

1 Dear Bruce,

2 Thank you for accepting our manuscript – we are also very grateful that it has been given the status
3 “invited paper”. I appreciate your additional suggestions which I have duly incorporated in this final
4 version. I just had one question inserted below with regards to figure 2.

5 Technical changes:

6 * Please check that all references cited are in the reference list and all references in the reference list
7 are cited at least once. I did a spot check and found items such as limi et al. (2016) line 83 was not in
8 the references. If you could check all, that would be helpful.

9 KSR: limi was in the references but I found other errors which I have corrected

10 * Can you do a last double check that all sentences with ideas/facts have appropriate in-text citations
11 or refers the reader to later in the manuscript where in-text citations are mentioned? For example,
12 line 97-98 discuss ‘building on research and publications’ but then does not give citations or direct
13 the reader to other parts of the manuscript.

14 KSR: I have reviewed and made a few corrections.

15 * Please ensure that three authors are first author surname and then et al. (line 100, this should be
16 Blaikie et al. not listing all three surnames).

17 KSR: Corrected

18 * Line 103, starting a new paragraph, it is a little confusing saying ‘this work’. I suggest you state “The
19 work presented in this paper”

20 KSR: Corrected

21 * For SI units, you do not need to explain what they are the first time you put them in. Line 136
22 kilometers can be left as just km.

23 KSR: Corrected

24 * Figure 2—can you put a scale or give us an idea of scale in the figure caption. Is there a credit?

25 KSR: I have added a scale. The credit was already in the caption – do you prefer it is inserted in the
26 photo?

27 * In-text citations—when you have more than one in-text citation, you sometimes do them by date
28 (oldest to newest), other times alphabetically by surname. I suggest the former, but please be
29 consistent.

30 KSR: Corrected by chronological order

31 * In-text citations—line 172, avoid putting ‘accepted’ in the text, this should be (if necessary) in the
32 reference list and read ‘in press’ if not other information.

33 KSR: Corrected

34 I’d like to thank you very much for having chosen to publish with NHESS and again apologize for
35 delays. I look forward to seeing your manuscript in print.

36

37 KSR: Thank you once again for this opportunity to publish with NHESS, wishing you all the best

38 Karen

39 **Invited perspectives:**

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

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48

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

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

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

79 However, benefits of roads need to be weighed alongside evidence that roads may benefit non-poor
80 households more, perhaps making development less even (Hettige, 2006). Furthermore, other
81 impacts, such as increased environmental hazards, pollution, crime and unwanted cultural influences
82 are often overlooked (Blaikie et al., 1976; Hettige, 2006; Jaboyedoff et al., 2016; Murton, 2016). This
83 manuscript builds on research and publications questioning the aspirations of the Government of
84 Nepal as early as the 1970s and 1980s. The Overseas Development Group at the University of East
85 Anglia pioneered studies to understand short-, medium- and long-term effects of road construction on
86 spatial and socio-economic inequality (Blaikie et al., 1976; Rankin et al., 2017). Blaikie et al. (1980)
87 revealed the inequalities created by road construction in Nepal, with loss of livelihoods for those
88 without possibilities to invest, and enhanced opportunities for those who could (Rankin et al., 2017).

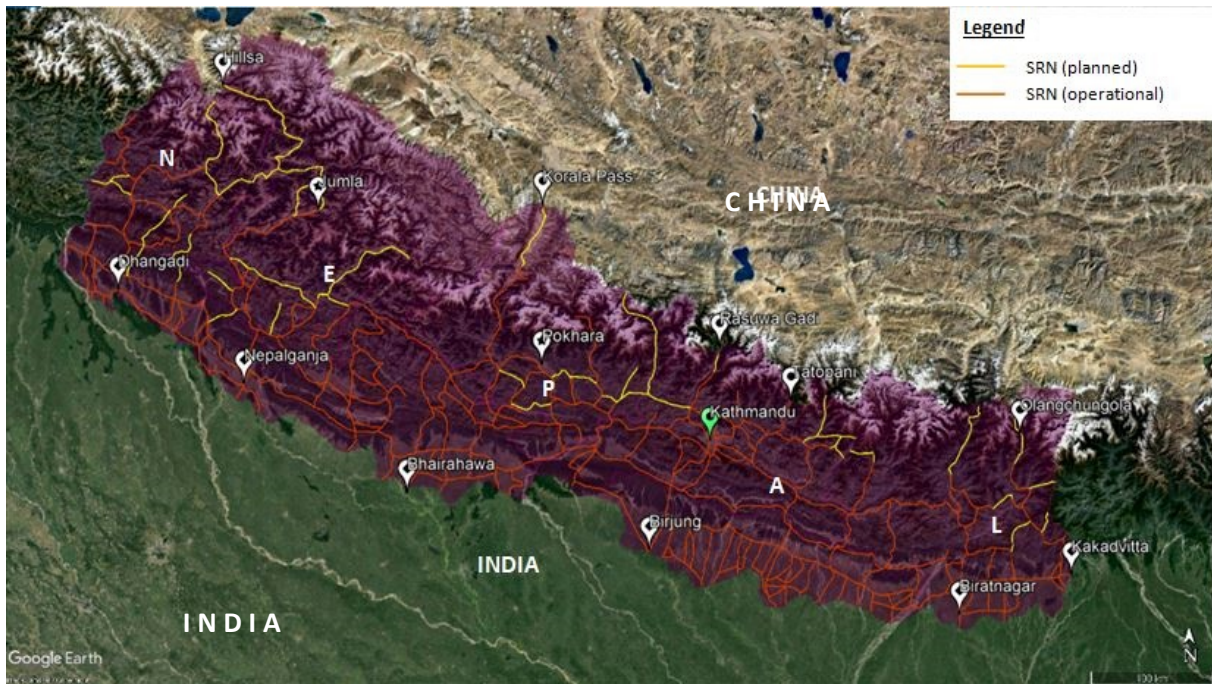
89 The work presented in this paper was conducted during the same period as the Laban (1979)
90 benchmark inventory of landslides in Nepal to document the number of landslides and their origin as
91 either natural or human-induced. Although roads represented a small proportion of total land area at
92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

