Policy brief: Harnessing data to accelerate the transition from disaster response to recovery

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Abstract

A number of challenges are usually faced following a disaster, including ineffective coordination between parties at both local and international levels, limited resources and financial constraints. These challenges have numerous complex factors, which lead to long response times and even longer recovery times, causing a great deal of tension, in addition to other cascading problems in the communities affected by the disaster. It is proposed to set up baseline data with integrated data repository for disaster response to accelerate the transition between response and recovery phases. This would enable the world to better understand the health, social, economic, environmental, and other problems that arise when we fail to invest adequately in combating natural hazards. Using different domain data could enhance management to deal with the emergency response process and enable a swift transition from the response to the recovery phase.

1. Introduction

The increase in frequency, intensity, and magnitude of extreme weather events, and increased vulnerability to natural hazards pose a serious threat to physical, social, economic, and environmental assets. According to the World Risk Report (2021), 171 countries are at risk of an extreme event leading to a disaster. Particularly, the developing nations which have limited resources and primary sectors like agriculture and fisheries, which are predominantly dependent on climate, are in the most vulnerable group with frequent probability and high impact disaster phenomena (Noy, Alwis, & Ferrarini, 2020; USEPA, 2022). It is reported that, in 2020, 313 major disasters (excluding epidemic) affected 123 countries of the world. The impacts of these disasters resulted in death toll of 15,000, affected nearly 98.9 million people and caused economic losses of USD173 billion (ADREM, NDRCC, & IFRCS, 2021). Weather-related disasters dominated in terms of holding responsibility for the majority of both human and economic losses in 2020. Near 95% of deaths in 2020 were due to climatological, hydrological, or meteorological disasters. Around 34% of people affected by disasters 2020 were affected by floods, while 53 % of recorded economic damages were due to storms (ADREM, NDRCC, & IFRCS, 2021). The year 2017 emerged as the second most costly year in terms of economic losses due to various disasters after 2011. In 2017, the Asian continent registered the highest disaster occurrence (43% of the total), however, in 2020, countries located in the southern part of North America and southern, southwestern and south-eastern parts of Eurasia are amongst the top 10 countries with the highest frequency of disasters (ADREM, NDRCC, & IFRCS, 2021). In terms of human losses, the United Kingdom and India witnessed the highest burden of natural disasters in 2020 with around 2,558 and 2,316 deaths.

The silver lining of disasters is that they provide a window of opportunity to improve the conditions and create resilient communities after these catastrophic events (Clark, 2008; Haigh & Amaratunga, 2011). The relief and response phase starts right after the disaster event, and involves search and rescue, supplying emergency relief items, and stalling the outbreak of an epidemic (FEMA, n.d.). It is typically a few hours to a few weeks long. It then transitions into the recovery, reconstruction, and rehabilitation phase, where affected people are no longer worried about survival and can turn to rebuilding their lives.

1.1. Operational challenges in data management from disaster response to recovery

Disaster response is a temporary phase, meaning that the stakeholders work in a different type of environment or on special tasks in relation to the specific situation under time pressure. The challenges in data management that emanate from this temporary nature include:

