Climate Change: Closing The Gap Between Challenges Faced by Developing and Developed Countries

Ann Louisa Williams[1*], Joe Cant[1], Christoph Kraus[1] and Dan Chamberose[1]

[1]Beca Ltd., Auckland, New Zealand

(*Corresponding E-mail: ann.williams@beca.com)

Abstract: Climate change is beginning to impact the global landscape, exposing vulnerabilities across both developed and developing nations. While disparities in resources and infrastructure remain, recent events - such as the devastating rainfall induced landslides and flooding in Marlborough and in the Hawke's Bay and Gisborne regions of New Zealand - highlight that extreme climate impacts do not discriminate. These shared experiences are fostering a new sense of urgency and solidarity, as nations across the development spectrum confront common challenges: infrastructure resilience, disaster preparedness, and the need for equitable recovery. This presentation explores the idea that climate change is closing the perceived gap between "first" and "third" world vulnerabilities, and how this convergence should be catalyzing more inclusive and cooperative response initiatives and climate action. Drawing on case studies, it argues that mutual learning, shared innovation, and equitable support mechanisms with local communities at the heart, are essential to living with climate change. It is also clear that a pre-event, whole-of-system approach is needed with up-front decision-making around risk acceptance and infrastructure prioritisation (e.g. route prioritisation in the case of roads and highways) and therefore response and recovery mitigations.

Keywords: ***Climate impacts, Infrastructure resilience, Landslides.***

Introduction

New Zealand has experienced widespread flooding and landslides in recent years, with at least five separate significant events being declared since 2020. Areas affected include the southern part of the South Island in February 2020, the north of the South Island in July 2021 and August 2022, Auckland in January 2023 (including the "wettest day on record") and the north and east of the North Island in February 2023 when cyclones Hale and Gabrielle made landfall in quick succession, resulting in circa 800,000 landslides (Massey et al., 2025). The impacts of Cyclone Gabrielle were such that a National State of Emergency was declared for the third time only, in New Zealand's history (the previous two times were the COVID pandemic and the Canterbury earthquake sequence, all within the last 15 years).

But New Zealand is not alone. Over the past year, heavy rainfall has triggered devastating floods and landslides worldwide—in China, Texas (USA), India, Pakistan, Switzerland, Austria, Papua New Guinea, Valencia (Spain), Nigeria, Mexico, and Nepal—causing catastrophic impacts on communities and infrastructure across both developed and developing regions. Agencies responsible for repair and recovery are increasingly struggling to prepare for, finance, and respond to these recurring disasters.

Frequency of Events

Rainfall-induced landslides are becoming more frequent and severe, occurring in areas previously unaffected (de Vilder et al., 2024). Increasingly intense rainfall now triggers thousands of landslides across wide regions. Scenario modelling for the Himalayas (Kirschbaum et al., 2020; Stanley et al., 2024) and studies in New Zealand (Smith et al., 2023) both indicate that climate change will significantly amplify landslide activity, particularly during monsoon seasons and near glacial lakes, heightening risks to vulnerable populations.

Planning and Response

Restoring infrastructure and managing flood and landslide debris is generally met by a wide group of parties responding to immediate needs (emergency services, government agencies, contractors, consultants), working alongside the local community and local organisations to support both the immediate and longer-term recovery process. As climate change takes hold and these events become more common, preparation for, and response to, rainfall-induced disruption also needs to alter.

Collaborative Response Entities

In New Zealand, collaborative response entities have increasingly been established to design and implement remedial works following major natural disasters. The New Zealand Transport Agency (NZTA) and KiwiRail formed the North Canterbury Transport Infrastructure Recovery (NCTIR) Alliance in 2016 to restore road and rail networks destroyed by the Kaikōura earthquake, involving over 8000 people from more than 1350 organizations. The Marlborough Roads Recovery Team (MRRT) was created by NZTA to coordinate recovery of local roads after severe storms in July 2021 and a more destructive rainfall event in August 2022, as repair costs and timelines escalated. Following Cyclone Gabrielle in 2023, NZTA and KiwiRail established the Transport

Rebuild East Coast (TREC) Alliance to plan and rebuild state highway and rail networks. These entities enable coordinated, consistent, and cost-effective responses that strengthen infrastructure resilience and support local employment. However, the time required to establish them can prolong community disruption, and uncertainty around funding may limit the adoption of more resilient designs. To enhance future effectiveness, such response entities should be pre-established, with agreed risk thresholds and recovery hierarchies defined in advance.

Landslide Susceptibility Models

Following Cyclones Hale and Gabrielle, which together triggered more than 50,000 landslides in the Auckland Region, Auckland Council undertook landslide susceptibility modelling to identify high-risk areas, inform land use planning, and support emergency management (McLelland and Roberts, 2025). Although such tools are valuable for guiding new developments away from hazard-prone zones, they are less effective at predicting the precise location and distribution of future landslides. Algorithm-based models—considering factors such as geology, slope geometry, land cover, and past landslide occurrences—do not fully capture dynamic, climate-driven variables such as shifting landslide frequency, rainfall intensity and duration, or cascading hazards. Nevertheless, they provide useful insights, though often with a bias toward recent events.

Standard Designs

Cyclone Gabrielle caused widespread flooding and the loss of highways and bridges across Hawke's Bay, isolating communities and disrupting essential services. Initial assessments identified hundreds of under-slip failures caused by river scour and stormwater runoff. To expedite recovery, standardized remedial and regional design details were implemented along entire road corridors, supported by engineering geological and geotechnical input. This collaborative approach, also used by the MRRT, significantly reduced time and cost (Chamberose and Yukich, 2025). Pre-agreed design life, safety factors, and code departures were key to restoring connectivity, even as some sections remain vulnerable to future events.

Monitoring of Flood and Rainfall Levels

In New Zealand's Marlborough region, located at the top of the South Island, 400–500 mm of rain fell over 54 hours during a 2021 storm, followed by more than 1000 mm over four days in 2022. Together, these storms triggered nearly 8000 landslides. Since then, the Marlborough District Council has developed a real-time, web-based flood mapping tool that allows landowners to assess local flood risk and prepare for potential isolation. Local engineering geologists have also used recent storm data to qualitatively relate river flood levels and rainfall magnitude to landslide initiation.

Conclusions

With rainfall-induced landslides becoming more frequent and severe, and repairs increasingly costly and time-consuming, a proactive, system-wide strategy is essential. Traditional planning and recovery tools struggle to predict or manage such events. Establishing collaborative response frameworks and predefined risk-acceptance hierarchies in advance is crucial. Although susceptibility maps and databases can guide land development, they are less effective for extreme events. Standardized design practices can improve the speed, efficiency, and cost-effectiveness of infrastructure and community recovery.

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