Research Article

Promoting Data Science in Disaster Risk Reduction: Glimpses from the Global South

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ABSTRACT

There are coordinated attempts to use Data Science in disaster risk reduction (DRR) across the world. Different special interest groups are formed within the data science community to formulate different action plans and strategies to use data science in the DRR. Some examples of community-driven initiatives are the CODATA Task Group FAIR Data for Disaster Risk Research (FAIR-DRR), CODATA Task Group Linked Open Data for Global Disaster Risk Research (LODGD), and ISC Integrated Research on Disaster Risk (IRDR). This chapter highlights the data science approaches, models, frameworks, and stakeholders mapping while dealing with the data collection, analysis, and reporting for strengthening data-driven decision-making at different levels. The chapter also explores the FAIR Data Principles that aim at achieving the findable, accessible, interoperable, and reusable data resources at the institutional and national levels. FAIR Data ensures various data users increasingly engage with data related to disasters. We also discuss some case studies and success stories from the Global South, which may inspire other countries in data-driven decision-making while dealing with natural disasters. The much-discussed "Data, Information, Knowledge and Action" (DIKA) model is highlighted in this chapter. For example, the recently launched "Data-Knowledge-Action for Urban Systems" podcast series of CODATA and CEPT Research and Development Foundation (CRDF) in Ahmedabad, talks about how the DIKA model helps in creating intelligent systems for DRR using scientific and quantitative data. On a podcast in related Series, the DRR practitioners and data science researchers discussed the use of big data to predict natural disasters. This chapter highlights notable examples of how big data helped predict natural disasters across the world, particularly in the Global South.

Keywords: Open Data, Disaster Management, Disaster Risk Reduction, Global South, India, Data Science, Developing Countries.

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INTRODUCTION

Data Science is a multidisciplinary domain where scientific methods and processes are applied to extract knowledge from noisy, messy, and unstructured data. The field 'Data science' embraces the domains like data mining, machine learning, big data, etc. The three major concepts, viz. statistics, data analysis, and informatics, along with their methods, are unified in "Data Science". It uses techniques and theories collected from diverse fields like mathematics, statistics, computer science, information science, and domain knowledge. However, data science is different from computer science and information science. According to Jim Gray, data science is the "fourth paradigm" of science (empirical, theoretical, computational, and now data-driven) and asserted that "everything about science is changing because of the impact of information technology" and the data deluge (Tony, Stewart & Kristin, 2009; Bell, Hey & Szalay, 2009). A data scientist is someone who creates programming code and combines it with statistical knowledge to create insights from data (Davenport, Thomas, & Patil, 2012).

The processing capacity, architecture and algorithms of traditional database systems are not coping with big data analysis. Big data are now rapidly growing in all science and engineering domains, including biological, biomedical sciences and disaster management. Thousands of human lives are lost every year around the globe, apart from significant damage to property, animal life, etc., due to natural disasters (e.g., earthquake, flood, tsunami, hurricanes and other storms, landslides, cloudbursts, heat waves, forest fire). Disaster management is thus becoming a prime issue today.

The characteristics of complexity formulate an extreme challenge for discovering helpful knowledge from big data. Spatial data is complex big data. Smartphones as mobile nodes in different communication infrastructures have been excessively explored

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in recent years. Such smartphones can be considered a good candidate for situations like Disaster Management, where there is no infrastructure available to support communication, and connectivity among the group members is a prime objective. Disaster rescue operations are generally based on location-intensive operations, including neighbouring nodes, locations, and availability. The storage limitations of such devices ask for suitable strategies to store information efficiently. Big data is an idea of informational collections that depicts a huge amount of information and complexity that conventional information preparing application programs lack to manage. Presently, big data is a widely known domain used in research, academics, and industries. It is utilized to store a substantial measure of information in a solitary brought together one. Challenges integrate capture, allocation, analysis, information precision, visualization, distribution, interchange, delegation, inquiring, updating, and information protection. In this digital world, putting away the information and recovering the data is an enormous errand for the vast organizations, and sometimes information ought to be a misfortune due to circulated information being put away. For this issue, the organization individuals are chosen to actualize the vast information to put away all the information identified with the organization. They are put away in one enormous database known as large information. The remote sensor is a science getting data used to distinguish the items or break down the range from a separation. It is anything but difficult to discover the question effortlessly with the sensor. In recent years, it has not been easy to classify a huge set of data due to the increasing population in urban places. As of now, satellite hyperspectral images provide information, but this is insufficient to classify urban areas data. To develop the urban areas, accurate and timely information is necessary for the government. Hence, airborne hyper-spectral data provides sufficient urban planning and disaster management information.

