Assessing damage data availability in national landslide databases for SFDRR reporting: a case study of Kuala Lumpur as a local-level application

Article *in* Landslides · June 2023

DOI: 10.1007/s10346-023-02085-9

5 authors, including:

Tariqur Rahman Bhuiyan
Universiti Kebangsaan Malaysia

Nurfashareena Muhamad
Universiti Kebangsaan Malaysia

Choun-Sian Lim
Universiti Kebangsaan Malaysia

Ah Choy Er
Universiti Kebangsaan Malaysia

Landslides
DOI 10.1007/s10346-023-02085-9
Received: 22 February 2022
Accepted: 5 May 2023

Tariqur Rahman Bhuiyan · Nurfashareena Muhamad · Choun-Sian Lim · Er Ah Choy · Joy Jacqueline Pereira

Assessing damage data availability in national landslide databases for SFDRR reporting: a case study of Kuala Lumpur as a local-level application

Abstract The measurement of global progress in implementing a Sendai Framework for Disaster Risk Reduction (SFDRR) targets should be able to report on a set of 38 indicators including those related to disaster damage. The ability of a hazard-specific database (e.g. landslide database in this case) in providing information that meets the SFDRR target is not well researched. This study aims to examine the coverage of information in the existing landslide databases that is relevant to the SFDRR indicators, to check the availability of damage data and to evaluate the current data collection practices according to SFDRR compatibility to local scale application in assessing the applicability of existing damage data to estimate the landslide costs. Content analysis was conducted to assess the availability of damage data and compile landslide events data from different sources to develop a local-level landslide database. Replacement cost and market price approaches were used to estimate landslide costs. Kuala Lumpur is chosen as a study area to represent the lowest spatial resolution at the municipal level. The results show that existing national landslide databases have significant shortages with regard to the availability of damage data necessary for SFDRR reporting. The landslide data in Kuala Lumpur show a high level of missing fundamental hazard information, such as the type (73%), cause (93%) and size (92%). Of the compiled events, 35.9% had no associated damage data, 64.1% had at least one accompanying recorded damage indicator and 58.6% had at least one accompanying reported monetizable damage indicator. This paper contributes to literature by identifying gaps in current landslide data management practices in Malaysia.

Keywords Landslide database · Damage indicator · Sendai framework for disaster risk reduction · Landslide damage · Disaster risk reduction

Introduction

Disaster databases provide observed data that reflect the impacts, damages and losses associated with disasters. After the adoption of the Hyogo Framework for Action (established from 2005–2015), countries were encouraged to invest in actions that progress their disaster risk reduction (DRR), response and reconstruction abilities (United Nations International Society for Disaster Reduction (UNISDR 2005). This incentivization has resulted in an increased demand for systematic and standardized disaster data collection, storage and management methods. In addition, the importance of having available disaster loss data at all disaster scales has been recognized by the Sendai Framework for Disaster Risk Reduction (SFDRR), 2030 Agenda for Sustainable Development, Intergovernmental Panel on Climate Change (IPCC) and Paris Agreement (Menoni et al. 2017). The diverse usefulness of disaster databases in applications such as post- and pre-event assessments, risk analyses and disaster loss projections can help stakeholders develop efficient risk reduction and adaptation strategies and policies. However, current issues in the disaster data field concern the thoroughness, accuracy and comparability of the available data, as these issues lead to gaps and overlaps in the data that result in the compromised quality of research and policies (Fakhruddin et al. 2017). To overcome these issues, establishing a basic data infrastructure model for disaster loss data collection systems (e.g. databases) is a great option. This process requires stakeholders to agree on the data collection, standardization, reporting and recording principles (De Groeve et al. 2014; Dilley and Grasso 2016). These are very important aspects concerning the SFDRR goals, as a set number of indicators have been established by the SFDRR to monitor progress globally. Among the 38 included indicators, 22 are crucially relevant for cost assessments. These 22 indicators cover targets A to D of the SFDRR (Tamrakar et al. 2020). Reporting the progress that has been made regarding these targets requires maintaining a proper database and ensuring the minimum data requirements can be met for all disasters. Such data can be used to estimate costs by employing simple formulas and can be used as baseline data to run rigorous and multifaceted models (World Health Organization (WHO 2020).