- **Good data management in the 'cold' phase only:** It is likely that the involved stakeholders have good data management practices in the cold phase, i.e., business-as-usual/daily basis (Centre for Humdata, 2018; OCHA, 2016). However, how compatible, adaptable, and scalable these practices are for the disaster response is often unknown or requires substantial transition efforts (Altay and Labonte, 2014).
- **Coordination difficulties in documenting data workflows and decision making:** Temporary nature of the disaster response phase often leaves people less or even no time to establish a proper data management workflow. There is also insufficient documentation of data and decision making process (Neeraj, Mannakkara, & Wilkinson, 2020). This is understandable but it could create challenges for policy making and transition into the recovery stage.
- **Lack of data processing transparency and community participation:** Community participation and empowerment is a common practice in disaster management (Pandey and Okazaki, 2005; Kusumasari and Alam, 2012; Baharmand et al., 2016). Data coming from different communities can be utilised for various purposes. Ensuring that appropriate data is available to stakeholders is a challenging, as various conditions in disaster response such as the organisational mandates of autonomous stakeholders, time pressure for providing feedback to affected communities and humanitarian communities including local governments, are involved (Horney, Dwyer, Aminto, Berke, & Smith, 2017). Furthermore, despite many initiatives of sharing disaster/humanitarian data from the community such as the Humanitarian Data Exchange, Humanitarian Response, Relief web (HDX, 2022; Humanitarian Response, 2022; Relief Web, 2022), it is still not in the disaster response procedure to prepare data to be available and reusable.
- **Lack of embedded data management capacity in disaster response teams:** Data management requires expertise on assessing, organising, and curating data/information (Carlson, Fosmire, Miller, & Nelson, 2011), which is different from disaster response decision making and slightly distinguished from information management. Therefore, data management capacity is often not integrated in the disaster response teams. This makes data management a separate action that is not done in the same timeline as the response progresses (A.Barabadi & Y.Z.Ayele, 2018; Cutter, 2003; Xu, An, & Nie, 2016).
- **Lack of centralised database:** The impact assessment or situational analysis and damage needs assessments or Post-Disaster Needs Assessment (PDNA) are both developed in the response phase, but data used for developing these assessments are completely different. Data such as the number of missing persons, affected people, deaths, required financial and psychological assistance, and needs for shelter and accommodation are usually required for preparing the impact assessment as it used to direct emergency response and relief resources (NEMA, 2020; ADB, n.d.). PDNA on the other hand needs data such as number of damaged houses, schools, hospitals, and other critical infrastructure and the direct and indirect monetary loss caused by the event to inform the longer-term reconstruction and rehabilitation needs (The World Bank, 2010). Similarly, the assessment developed during the disaster recovery such as disaster recovery strategy and the mitigation strategy are different. Disaster recovery strategies are developed based on the information from PDNA and latest risk data (i.e., hazard, vulnerability, and exposure) (UNDP, 2011), while the mitigation strategy includes present and future risk data (ISDR, n.d.).

Data integration, as a rule, is carried out on the basis of existing databases and data sets without considering all tasks of their use. The prospect for development of data integration is the widespread use of data in various types of models, tasks of response and recovery after a natural disaster and creating a digital twin (DT). The DT should include environmental data and additional information from other domains (economics, finance, social information, demography, transport).

The data for these assessments (Figure 1) are usually collected and stored by different agencies due to the lack of centralised database which can sometimes create duplication of data and efforts and may not accurately inform decision makers on the situation for disaster recovery (ADB, n.d.). Other contributing factors such as institutional silos, lack of policy on data sharing, unclear roles and responsibilities, and lack of standardised methodology for data collection could hinder data management (Fakhruddin & Sims, 2021). Also, data is often not easily disaggregated into key social variables, e.g., gender, age, ability and/or ethnicity. This is a missed opportunity for targeted social policy as part of risk reduction.

