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Stakeholder perspectives on landslide triggers and impacts in five countries

Abstract Expert perspectives drive landslide mitigation and post-disaster policy planning. This study examines landslide risk perceptions among the stakeholders (government officials, academics, policy experts, local community representatives, and representatives of NGOs/civil society) across Brazil, Colombia, Nepal, Iran, and Pakistan, identifying both shared concerns and local heterogeneity. Key informants revealed a discrepancy in their degree of concern about landslides, with government officials exhibiting greater apprehension compared to local community representatives. Local community representatives incorrectly perceived landslides to be the result of natural phenomena. In contrast, governmental and academic stakeholders felt that human-induced triggers, specifically those related to land use and land cover change, were significant contributors to landslide occurrences, necessitating stringent law enforcement. The comprehensive impacts of landslides included economic losses, infrastructure disruption, agricultural losses, and food security concerns, underscoring the multifaceted nature of this hazard. Our results suggest the need for proactive citizen engagement in landslide monitoring, recognizing the importance of local contexts. We end by proposing a dual-pronged policy approach that emphasizes the socio-economic context of each region.

Keywords Landslides · Multi-country analysis · Key informant's perspective · Land use/land cover changes · Stakeholder's dialogue

Introduction

Climate change is causing global concern due to shifting precipitation patterns, rising temperatures, and an increased frequency and intensity of extreme weather events. These changes are unfolding at an alarming rate (Olaoluwa et al. 2022; Intergovernmental Panel on Climate Change (IPCC) 2023). Extreme weather events related to climate change cause devastation worldwide, particularly in the densely populated and climate-vulnerable Global South (Abbass et al. 2022). Landslides, one such hazard, occur in multiple parts of the world and have significant impacts on human health and livelihoods (Jakob 2022; Nefros et al. 2023). Among natural disasters, landslides are the fourth leading cause of human mortality (Mertens et al. 2016). Between 1995 and 2014, 3876 landslides caused a total of 163,658 deaths and 11,689 injuries worldwide (Haque et al. 2019).

To address this natural hazard, global documents such as the IPCC (Intergovernmental Panel on Climate Change) reports, the Paris Agreement, the United Nation's Sustainable Development Goals, the Sendai Framework for Disaster Risk Reduction 2015-203, and the Kyoto 2020 Commitment for Global Promotion of Understanding and Reducing Landslide Disaster Risk emphasize multi-level and comprehensive risk reduction measures (Aitsi-Selmi et al. 2016; Handmer et al. 2019; Alcántara-Ayala and Sassa 2021; IPCC 2021). The key principle highlighted in these measures is the inclusion of all levels of society to build resilience (Samuel and Cornforth 2019). However, developing these joint societal efforts is not straightforward. The commitment, intention, knowledge, experience, and resources of all stakeholders are crucial (Matsuoka and Gonzales Rocha 2020). There is also a need to elevate the role of local and scientific knowledge for disaster risk reduction (DRR) as well as disaster risk management through enhanced communication and the appropriate use of participatory methods. Effective landslide mitigation strategies, such as modifying slope geometry, using chemical or biochemical agents to reinforce slope material, installing structures, such as anchors, piles, and retaining walls, grouting rock joints and fissures, diverting debris pathways, and rerouting surface and underwater drainage (Dnr 2019; Mertens et al. 2016; Perera et al. 2018; Ferreira et al. 2022, Sharma et al. 2024) require a strong understanding of both local geography and local risk (Ndlela 2019; Shayan et al. 2022). Community representatives play a particularly crucial role in hazard reduction through the preparation of risk maps and the monitoring of landslide movement (Klimeš et al. 2019a, b). To enhance resilience, a comprehensive understanding of local perceptions, alongside a scientific and accurate understanding of risk, is vital for integrated planning and public awareness (Alrawad et al. 2023; Keating 2020).

While quantitative studies have extensively explored the impacts of landslides in various countries (Linnerooth-Bayer et al. 2016; Spegel and Ek 2022), fewer have investigated divergent perspectives on landslides among government officials, academics, and community representatives. Our transregional, cross-cultural comparative analysis of stakeholders' perceptions and actions on landslides in selected countries aims to uncover whether policymakers align their actions with local knowledge and perceptions, examining their insights into community understanding and awareness initiatives.

This study was conducted in Brazil, Colombia, Nepal, Iran, and Pakistan engaging diverse stakeholder groups to explore the comprehensive impacts, outcomes, and challenges associated with mitigating landslide risks.

Material and methods

Conceptual framework

Drawing upon the latest literature and seminal risk reduction documents, this study employs a conceptual framework based on a hierarchical understanding of landslide risk reduction, with a specific emphasis on stakeholder engagement and public participation (Fig. 1).