102

103 **Nepal’s mountain roads – vehicles of disaster?**

104 Roads in Nepal are generally classified as national roads, (i.e. Strategic Road Network, SRN) under the
105 jurisdiction of the Department of Roads (DOR), or local roads (i.e. Local Road Network, LRN). The LRN
106 is comprised of District Road Core Network (DRCN) and Village Roads (VR) under the jurisdiction of the
107 Department of Local Infrastructure Development and Agricultural Roads (DOLIDAR) (Figure 1). Road
108 building started to gain momentum in Nepal with the advent of multi-party democracy in the early
109 1990s, intensified further after the Maoist insurgency ended in 2006 and continues to be one of the
110 country’s main priorities (DOLIDAR, 2016a; Upreti and Shrestha, 2016).

111



112

113 **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).**

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118 Twenty years ago, Nepal’s road network was one of the smallest in the world with a road density for
119 both SRN and LRN estimated at 13.7 km per 100 km² in 1998 (DOR, 2002; DOR, 2017). By 2016, it had
120 increased to 49.6 km per 100km² and continues to increase at a very rapid pace (DOLIDAR, 2016a). The
121 SRN expanded rapidly from 4,740 km (blacktop, gravel and earthen) in 1998 to 15,404 km in 2016
122 (DOLIDAR, 2016a). The LRN experienced a 1200 percent increase during this period, from 4,780 km in
123 1998 to 57,632 km in 2016 and are the most common roads in rural areas (DOLIDAR, 2016a).

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

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

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



145
146 **Figure 2. Local road, Lower Mustang District, Province 4, Nepal. Credit: Rajbhandari, 2016.**

147
148 Such rapid and ineffective road construction throughout the country, but particularly in the middle hill
149 and mountain areas, is placing increasing pressure on fragile ecosystems, wasting government
150 resources and increasing risk to road passengers and roadside dwellers (DoR, 2013a; Singh, 2018).
151 Studies have demonstrated that roads are one of the greatest anthropogenic drivers of environmental
152 degradation, erosion and landslides in Nepal (Petley et al., 2007; Leibundgut et al., 2016; Froude and
153 Petley, 2018; McAdoo et al., 2018; Vuilliez et al. 2018). This situation is worsening due to the
154 intensifying rainfall during the monsoon, largely attributed to climate change (Petley et al., 2007; Bharti
155 et al., 2016; Devkota et al. 2018; Froude and Petley, 2018), which has led to a greater occurrence of
156 landslides, especially in the middle hills (McAdoo et al., 2018). The possibility of an earthquake of even
157 greater magnitude than the 2015 Gorkha earthquake (M 7.8) raises concerns about poorly designed
158 roads increasing the likelihood of catastrophic landslides (Singh, 2018).

159
160 **Nepal at a governance crossroads**

161 Nepal has a range of acts, regulations, guidelines and directives that require proper road engineering
162 practices, various levels of environmental assessments and approval. However, while funded by
163 government budgets, a majority of local roads do not follow established government practices (ITAD,
164 2017). Hence, although the legal framework for ensuring proper governance of infrastructure
165 development is well developed with public bodies to monitor and enforce governance, the lack of
166 political will and consensus among political leaders has undermined the impact of these bodies (WB-
167 GoN, 2013).

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

177 Another development which may affect the type and pace of road construction in Nepal is China's Belt
178 and Road Initiative (BRI). In May 2017, Nepal became a signatory to the BRI with the promise of
179 expanding several trunk roads in order to foster new trade and economic benefits (The Economist,
180 2017). This new "Silk Road" will develop a trade and infrastructure network from China towards the
181 west and south including countries in Central and South Asia and Eastern Europe.

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

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

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

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

212 **Conclusions**

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

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

231

232

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241

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