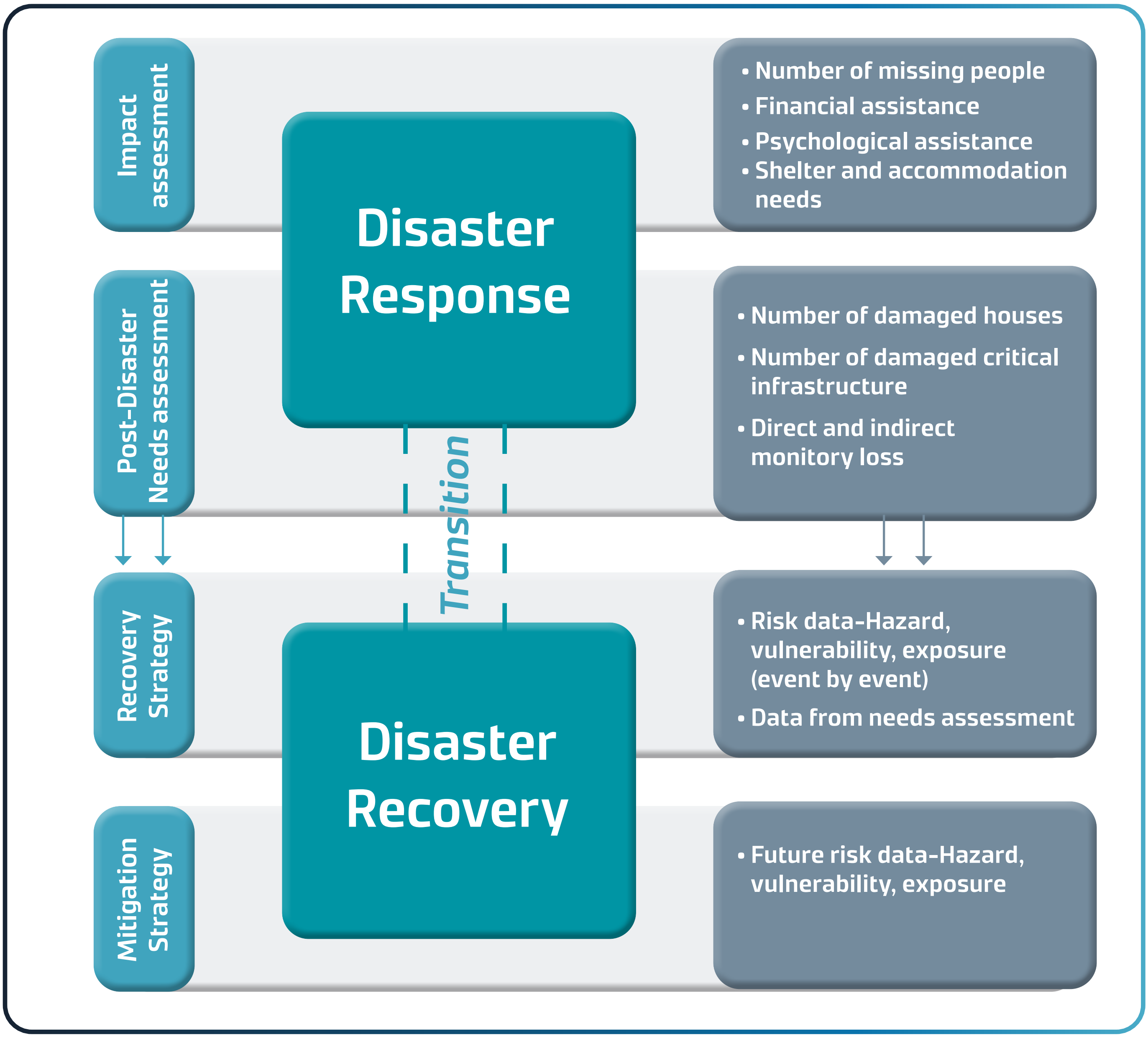

Figure 1: Data needs during disaster response and recovery phase (example)

- Lack of guidelines for the transition from response to recovery: The disaster recovery activities beings while response phase is still in progress. Even though the priorities are different during each phase, decisions taken during the disaster response phase have a direct impact on the disaster recovery (ADB, n.d.; Blackman, Nakanishi, & M.Benson, 2017; Lloyd-Jones, 2006). Also, the disaster response phase can prolong for a longer period due to the lack of clear guidelines or strategy on transition (Blackman, Nakanishi, & M.Benson, 2017). For instance, institutions responsible for recovery activities tend to prolong the response phase to utilise the funding provided by the donor agencies or the remaining funding must be returned to the donor organisations (Lloyd-Jones, 2006).
- Slow progress of reconstruction, rehabilitation, and recovery due to lack of accurate data: Many authors conveyed that the reconstruction, rehabilitation, and recovery phase of the disaster management cycle is often ignored, not very well understood, and slow due to many limitations (Halvorson & Hamilton, 2009; Smith & Wenger, 2007; Berke, Kartez, & Wenger, 1993). Lack of accurate data in this phase (such as on socio-economic factors, vulnerabilities), lack of data sharing policy, and institutional silos are considered as major factors for slow progress (A.Barabadi & Y.Z.Ayele, 2018; Lloyd-Jones, 2006).

