

Landslides (2020) 17:2253–2269
 DOI 10.1007/s10346-020-01519-y
 Received: 15 July 2020
 Accepted: 17 August 2020
 Published online: 31 August 2020
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 part of Springer Nature 2020

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Sendai voluntary commitments: landslide stakeholders and the all-of-society approach enhanced by UNDRR

Abstract The resilience of communities and nations is a necessary condition for sustainable development. Building resilience, however, is not always a straightforward process and requires joint efforts, an all-of-society approach. Thus, the commitment, goodwill, knowledge, experience, and resources of all stakeholders contributing to disaster risk reduction (DRR) are crucial. In UNDRR's Sendai Framework Voluntary Commitments online platform, the work of all stakeholders can be showcased and tracked. Using novel data from this platform, this article presents descriptive information about the types of commitments made by stakeholders working on landslides. Results suggest that landslide is the third most covered hazard. Commitments working on this hazard have a more balanced distribution of global, regional, and local actions as compared with the whole sample. Also, landslide commitments tend to display higher levels of collaboration (as measured by the number of organizations involved) and longer duration (a commitment will last 7.6 years on average). Common issues being addressed include capacity development, risk management, and community-based DRR. When looking at specific regions and countries, there are opportunities for increased partnerships and effectiveness in topics such as knowledge sharing and technology solutions. The systemic nature of risks is increasingly apparent, and this article may stimulate further studies analyzing complexity and the joint action of all stakeholders committed to accelerate the implementation of the Sendai Framework.

Keywords Stakeholders · Landslide · All-of-society · Commitments

Introduction

Sustainable development depends on achieving the resilience of nations and communities among other conditions necessary to expand well-being around the world. While resilience alone is not sufficient for sustainable development, it is increasingly clear that proper disaster risk management is indispensable. Hard-earned development gains can be wiped out, set back, or slowed down because of the occurrence of hazard events that, in the absence of proper preparations, become disasters. Another reason is the increased frequency, intensity, and duration of some weather-related events. This seems to be the case in areas affected by drought and for water-related hazards associated with events such as El Niño Southern Oscillation (ENSO), hurricanes, and cyclones (Cann et al. 2013). Risks generated from these amplifications interact with complex and natural systems creating reverberations, loops, and cascading effects that are larger, more complex, and more difficult to foresee (Gordon et al. 2019).

The previous factors are evidently intertwined with socio-economic conditions. In 2018, more than 60 million people were affected by natural hazards (CRED 2019; Gu 2019). In 2018, the occurrence of landslides was registered as 13 below the average of 19 for the period 2008–2017. For 2018, the number of deaths

accrued to landslides was 275 (the average was 1034 for 2008–2017), the number of affected people was almost 0.1 million (0.3 million for 2008–2017), and economic losses are around USD0.9 billion which represents an increase from the USD0.3 billion average for 2008–2017 (CRED 2019). Data from “EM-DAT: The Emergency Events Database” indicated that between the years 2000 and 2018, on average, more than 200 million people were affected and as many as 70,000 lives were lost every year. In addition to the tragedy of disaster mortality and affected people, the economic losses are also significant. A study across 117 countries found that while asset losses may account for an average of USD237 billion a year (high-income countries are more affected in absolute economic terms), when accounting for well-being losses, the cost rises to around USD520 billion a year (Hallegatte et al. 2017; The World Bank 2017). The study also found that poor people, in the bottom 20% with respect to the income distribution, experience only 11% of total asset losses, but as much as 47% of well-being losses. This is because disaster losses tend to concentrate on narrow shares within the population of a country. Inequality exacerbates imperfections in the sharing of losses because poor people have limited capacity to cope with them. These results further strengthen the evidence that poor people are more severely affected by disasters in terms of their lives, homes, and livelihoods. In several low- and middle-income countries, people exposed to natural hazards are seven times more likely to die and six times more likely to be injured, lose their home, be displaced, be evacuated, or require emergency assistance as compared with people in high-income countries (Wallemacq and House 2018). As a result of disasters, around 26 million people are forced into poverty each year (Hallegatte et al. 2017).

Facing this complex scenario, coordinated efforts from all relevant actors are necessary (UNDRR 2019b). The Sendai Framework for Disaster Risk Reduction 2015–2030 (Sendai Framework), the global roadmap for reducing disaster losses by 2030, stipulated that the primary responsibility for disaster risk reduction lies with the State, but it also underlined that all other stakeholders share this responsibility. In other words, an all-of-society approach is critical for DRR. To further strengthen this approach and put into practice the discourse, the United Nations Office for Disaster Risk Reduction (UNDRR) launched on 31 December 2018 the Sendai Framework Voluntary Commitments online platform (VC platform hereafter). The initiative of the VC platform can be tracked back to the General Assembly (GA) resolutions A/68/211 (2013) and 69/219 (2014) that recognize the importance of partnerships for DRR. After the Third UN World Conference on Disaster Risk Reduction (WCDRR), organized in March 2015 in Sendai, Japan, GA resolution A/69/283 (2015) called for all stakeholders to contribute with VCs that are specific and time bound at local, national, regional, and global levels in line with DRR strategies and plans as a way to support the implementation of the Sendai Framework. UNDRR was designated to provide an online infrastructure to

publicize these VCs. The VC platform confirms the value that UNDRR puts on the all-of-society approach as an effective path to build more resilient communities around the world. All stakeholders (local governments, the private sector, civil society organizations, academia, science and technology, media, etc.) working on DRR can submit their VCs to support the implementation of the Sendai Framework at <https://sendaicommitments.undrr.org/>.

Since its launch, the VC platform has already published commitments made by stakeholders that are covering hazards of landslides (landslides VCs hereafter). The International Consortium on Landslides (ICL) published one of the flagship commitments on this topic under the title “Sendai Landslide Partnerships 2015–2025.” This VC aims at reducing landslide disaster risk by promoting research, practical tools, and capacity building (available at https://sendaicommitments.undrr.org/commitments/20190110_001). It was signed during the WCDRR in Sendai, Japan, and it is currently supported by 22 different global stakeholders working on landslide disaster risk reduction, including UNDRR. Among the committed deliverables, there are knowledge products such as books, teaching tools, and journal papers as well as the organization of forums, among others (Sassa 2019a, b). Nevertheless, there are also a number of other VCs that address landslides within their actions.

The article aims to better understand these VCs by focusing on three issues: the attention being paid to landslides among all stakeholders working on DRR (those who published VCs at UNDRR’s Sendai Framework Voluntary Commitments online platform); the characteristics of landslide VCs; and the existence of commonalities among these VCs. Eventually, it is hoped that the information presented could stimulate cooperation and systemic approaches. Data is provided by the VC platform, and the methodology is mainly descriptive. In addition to the descriptive statistical analysis of main variables, this article also applies an algorithm to the texts provided by stakeholders describing their VCs to identify other non-standard thematic commonalities. Overall, results suggest that among published VCs, landslide is the third most common hazard (9.6%) behind floods (13.3%) and earthquakes (11.7%). As a matter of fact, a little more than 60% of all currently published VCs include landslides within their hazard coverage. Landslide VCs display more cooperation (higher average number of implementers and other partners) and longer durations (7.6 years on average for how long a commitment will last from the starting to the ending date). Among the themes and issues covered by landslide VCs, capacity development, disaster risk management (DRM), and community-based DRR are the most frequent themes being addressed. The Sendai Priority for Action 1 (understanding disaster risk) is the most covered along with Target B on reducing the number of affected people attributed to disasters (along with indicator B1) and Target E on increasing the number of countries with DRR strategies (along with indicator E2). Finally, Sustainable Development Goals (SDGs) 11 (sustainable cities and communities), 13 (climate action), and 17 (partnerships for the goals) stand out as the most frequently addressed SDGs among the landslide related VCs.

The contribution of this article is the use of novel data containing quantitative and qualitative indicators describing stakeholders’ voluntary commitments to implement the Sendai Framework. To our knowledge, there are no other studies providing this information while also being able to focus on specific hazards such as

landslides within a systemic framework. The authors hope that the information presented provides additional evidence for continuously fine-tuning the meaningful work of stakeholders toward a coherent implementation and accelerated progress. Likewise, the data and results may stimulate additional questions to be studied in the future. The next section covers data and methodology. The “Results” section presents and discusses the results. The final section draws some conclusions.