Context

Five countries were selected for this based on their varying levels of vulnerability, economic status, and different climates, all of which contribute to landslide vulnerability and impacts (Fig. 2). Each country possesses distinctive natural characteristics that add complexity to the observed landslides in these regions, combined with socio-economic and cultural factors.

With its vast territory and diverse morphology, Brazil experiences a wide range of geological formations and dynamic climate patterns. The country reported 2544 deaths and injuries by 62 landslides from 1995 to 2014 (Haque et al. 2019). According to the National Emergency Management Organization (NEMO), floods and landslides are the disasters with the highest number of victims, the greatest total cost, and greatest total losses as a percentage of GDP (Toro et al. 2014).

Characterized by geological complexity and varied terrain, Colombia experiences a significant number of landslides (Grima et al. 2020). According to the National Unit for Disaster Risk Management (UNGRD) of Colombia, and the Unified Global Landslide Database (UGLD), Colombia had the highest number of landslides (10,393) and fatalities (35,686) between 1903 and 2020 (Gómez et et al. 2023). Specifically, there were 1105 causalities in 44 landslides during the period 1995 to 2014 (Haque et al. 2019).

Located in the Himalayan region, Nepal frequently experiences landslides due to its unique blend of dynamic geological features, morphology, and the risk of extreme weather events (Dahal and Hasegawa 2008). The country ranks seventh in human casualties from floods, landslides, and avalanches. Nepal's susceptibility to landslides is further compounded by seismic activity, low soil quality, erosion, and slope instability (He et al. 2023). Between 1995 and 2014, a total of 3492 people died or were injured in 236 recorded landslide events (Haque et al. 2019).

Iran's geology and climatic patterns underscore the importance of addressing landslides within its borders. Approximately 20% of Iran's land areas are highly or very highly susceptible to landslides (Ngo et al. 2021). The National Disaster Management Organization (NDMO) identified a total of 147 death and injuries during 20-year period from 1995 to 2014 (Haque et al. 2019).

Finally, Pakistan, known for its rugged terrain, active seismicity, monsoon rains, and other geohazards, frequently experiences landslides with significant impacts on the economy and society (Ali et al. 2019; Khan et al. 2019). According to the Pakistan National Disaster Management Authority (NDMA), around 100,000 people were either killed or injured by 114 landslides between 1995 and