2. Case study: Mapping the neighbourhood in Uttarakhand: the Case of Department of Science and Technology Response for Better Data Creation

In June 2013, a catastrophic natural disaster occurred in Kedarnath Valley in Indian state Uttarakhand. The calamity led to heavy loss of human lives and property. Department of Science and Technology (DST), Government of India, initiated a coordinated programme on "Map the Neighbourhood in Uttarakhand" for development of sound scientific database based on pattern of damages and also for the identification of the areas which are safe for reconstruction and relocation of infrastructural services in the State (Romshoo, Ahmad, Singh, & Rafiq, 2013).

Number of organisations participated in the programme, including organisations like, Survey of India, Wadia Institute of Himalayan Geology, Deharadun, HNB Garhwal University, Srinagar, Kashmir University, Srinagar, Kumaon University, Nainital, Indian Institute of Remote Sensing, Dehradun, and University of Delhi. Crucial data were collected with the active involvement of scientists, faculty members and researchers of these institutions and universities. Field photographs with GPS coordinates of all damaged objects along the roads and major rivers were collected and uploaded on Bhuvan Portal. The major data were collected on buildings damages, infrastructural damages and loss of natural ecosystem. An integrated geographical information system of Uttarakhand devastation was also developed (Romshoo, Ahmad, Singh, & Rafiq, 2013).

Based on learning experiences gained in this programme, DST has initiated a "Large Scale Mapping" along the extensive corridor from Rishikesh to Kedarnath for understanding the underlying causes of the geological structures, geotechnical aspects and analysis of slope stability to develop a more precise and scientific development plan for disaster risk reduction in Uttarakahand state. Such initiative brings recovery performance at highest level.

3. Key opportunities for enhancement

3.1. Integrated and unified response system

- Response measures are those taken immediately after receiving early warnings, anticipating an impending disaster, or post-disaster in cases where an event occurs without warning. Different central ministries and departments provide emergency support to the response effort as per request from the state government. The State Disaster Management Authority, Department of Revenue or Relief Commissioner (as applicable) is the nodal agency for coordination of disaster response.

- At the national level, assigning a nodal responsibility to specific ministries for coordinating responses, and activating the Incident Response Teams at state, district, or the block level could improve the response phase.

- An integrated and unified response system ensures quick action and move towards recovery. Unified system includes government, civil society, corporate social responsibility, citizens and Inter-Faith processes. Integration should be at various government levels like central, state, district, and local governments.

3.2. Establishing a centralised database

- Having a centralised database supports in systematically collecting and recording data on hazard, vulnerability, exposure, disaster occurrence, losses, impacts, and needs (UNDRR, 2019). Storing the data in a centralised database could improve the access to data and may avoid duplication of data and efforts. For example, storing an ongoing rapid damage assessment and PDNA in the centralised database could support in understanding the transition from response to recovery. Also, the centralised database could support in moving beyond the typical emergency management (such as including biological hazards) and supports in managing multiple hazards (where data from previous disaster could be used as a baseline) (Fakhruddin, Blanchard, & Ragupathy, 2020).

3.3. Development of a DT of the enterprise, taking into account environment data

• The DT must connect disparate data and applications from different domains. It should provide the capabilities you need to manage data, connect, integrate, transform, analyse, use and store data, and manage APIs, allowing you to solve many emerging problems during a disaster and recovery faster and with less complexity than using existing web-portals and web-sites. The use of DT to serve users during the response and recovery period requires the use of a wider range of data (Viazilov E., 2021) - operational observations, forecasts, climate generalisations, information on the state of serviced industrial enterprises, reflecting current economic, social, technical and economic and organisational conditions. In this case, it allows modelling possible impacts on various objects, assessing possible damage at a particular level of danger, calculating the cost of preventive actions and optimising business processes taking into account the available comprehensive information.