Data and methods

The data used comes from the “commitments” database managed through the VC platform being operated by UNDRR. Data was accessed on 18 June 2020 and includes all published voluntary commitments to that date. There are 37 published voluntary commitments where 105 focal points from 88 different organizations around the world are working to build more resilient societies (the number of 88 organizations accounts for and eliminates duplicates. An organization can be involved in more than one VC). Out of those 37 commitments, 23 include landslides within their covered hazards. Each VC reports a number of data that are validated and subsequently published in the VC platform. For example, stakeholders may report that their projects are covering more than one hazard (*hazards*) at the same time. The same is applied to themes and issues (*themes*), which is based on PreventionWeb’s standardized list aiming to be both wide and cross-cutting. The Sendai Framework outlines four priorities for action and seven clear global targets to prevent new and reduce existing risk. The four Sendai Priorities for Action (*priorities*) are understanding disaster risk, strengthening disaster risk governance to manage disaster risk, investing in disaster risk reduction for resilience, and enhancing disaster preparedness for effective response, and to “Build Back Better” in recovery, rehabilitation, and reconstruction. The set of seven targets (*targets*) and indicators (*indicators*) provide clear strategic orientation to fulfill the Sendai priorities for action. The seven global targets and indicators set the road for substantial reduction of disaster risk and losses in lives, livelihoods, and health, and in the economic, physical, social, cultural, and environmental assets of persons, businesses, communities, and countries. In 2015, the 2030 Agenda for Sustainable Development set 17 sustainable development goals (SDGs) increasing attention to the roles played by global leadership, resources, and solutions combined with local actions as reflected in policies, plans, budgets, institutions, and regulatory frameworks. To increase alignment and coherence across these international agendas (Sendai Framework and SDGs, among others), the monitoring of the previous variables is recommended. Likewise, a VC can have more than one focal point (*focal points*) representing either implementing organizations (*implementers*) who are directly involved in the execution of the VC or other organizational partners (*other partners*) who are supporting the VC, but not directly involved in the VC. Each VC can also be supported by donors (*donors*) and contribute to one or more umbrella initiatives (*umbrella initiatives*). The guidelines for VC submission indicates that “An umbrella initiative is a major project/plan that is often formally agreed and defined. It provides a framework and consolidates efforts by several entities to support and advance specific areas of work, such as a joint stakeholder commitment at a Regional Platform” (available at <http://unisdr.org/go/sfvc/guidelines>). Finally, to increase accountability and facilitate the

Table 1 Summary statistics (selected variables)

Variable	VCs (all) Mean	SD	Min.	Max.	CV	<i>n</i>	VCs (landslides) Mean	SD	Min.	Max.	CV	<i>n</i>
Hazards	6.49	4.03	1	17	0.62	37	8.09	4.00	1	17	0.49	23
Themes	8.81	6.21	1	26	0.70	37	10.83	6.34	2	26	0.59	23
Targets	3.46	1.56	1	7	0.45	37	3.96	1.66	1	7	0.42	23
Priorities	2.95	0.97	1	4	0.33	37	3.09	1.00	1	4	0.32	23
Indicators	7.00	6.11	1	38	0.87	37	7.78	7.42	1	38	0.95	23
SDGs	4.24	2.18	1	11	0.51	37	4.65	2.19	1	11	0.47	23
Focal points	2.84	1.85	2	12	0.65	37	2.65	0.98	2	5	0.37	23
Donors	1.08	1.62	0	7	1.50	37	1.22	1.88	0	7	1.55	23
Umbrella initiatives	0.65	0.48	0	1	0.75	37	0.65	0.49	0	1	0.75	23
Implementers	1.76	1.44	1	7	0.82	37	2.04	1.74	1	7	0.85	23
Other partners	3.18	2.40	1	9	0.75	11	4.00	3.83	1	9	0.96	4
Years	6.37	5.52	0.33	18.01	0.87	37	7.06	5.67	0.33	18.01	0.80	23
Deliverables	3.19	1.75	1	9	0.55	37	3.17	1.61	1	8	0.51	23
Completed deliverables	2.60	1.93	1	9	0.74	20	2.36	1.43	1	6	0.61	11
Progress reports	0.46	0.65	0	2	1.41	37	0.48	0.67	0	2	1.39	23

Variables indicate number of items per commitment. SD stands for standard deviation and CV for coefficient of variation as measures of dispersion. Min. and Max. indicate minimum and maximum values for each variable respectively. Values under *n* present the number of observations in terms of voluntary commitments (number of voluntary commitments containing that observation)

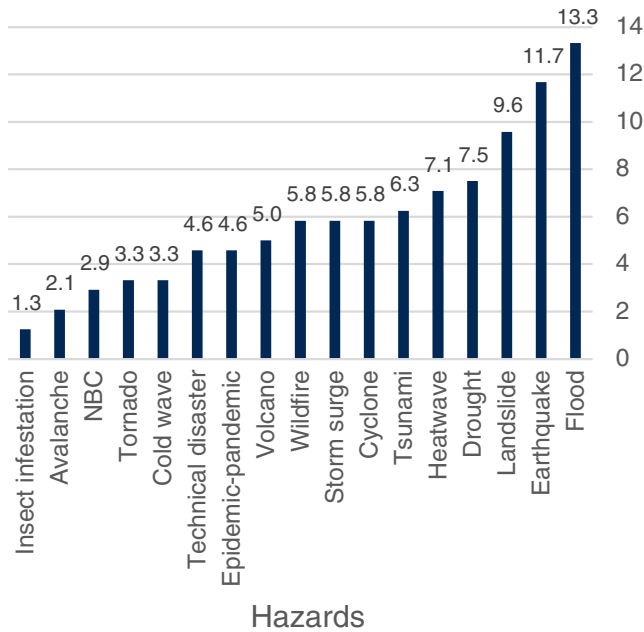


Fig. 1 Hazards covered by VCs (all). Source: UNDRR Voluntary Commitments. NBC stands for Nuclear, Biological, Chemical hazards

monitoring by stakeholders, a VC states specific deliverables (*deliverables*) to be reached within specific intended dates of delivery, provides the output(s) of these deliverables when they are completed (*completed deliverables*), and submits regular progress reports (*progress reports*). Table 1 provides summary statistics for these variables.

Even though each one of these variables will be analyzed in more detail in the rest of the article (Figs. 6, 7, and 8, in particular, share a more detailed comparative analysis of basic characteristics), it is

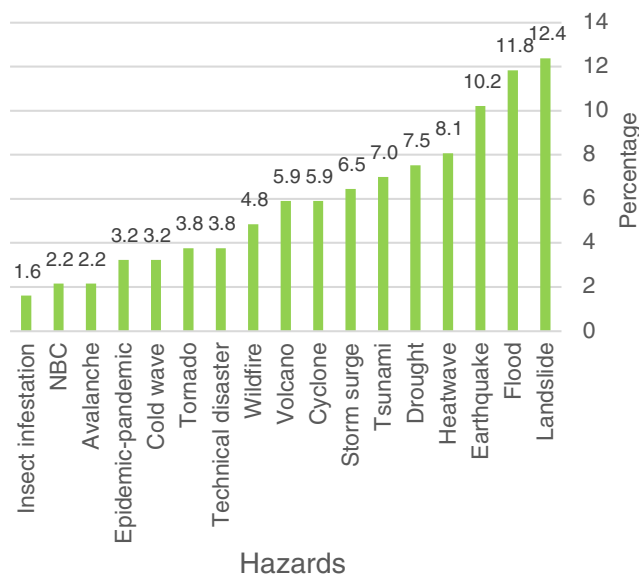


Fig. 2 Hazards covered by VCs (landslides). Source: UNDRR Voluntary Commitments. NBC stands for Nuclear, Biological, Chemical hazards

noteworthy that non-trivial differences emerge between summary data for all published VCs and data for VCs covering landslides. For instance, while a landslide VC covers an average of 8 different hazards with each project (signaling perhaps the consideration of a multiple-hazard approach), the rest of the VCs are covering around 6 hazards each. In the case of *implementers* and *other partners*, it can be observed that landslide VCs have on average a larger number of organizations working together and collaborating for implementing each project (generally more than 2 organizations directly implementing and more than 4 organizations supporting each landslide VC. For the whole sample, these numbers are lower). Given that each variable represents the number of items featured in each VC, similar observations can be made for other variables. Another observation is that, having executed the data cleaning procedure, the values of analyzed variables are within expected ranges and there are no outliers. Overall, landslides VCs have less dispersion as well (as measured by standard deviation and the coefficient of variation). It is quite apparent that landslide VCs are more ambitious in terms of coverage of DRR issues (as measured by the average number of hazards, themes, targets, etc.) and collaboration to implement VCs. The analysis of these points will be expanded in the next section.