The uses of Social Media (SM) are now emergent. They are used in all sectors, right from individual citizens to non-government organizations, the private sector, government stakeholders, and volunteering organizations, for aiding in information communication or knowledge transfer during disaster situations. There are a number of case studies that are narrated to show how Big Data and SM usages are helpful in preparedness, response, recovery, and mitigation phases to reduce the hazard, risk, and vulnerability of the affected communities. The power of SM has spawned new fields of research, which harness the ability to arrive at instantaneous decisions, which are needed in disaster situations. Big Data analytics thus provides a new tool that matches the speed with which disasters occur and thus aids in rapid decision-making. These technologies are beneficial for adaptation and can help communities become more resilient. Big data is rapidly growing in all science and engineering domains, including biological, biomedical sciences, and disaster management. The characteristics of complexity formulate an extreme challenge for discovering helpful knowledge from big data. Spatial data is big complex data (Francis & Das, 2019; Das, 2021).

Big data created by social media and mobile networks provide an exceptional opportunity to mine valuable insights from them. Business entities harness this information to measure the level of customer satisfaction, but its application in disaster response is still at its inflection point. Social networks are increasingly used for emergency communications and help-related requests (Rajeshkannan & Kogilavani, 2021). During disaster situations, such emergency requests need to be mined from the big data pool to provide timely help. Though government organizations and emergency responders work together through their respective national disaster response frameworks, the sentiment of the affected people during and after the disaster determines the success of the disaster response and recovery process (Das & Dutta, 2020; Das, 2020).

LITERATURE REVIEW

Venkatesan, Arunkumar, and Prabhavathy (2015) proposed a novel co-located classifier utilising the CP-Tree algorithm to handle complex spatial landslide big data. Pal *et al*. (2015) proposed a method that employs an extra layer of compression while storing location data in the form of latitude-longitude (lat-long) pairs to the HBase database. The location data in a mobile network is big-data, as an un-interrupted gathering of such information adds copious data inputs. By incurring a negligible overhead on the system in the form of small encoding and decoding time, the proposed method obtains an almost 70% compression ratio, even for thousands of input data. Shalini *et al*. (2017) described how calamity happens and figured out the consequence of informational collection. This paper helps to predict the spatial dataset by applying the XLMINER and WEKA tools. Anand, Veni and Aravinth (2017) discussed the improvement of the classification accuracy in big data images for the facilitation of growth in urban areas. Archana and Chitrakala (2017) observed that social media like Twitter offers an essential window into the emotions of those who use the platform to share opinions on various topics. Nearly 79% of the world's population use social media to express their opinions on various topics. Various commercial organizations like E-commerce sites, health departments, disaster management activities, etc. may want to compute the emotion levels of tweets for analysing and gaining useful insights into the user's opinions and preferences and using the result of the analysis for various purposes like determining social influence, information diffusion modelling, sentiment analysis, etc. However, the existing tools for computing the emotion level polarity do not consider sarcasm that most predominantly exists in short texts like tweets. Their paper presents a big data approach for computing emotion.

Ragini, Anand and Bhaskar (2018) proposed a big data-driven approach for disaster response through sentiment analysis. Their proposed model collects disaster data from social networks and categorizes them according to the needs of the affected people. The categorized disaster data are classified through machine learning algorithms for analysing the sentiment of the people. The results show that the lexicon-based approach is suitable for analysing the needs of the people during a disaster.