Landslide databases are also called landslide inventories or catalogues; these databases record and store systematically collected necessary information on past landslides (Hervás 2013). The details gathered from relevant sources for the databases are useful for both post-event and pre-event assessments and provide information about causes, types and processes of landslides as well as the impacts and risks associated with landslides (Guzzetti et al. 2003; Hilker et al. 2009; Rossi et al. 2010; Van Den Eeckhaut et al. 2010; Hurst et al. 2013; Klose et al. 2015b; Tonini et al. 2014). Several types of landslide databases have been developed in the past by researchers who were focused on constructing inventories for the purpose of analysing landslide hazards and developing mitigation measures, as 'the past and present are keys to the future' (Brunsden 1993; Guzzetti et al. 1999; Ghosh et al. 2012; Guzzetti et al. 2012; Samia et al. 2017). Most landslide databases are historical in nature and comprise information ranging from local to global scales over time (Malamud et al. 2004; Galli et al. 2008) and normally the coverage does not include small-scale landslides. This information is

Funding

This research is part of the fund from Ministry of Higher Education (MOHE) project on 'Multi-Hazard Forecasting of Disaster Risks for Critical Areas in Selangor' (FRGS/1/2019/STG09/UKM/03/1) and project on 'Disaster Resilient Cities: Forecasting Local Level Climate Extremes and Physical Hazards for Kuala Lumpur' (XX-2017–002) supported by the Research and Innovation Bridges Programme of the Newton-Ungku Omar Fund administered by the Malaysian Industry-Government Group for High Technology (MIGHT) and Innovate UK.

Declarations

Conflict of interest The authors declare no competing interests.

References

Bakkensen LA, Shi X, Zurita BD (2018) The impact of disaster data on estimating damage determinants and climate costs. Econ Disasters Clim Chang 2:49–71. https://doi.org/10.1007/s41885-017-0018-x

Balbi S, Giupponi C, Olschewski R, Mojtahed V (2015) The total cost of water-related disasters. Rev Econ 66:225–252

Bhuiyan TR, Er AC, Lim CS, Muhamad N, Abu Bakar A, Pereira JJ (2022) Disaster loss indicators for reporting to DesInventar Sendai and enabling rapid monetary valuation in Malaysia. Weather and Climate Extremes 37:100488. https://doi.org/10.1016/j.wace.2022.100488

Bíl M, Raška P, Dolák L, Kubeček J (2021) CHILDA – Czech Historical Landslide Database. Nat Hazards Earth Syst Sci 1–21. https://doi.org/10.5194/nhess-2021-112

Blahůt J, Balek J, Klimeš J et al (2019) A comprehensive global database of giant landslides on volcanic islands. Landslides 16:2045–2052. https://doi.org/10.1007/s10346-019-01275-8

Brans EHP (2005) Liability for damage to public natural resources under the 2004 EC Environmental Liability Directive: standing and assessment of damages. Environ Law Rev 7:90–109. https://doi.org/10.1177/146145290500700202

Brunsden D (1993) Mass movement; the research frontier and beyond: a geomorphological approach. Geomorphology 7:85–128. https://doi.org/10.1016/0169-555X(93)90013-R

Corbane C, Groeve T De, Ehrlich D et al (2015) A European framework for recording and sharing disaster damage and loss data. Int Arch Photogramm Remote Sens Spat Inf Sci XL 277–283. https://doi.org/10.5194/isprsarchives-XL-3-W3-277-2015

Creighton R, Doyle A, Farrell E et al (2006) Landslides in Ireland geological survey of Ireland

Damm B, Klose M (2015) The landslide database for Germany: closing the gap at national level. Geomorphology 249:82–93. https://doi.org/10.1016/j.geomorph.2015.03.021

De Groeve T, Corbane C, Ehrlich D, Poljansek K (2014) Current status and best practices for disaster loss data recording in EU member states: a comprehensive overview of current practice in the EU member states. Scientific and technical research reports, report EUR 26879

Department of Statistics Malaysia (DOSM) Official Portal (2022) In: Dep. Stat. Malaysia. https://www.dosm.gov.my/v1/index.php?r=column/cone&menu_id=bjRlZXVGdnBueDJKY1BPWEFPRlhIdz09

Devoli G, Strauch W, Chávez G, Høeg K (2007) A landslide database for Nicaragua: a tool for landslide-hazard management. Landslides 4:163–176. https://doi.org/10.1007/s10346-006-0074-8

DID (2003) Flood damage assessment of 26 April 2001 flooding affecting the Klang Valley and the generalised procedures and guidelines for assessment of flood damages. Dep Irrig Drain 2:78

DID (2012) Updating of condition of flooding and flood damage assessment in Malaysia, final report

Dilley M, Grasso VF (2016) Disaster reduction, loss and damage data, and the post-2015 international policy agenda. Environ Sci Policy 61:74–76. https://doi.org/10.1016/j.envsci.2016.04.002