The methodology included a data cleaning process and a statistical analysis that are mainly descriptive and focused on the characteristics of VCs working on landslides. For each variable, the article presents a visual representation of the data analysis results along with text observations to complement the statistical outputs. When informative, results for landslides VCs are compared with the results corresponding to the analysis of all currently published VCs. Along with the descriptive statistical analysis, a sentiment analysis was executed based on an algorithm measuring word frequencies within the texts provided by main focal points to describe their VCs. The algorithm counts frequencies both for individual words and phrases. The first step is the standardization of texts. Then, there is a removal process of connecting words using standardized datasets along with the extraction of punctuation, other symbols, and filters to study outputs beyond frequent or non-relevant words. While most of the main statistical analyses were done using Stata and Tableau, the algorithm for the analysis of frequency in text was executed in R. Results are presented in an aggregated manner. Data marked as private by VC's main focal points is neither revealed nor presented individually.

Results

For a better understanding of VCs working on landslides, this section addresses the following: how common is the hazard of landslides among stakeholders' VCs, the characteristics of VCs covering the hazard of landslides, and the existence of any other additional commonalities as a window to explore potential collaboration and systemic action. For several cases, results corresponding to all published VCs are presented along with landslide VCs, particularly when the comparison can help identify meaningful differences.

Attention being paid to landslides among stakeholders working on DRR

Each voluntary commitment can specify a range of information. Among the information provided is the type of hazards being covered as a result of the actions implemented by a commitment.

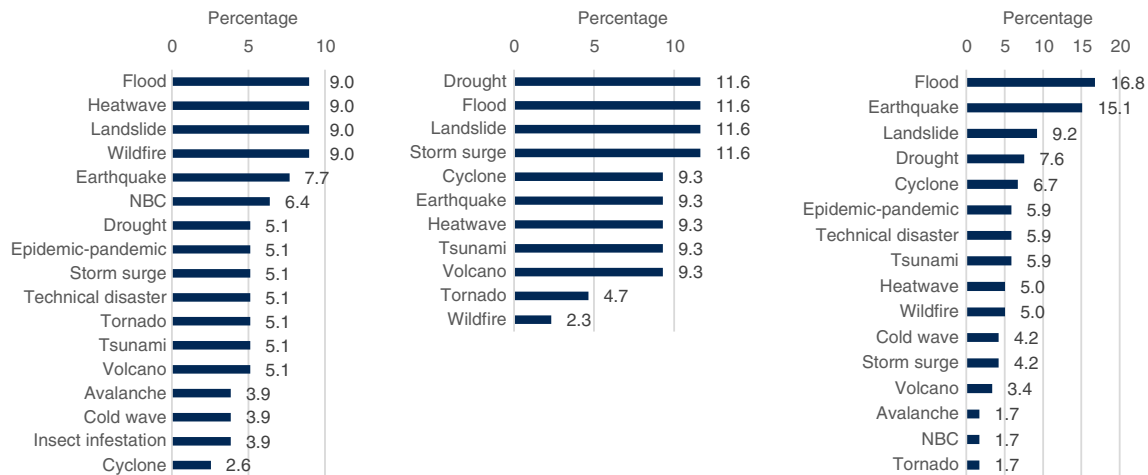


Fig. 3 Hazards covered by VCs by scope type (all). Source: UNDRR Voluntary Commitments. NBC stands for Nuclear, Biological, Chemical hazards

In Fig. 1, we present a description of all types of hazards being covered by the published commitments so far. The standard for classifying hazards is the same one used by PreventionWeb. Results indicate that landslide is the third most covered hazard by all published commitments (9.6%). Flood (13.3%) and earthquake (11.7%) accompany landslide at the top three. As expected, when the results are analyzed focusing only on landslide VCs, the top hazard is landslide (12.4%) (Fig. 2). Even though there is a re-positioning, the top five hazards being covered for both cases are the same.

Commitments can have three different levels of geographic scope: global, regional, or national/local (Fig. 3). The global scope indicates that a VC could be implemented in any country/territory in the world (it does not necessarily mean that a VC with global scope is currently being implemented in all countries/territories) (Fig. 3a). The regional scope indicates that a VC could be implemented in any country/territory within a specified region (as in the global case, a regional VC does not necessarily

imply current implementation in all countries/territories within the selected regions) (Fig. 3b). Lastly, a VC with national/local scope is typically focused at the state/province/prefecture; city; and/or locality levels (Fig. 3c). Among currently published VCs, 59.5% have a national/local scope (47.8 for landslide VCs), 27% have a global scope (30.4% for landslide VCs), and 13.5% have a regional scope (21.8 for landslide VCs) (Fig. 4). Overall, results are replicated. However, in comparison with all VCs, landslide VCs have increased attention to global and regional scopes which could be an indication for more systemic approaches (especially VCs working in specific issues and territories across different regions). Also, regional organizations have an important role in supporting the promotion and advancement of determined pressing issues (Mizutori 2020b).

For each scope type, landslide and flood are consistently among the top three hazards both for all and landslide VCs. In addition to those hazards, heatwave (global, 8.8%), earthquake (national/local, 13.3%), and drought (regional, 11.6%) are also highly relevant.

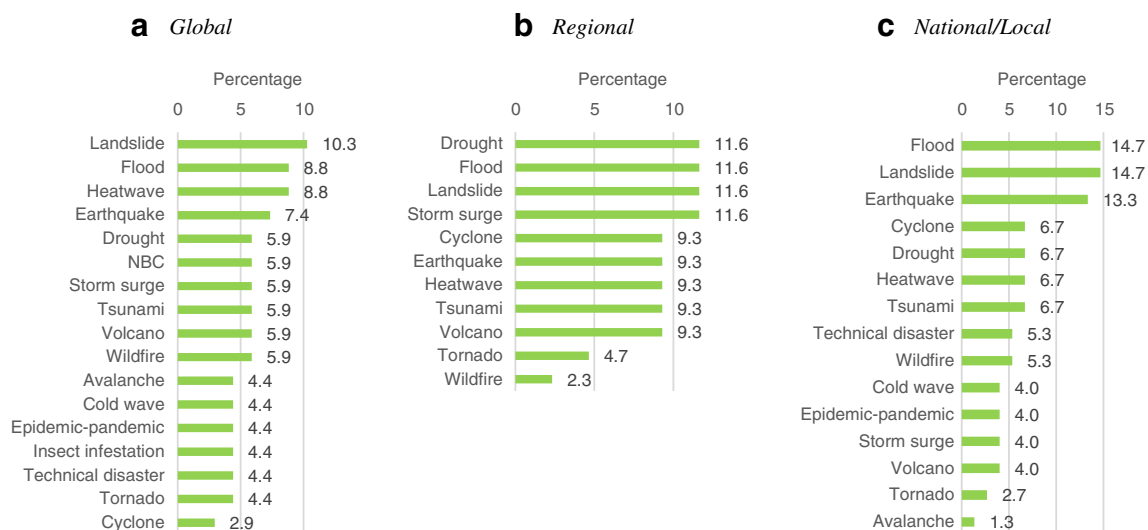


Fig. 4 Hazards covered by VCs by scope type (landslides). Source: UNDRR Voluntary Commitments. NBC stands for Nuclear, Biological, Chemical hazards