Goswami *et al*. (2018) focussed on reviewing the application of data mining and analytical techniques designed so far for (i) prediction, (ii) detection, and (iii) development of appropriate disaster management strategies based on the collected data from disasters. A detailed description of the availability of data from geological observatories (seismological, hydrological), satellites, remote sensing and newer sources like social networking sites such as Twitter is presented. This work proposed a framework for building a disaster management database for India hosted on open-source big data platforms like Hadoop in a phased manner. The study is focussed on India, which ranks among the top five counties in terms of absolute number of the loss of human life. Joseph *et al*. (2018) presented big data analytics and data mining of social media (SM) for effective emergency management and its uses during different phases of disaster management processes. It draws attention to the basic concepts of SM (characters, type), Big Data (data mining and analytics), interlinks in SM, and disaster management. Samui, Kim and Ghosh (2018) bridge the gap between scientific research on natural disasters and disaster management practice. It examines natural hazards, including earthquakes, landslides, and tsunamis, and uses integrated disaster management techniques, quantitative methods, and big data analytics to create early warning models to mitigate the impacts of these hazards and reduce the risk of disaster. Venkatesan and Prabhavathy (2018) proposed a multi-ranking decision tree big data approach to handle complex spatial landslide data. The proposed classifier performance is validated with a massive real-time dataset. The results indicate that the classifier exhibits both time efficiency and scalability. Raj and Kajla (2018) executed social media analytics (SMA), one of the most talked-about research areas. The research builds up a big data analytics (BDA) framework for carrying out SMA on Twitter data by using R and Hadoop. The main objective of this research is to check the popularity of tourist places on social media and perform various text analytics methods to gain some insights into the data. The study results show the significance of the social web in getting an in-depth understanding of the opinions of Twitter handlers.

Sahni, Arora, and Dubey (2017) highlight the use of Big Data Analytics to provide the application of healthcare waste in the agriculture and disaster management sector. The predictions show that if planning is adequate, then the waste of one sector can be fully utilized in another sector at a low cost. Duvvuru *et al*. (2019) discuss a few issues like data security, data privacy, expenses, bad analytics, and bad data. Their work describes threats to the Geo-Spatial Big Data (GSBD) like Spammy locksmith attack, impersonation attack, Denial-of-Service attack (DOS), and many more and their impact on the GSBD. These security issues will help researchers and practitioners design and develop a novel robust security mechanism for GSBD. Sachdeva and Sodha (2020) discussed the cyber threats to the power networks and prevention techniques for system technology involving IoT sensor nodes, bidirectional communication protocols, cloud architecture, and predictive data analytics. Khan, Gupta, and Gupta (2020) present a critical analysis of the existing methods and technologies that are relevant to a disaster scenario, such as WSN, remote sensing technique, artificial intelligence, IoT, UAV, and satellite imagery, to encounter the issues associated with disaster monitoring, detection, and management. It focuses on the role of the alternate networks and the associated technologies in maintaining connectivity in various disaster scenarios. It presents a comprehensive study on multiple disasters such as landslides, forest fires, and earthquakes based on the latest technologies to monitor, detect, and manage the various disasters. It focuses on several necessary parameters for disaster detection and monitoring and offers appropriate solutions. It also touches upon big data analytics for disaster management.

Wang and Qin (2020) and Khurshid *et al*. (2020) discussed the integration of Cloud-assisted IoT (CIoT) and Big Data systems for information retrieval systems, which assist the government in making decisions during disaster conditions in an effective fasten manner. This paper features the fundamental research that moves through experimental validation, which has been conducted and reported with numerical data in a virtual environment. Zhou *et al*. (2021) discussed the Internet of Things assisted disaster risk management framework (IOTDRMF) proposed for technical resources to communicate the emergency time and better visibility into reliable and prompt decision-making through observing, evaluating, and forecasting natural disasters. This IOTDRMF utilizes big data analytics to analyse disaster risk management and build a kind of spatial data communication network infrastructure, making it a priority to establish rules, protocols, and knowledge sharing. The experimental results show that IOTDRMF and big data analytics compensate for a weak communication network infrastructure and better decision-making to handle disaster risk management. Manoj and Shweta (2021) emphasize their importance in responding to the COVID-19 outbreak and preventing the severe effects of the COVID-19 pandemic. This study first presents an overview of AI and big data and their applications in fighting against COVID-19. Then, an attempt is made to standardize ongoing AI and deep learning activities in this area. Finally, this study highlighted challenges and issues associated with State-of-the-Art solutions to control the COVID-19 situation effectively. Elsotouhy, Jain, and Shrivastava (2021) studied to develop a pandemic disaster management approach based on Big Data (BD). BD text analytics potential is immense in effective pandemic disaster management via visualization, explanation, and data analysis. To seize the understanding of using BD toward disaster management, they have taken a comprehensive approach in place of a fragmented view by using the BD text analytics approach to comprehend the various relationships about disaster management theory. Their study's findings indicate that it is essential to understand all the pandemic disaster management performed in the past and improve the future crisis response using BD. Though worldwide, all the communities face big chaos and have little help reaching a potential solution.