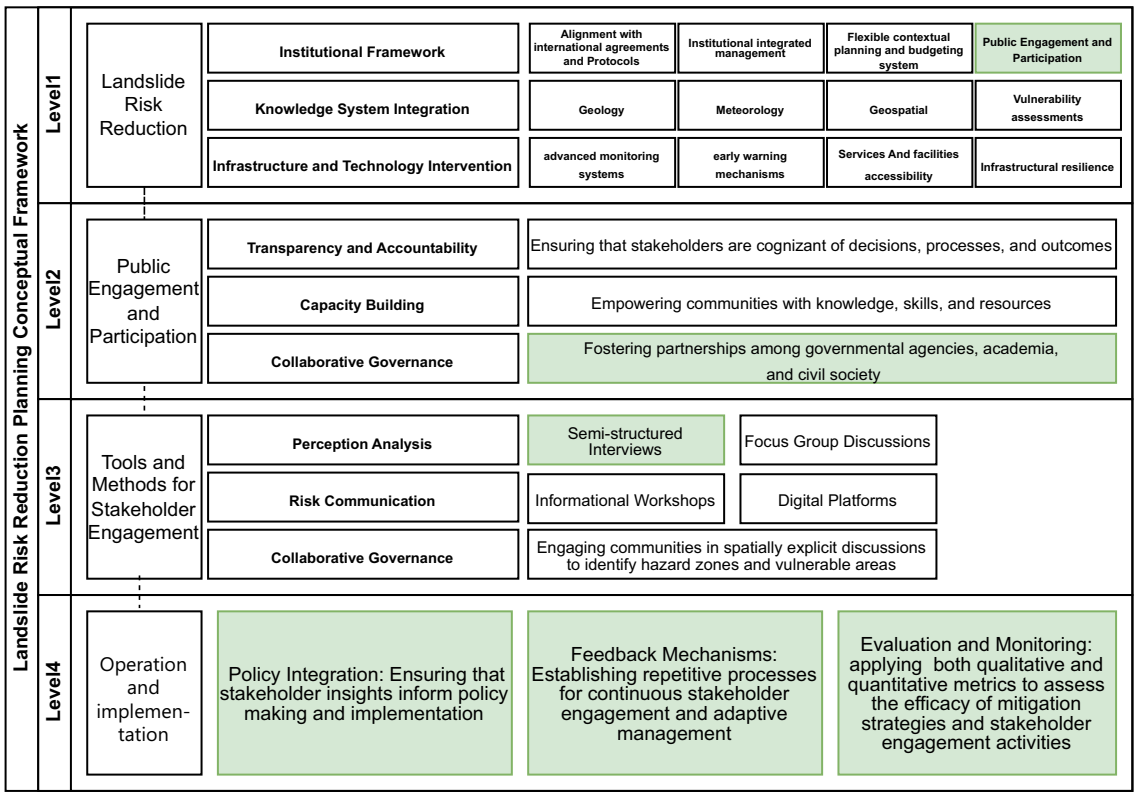

Fig. 1 Conceptual framework

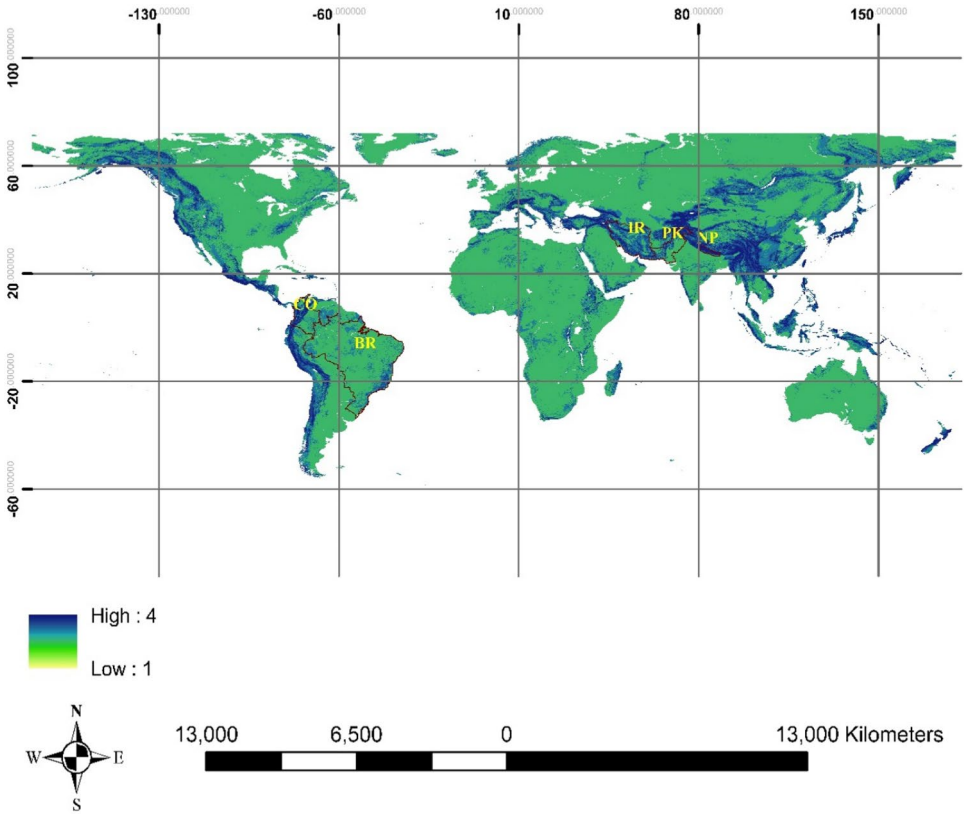

Fig. 2 Location of the five countries under-study on the Global Landslide Hazard map (World Bank 2021)

Table 1 Landslide's fatalities and triggers in the five countries (Haque et al. 2019)

Country	Fatalities	Key triggers
Brazil	2544	Rainfall and flood
Colombia	1105	Rainfall and mining
Nepal	3495	Rainfall
Iran	147	Rainfall
Pakistan	100,000	Rainfall and earthquakes

2014 (Haque et al. 2019). Table 1 summarizes the effects of landslide events and the most important triggers between 1995 and 2014 according to Haque et al. (2019).

Identifying key informant interview (KII) concepts and participants

To develop our interview guide, we first convened a panel of six experts from diverse backgrounds, including geology, urban planning, disaster expert, climate change, environmental engineering, and urban climatology (including authors Ubydul Haque and Safiyeh Tayebi). The panel was tasked with selecting, rating, and weighing the most important concepts related to landslides in the five mentioned countries (Table 1). The results were used to develop a KII guide, which was subsequently used in data collection.

Data Collection

Data were collected between May and July 2023. The final guide included eleven key questions (Table S3), supplemented by sub-questions, supporting the ability of participants to provide comprehensive insights into landslides.