- Directions for the application of the DT in the field of response and recovery are: modelling and forecasting the state of the environment with higher detail for the disaster area; global modelling of climate change, affecting the increase in the extremeness of natural phenomena; managing the economic efficiency of enterprises, taking into account the assessment of the impact of disasters and environmental situations on industrial facilities and the population, adaptation to climate change, assessment of damages and calculations of the cost of preventive actions. • The creation of a DT allows entering a new era of mutually beneficial data exchange, when any user can receive open data from the DT through the use of APIs. The DT is the next stage in the development of the data access model - "anytime, anyone, anywhere, any information."

3.4. Transparency

- Post-disaster communication is important to keep everyone informed of the recovery process. Communicating the decisions taken during response and recovery phase with the community makes them feel belonged in the process, improves the trusts on the institutions, and improves the speed of recovery process (Mannakkara & Wilkinson, 2015). Risk data, disaster strategies (e.g., disaster response plan, disaster recovery plan) and other relevant information needs to be made available for public through appropriate information and risk communication systems to ensure they understand the risks around them and the necessary steps that are being taken to minimise or avoid the risk (ADB, n.d.; Mannakkara & Wilkinson, 2015; Fakhruddin, Blanchard, & Ragupathy, 2020).

3.5. Recovery and building back better

- Globally, the approach towards post-disaster restoration and rehabilitation has shifted to one of betterment reconstruction (UNDRR, 2015; Neeraj, Mannakkara, & Wilkinson, 2020). "Build Back Better" is a concept where post-disaster recovery is considered an opportunity to recover, reconstruct, and rehabilitate the affected communities better than they were before (UNDRR, 2021). The reconstruction process varies depending on the actual disaster, location, pre-disaster conditions, and the potentialities that emerge at that point of time (Olshansky, 2005). Therefore, an event-by-event disaster recovery strategy based on the PDNA and existing risks such as hazard, vulnerability, and exposure with possible elements of betterment reconstruction is needed. The recovery strategy needs to be developed based on the National Disaster Management Plan, as it provides a generalised framework for recovery.

3.6. Guidelines for response to recovery

- Guidelines for transition or an exit strategy can guide the institutions and individuals in moving from the response operations to recovery activities. The guidelines need to include institutional and financial mechanism, data management, and establish clear roles and responsibilities of the actors involved in the response and recovery phases to avoid duplication of efforts and to effectively utilise the resources.

3.7. Community Centric Disaster Recovery Services based on Community Data Collection

- Emphasis needs to be provided on the identification of dimensions of exposure, vulnerability and risk at local level while taking into consideration the social structure of region. Vulnerable groups of society i.e., children, women, elderly, differently abled people, and animals require special attention (Singh & Kumar, 2015). Urban centres in mountain regions due to their haphazard expansion on limited resources, unstable land and increasing density are more vulnerable. Human resource inventory at micro level should be promoted along with mapping of local resources, multi hazard mapping of vulnerable areas at micro level viz. panchayat or ward level. Enhancing the local level decision making institution and decisions should be based on indigenous knowledge, community resources and with its scientific validation. Community based recovery plan will help in mitigating disasters (Moatty & Freddy, 2016; Kusumasari & Alam, 2012). It is equally importantly that there should be uniformity of indicators while preparation of vulnerability index in order to have better comparison among regions.

References

A.Barabadi, & Y.Z.Ayele. (2018). Post-disaster infrastructure recovery: Prediction of recovery rate using historical data. Reliability Engineering & System Safety, 209-223.