Ramesh, Rajkumar, and Livingston (2020) deal with disaster management techniques used in smart cities to detect disasters like building fires, pollution in the atmosphere, and route blockage using Big Data Analysis and the Internet of Things (IoT). Hadoop environments are combined in disaster-resilient smart cities (Papadopoulos *et al*., 2017). IoT is used as a front end to collect real-time data sets and big data analysis for data pre-processing and aggregation. This work evaluates the threshold capacity of each data, which is collected for these disasters using Z-score normalization, and if the accumulated parameter exceeds the threshold value, then an alert message is sent to public service sectors such as fire stations, police stations, and hospitals. Different challenges faced by this evaluation are discussed in this manuscript. Supriya, Manjunath, and Kavana (2021) explain why IoT and big data are needed to cope with disasters and how these technologies work to solve the problem. Mukherjee, Kumar, and Balaaim (2022) identify pertinent information communicated amidst a disaster to unearth linguistic and thematic features that make tweets popular and attract human involvement. This research is based on the calamities during the last decade in the Indian subcontinent. They applied computational intelligence to identify features that make a tweet popular during a disaster. Their research suggests that Tweet's popularity in attracting human action in a disaster is affected by communication style over social media.

ISC Programmes in Promoting Data-Driven Policymaking in Disaster Risk Reduction

The International Science Council (ISC), earlier known as the International Council of Scientific Unions (ICSU), has been actively engaged in promoting DRR through its Programme on Integrated Research on Disaster Risk (IRDR). IRDR is a decade-long research programme co-sponsored by the ISC and the United Nations Office for Disaster Risk Reduction (UNDRR). The Mission of IRDR is to develop trans-disciplinary, multi-sectoral alliances for (i) In-depth, practical DRR research studies and (ii) The implementation of effective evidence-based disaster risk policies and practices. In 2021, ISC and UNDRR jointly released the Hazard Information Profiles (HIPs) to help policymakers improve DRR policies. ISC Policy Brief 1 showcases how the hazard definitions published in the UNDRR/ISC HIPs are being used to support DRR at global and national levels. This Policy Brief is based upon earlier ISC documents on hazard definition and classification review and the HIPs. ISC Policy Brief 2 analyses the science-technology gap and its incorporation into DRR management at local levels. ISC Policy Brief 3 makes seven key policy recommendations, including improving partnerships between intra-governmental agencies, academic, private sector, NGOs, and insurance authorities, ensuring standardized disaster loss data quantification, and identifying gaps in risk assessment. ISC's Global Risks Perceptions Report 2021 highlights the scientists' perceptions of the top 35 global risks and other additional risks identified by scientists beyond the top 35. CODATA also released two policy briefs and three white papers to facilitate the public policymakers in data governance at the regional, national, and local levels for effective DRR management. Table 1 highlights some of the key policy documents and technical reports produced by the different functional units of the ISC and CODATA during 2017-2022, in association with UNDRR and other international institutions. CODATA has been publishing a monthly newsletter titled "Disaster Reduction and Open Data Newsletter" since October 2018. This publication focuses on the latest data-driven DRR information news, publications, and upcoming events collected from all DRR and disaster data networks.

CODATA in Promoting Data-Driven Disaster Risk Reduction

The CODATA (Committee on Data of the International Science Council) in association with the Centre for Applied Geomatics at CEPT Research and Development Foundation in Ahmedabad, India, launched a podcasting series titled "Data for Resilient Cities" on 15 October 2020. This Series contained 12 episodes and offered good practices, lessons learned, and communities of practice from the global South as well as the Global North. Series 1 offered a rich collection of conversations, case studies, and audio essays. The second podcasting series titled "Data-Knowledge-Action for Urban Systems" was launched on 30 July 2021, and hosted 9 episodes. Jointly created by the Centre for Applied Geomatics, CODATA, and Urban Health and Wellbeing Programme (UHWB), the Series focused on the systematic changes required for making cities adaptive and intelligent for handling urban wellbeing. The showcased "Data-Information-Knowledge-Action" (DIKA) model for urban systems helps create intelligent systems for DRR using scientific and quantitative data. The third podcasting series titled "Data for Disaster Risk Reduction" was launched on 25 May 2022 and will be hosting about ten episodes. The third Series, created jointly by the CODATA, Tonkin and Taylor in New Zealand, and the Centre for Applied Geomatics, focuses on the systemic use of data for handling disasters and effective decisions for post-disaster

Table 1: ISC and CODATA Policy Documents to Promote Data-Driven Policymaking in Disaster Risk Reduction.