DOSM Malaysia CPI Inflation Calculator (n.d.) https://www.dosm.gov.my/cpi_calc/index.php. Accessed 18 Oct 2021

Fakhruddin BS, Murray V, Maini R (2017) Disaster loss data in monitoring the implementation of the Sendai Framework. In: Global Platform for Disaster Risk Reduction, 2017. Cancun, Mexico

FMT - Frfree Mmalaysia Ttoday (2021) Probe Kg Sg Penchala landslide promptly, King tells govt

Foster I (2011) Globus Online: accelerating and democratizing science through cloud-based services. IEEE Internet Comput 15:70–73

Freeman AM III, Herriges JA, Kling CL (2014) The measurement of environmental and resource values. Routledge

Froude MMJ, Petley DND (2018) Global fatal landslide occurrence from 2004 to 2016. Nat Hazards Earth Syst Sci 18:2161–2181. https://doi.org/10.5194/nhess-18-2161-2018

Gall M (2015) The suitability of disaster loss databases to measure loss and damage from climate change. Int J Glob Warm 8:170–190. https://doi.org/10.1504/IJGW.2015.071966

Galli M, Ardizzone F, Cardinali M et al (2008) Comparing land- slide inventory maps. Geomorphology 94:268–289

Ghosh S, van Westen CJ, Carranza EJM et al (2012) Generating event-based landslide maps in a data-scarce Himalayan environment for estimating temporal and magnitude probabilities. Eng Geol 128:49–62. https://doi.org/10.1016/j.enggeo.2011.03.016

Guzzetti F, Carrara A, Cardinali M, Reichenbach P (1999) Landslide hazard evaluation: a review of current techniques and their application in a multi-scale study, Central Italy. Geomorphology 31:181–216. https://doi.org/10.1016/S0169-555X(99)00078-1

Guzzetti F, Mondini AC, Cardinali M et al (2012) Landslide inventory maps: new tools for an old problem. Earth-Science Rev 112:42–66. https://doi.org/10.1016/J.EARSCIREV.2012.02.001

Guzzetti F, Reichenbach P, Cardinali M et al (2003) The impact of landslides in the Umbria region, central Italy. Nat Hazards Earth Syst Sci 3:469–486. https://doi.org/10.5194/nhess-3-469-2003

Herrera G, Mateos RM, García-Davalillo JC et al (2018) Landslide databases in the Geological Surveys of Europe. Landslides 15:359–379. https://doi.org/10.1007/s10346-017-0902-z

Hervás J (2013) Landslide inventory. Encycl Nat Hazards 610–611

Hilker N, Badoux A, Hegg C (2009) The Swiss flood and landslide damage database 1972–2007. Nat Hazards Earth Syst Sci 9:913–925. https://doi.org/10.1111/jfr3.12510

IKRAM (2021) Slope failure at Jalan Palimbayan, Sg. Penchala, Kuala Lumpur 18.12.2021. https://www.freemalaysiatoday.com/category/nation/2021/12/24/probe-kg-sg-penchala-landslide-promptly-king-tells-govt/. Accessed 9 November 2022

Hurst MD, Ellis MA, Royse KR et al (2013) Controls on the magnitude-frequency scaling of an inventory of secular landslides. Earth Surf Dyn 1:67–78. https://doi.org/10.5194/esurf-1-67-2013

IRDR (2014) Peril Classificationa and Hazard Terminologyeijing (IRDR DATA Publication No. 1). In: Integr Res Dis Risk. http://www.irdrinternational.org/2014/03/28/irdr-peril-classification-and-hazard-glossary/. Accessed 29 May 2020

Jaupaj O, Lamaj M, Kulici H et al (2017) Advancing culture of living with landslides. Adv Cult Living with Landslides 39–44. https://doi.org/10.1007/978-3-319-53498-5

Kirschbaum D, Stanley T, Zhou Y (2015) Spatial and temporal analysis of a global landslide catalog. Geomorphology 249:4–15. https://doi.org/10.1016/j.geomorph.2015.03.016

Kirschbaum DB, Adler R, Hong Y et al (2010) A global landslide catalog for hazard applications: method, results, and limitations. Nat Hazards 52:561–575. https://doi.org/10.1007/s11069-009-9401-4

Klose M (2015) Landslide Databases as tool for integrated assessment of landslide risk

Komac M, Hribernik K (2015) Slovenian national landslide database as a basis for statistical assessment of landslide phenomena in Slovenia. Geomorphology 249:94–102. https://doi.org/10.1016/j.geomorph.2015.02.005