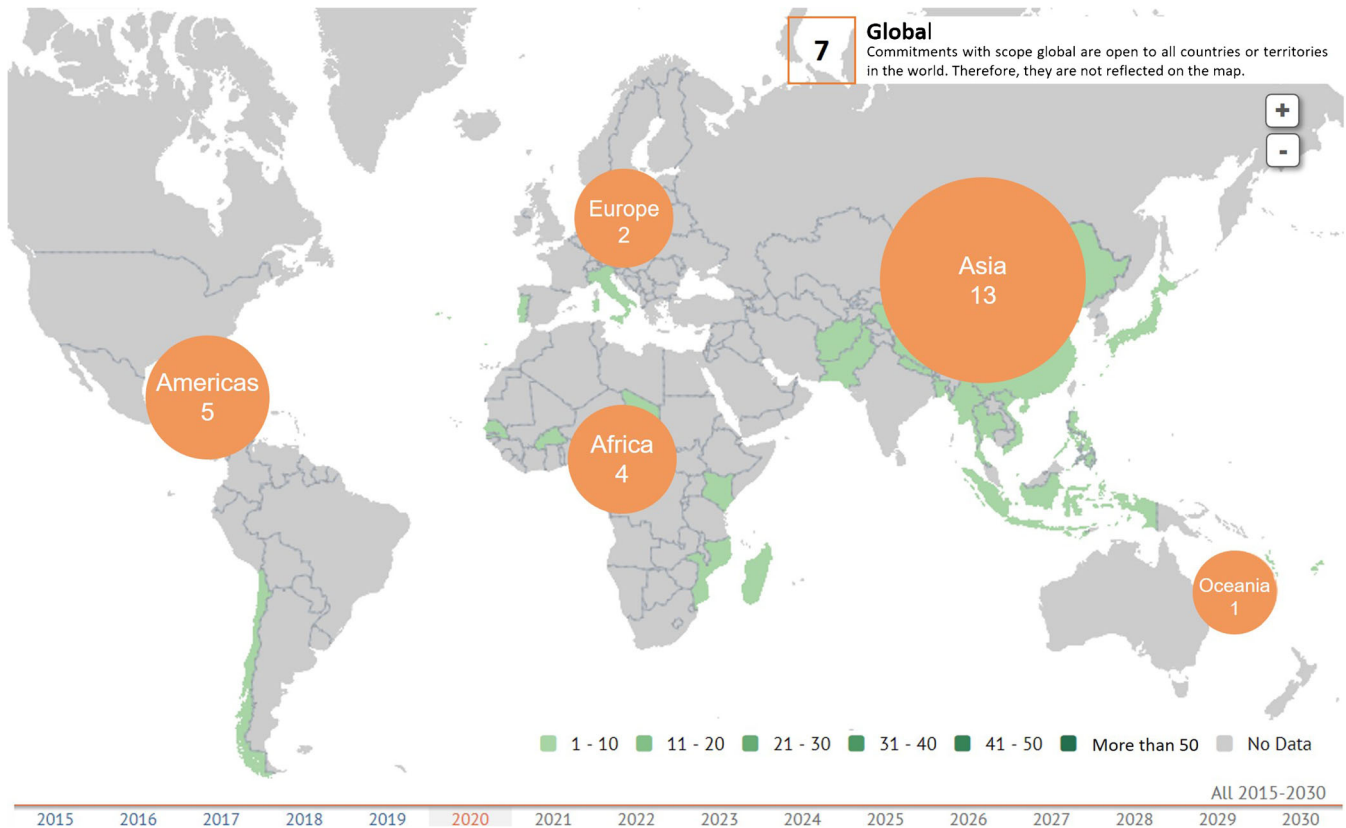


Fig. 5 Regions with countries/territories having VCs that cover landslide hazards around the world by region. Source: UNDRR Voluntary Commitments. There are 7 commitments with global scope that are not included in the map as they cover all countries/territories. Data on the map reflect the number of countries/territories covered by voluntary commitments. They do not reflect the total number of voluntary commitments (for instance, one commitment may cover countries/territories in three regions at the same time).

Drought can often be expressed as a slow-onset disaster. The challenges behind drought might be interconnected, which may explain why they are prioritized at the regional level. Landslides

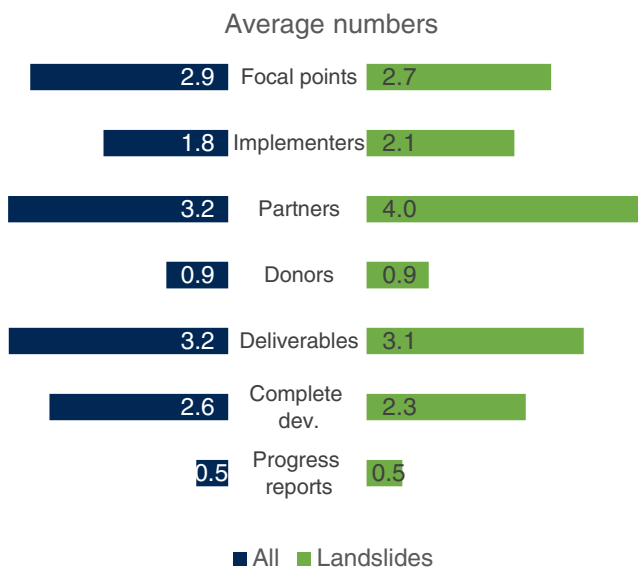


Fig. 6 Basic characteristics. Source: UNDRR Voluntary Commitments

can be caused by natural or human triggers. Human triggers include deforestation, irrigation leakage, mine tailings, ocean current alteration, etc. With regard to natural triggers, it is possible that more landslides may occur as global warming influences rainfall intensity. Nevertheless, landslides are also caused by flooding, earthquakes, volcanic eruptions, and others (Mizutori 2020a). It is estimated that between 2004 and 2016, more than 55,000 people lost their lives in 4862 distinct landslide events (Froude and Petley 2018). There are good reasons for landslides to be among the three most covered hazards.

A better understanding of individual hazards is useful. Nonetheless, looking at the future, it is increasingly apparent that hazard-by-hazard risk reduction is given way to reflections on the systemic nature of risks (UNDRR 2019a). The next section of the article aims at providing more information

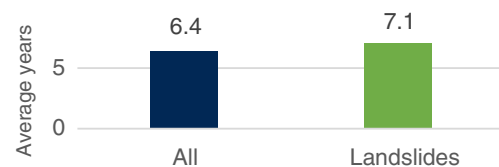


Fig. 7 Average years. Source: UNDRR Voluntary Commitments

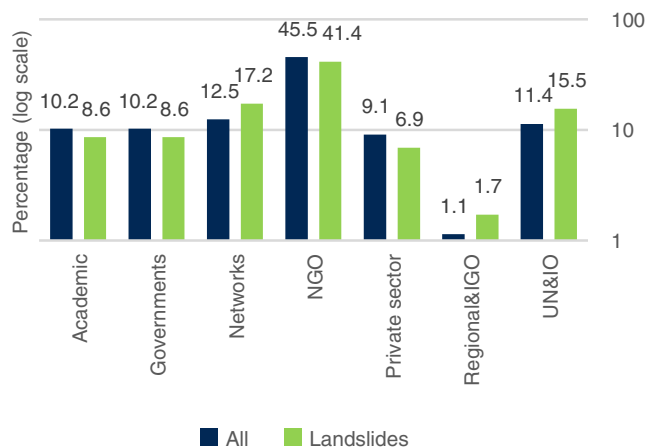


Fig. 8 Organization types. Source: UNDRR Voluntary Commitments

that could help understand VCs further than only the hazards that are being covered.

Types of commitments that are covering the landslides hazard

Out of 23 VCs covering landslides, 7 have a global scope and the others (with regional and national/local scopes) are distributed across five regions of the world (Fig. 5). The region of Asia has a larger coverage along with a more spread distribution within the region (regions include Africa, Americas, Asia, Europe, and Oceania; this classification is in agreement with the standard regional categories defined by the United Nations Statistical Division (UNSD)). For other regions, there is room for improvement in terms of increased submission of VCs. The Appendix Table 2 presents a complete list of all VCs that include landslides within the hazards being covered by their activities. A similar list could also be visualized online using the filters of the VC platform, as one of the objectives of the platform is to know “who is doing what, where.”

Taking a look at the basic characteristics, it can be observed that as compared with all VCs, landslide VCs seem to display higher levels of cooperation (Fig. 6, Fig. 7). This can be supported by the larger number of organizations (both implementers and other partners) that are involved in each VC (Fig. 8). When analyzing the duration, landslide VCs have on average longer life spans (the