Sl. No.	Title	Year of Publication	Produced by
ISC Policy Brief 1	Using UNDRR/ISC Hazard Information Profiles to Manage Risk and Implement the Sendai Framework for Disaster Risk Reduction	May 2022	ISC Programme on Integrated Research on Disaster Risk (IRDR)
ISC Policy Brief 2	Closing the Gap Between Science and Practice at Local Levels to Accelerate Disaster Risk Reduction	May 2022	ISC Programme on Integrated Research on Disaster Risk (IRDR)
ISC Policy Brief 3	Disaster Loss Data in Monitoring the Implementation of the Sendai Framework	May 2019	ISC Programme on Integrated Research on Disaster Risk (IRDR)
ISC Pub 1	Briefing Note on Systemic Risk	March 2022	ISC Programme on Integrated Research on Disaster Risk (IRDR)
ISC Pub 2	Hazard Definition & Classification Review: Technical Review	July 2020	ISC and UNDRR
ISC Pub 3	Hazard Information Profiles: Supplement to UNDRR-ISC Hazard Definition & Classification Review – Technical Report	October 2021	ISC and UNDRR
ISC Pub 4	Global Risks Perceptions Report 2021	December 2021	ISC Programme on Integrated Research on Disaster Risk (IRDR)
CODATA Policy Brief 1	Are We There Yet? The Transition from Response to Recovery for the COVID-19 Pandemic	May 2020	CODATA Task Group on FAIR Data for Disaster Risk Research
CODATA Policy Brief 2	Harnessing Data to Accelerate the Transition from Disaster Response to Recovery	May 2022	CODATA Task Group on FAIR Data for Disaster Risk Research
CODATA White Paper 1	Gap Analysis on Open Data Interconnectivity for Global Disaster Risk Research	May 2020	CODATA Task Group on Linked Open Data for Global Disaster Risk Research (LODGD)
CODATA White Paper 2	Next-Generation Disaster Data Infrastructure	November 2019	CODATA Task Group on Linked Open Data for Global Disaster Risk Research (LODGD)
CODATA White Paper 3	Disaster Loss Data: Raising the Standard	October 2017	CODATA Task Group on Linked Open Data for Global Disaster Risk Research (LODGD)

recovery. Eminent thinkers have been engaged in discussions offering knowledge and solutions. The Series further reflects on the role of data at each stage of the disaster management cycle, viz., mitigation, preparedness, response, and recovery. Table 2 depicts the diverse and multidisciplinary topics selected for the episodes of each podcast series. The Series drew the global experts to discuss critical issues and pointed out the way forward. In the Series, the DRR practitioners and data science researchers cross-talked about the use of big data to predict natural disasters. These also reflected the interdisciplinary approaches taken and/or taken by various smart, resilient, or sustainable cities worldwide to achieve the Sustainable Development Goals and other goals as depicted in the Sendai Framework for Disaster Risk Reduction, 2015-2030. CODATA and several other organizations have been promoting FAIR Data Principles for scientific data, research data, and DRR data, while the data-driven ecosystem of resources ensures data is FAIR (Findable, Accessible, Interoperable, and Reusable) for humans and machines. CODATA Task Group on FAIR Data for Disaster Risk Research, in addition to other task groups and working groups of CODATA, ensures effective maximally automated data stewardship, effective terminologies, metadata specifications, and global partnerships through CODATA Decadal Programme "Data for the Planet: Making Data Work Across Domain Boundaries".

Table 2: **CODATA Podcasting Series to Promote Data-Driven Policymaking in Disaster Risk Reduction.**