ADB. (n.d.). Policy Note: Recommendations for Dealing with the Transition from Disaster Response to Recovery. Asian Development Bank. Retrieved from https://www.adb.org/sites/default/files/publication/29455/disaster-response-recovery.pdf

ADREM, NDRCC, & IFRCS. (2021). 2020 Global Natural Disaster Assessment Report. Academy of Disaster Reduction and Emergency Management, National Disaster Reduction Center of China, International Federation of Red Cross and Red Crescent Societies. Retrieved from https://reliefweb.int/sites/reliefweb.int/files/resources/2020%20Global%20Natural%20Disaster%20Assessment%20Report-EN%282%29.pdf

Berke, P. R., Kartez, J., & Wenger, D. (1993). Recovery after disaster: achieving sustainable development, mitigation and equity. Disasters, 192-207.

Blackman, D., Nakanishi, H., & M.Benson, A. (2017). Disaster resilience as a complex problem: Why linearity is not applicable for long-term recovery. Technological Forecasting and Social Change, 89-98.

Carlson, J., Fosmire, M., Miller, C., & Nelson, M. S. (2011). Determining Data Information Literacy Needs: A Study of Students and Research Faculty. Retrieved from Project Muse: Libraries and the Academy: https://muse.jhu.edu/article/428877/summary

Centre for Humdata. (2018). Data Responsibility. Retrieved from Centre for Humdata: https://centre.humdata.org/data-responsibility/

Clark, C. (2008). The Shock Doctrine: The Rise of Disaster Capitalism. The Geographical Journal, 284-287.

Crutchfield, M. (2013). Phases of Disaster Recovery: Emergency Response for the Long Term. Retrieved from Relief Web: https://umcmission.org/Find-Resources/New-World-Outlook-Magazine/2013/March-April-2013/0430-Phases-of-Disaster-Recovery-Emergency-Response-for-the-Long-Term

Cutter, S. L. (2003). GI Science, Disasters, and Emergency Management. Review Article, 439-445.

Fakhruddin, B., & Sims, B. (2021). Analysis of DRR inclusion in national climate change commitments. Geneva: UNDRR.

Fakhruddin, B., Blanchard, K., & Ragupathy, D. (2020). Are we there yet? The transition from response to recovery for the COVID-19 pandemic. Progress in Disaster Science.

FEMA. (n.d.). Emergency Management in the United States. United States of America. Retrieved from https://training.fema.gov/emiweb/downloads/is111_unit%204.pdf

Haigh, R., & Amaratunga, D. (2011). A window of opportunity. International Journal of Disaster Resilience in the Built Environment.

References cont...

Halvorson, S. J., & Hamilton, J. P. (2009). In the aftermath of the Qa'yamat: the Kashmir earthquake disaster om northen Pakistan. Disasters, 184-204.

HDX. (2022). Humanitarian Data Exchange. Retrieved from Humanitarian Data Exchange: https://data.humdata.org/

Horney, J., Dwyer, C., Aminto, M., Berke, P., & Smith, G. (2017). Developing indicators to measure post-disaster community recovery in the United States. Disasters, 124-149.

Humanitarian Response. (2022). Humanitarian Response. Retrieved from Humanitarian Response: https://www.humanitarianresponse.info/en

ISDR. (n.d.). Guidelines: National Platforms for Disaster Risk Reduction. International Strategy for Disaster Reduction. Retrieved from https://www.unisdr.org/files/601_engguidelinesnpdrr.pdf

Kusumasari, B., & Alam, Q. (2012). Bridging the gaps: the role of local government capability and the management of a natural disaster in Bantul, Indonesia. Natural Hazards, 761-779.

Lloyd-Jones, T. (2006). Mind the Gap! Post-disaster reconstruction and the transition from humanitarian relief. RICS, University of Westminster. Retrieved from https://www.preventionweb.net/files/9080_MindtheGapFullreport1.pdf

Mannakkara, S., & Wilkinson, S. (2015). Supporting post-disaster social recovery to build back better. International Journal of Disaster Resilience in the Built Environment, 126-139.

Moatty, A., & Freddy, V. (2016). Post-disaster recovery: The challenge of anticipation. E3S Web of Conferences.