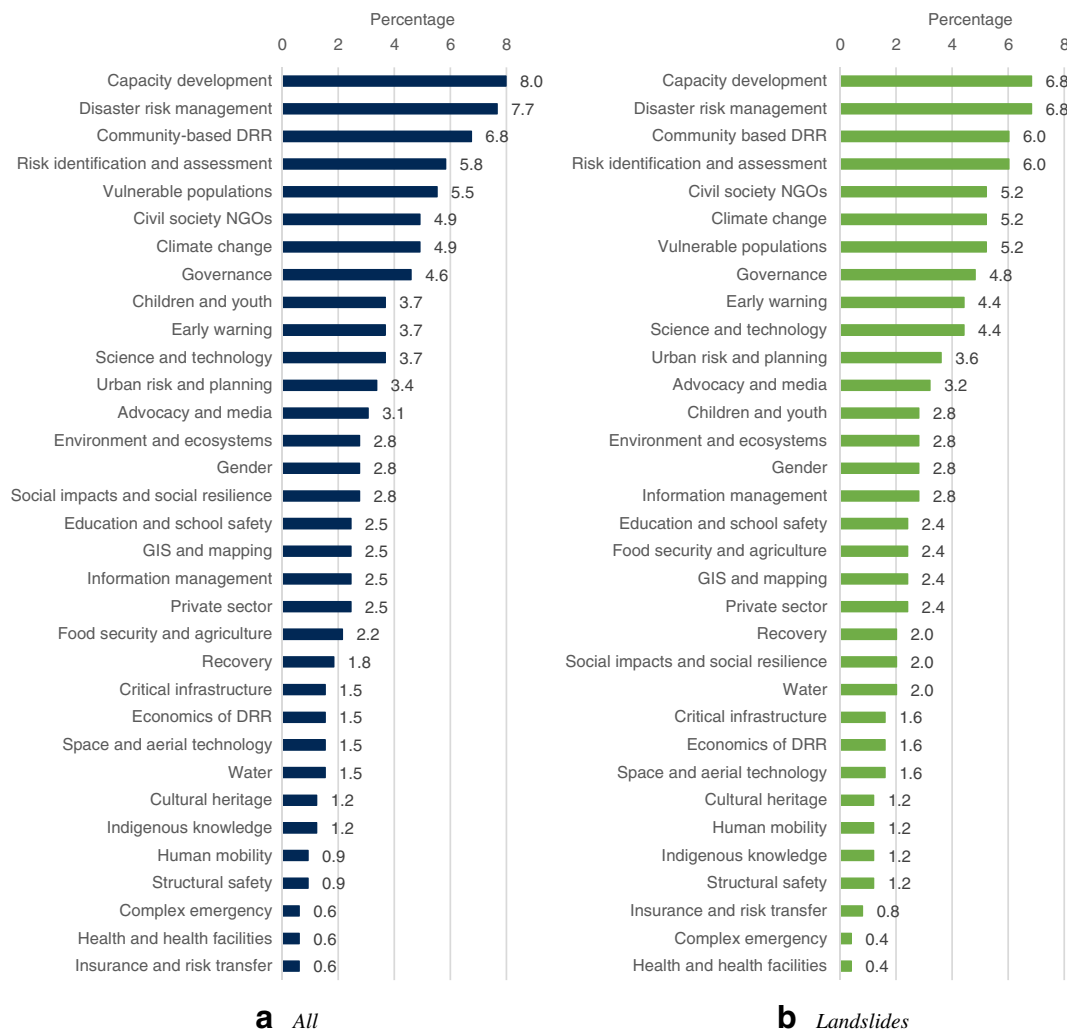


Fig. 9 Coverage of themes and issues (landslides). Source: UNDRR Voluntary Commitments

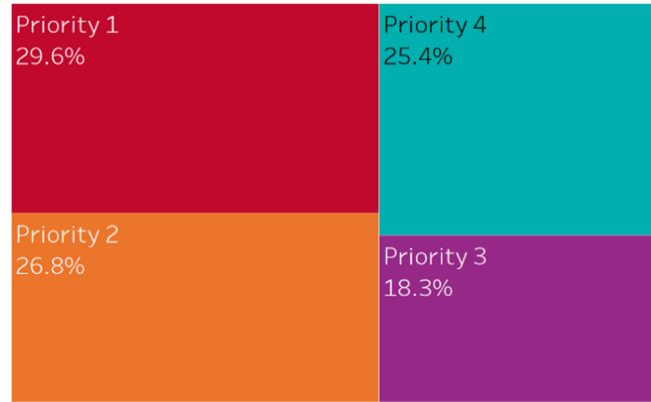


Fig. 10 Coverage of priorities (landslides). Source: UNDRR Voluntary Commitments

mean duration is 7.1 years). On average, three deliverables are produced by VCs and about half of them have reported on progress at least once. The results in terms of deliverables should be taken with care because the quantity measured in these indicators does not always convey a meaningful message in terms of the quality of these deliverables.

Based on a standard classification of themes and issues, capacity development, disaster risk management, and community-based DRR appear as priority areas of work for VCs (Fig. 9). One of the reasons why capacity development is a common theme could be related to the important role of implementation and the fact that there are several academic and research institutions among the organizations working to build resilience for landslides. Among the top ten, there are other themes including civil society, non-governmental organizations, and vulnerable populations which could be related to the community work on DRR. These results are in line with evidence suggesting that landslides triggered by human activity are increasing (construction, illegal mining, and hill cutting) which at least should increase attention to human disturbance in addition to climate in future landslide incidence (Froude and Petley 2018). Climate change, governance, and early warning systems are also included. The latter seem to be gaining ground though a review of landslide early warning systems (LEWS) worldwide between 1977 and 2019 found that only a

limited number of countries are using them (Guzzetti et al. 2020). There is also some evidence about the role of the plurality of voices and participatory processes for inclusive risk governance in landslides as a way to face obstacles of political instability, unfair allocation of resources at the local level, residents' lack of knowledge, and divergent views on illegal development, among others (Scolobig 2016). The Sendai Framework advocates for better understanding of disaster risk and governance as key pieces to reduce risk.

Next, strategic characteristics in terms of Sendai Priorities for Action, Targets and Indicators are analyzed. Focusing on landslide VCs (there are no meaningful differences when comparing the results to the outputs by all VCs), there is a rather balanced approach for covering all four priorities for action (Fig. 10). Among the four priorities for action, however, priority number three (investing in disaster risk reduction for resilience) is currently receiving less attention. Based on several progress reports, access to resources seems to be a prevalent obstacle in particular for smaller organizations. In terms of targets (Fig. 11), Target B on reducing the number of affected people by disasters (20.9%) is the most frequently covered. After Target B, Targets E on increasing the number of countries with DRR strategies (15.4%), G on increasing multi-hazard early warning systems, disaster risk information as well as assessments (15.4%), and C on reducing direct

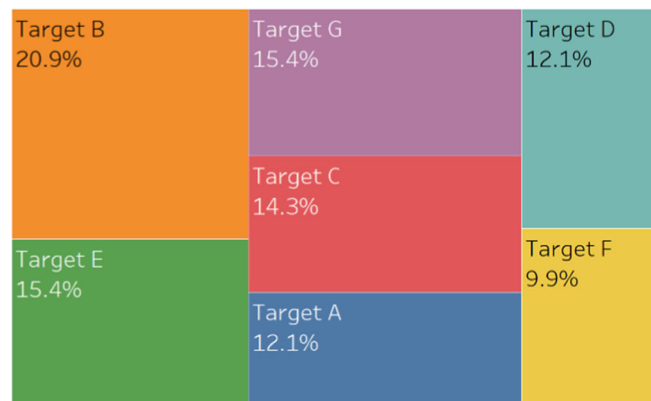


Fig. 11 Coverage of targets (landslides). Source: UNDRR Voluntary Commitments

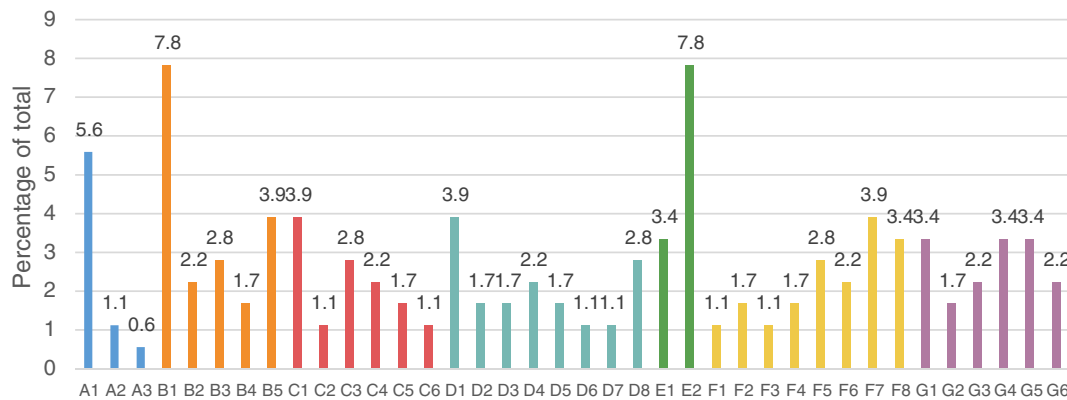


Fig. 12 Coverage of indicators (landslides). Source: UNDRR Voluntary Commitments

disaster economic loss (14.3%) are covered with similar proportions. Given that Targets A to D are more outcome-focused and Targets E to G are more input-focused (Mizutori 2020b), it is encouraging to see one from each group at the top.

The Open-ended Intergovernmental Expert Working Group (OIEW) identified 38 indicators to monitor progress in the implementation of the Sendai Framework. Among landslides VCs, all indicators are covered at least once (Fig. 12). When indicators are analyzed separately, it was found that indicator B1 (number of directly affected people attributed to disasters per 100,000 population) and indicator E2 (percentage of local governments that adopt and implement local disaster risk reduction strategies) are most frequently covered, each with 7.8% of landslides VCs. Among the top three, indicator A1 (5.6%) is also frequently covered. These results could be aligned with evidence indicating that global

disaster mortality appears to be declining for some specific hazards (Bouwer and Jonkman 2018), but the number of affected people and economic losses are increasing (Green et al. 2019).