A total of 28 government officials, policy experts, academics, NGO/Civil society representatives, and local community representatives participated in the study (Tables S1 and S2). The selection criteria included expertise or work related to landslides, policy experience, relevance to the study subject, and willingness to engage in detailed discussions. Interviews were conducted on Zoom platform, a collaborative video conferencing service that ensures a secure, recordable, online meeting platform. The interviews were conducted in Persian, Urdu, or English (i.e., in the native language of the country except in Brazil and Nepal).

Data analysis

We conducted a content analysis of interview data, using QSR NVivo Version 12.2 software. Our three-stage analysis process included (i) line-by-line coding of the text for meaning and context, (ii) use of the interpretive description method (Hanson et al. 2017) to pinpoint or delineate illustrative themes and create code

groups that identified patterns and dominant concepts, and (iii) the generation of analytic themes that identify abstract messages (Saldana 2021). Throughout this process, themes and sub-themes were collaboratively discussed by the authors to ensure a deeper understanding of the participants' words and ideas, ultimately enriching the qualitative analysis. Figure 3 presents the model adopted for this study.

Ethical considerations

The study received ethical approval from the University of North Texas Institutional Review Board (Reference Number 2022-065). Prior to the interview, participants were introduced to the study's background and objectives and ethical information and were provided the contact details of the project investigator. Participants provided verbal consent to recorded conversations. Interviews were anonymized, and personal identifiers were not gathered. Respondents had the right to terminate their participation at any time.

Results

Drawing from the four main concepts identified by the expert panel, our analysis of key informants' responses identified four themes related to the level of concerns of stakeholders, main landslide triggers, impacts, and mitigation strategies in the five countries.

Theme 1: the level of concern of stakeholders about the landslides

In response to questions about concerns regarding landslides, interviewees pointed to a lack of concern among the general population and a greater concern of local governments. Government officials in all five countries mentioned laws established to reduce the risk of landslides. For instance, a Brazilian Government Official said,

> In Brazil, many regions suffered disasters caused by landslides; for example, the 2011 landslide caused almost 920 deaths in the Serrana region, Rio de Janeiro. After that, the