Neeraj, S., Mannakkara, S., & Wilkinson, S. (2020). Build back better concepts for resilient recovery: a case study of India's 2018 flood recovery. International Journal of Disaster Resilience in The Built Environment. doi:10.1108/IJDRBE-05-2020-0044

Neeraj, S., Mannakkara, S., & Wilkinson, S. (2020). Evaluating socio-economic recovery as part of building back better in Kaikoura, New Zealand. International Journal of Disaster Risk Reduction, 52. doi:https://doi.org/10.1016/j.ijdrr.2020.101930

NEMA. (2020). National Impact Assessments Data Set and Dictionary: Technical Standard. Wellington: Civil Defeence.

Noy, I., Alwis, D. D., & Ferrarini, B. (2020). Defining Build-Back-Better after Disasters with an Example: Sri Lanka's Recovery after the 2004 Tsunami. International Review of Environmental and Resource Economics, 14, 349-380.

OCHA. (2016). Building data responsbility into humanitarian action. OCHA Policy Development and Studies Branch (PDSB), Policy Analysis and Innovation Section. Retrieved from https://www.unocha.org/sites/unocha/files/Building%20data%20responsibility%20into%20humanitarian%20action.pdf

Olshansky, R. B. (2005). How do communities recover from disaster? A review of current knowledge and an agenda for future research. 46th annual conference of the association of collegiate schools of planning, (pp. 1-19).

Relief Web. (2022). Relief Web. Retrieved from Relief Web: https://reliefweb.int/

Romshoo, S. A., Ahmad, T., Singh, B., & Rafiq, M. (2013). Map the Neighborhoood in Uttarakhand (MANU), Uttarakhand Disaster 2013. Delhi: Government of India. Retrieved from https://www.researchgate.net/publication/281280295_Map_the_Neighborhoood_in_Uttarakhand_MANU_Uttarakhand_Disaster_2013

Singh, R. B. (2015). A Geographical Mosaic of Incredible India: Introducing Natural and Cultural Heritage. Progress in Indian Geography.

Singh, R. B., & Kumar, A. (2015). Climate variability and water resource scarcity in drylands of Rajasthan, India. Geoenvironmental Disaster, 1-10.

Smith, G. P., & Wenger, D. (2007). Sustainable disaster recovery: Operationalizing an existing agenda. Handbook of disaster research. Springe. In H. Rodríguez, E. L.Quarantelli, & R. R. Dynes, Handbook of disaster research.

The World Bank. (2010). Damage, Loss, and Needs Assessment. Washington: The World Bank. Retrieved from https://openknowledge.worldbank.org/bitstream/handle/10986/19047/880860v10WP0Bo0PUBLIC00TTL0Vol10WEB.pdf?sequence=1&isAllowed=y

UNDP. (2011). Methodological Guide for Post-Disaster Recovery Planning Processes: guidelines and actions for national, regional and local governments. UNDP. Retrieved from https://www.preventionweb.net/files/32306_32306guametodolgicaparaprocesosdepl.pdf

References cont...

UNDRR. (2015). Sendai Framework for Disaster Risk Reduction 2015-2030. United Nations Office for Disaster Risk Reduction.

UNDRR. (2019). Disaster loss database. Retrieved from UNDRR Terminology: https://www.undrr.org/terminology/disaster-loss-database

UNDRR. (2021, April). Build Back Better. Retrieved from United Nations Office DIsaster Risk Reduction: https://www.undrr.org/terminology/build-back-better

USEPA. (2022). Climate Impacts on Agriculture and Food Supply. Retrieved from United States Environmental Protection Agency: https://climatechange.chicago.gov/climate-impacts/climate-impacts-agriculture-and-food-supply

World Risk Report. (2021). World Risk Report. Bündnis Entwicklung Hilft; Ruhr University Bochum. Retrieved from https://reliefweb.int/sites/reliefweb.int/files/resources/2021-world-risk-report.pdf

Xu, J., An, J., & Nie, G. (2016). A quick earthquake disaster loss assessment method supported by dasymetric data for emergency response in China. Nat. Hazards Earth System Sciences, 885-899.