Last but not the least, an analysis of coverage for SDGs concludes this subsection describing landslides VCs (Fig. 13). Results indicated that SDG 11 (19.6%), SDG 13 (15.9%), and SDG 17 (14%) clearly stand out as goals upon which more landslide VCs are focusing their efforts.

In addition to financial resources, the available scientific, academic, and technological resources along with capabilities are also limited. Thus, increased alignment and more effective application of resources are important. The existence of frameworks for the governance of systemic risks can certainly smooth the building of resilient societies increasingly capable to deal with complexity and uncertainty (Gordon et al. 2019; Mizutori 2020b). For instance,

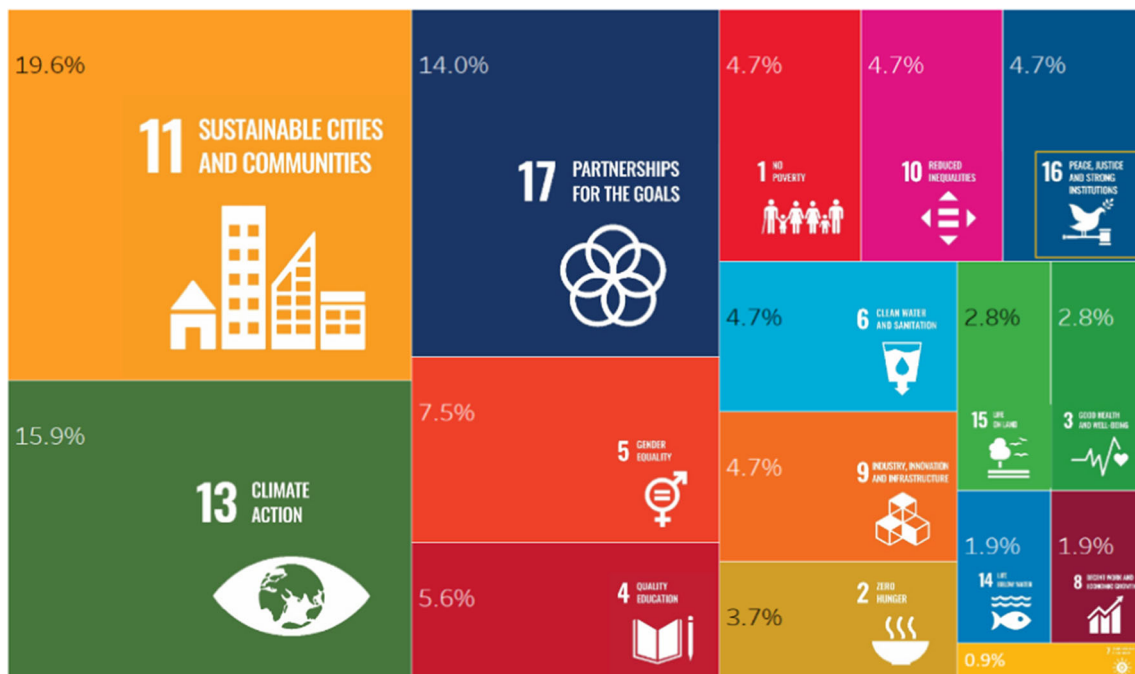


Fig. 13 Coverage of SDGs (landslides). Source: UNDRR Voluntary Commitments



Fig. 14 Frequent words in description (all-filtered). Source: UNDRR Voluntary Commitments

COVID-19 made it clear that emerging risks are multidimensional and cannot be contained within national borders. UNDRR has developed a Global Risk Assessment Framework (GRAF) as a tool for decision makers to better understand, reduce, and mitigate risk with a special focus on cascading and systemic risks.

Potential commonalities among these VCs (potential for collaboration)

Finally, this subsection conducts two additional analyses to further understand the specific details of landslide VCs. There are two types of analysis focused on frequency of concepts and exploration of connectivity. Spatial and temporal considerations need to be incorporated into the interaction of social, ecological, and economic systems (Gordon et al. 2019). The purpose is to produce some basic results that may invite reflection of researchers and other stakeholders working in DRR toward the elaboration of more sophisticated studies and/or increased systemic action.



Fig. 15 Frequent words in description (landslides-filtered). Source: UNDRR Voluntary Commitments

The first analysis focused on discovering any commonalities by exploring text patterns in the VCs. The idea was to observe beyond the standardized provision of information (for example, selected themes and issues). For this purpose, an algorithm was executed to analyze the contents provided by the main focal points for the description of each commitment. Ideally, there should be a correspondence between the issues selected in the standard categories and the results obtained from the analysis of the actual contents describing each commitment. The first set of results reveal that common words for DRR such as “disaster,” “risk,” “resilience,” and “DRR” are the most frequently used in the text provided to describe a VC (results are not presented for brevity). These results, however, generated a motivation to see what is behind words that are, after all, of common usage in the field. So, the algorithm was modified to exclude the four most frequent words (disaster, risk, resilience, and DRR) and run the analysis again (Fig. 14, Fig. 15). The results reveal interesting information. For instance, it could be said that local community is a strong concept behind the actions of landslide VCs. To some extent, there is an agreement between standard information selected and frequent concepts used to describe the commitment. As it can be recalled, “community-based DRR” was among the top three issues in the standardized selection. A third run of the algorithm was executed after eliminating common words such as “Sendai” and “Framework.” After this exercise, words such as “commitment,” “management,” and “knowledge” are more visible among the most frequent. Results are not presented for brevity.

For the second focused analysis, we determined the country which benefits from the largest number of VCs (Fig. 16). Results indicated that Nepal, Japan, and the Philippines currently benefit from the largest number of commitments (with Japan having mainly VCs with scopes national/local). Even though the spatial distribution of landslides is heterogeneous (Fig. 17), Asia is the geographical area where occurrences are dominant. Thus, it is understandable that the three countries at the top belong to the region of Asia.

With Nepal identified as being more active in terms of VCs, a more in-depth study about the network was conducted (Fig. 18). This network analysis will consider not only those commitments that provided specific countries/territories but also VCs with regional and global scopes. The analysis found that there are four VCs directly working in Nepal which include landslides among the hazards being covered by their activities. Two of these commitments are being implemented by organizations working with youth and young professionals particularly on issues related to science and technology (ID 20190209_001 and ID 20200613_001). They have one organization in common, U-INSPIRE Nepal. A third VC (ID 20190307_002) is being implemented by the International Union for the Conservation of Nature (IUCN) while the fourth VC (ID 20190219_001) is being implemented by seven organizations belonging to the Disability-Inclusive Disaster Reduction Network (DiDRRN). The last two VCs are being implemented in countries belonging to other regions as well. In addition to Nepal, the VC working on ecosystems protecting infrastructure and communities (ID 20190307_002) is also being implemented in Burkina Faso, Chile, China, Senegal, and Thailand. The VC promoting leadership of persons with disabilities in delivering the Sendai Framework (ID 20190219_001) is being implemented in Bangladesh, Fiji, Indonesia, Myanmar, Pakistan, Philippines,

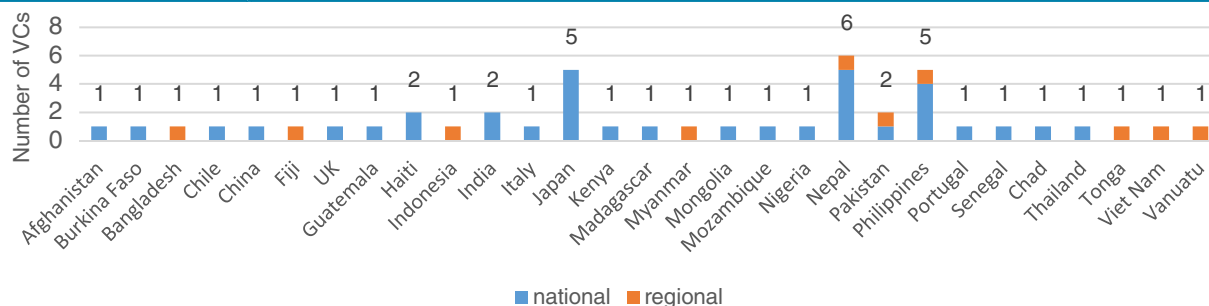


Fig. 16 Countries covered by VCs (all). Source: UNDRR Voluntary Commitments. The first step is to account for VCs with national/local scope and analyze the countries/territories being covered. Next, for the case of VCs with regional scope, the analysis needs to focus on those that selected a region as well as specific countries/territories. There are Regional VCs that only specify regions (these will be used later in the in-depth analysis, but they cannot be used for the country/territory analysis)

Tonga, Vanuatu, Vietnam, and, of course, Nepal. This is an interesting feature because in terms of ecosystem-based, as well as inclusive (for persons with disabilities), approaches knowledge and good practices could be shared across regions and adapted to different local contexts. All four commitments have a component of work with local communities. This is in line with the results from the standardized selection and the text analysis algorithm.