Klose M, Damm B, Highland LM (2015a) Databases in geohazard science: an introduction. Geomorphology 249:1–3. https://doi.org/10.1016/j.geomorph.2015.06.029
Klose M, Damm B, Terhorst B (2015b) Landslide cost modeling for transportation infrastructures: a methodological approach. Landslides 12:321–334
Malamud BD, Turcotte DL, Guzzetti F, Reichenbach P (2004) Landslide inventories and their statistical properties. Earth Surf Process Landforms 687–711
Malaymail (2019) 65 residents evacuated from KL apartment building after landslide. https://www.malaymail.com/news/malaysia/2019/10/11/65-residents-evacuated-from-kl-apartment-building-after-landslide/1799250. Accessed 9 November 2022
Mazengarb C, Flentje P, Miner A, Osuchowski M (2010) Designing a landslide database ; lessons from Australian examples
Mazhin SA, Farrokhi M, Noroozi M et al (2021) Worldwide disaster loss and damage databases: a systematic review. J Educ Health Promot 10:1–13. https://doi.org/10.4103/jehp.jehp
Menoni D, Molinari S, Ballio F (eds) (2017) Geophysical Monograph 228: flood damage survey and assessment: new insights from research and practice. American Geophysical Union and John Wiley and Sons, Inc
Middelmann-Fernandes MH (2010) Flood damage estimation beyond stage-damage functions: an Australian example. J Flood Risk Manag 3:88–96. https://doi.org/10.1111/j.1753-318X.2009.01058.x
Mirus BB, Jones ES, Baum RL et al (2020) Landslides across the USA: occurrence, susceptibility, and data limitations. Landslides 17:2271–2285. https://doi.org/10.1007/s10346-020-01424-4
Mohd Noor N, Abdullah A, Manzahari MNH (2013) Land cover change detection analysis on urban green area loss using GIS and remote sensing techniques. Journal of the Malaysian Institute of Planners XI: 125–138. http://irep.iium.edu.my/33788/1/Article_7_-_Norzailawati_Mohd_Noor.pdf. Accessed 9 November 2022
Niculiță M, Adrian A, Lupu C (2017) The landslide database of North-Eastern Romania. In: Proceedings of romanian geomorphology symposium. pp 81–84
Nowicki Jessee MA, Hamburger MW, Ferrara MR et al (2020) A global dataset and model of earthquake-induced landslide fatalities. Landslides 17:1363–1376. https://doi.org/10.1007/s10346-020-01356-z
Nussbaumer SU, Zambrano E, Stäubli A et al (2018) Analysis of weather- and climate-related disasters in mountain regions using different disaster databases. In: Mal S, Singh RB, Huggel C (eds) Climate change, extreme Events and disaster risk reduction: towards sustainable development goals. pp 17–41
Osuteye E, Johnson C, Brown D et al (2017) The data gap: an analysis of data availability on disaster losses in sub-Saharan African cities. Int J Disaster Risk Reduct 26:24–33. https://doi.org/10.1016/j.ijdrr.2017.09.026
Panwar V, Sen S (2019) Disaster damage records of EM-DAT and DesInventar: a systematic comparison. Econ Disasters Clim Chang. https://doi.org/10.1007/s41885-019-00052-0
Pennington C, Freeborough K, Dashwood C et al (2015) The National Landslide Database of Great Britain: acquisition, communication and the role of social media. Geomorphology 249:44–51. https://doi.org/10.1016/j.geomorph.2015.03.013
Petley D (2012) Global patterns of loss of life from landslides. Geology 40:927–930
PWD (2009) National Slope Master Plan 2009–2023
Rayhan M, Grote U (2010) Crop diversification to mitigate flood vulnerability in Bangladesh: an economic approach. Econ Bull 30:597–604
Rossi M, Witt A, Guzzetti F et al (2010) Analysis of historical landslide time series in the Emilia-Romagna region, northern Italy. Earth Surf Process Landforms 35:1123–1137. https://doi.org/10.1002/esp.1858
Samia J, Temme A, Bregt A et al (2017) Do landslides follow landslides? Insights in path dependency from a multi-temporal landslide inventory. Landslides 14:547–558. https://doi.org/10.1007/s10346-016-0739-x
Sezer EA, Pradhan B, Gokceoglu C (2011) Manifestation of an adaptive neuro-fuzzy model on landslide susceptibility mapping: Klang valley, Malaysia. Expert Syst Appl 38:8208–8219. https://doi.org/10.1016/J.ESWA.2010.12.167