Podcast Series Name	Episode Title	Discussants/ Speakers
Data for Resilient Cities [http://crdf.org.in/podcast/data-for-resilient-cities]	Introduction to the Podcast Series	S. Hodson, France; S. Gandhi, India
	Contribution of Technology in making cities resilient	T.D. Vries, USA; V. Chandra, India
	Data Analytics Supporting Cities Mobility and Resilience	W. Ritter, Germany; S. Swamy, India
	Data-driven Geospatial Solutions to Address Community Based Challenges	V. Grant, Jamaica; U. Rajasekar, India
	Data-driven Policymaking for Resilient Built Environments	J. Liu, China; Y. Shukla, India
	Implementing Integrated Systems to Scale Up the Urban Resilience	S. Passmore, UK; L. Garg, India
	Importance of Open Data and Data Sharing Along with its Implication for Urban Studies	L. Bermúdez, USA; V. Kanungo, India
	Massive cross domain data required for understanding Intelligent Urban Systems	F. W. Gatzweiler, China; M. Baradi, India
	Monitoring SDG Goal 6: Role of City and Country Systems along with Citizens' Voice	M.R. Mondardini, Switzerland; M. Mehta, India
	Role of data for COVID response using Gujarat, India and London, UK as examples	V. Murray, UK; D. Mavalankar, India
	Role of Data in Building Resilient Cities Focus on Urban Floods	S. Diggs, USA; N. Bhakuni, India
	Towards a Paradigm shift for Open Data in Planning for Urban Sustainability, Liveability and Resilience	D. Robinson, UK; A. Pendharkar, India
	Using Big Data to Predict Natural Disasters	B. Fakhruddin, New Zealand; C.K. Koshy, India
Data-Knowledge-Action for Urban Systems [http://crdf.org.in/podcast/data-knowledge-action-for-urban-systems]	Introduction episode: What are Data-Knowledge-Action Systems (DAKAS)	S. Hodson, France; F. W. Gatzweiler, China; S. Gandhi, India
	How are DAKAS used in cities	S. Hodson, France; F. W. Gatzweiler, China
	Converting Mobility Data to Knowledge for Making Cities Healthy	R. Marshall, Australia; P. Saldiva, Brazil
	Data for Policymakers to Improve Decision Making in Cities Wellbeing	A. Alijla, Sweden; R. Cooper, UK
	FAIR Data Sharing Practice for Making Integrated Systems Work Dynamically for Cities	A. Young, USA
	Impact of Environment on Human Health	S. Bhattarai, Nepal; K. Nakamura, Japan
	Integrating Health into Urban Planning	P. Carbajal, Mexico
	Role of Community Data in Making Cities Healthy	A. Dasgupta, India
	Trust is the Heart for Urban Wellbeing	T. D. Anderson, Australia; A. Ortigoza, USA
Data for Disaster Risk Reduction [http://crdf.org.in/podcast/data-for-disaster-risk-reduction]	Data Driven Dynamics for Resilience: Coherence of Disaster Risk Reduction, Climate Change, Sustainable Development and Health	V. Murray, UK; B. Fakhruddin, New Zealand

Research Data Alliances in Promoting Data-Driven Disaster Risk Reduction

The Research Data Alliances (RDA) is a community-driven global organization of data scientists, research data managers, and the professionals and institutions engaged with scientific and research data. RDA is built on principles that include openness, inclusivity, and transparency. This international network represents over 12,400 members from 145 countries. RDA constitutes several Working Groups (WGs) and Interest Groups (IGs) for promoting data-driven DRR globally. For example, the RDA COVID-19 Epidemiology Sub-Working Group released a comprehensive report titled "COVID-19 Data Sharing in Epidemiology" in November 2020. RDA Working Group on Epidemiology Common Standard for Surveillance Data Reporting held a Session in the RDA Plenary-16 in 2020. RDA WGs and IGs have been working closely with the CODATA, World Data System (WDS), and Integrated Research on Disaster Risk (IRDR) to promote data-driven disaster risk reduction and set up standards and best practices for the sharing and governance of DRR data.

CONCLUSION

In recent times, since the Sendai Framework for Disaster Risk Reduction came into existence, international collaborations in data-driven DRR have been taking a great leap involving the globally well-respected organizations, institutions, and networks. DRR professionals are effectively engaged with data science professionals in each stage of the disaster management cycle, mitigation, preparedness, response, and recovery. On the other hand, data science embraces emerging technologies such as artificial intelligence, machine learning, deep learning, the internet of things (IoTs), and connected networks to mitigate the risks associated with natural and other kinds of disasters. Big data analytics appear to be very effective in analysing and visualising large-scale datasets related to all types of disasters and helping public policymakers interpret disaster events and predict future events. Many prototypes have been developed to aid data-driven DRR. Mobile apps are also being developed by start-ups, professional developers, and researchers to assist the risks and disaster response communities locally and nationally. Their success stories and best practices will inspire other start-ups and entrepreneurs to use notable big data analytics in predicting natural disasters, enhancing the agility of disaster response communities across the world, and more particularly in the Global South. The international networks and data-driven DRR communities are here to serve and collaborate with the national and provincial governments hand-holding them to sail through the toughest disaster events.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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