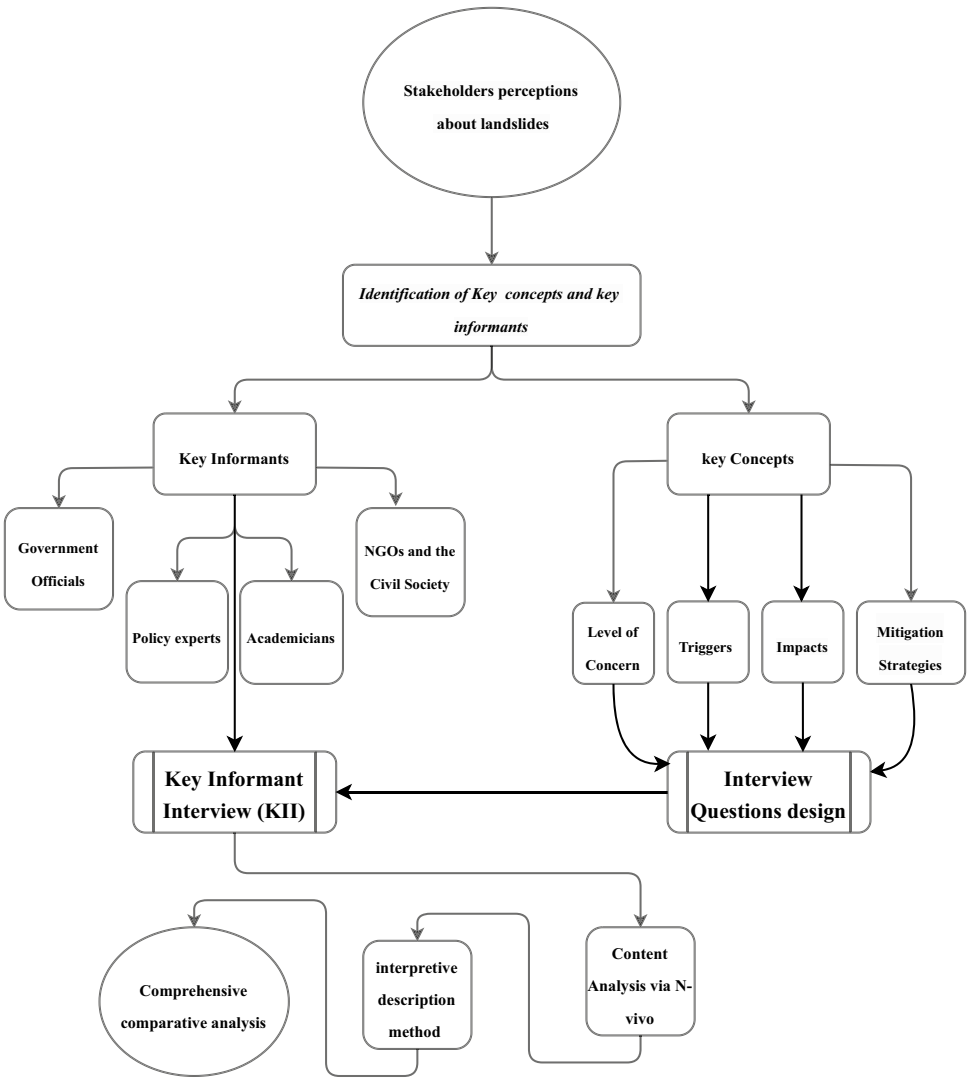

Fig. 3 Design development to collect data on landslide scenarios of five countries

> government instituted the National Civil Protection and Defense Policy, focusing on disaster risk reduction, which encompasses additional laws and investments to prevent such phenomena.

In contrast, a Nepali NGO/Civil Society representative pointed out the lack of concern of local governments, saying "There is a political economy. Immediate income and incentive, for authorities, is in harvesting resources rather than protecting hill slopes. (There is) more focus is on road construction, which has two immediate benefits – financial income from bulldozer operation, and public support for 'development'." The general population was perceived to be relatively unconcerned about landslides because the immediate benefits of living, working, and earning money in landslide-prone areas exceeded the perceived risk. As a result, despite feeling unsafe, many individuals did not consider landslides to be a serious enough risk to merit relocating. This issue was reflected in the statement from a local community representative from Colombia:

> In the population of Antioquia, the ease of developing an economic activity leads many people to live in places with high susceptibility to landslides.

Theme 2: main triggers

Interviewees reported that landslides were triggered by a combination of natural and human factors. Across all countries, most respondents emphasized that the interplay between these factors compounded their effects. Prominent natural triggers included extreme rainfall, earthquakes, and snowmelt, while human factors included land use land cover changes and inappropriate land management. Extreme rainfall events related to climate change emerged as a prominent trigger in all countries, while earthquakes were specifically mentioned in Brazil, Nepal, and Pakistan. Academics highlighted the impact of human-induced changes more than government officials, whereas government officials emphasized long-term factors like climate change. In contrast, local community representatives and officials focused more on immediate natural factors.

Some interviewees noted that the absence of laws or enforcement measures failed to prevent man-made activities in hilly, landslide-prone regions. A forestry professor in Pakistan mentioned,

> I belong to Gilgit, Pakistan; in my opinion, deforestation is the first major trigger of the landslides in this area. There are no land rules and regulations. People can construct infrastructure anywhere.

Major human activities of concern included agricultural land use and the unregulated or underregulated construction for housing. Agricultural activities contributed to landslides in various ways. In Iran, the conversion of gardens and natural forests into agricultural land made the soil more susceptible to landslides. Brazil's agricultural and terraced areas sometimes result in drainage concentration on slopes, favoring landslide events. In Colombia, agriculture, particularly cash crops, like coffee or plantation crops, destabilized the superficial layer of soil and maintained higher moisture levels, contributing to increased landslide risk. In contrast, participants from Nepal highlighted,

> …by increasing soil stability and lowering surface runoff, terracing, contour farming, and other soil conservation techniques can also help to lower the risk of landslides. Additionally, efficient irrigation system management helps avoid soil saturation and lessens the chance of landslides.

In Colombia, human activities focused on the development of unplanned settlements, transportation infrastructures, and livelihoods that act as triggers for landslides in the region. Poor surface runoff management was also described as a key landslide risk. All of these factors modified the natural conditions of the terrain, such as the slope and vegetation cover, generating greater susceptibility. In Iran, Pakistan, and Nepal, the construction of houses on the banks of rivers and hazardous slopes without proper planning was highlighted as a major concern.

Respondents from Pakistan, Iran, and Nepal advocated for rigorous law enforcement to address these risks, while those from Brazil and Colombia expressed a preference for social approaches in landslide-prone areas.

Theme 3: impacts

Although participants identified multiple impacts of landslides, impacts on agricultural products (by community representatives) and agricultural distribution systems (by academics and governmental representatives) were regarded as the most significant impact by all stakeholders, because of their effects on food insecurity and public health.