Spizzichino D, Claudio, Margottini Alessandro T, Carla I (2010) Chapter 9: Landslides. In: European Environment Agency (ed) Mapping the impacts of natural hazards and technological accidents in Europe: an overview of the last decade. pp 81–93
Strouth A, McDougall S (2021) Historical landslide fatalities in British Columbia, Canada: trends and implications for risk management. front Earth Sci 9:1–8. https://doi.org/10.3389/feart.2021.606854
Tamrakar A, Bajracharya R, Khatiwada P et al (2020) Standardization of loss and damage datasets on BIPAD. Banshidhar Marg, Kathmandu
Tanyaş H, van Westen CJ, Allstadt KE et al (2017) Presentation and analysis of a worldwide database of earthquake-induced landslide inventories. J Geophys Res Earth Surf 122:1991–2015. https://doi.org/10.1002/2017JF004236
Taylor FE, Malamud BD, Freeborough K, Demeritt D (2015) Enriching Great Britain's National Landslide Database by searching newspaper archives. Geomorphology 249:52–68. https://doi.org/10.1016/j.geomorph.2015.05.019
Thieken AH, Apel H, Aronica G (2007) Comparison of different approaches for flood damage and risk assessment. Czech Republic, Prague
Tong B, Li Y, Yang X et al (2021) The development and application of China national landslide database and information system. Arab J Geosci 14. https://doi.org/10.1007/s12517-021-06825-w
Tonini M, Pedrazzini A, Penna I, Jaboyedoff M (2014) Spatial pattern of landslides in Swiss Rhone Valley. Nat Hazards 73:97–110. https://doi.org/10.1007/s11069-012-0522-9
UNDRR (2022) DesInventar as a disaster information management system. https://www.desinventar.net/data_sources.html. Accessed 6 November 2022
UNISDR (2005) Hyogo framework for action 2005–2015: building the resilience of nations and communities to disasters. In: Extract from the final report oftheWorld Conference on Disaster Reduction (A/CONF.206/6) (Vol. 380). The United Nations International Strategy for Sisaster Reduction Geneva
Valenzuela P, Domínguez-Cuesta MJ, Mora García MA, Jiménez-Sánchez M (2017) A spatio-temporal landslide inventory for the NW of Spain: BAPA database. Geomorphology 293:11–23. https://doi.org/10.1016/j.geomorph.2017.05.010
Van Den Eeckhaut M, Hervás J (2012) State of the art of national landslide databases in Europe and their potential for assessing landslide susceptibility, hazard and risk. Geomorphology 139–140:545–558. https://doi.org/10.1016/j.geomorph.2011.12.006
Van Den Eeckhaut M, Poesen J, Vandekerckhove L et al (2010) Human-environment interactions in residential areas susceptible to landsliding: the Flemish Ardennes case study. Area 42:339–358. https://doi.org/10.1111/j.1475-4762.2009.00919.x
Van Den Eeckhaut M, Hervas J, Montanarella L (2013) Landslide databases in Europe: analysis and recommendations for interoperability and harmonisation. In: Montanarella L, Van Den EM, Hervas J (eds) Landslide science and practice. Springer-Verlag, Berlin Heidelberg, pp 35–42
WHO (2020) WHO technical guidance notes on Sendai Framework reporting for Ministries of Health. Geneva
Wood JL, Harrison S, Reinhardt L, Taylor FE (2020) Landslide databases for climate change detection and attribution. Geomorphology 355:107061. https://doi.org/10.1016/j.geomorph.2020.107061
Zêzere JL, Pereira S, Tavares AO et al (2014) DISASTER: a GIS database on hydro-geomorphologic disasters in Portugal. Nat Hazards 72:503–532. https://doi.org/10.1007/s11069-013-1018-y

Tariqur Rahman Bhuiyan · Nurfashareena Muhamad (✉) · Choun-Sian Lim · Joy Jacqueline Pereira
Southeast Asia Disaster Prevention Research Initiative (SEADPRI-UKM), Institute for Environment and Development, Universiti Kebangsaan Malaysia, Level 6, Block 1, Keris Mas Building, , 43600 Bangi, Malaysia
Email: fasha@ukm.edu.my

Er Ah Choy
Research Centre for Development, Social and Environment Faculty of Social Sciences and Humanities, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor Darul Ehsan Malaysia, Malaysia

Tariqur Rahman Bhuiyan
DM Watch Limited, Begum Rokeya Sharoni, 586/3 West Shewrapara, Mirpur, Dhaka 1216, Bangladesh