The VCs being implemented locally can also interact with regional and global VCs. At the regional level, there are two VCs implemented by CITYNET (ID 20191121_001 and ID 20191206_001) which include a knowledge sharing component, one VC implemented by Kokusai Kogyo Co. Ltd. (ID 20190305_003) with a strong component in technology solutions, and a fourth VC implemented by ACT Alliance (ID 20190121_002) with expertise on grassroots organizations. It is encouraging to find some alignment between regionally and locally implemented commitments. In particular, there is potential for enhanced collaboration and learning in terms of knowledge sharing, technology solutions, and community action for DRR.

Finally, at the global level, we can find the VC for landslides being implemented by the International Consortium on Landslides (ID 20190110_001), the VC by UNDRR's Scientific and Technological Advisory Group (GSTAG, ID 20190128_001), or the VC for the Global Center for Disaster Statistics (ID 20190203_001) jointly implemented by Tohoku University, Fujitsu, and the United Nations Development Programme (UNDP) along with several

other VCs focused on relevant issues. Across these global VCs working on landslides, some common themes are also found. For instance, knowledge management and capacity building are two of them. Concrete examples of knowledge management include studies on expert engagement in participatory processes of policy design (Linnerooth-Bayer et al. 2016). There are good reviews on statistically based landslide susceptibility models and rainfall threshold for landslides (Reichenbach et al. 2018; Segoni et al. 2018). Here, there are opportunities for partnerships that unite efforts and increase effectiveness not only among VCs with global scope but also in connection with local VCs working in Nepal.

The Sendai Framework considerably expanded the scope of hazards beyond natural and into man-made, environmental, technological, and biological hazards. This created a shift from managing disasters (reaction) to managing risks (prevention) and a logical consequence to better understand all these risk drivers along with their impacts (Gordon et al. 2019; Mizutori 2020b). Now, the COVID-19 pandemic has made more apparent the systemic nature of risk. This suggests that, toward the future, it will be important to not only work on distinct even isolated areas of risk but also further engage in integrated and multisector risk assessment, analysis, and decision-making (Gordon et al. 2019). Such an interdisciplinary and transdisciplinary approach can also reduce duplication of efforts and increase effectiveness.

Information needs to be translated into action. In this information age, data and connectivity are increasingly available. This

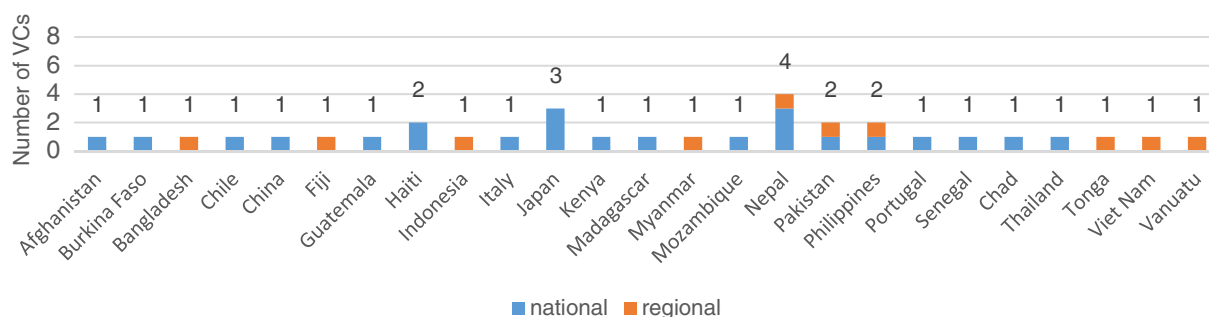


Fig. 17 Countries covered by VCs (landslides). Source: UNDRR Voluntary Commitments. The first step is to account for VCs with national/local scope and analyze the countries/territories being covered. Next, for the case of VCs with regional scope, the analysis needs to focus on those that selected a region as well as specific countries/territories. There are Regional VCs that only specify regions (these will be used later in the in-depth analysis, but they cannot be used for the country/territory analysis)

Fig. 18 Dive into VCs in Nepal (landslides). Source: UNDRR Voluntary Commitments

has contributed to a better understanding of issues that were previously unknown or uncertain. But, at the same time, it also makes it more apparent how much is still unknown (UNDRR 2019a). Information on specific and time bound VCs contributes an additional perspective to data on DRR which, overall, plays meaningful roles for risk assessments, disaster risk management, responding to emergencies, prevention and preparedness, and identifying research or implementation gaps, among others (Green et al. 2019). Furthermore, not only consistent collection and access to information is required but also capacity for contextual analysis, political will, funding, and concrete actions so that investments on sustainable development are risk-informed (Mizutori 2020b).

Conclusions

One necessary component to fulfill the 2030 Agenda for Sustainable Development is the resilience of communities and nations. Disasters can severely affect human lives, assets, and livelihoods, wiping out hard-earned development gains. Systems are complex, and thus building resilience requires the participation of all-of-society. In this case specifically, voluntary commitments of stakeholders working on landslides are needed. These commitments reflect their goodwill, knowledge, and experience as well as resources and can be logged at UNDRR's Sendai Framework Voluntary Commitments online platform (<https://sendaicommitments.undrr.org/>). More than 60% of all currently published commitments selected landslides within the hazards covered by their activities. This article provided descriptive information about landslide commitments.

Voluntary commitments addressing landslides can be a good barometer not only about the knowledge and evidence being produced on why landslides happen or geological or other factors that are associated to them but also on whether and how society, in

particular non-governmental organizations, take possession of that information and implement it. First, results clearly indicate the importance of landslides as it is among the top three hazards being addressed by commitments. While landslide commitments have a rather balanced distribution in terms of global, regional, and local scopes, it is the region of Asia that is currently benefiting from the largest number of registered initiatives. Second, a detailed description of the characteristics reveals that there is a higher number of organizations working together in the implementation of a single landslide commitment (around two implementers and four other partners per commitment on average) which may hint higher levels of collaboration, longer duration (landslide commitments can last 7.6 years on average), more ambitious goals, and systemic approaches. The analysis of the most common themes was done by taking a look at the provision of standardized information and also by applying an algorithm measuring frequencies of issues within the description text provided for each commitment. Both methods point in a similar direction and identified capacity development, risk management, and community-based DRR as the most frequent themes being addressed by commitments covering landslides. Third, on a strategic level, Sendai Targets B (reduce the number of affected people by disasters), E (increase the number of countries with DRR strategies), and G (increase multi-hazard early warning systems, disaster risk information and assessments) along with SDGs 11 (sustainable cities and communities), 13 (climate action), and 17 (partnerships for the goals) are most widely covered. Finally, when focusing the analysis at a country level, opportunities for partnerships that may accelerate the implementation of the Sendai Framework can be identified. Taking the example of Nepal (it benefits from being covered by the largest number of commitments), it was observed that community-based approaches for knowledge sharing and technology solutions are among the most relevant issues

addressed by commitments with local focus. A positive aspect is that there are commitments both at the regional and global levels addressing similar or related issues. So, there can be potential for collaboration to increase effectiveness.

UNDRR supports the work of the International Consortium on Landslides as expressed in the commitment “Sendai Landslide Partnerships 2015-2025.” The results from the 5th World Landslide Forum to be held in November 2021 can further strengthen the direction of future commitments by stakeholders working on landslides. Based on and in addition to the descriptive findings shared in this article, future studies could shed more light on distributional analyses at different levels. Averages often mask large disparities within groups in a population or within smaller units of analysis (UNDRR 2019a). Another area with potential for research is temporal and geospatial analyses, particularly focused on increased collaboration and systemic approaches. Furthermore, to expand the all-of-society approach, we may need a better understanding on how

individual choice and behavior (how and what we consume) influences collective accountability for risk creation or reduction which, in turn, can re-shape food, energy, and transportation systems (UNDRR 2019a). This evidence may help to reflect upon institutional processes, ecological systems, and human behavior.

Compliance with ethical standards

The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors. They do not necessarily represent the view of the United Nations Office for Disaster Risk Reduction (UNDRR). Maps, the designations employed, and the presentation of the data do not imply the expression of any opinion whatsoever on the part of the United Nations Secretariat concerning the legal status of any country, territory, city or area, or of its authorities, or concerning the delineation of its frontiers or boundaries.