Impacts on agriculture

All participants ($n = 28$) emphasized that landslides have detrimental effects on agricultural lands, both directly through washout and indirectly through debris deposition. These impacts varied in intensity across the five countries studied. Participants also noted that landslides alter the terrain, causing erosion, loss of topsoil, and changes in soil composition, impacting soil fertility and damaging crops. Finally, landslides destroyed roads that are critical for food distribution. In all countries, most government officials mentioned food insecurity as an impact of landslides because of these effects on agricultural lands and distribution networks. A Nepali government official mentioned,

> Landslides can disrupt food systems, which can raise the risk of malnutrition by causing food shortages, higher prices, and restricted access to healthy foods, especially for children, expectant and nursing mothers, and the elderly.

Additionally, a Colombian local community representative stated,

> The barriers to transferring agricultural products arise due to the destruction of the roads network with debris flows.

Other economic impacts on assets and infrastructures

All key informants ($n = 28$) stressed that their countries often experienced significant economic losses and damage from landslides. An academic in Iran stated,

> The old buildings are not safe enough against landslides. In the case of new buildings, although High-Performance Construction Materials are used, limited access to open spaces and limited accessibility for emergencies threaten them.

Participants from all five countries also mentioned impairment to utilities such as water and electricity infrastructures. They highlighted damage to economic networks due to disruptions in roads and other transportation infrastructure, affecting the movement of goods and people's mobility. Large structures, like hydropower stations or dams, were also affected by the mud or debris of landslides, leading to downstream economic impacts for the general population.

Theme 4: mitigation strategies

As mentioned, one notable finding was that public and authorities tended to underestimated landslide risks. Local governments were frequently unaware of the influence of land use and land cover changes on landslide occurrence, leading to less willingness to invest in mitigation strategies. Despite this, some actions have been taken. For example, in recent years, the government of Medellín, in Colombia, has implemented several measures to mitigate the risk of landslides in the city, including sustainable land use practices, such as reforestation.

Many experts emphasized the importance of raising public awareness to mitigate landslide risks. A few advocated for the introduction or enhancement of early warning systems to reduce landslide impacts. Additionally, some participants highlighted the significance of conducting risk assessments and mapping landslide-prone areas.

In Iran, experts recommended several measures to address landslide risks exacerbated by heavy rains. These measures include improving old and deteriorating infrastructure, relocating residents from unsafe areas, employing soil stabilization techniques, implementing artificial afforestation, and adopting water management strategies.

A representative from the civil society in Nepal emphasized the importance of proactive measures,

> It is difficult to reduce economic impacts once there is a landslide. We should think about it before the event hits. Some measures could be preventing/mitigating landslide risk, shifting people/settlement to safe places, avoiding landslide risk zones while building development projects/infrastructure, and managing residual risks through alert and warning.

Lack of internet access, and lack of electronic devices, handheld devices, and mobile phones, among others, also posed critical challenges to engaging citizens for landslide reduction. A respondent from Iran (academic) highlighted a lack of collaboration among authorities in landslide mitigation strategies,

> The most important issue in urban management in Iran is the lack of integrated management and weak cooperation of stakeholders. Much damage to critical infrastructures could be predicted before the accident with coordinated management.

Discussion

This study provides insights into landslide concerns, triggers, impacts, and mitigation strategies in Brazil, Colombia, Nepal, Iran, and Pakistan (Fig. 4). Our results were consistent with previous studies (Garcia-Chevesich et al. 2021; Sidle and Bogaard 2016; Nema et al. 2023, Pacheco Quevedo et al. 2023) that emphasized the significance of the interaction between climate change and human activities, including deforestation, land use/land cover changes, and inadequate land management as substantial contributors to the increasing impacts of landslides.

Our results also suggest that government officials are more concerned about the potential dangers of landslides compared to local communities (Table 2). Local community members tended to weigh the risk of landslides against the economic opportunities that could arise from living or working in a landslide-prone area. At a broader level, this household and community level cost-benefit calculation

