperation
297 (SDC), District Roads Support Programme (DRSP) Kathmandu: SDC, 82 pp.
298 https://doc.rero.ch/record/255566/files/46-External_Review_District_Roads.pdf 2013.
299 The Economist.: The two sides of the mountain. December 23, 2017.
300 https://www.economist.com/news/asia/21732851-maldives-nepal-and-sri-lanka-are-no-longer-meek-
301 they-used-be-india-faces-growing 2017.
302 The Wire.: One Belt, One Road Fuels Nepal's Dreams. July 11, 2017.
303 https://thewire.in/156554/nepal-china-obor-transport-infrastructure/ 2017.
304 Upreti, B. R., and Shrestha, G.: Linking migration, mobility, and development for strengthening adaptation to
305 climate and disaster Risks: Reflections from Nepal. In K. Sudmeier-Rieux, M. Jaboyedoff, M. Fernandez,
306 I. Penna, & J. C. Gaillard (Eds.). (2016) Identifying emerging issues in disaster risk reduction, migration,
307 climate change and sustainable development - shaping debates and policies. Springer Publisher, 146-
308 160. 2016.
309 Vulliez, C, Tonini, M, Sudmeier-Rieux, K, Devkota, S. Derron, M-H, and M. Jaboyedoff, M.: Land use changes in
310 the Phewa Lake Watershed of Western Nepal. A comparative study 1979-2016. Journal of Applied
311 Geography 94. 30-40. 2018.
312 WB-GON [World Bank, Government of Nepal]. Nepal Road Sector Assessment Study. Kathmandu; WB-
313 GoN, 54pp. http://rapnepal.com/sites/default/files/report-
314 publication/road_sector_assessment_study_main_report_final_30may2013.pdf 2013.
315
316