Appendix

Table 2 List of voluntary commitments covering landslides. For the latest information, please visit https://sendaicommitments.undrr.org/commitments?selectedHazard=LAND_SLIDE

ID	Title	Implementing organizations	Scope
20190110_001	Sendai Landslide Partnerships 2015-2025	<ul style="list-style-type: none"> •International Union of Geological Sciences •United Nations University •United Nations Office for Disaster Risk Reduction •International Consortium of Landslides •United Nations Educational, Scientific and Cultural Organization – Headquarters •World Federation of Engineering Organizations World Meteorological Organization •Food and Agriculture Organization of the United Nations - Headquarters •International Science Council •International Union of Geodesy and Geophysics 	Global
20190121_002	Raise DRR awareness through faith-based organisations	•ACT Alliance – Geneva	Regional - Africa, Americas, Asia
20190128_001	Science Technology Commitment to support implementation of Sendai Framework	•Scientific and Technical Advisory Group	Global
20190201_002	Strengthening disaster risk management through institutional development	•Mongolian Red Cross Society	Local
20190203_001	Global Centre for Disaster Statistics (GCDS)	<ul style="list-style-type: none"> •United Nations Development Programme •International Research Institute of Disaster Science, Tohoku University •Fujitsu 	Global

Table 2 (continued)

ID	Title	Implementing organizations	Scope
20190205_002	Improving Disaster Resilience in an Ageing Greater Manchester	<ul style="list-style-type: none"> •Association of Greater Manchester Authorities •Greater Manchester Centre for Voluntary Organisation •Association of Greater Manchester Authorities 	Local
20190209_001	Building Resilience Through Capacity Development of DRR Young Scientist in Nepal	<ul style="list-style-type: none"> •Himalayan Risk Research Institute 	Local
20190211_001	ResponderCQ: A Disaster Resilience Assessment and Data Management Service	<ul style="list-style-type: none"> •Disaster Resilience Leadership Academy, Tulane University •100 Resilient Cities •Department of Homeland Security Science and Technology Directorate •SPIN Global 	Global
20190211_002	Support Urban Risk Reduction and Resilience Building	<ul style="list-style-type: none"> •Urban Climate Change Research Network •Global Alliance for Urban Crises •Global Network of Civil Society Organisations for Disaster Reduction •Making Cities Resilient Campaign Cities, Partners and Task Forces Instituto Internacional de Medio Ambiente y Desarrollo - América Latina •Center for Urban Disaster Risk Reduction & Resilience 	Global
20190214_001	India: Strengthening DPRR in six State and District DM Authorities	<ul style="list-style-type: none"> •Sustainable Environmental and Ecological Development Society •Tata Institute of Social Sciences •Mainstreaming Adaptation, Resilience and Sustainability into Development •RedR – India 	Local
20190214_004	One Billion Coalition for Resilience	<ul style="list-style-type: none"> •United Nations Children's Fund (Global Headquarters, New York) •Interpeace •International Federation of Red Cross and Red Crescent Societies •World Food Programme •Connecting Business initiative 	Global
20190219_001	Leadership of persons with disabilities in delivering the Sendai Framework	<ul style="list-style-type: none"> •Centre for Disability in Development •CBM International •Pacific Disability Forum •Humanity & Inclusion •Arbeiter-Samariter-Bund Indonesia and the Philippines •Malteser International •South Asian Disability Forum 	Regional - Asia, Oceania
20190220_001	Seminars of the Sendai Framework for DRR for citizens in Sendai City	<ul style="list-style-type: none"> •Sendai City 	Local

Table 2 (continued)

ID	Title	Implementing organizations	Scope
		•International Research Institute of Disaster Science, Tohoku University	
20190222_001	International Wildfire Preparedness Mechanism (IWPM)	<ul style="list-style-type: none"> •Regional Fire Management Resource Center – South East Asia Region •Global Fire Monitoring Centre •Regional Central Asia Fire Management Resource Center •Regional Southeast Europe / Caucasus Fire Monitoring Center •Regional Eastern European Fire Monitoring Center 	Global
20190228_002	Building Community Resilience through Community-Based Disaster Risk Management	<ul style="list-style-type: none"> •Help in Need •Asociación de Servicios Comunitarios de Salud •Agency for Humanitarian and Development Assistance for Afghanistan •Afghan Development Association •Society for Human & Natural Resource Development •Lutheran World Federation Chad 	Local
20190301_001	Localised Preparedness for More Effective Response with Affected Communities	<ul style="list-style-type: none"> •Sampan'Asa mombany Fampandrosoana / Church of Jesus Christ in Madagascar •Citizens' Disaster Response Center •Comité Ecueménico para o Desenvolvimento Social 	Local
20190305_002	Restoring the Human Spirit Through Music	•Soka Gakkai International	Local
20190305_003	Contributing via Business Strengths, DRR Innovation and Partnerships	•Kokusai Kogyo Co, Ltd.	Regional - Asia
20190305_005	RegionsAdapt	<ul style="list-style-type: none"> •Basque Centre for Climate Change •Network of Regional Governments for Sustainable Development 	Global
20190305_006	Decision-making and Taking Action - Promotion of Women Leadership Program	<ul style="list-style-type: none"> •Sendai Gender Equal Opportunity Foundation •Sendai City 	Local
20190305_008	Resilience in the tourism sector: ARISE Japan Activity Plan 2019-2022	•ARISE Japan	Local
20190307_002	Ecosystems protecting infrastructure and communities	<ul style="list-style-type: none"> •International Union for the Conservation of Nature •International Union for the Conservation of Nature 	Local
20190308_001	Updated Hazard Maps for Selected Metro Manila Communities	<ul style="list-style-type: none"> •PLAN International Philippines •Earthquakes and Megacities Initiative 	Local
20190308_003	Building Resilience of Small and Medium Enterprises (SMEs) in the Philippines	<ul style="list-style-type: none"> •SM Prime Holdings, Inc. •University of the Philippines •Office of Civil Defense (Philippines) •National Resilience Council •Manila Observatory, the 	Local

Table 2 (continued)

ID	Title	Implementing organizations	Scope
20190308_007	Strengthening inclusive Resilience to Disasters boosting Sustainable Development	•Provincia di Potenza	Local
20190308_010	Intense Promotion of the Sendai Framework with the Haitian communities	•Centre de la Prédication Évangéliques d'Haiti •Global Network of Civil Society Organizations for Disaster Reduction	Local
20190312_002	DRR Business support group for small scale farmers and businesses in Nigeria	•Nigerian Women Agro Allied Farmers Association	Local
20190517_001	Strengthen leadership, cooperation and participation in disaster risk reduction in the Municipality of Amadora	•Câmara Municipal da Amadora	Local
20190918_002	A "Specific" Drone For Night Time Aerial Wildfire Fighting: The NitroFirex Project	•Dirección General de Desarrollo Rural, Innovación y Política Forestal •European Commission Humanitarian Aid and Civil Protection DG •NITROFIREX S.L. •NITROFIREX S.L. •NATIONAL AERIAL FIREFIGHTING CENTER AUSTRALIA •Federal Emergency Management Agency •Canadian Council of Forest Ministers - Conseil canadien des ministres des forêts •Canadian Council of Forest Ministers - Conseil canadien des ministres des forêts •U.S. Forest Service •California Department of Forestry and Fire Protection •Australasian Fire and Emergency Service Authorities Council •NATIONAL AERIAL FIREFIGHTING CENTER AUSTRALIA	Global
20191121_001	CITYNET Disaster Cluster	•CITYNET Yokohama Project Office	Regional - Asia
20191121_002	Community Based Adaptation and Resilience Against Disasters (CBARAD) in the City of Iloilo	•Iloilo City Government •CITYNET Yokohama Project Office •Plus Arts NPO •City of Yokohama	Local
20191121_003	School Based Sustainable DRR Education and Material Development Project in Nepal	•Informal Sector Service Center •CITYNET Yokohama Project Office •Plus Arts NPO	Local
20191122_001	Training on Structural and Seismic Engineering between Japan and Nepal	•City of Yokohama •CITYNET Yokohama Project Office •Kathmandu Metropolitan City	Local
20191206_001	CITYNET Disaster Cluster Annual Seminar	•CITYNET Yokohama Project Office •Citynet •City Government of Makati •City of Yokohama	Regional - Asia
20191226_002			Local

Table 2 (continued)

ID	Title	Implementing organizations	Scope
	Shaping Disaster Resilient India: An initiative to build the capacities of YYPs in DRM and CCA through University Networks	•Confederation of Risk Reduction Professionals	
20200102_001	Capacity Building and Scientific Research for Sendai Framework by the Japan Society of Disaster Nursing	•Japan Society of Disaster Nursing	Global
20200613_001	Paving the way for building Resilience in Nepal: An initiative to understand and assess risk through the use of frontier technology	•Institute of Himalayan Risk Reduction	Local

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