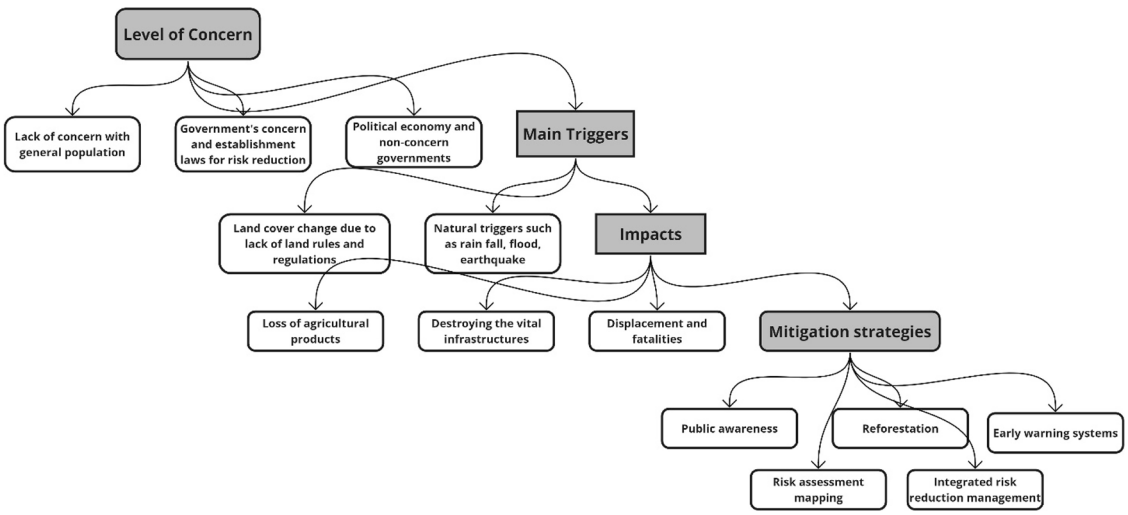

Fig. 4 Summary of key insights across themes

is influenced by broader economic and political forces, driven by both the public and the private sector. Although respondents highlighted laws preventing the modification of natural land cover in areas prone to landslides in their respective countries, poverty hindered the effective implementation of these laws. Addressing this issue at the local level necessitates a social approach rooted in empowerment, while addressing it at the national level demands the establishment of robust laws and their stringent enforcement (Petrisor et al. 2020; Verburg et al. 2019). For example, Xu et al. (2020) recommended re-allocating budgets to encourage local governments to invest not only in post-disaster reconstruction but also in incentivizing resident relocation. This approach aims to enhance land resilience and safeguard agricultural areas (Xu et al. 2020).

We also noted that most participants, including government officials, attributed landslide triggers to natural factors. In contrast, academics emphasized the exacerbation of risk stems from human activities, particularly alterations in land use and land cover. Greater awareness of the modifiable human factors that can reduce risk may promote engagement around landslide prevention, especially for governmental officials with decision-making power.

Our third theme revolved around the impacts of landslides. The perceived importance of various landslide impacts varied among different groups, with community leaders focusing on agricultural losses, and academics and government officials focusing on food system and infrastructure impacts. While prior studies acknowledge the economic, environmental, and social effects of landslides, fewer have comparatively analyzed how diverse interviewee groups perceive and understand these effects (Klose et al. 2016; Pazzi et al. 2019). Building upon these insights, our results suggest that the different priorities expressed by stakeholders may impede cooperation but could also be leveraged to emphasize shared concerns.

Our fourth theme focused on mitigation strategies. Local communities generally emphasized the importance of financial support and prompt assistance in the aftermath of a disaster, while academics leaned towards a process-oriented approach, and government officials tended to be more result-oriented. This bias is natural to some extent, given that the performance of government officials is typically assessed based on achieved results. Although all groups emphasized the importance of involving local communities to initiate planning from the grassroots level, engaging with relatively impoverished communities in these high-risk regions poses a complex challenge. Strategies that foster participation alongside empowerment may be especially valuable to overcome this difficulty (Klimeš et al. 2019a, b; Pan et al. 2022). Actively involving the community in planning and implementation through a participatory approach can promote heightened awareness and resilience. Such planning signifies a mutual success for both the local inhabitants and the government.

In addition to providing insight into similarities and differences in stakeholder perspectives across different stakeholder groups, our results also highlighted similarities and differences across countries (Table 3). In Brazil and Colombia, the governmental response to landslides has been proactive, with comprehensive laws and policies aiming at landslide risk reduction reflecting a higher level of concern at the government level. Conversely, in Nepal, local governments have tended to prioritize immediate economic benefits over landslide mitigation. In both countries, the level of concern of governmental officials remained higher than that of local community representatives.

Similarly, while participants from all countries described the interplay between natural and human-induced factors, the emphasis on specific triggers varied. Academic and government respondents in Brazil, Iran, and Pakistan highlight climate change impacts, whereas respondents from Nepal and Colombia emphasized more immediate natural triggers and inadequate land management practices. This variation underscores the complexity of landslide triggers, which encompass both broad, long-term environmental changes and immediate, local land management practices. It emphasizes the need for a multi-faceted approach to landslide mitigation, combining immediate relief measures with long-term strategies that address the root causes of landslides, such as climate change and land use mismanagement.

Table 2 The level of concern about the landslides, comparing community members and local governments perceptions

Country	People concern		Local government concern	
	Yes	No	Yes	No
Brazil	50%	50%	100%	0%
Colombia	33%	67%	100%	0%
Nepal	33%	67%	78%	22%
Iran	38%	63%	75%	25%
Pakistan	40%	60%	60%	40%

Conclusion

This research underscores the need for a nuanced, dual-pronged policy approach to effectively address landslide risk. Recognizing that government officials perceive landslides as a major threat, we propose policy strategies that incentivize resident relocation as well as reconstruction following landslides.

Rigorous law enforcement and sustainable development practices are also required to prevent human activities that increase the risk of future landslides through changes in land use and land cover. Alongside these governmental actions, fostering citizen engagement in monitoring and proactive measures is crucial.

Thus, building global resilience to landslides requires higher-level investment and government action as well as citizen education and engagement in monitoring and proactive local measures. Effective strategies that balance reconstruction, relocation, law enforcement, and community engagement to enhance overall resilience will be critical for future developments in landslide risk reduction.

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Table 3 Keywords for each theme in the five countries and the percentage mentioned by each interviewee group

Country	Triggers	Impacts	Mitigation
Brazil	• Rainfall (government officials 100%, academics 100%) • Land cover changes (government officials 50%, academics 100%)	• Displacement (government officials 50%, academics 100%) • Agricultural damages (government officials 50%, academics 100%) • Economic losses (government officials 100%, academics 100%)	• Assessment and mapping (government officials 50%, academics 100%) • Early warning system (government officials 50%, academics 100%)
Colombia	• Rainfall (government officials 100%, local community representatives 100%) • Earthquakes (government officials 100%, local community representatives 0%) • Land use mismanagement (government officials 100%, local community representatives 0%)	• Displacement (government officials 100%, local community representatives 100%) • Agricultural damages (government officials 100%, local community representatives 100%) • Economic losses (government officials 100%, local community representatives 100%) • Impact of food (government officials 100%, local community representatives 0%)	• Increase awareness (government officials 100%, local community representatives 0%) • Early warning system (government officials 100%, local community representatives 100%) • Regional and land use planning improvement (government officials 100%, local community representatives 0%)
Nepal	• Rainfall (government officials 100%, NGO/civil society representatives 100%, local community representatives 100%) • Earthquakes (government officials 100%, NGO/civil society representatives 50%, local community representatives 0%) • Land use mismanagement (government officials 66%, NGO/civil society representatives 100%, local community representatives 66%)	• Displacement (government officials 66%, NGO/civil society representatives 33%, local community representatives 100%) • Agricultural damages (government officials 100%, NGO/civil society representatives 100%, local community representatives 100%) • Economic losses (government officials 66%, NGO/civil society representatives 100%, local community representatives 66%) • Impact of food (government officials 66%, NGO/civil society representatives 100%, local community representatives 66%) • Loss of lives (government officials 100%, NGO/civil society representatives 100%, local community representatives 100%)	• Assessment and mapping (government officials 100%, NGO/civil society representatives 66%, local community representatives 0%) • Increase awareness (government officials 66%, NGO/civil society representatives 100%, local community representatives 100%)
Iran	• Rainfall (government officials 100%, academics 100%, policy experts 100%) • Earthquakes (government officials 75%, academics 100%, policy experts 0%) • Man-made causes (government officials 50%, academics 100%, policy experts 100%) • Climate change impacts	• Economic losses (government officials 100%, academics 100%, policy experts 100%) • Agricultural damages (government officials 100%, academics 100%, policy experts 100%)	• Assessment and mapping (government officials 75%, academics 100%, policy experts 100%) • Increase awareness (government officials 100%, academics 100%, policy experts 100%)

Table 3 (continued)

Country	Triggers	Impacts	Mitigation
Pakistan	Rainfall (government Officials 100%, academics 100%) • Earthquakes (government officials 100%, academics 100%)	• Loss of lives (government officials 66%, academics 100%) • Economic losses (government officials 66%, academics 100%) • Impact of food (government officials 33%, academics 100%)	• Increase awareness (government officials 100%, academics 100%) • Early warning system (government officials 66%, academics 100%)

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Author contribution

Safiyeh Tayebi and Ubydul Haque conceived the study design and collected data. Safiyeh Tayebi and Md. Akib Jabed analyzed data. Safiyeh Tayebi and Md. Akib Jabed drafted the initial version of the manuscript. Ana Lorena Ruano, Gwenyth Lee, Paula F. da Silva, Saleh Ahmed, Edier V. Aristizábal G., Ranjan Kumar Dahal, Arezoo Soltani, Mohammad Imran, Md. Atiqur Rahman, and M-Ashraful Islam contributed in writing. All authors read and approved the final version of the manuscript.

Declarations

Conflict of interest The authors declare no competing interests.

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