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Short Communication

Hydrometeorological disasters during COVID-19: Insights from topic modeling of global aid reports

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HIGHLIGHTS

• Disaster management experiences during COVID-19 pandemic need to be understood.
• Topic modeling on global humanitarian reports (during COVID-19 pandemic) is performed.
• Maintaining social distancing is challenging for disaster evacuation.
• Children are a priority, but other vulnerable groups need attention.
• ‘Hygiene’ is not a highly weighted topic, while ‘health’ is highly weighted.

GRAPHICAL ABSTRACT

ABSTRACT

Since the beginning of the COVID-19 pandemic, the world has experienced numerous hydrometeorological disasters along with it. The pandemic has made disaster relief work more challenging for humanitarian organizations and governments. This study aims to provide an overview of the topics/issues of concern in the countries while responding to hydrometeorological extreme events (e.g., floods and cyclones) during the pandemic. Latent Dirichlet Allocation (LDA), a computational topic modeling technique, is employed to reduce the numerous (i.e., 1771) humanitarian reports/news to key terms and meaningful topics for 24 countries. Several insights are derived from the LDA results. It is identified that countries have suffered multiple crises (such as locust attacks, epidemics and conflicts) during the pandemic. Maintaining social distancing while disaster evacuation and circumventing the lockdown for relief work have been difficult. Children are an important topic for most countries; however, other vulnerable groups such as women and the disabled also need to be focused upon. Hygiene is not a highly weighted topic, which is of concern during a pandemic that mandates good sanitation to control it effectively. However, health is of great importance for almost all countries. The novelty of the paper lies in its interdisciplinary approach (usage of a computational technique in disaster management studies) and the timely examination of disaster management experiences during the ongoing pandemic. The insights presented in the study may be helpful for researchers and policy-makers to initiate further bottom-up work to address the challenges in responding to hydrometeorological disasters during a pandemic.

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1. Introduction

The COVID-19 pandemic has ravaged across countries since February 2020, and has impeded economic development, movement of people and supplies. In order to contain the pandemic, social distancing and imposing large-scale lockdowns (country-wide, district-wide, etc.) have become a norm. Along with the pandemic, many countries have also experienced disastrous extreme weather events (Asfara, 2021). For example, in the year 2020, cyclone Amphan hit India and Bangladesh, typhoons Vongfong, Molave, Goni, and Vamco affected the Philippines, Somalia faced cyclone Gati and flash floods, etc. These events have devastated the lives and properties of populations residing in the concerned areas. Humanitarian aid and response after a disaster are vital drivers of both short and long-term community recovery. However, due to the pandemic, new challenges have developed for humanitarian action (Kishore, 2020). These include maintaining social distancing norms while evacuating and housing disaster victims, and restrictions on the movement of volunteers and relief items due to lockdown. It seems that in these unprecedented times, the impact of disasters on communities and response can be different. Documenting and understanding these experiences and challenges across nations is essential for developing necessary solutions and innovating disaster management.

In the short period since the beginning of the pandemic, the literature has been enriched with studies on disasters during COVID-19. Most of them are commentaries and viewpoints. Some of them have conveyed the health effects of floods during a pandemic (Guo et al., 2020; Pramanik et al., 2021), and the emergent need to simultaneously manage climate hazards and pandemics (Phillips et al., 2020). Simonovic et al. (2021) highlight the necessity of being proactive or prepared. Ishiwari et al. (2020) have given few guidelines on responding to disasters during a pandemic. These include the need to — decide the level of trade-off between evacuating and maintaining social distancing based on the severity of the hazard and COVID-19, protect volunteers, communicate risk to local communities, coordinate with stakeholders, etc.

The present study aims to add to this body of literature by reviewing and providing insights from the on-field experiences of humanitarian organizations in responding to hydrometeorological disasters amid a pandemic. Unlike previous studies, it attempts to be comprehensive by analyzing multiple disasters that have occurred in the past year during the pandemic across the world. Further, the study adopts a computational reviewing technique called topic modeling to identify the predominant issues faced in the disaster-impacted regions. This has not been attempted in the previous studies on the coincidence of the pandemic and extreme weather disasters. Through this technique, the important topics of concern while managing a disaster during a pandemic are identified. The study results in some noteworthy observations that can guide future work on examining and improving disaster management during public health emergencies.

2. Methodology

2.1. Data

This study uses the reports/news articles of humanitarian organizations to understand the challenges that cropped up when extreme events and the COVID-19 pandemic coincided. ReliefWeb (2021), the world’s largest portal for humanitarian information, is used to access the reports associated with the hydrometeorological disasters that occurred during the pandemic. The time period considered in the study is April 2020 (as this was when the COVID-19 pandemic started spreading aggressively across the world and the number of infections began to rise) to the end of the year, that is, December 2020. To assess the country-specific challenges, the reports of all disasters that affected each country during this time period are grouped together. Most countries experienced single extreme events (details of hydrometeorological disasters in different countries are given in Supplementary Material). However, Bangladesh, India, Philippines, Somalia, Vietnam, Latin America and the Pacific Islands faced multiple hydrometeorological extreme events during these months. For example, Vietnam experienced floods in September, cyclone Goni in October and Vamco in November 2020, and reports associated with all three events are considered together while running the assessment for the country. Next, smaller countries lying in Latin America (that is, Belize, Colombia, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama) and the Pacific Islands (that is, Fiji, Vanuatu, Tonga and Solomon Islands), which have experienced almost the same events and share a large number of common reports, are grouped together.

Thereafter, the reports belonging to each country are manually screened. Documents such as posters, warnings and maps in any language other than English are excluded. The filter present on the ReliefWeb website also helped in screening the documents. ReliefWeb generally does not publish duplicate documents in the same language (that is, English). However, some documents may have been similar, if not the same. For example, there are documents that provide weekly or daily updates on the affected community or location. These documents can have overlapping and common words. Nevertheless, while selecting the documents, utmost care was taken not to duplicate them. The study considers all relevant reports related to the disasters that occurred between April–December 2020 and published till 28th February 2021 for each country/region in its analysis.

It is found that a total of thirty-eight countries (and regions, that is, Latin America and Pacific Islands) have faced hydrometeorological extreme events from April–December 2020 (list in Supplementary Material). However, out of these, fourteen countries had very few documents (that is, less than ten), which is not sufficient for applying topic modeling and obtaining meaningful results, and hence had to be excluded. This led to a total of twenty-four countries/regions (Fig. 1), amounting to a total of 1771 documents, for which topic modeling could be performed.

2.2. Topic modeling

As the reports/news articles (described in Section 2.1) are quite sizable, the review is conducted through a computational technique called topic modeling. This method identifies the topics of discussion in a set of documents by recognizing similar text patterns and clustering them. The technique uses machine learning algorithms and is one of the many approaches for Natural Language Processing (NLP). It has been used in numerous studies to synthesize large and complex text data into meaningful smaller snippets. This includes analysis of the scientific literature, policy documents, media, corporate reports, etc. (Szekely and Brocke, 2017; Asmussen and Møller, 2019; Heidenreich et al., 2019; Goyal and Howlett, 2021). Topic modeling enables reviewing large textual information within a short time and with low human resources. This makes it an ideal approach for our study, which involves multiple reports for the different countries.

In this study, Latent Dirichlet Allocation (LDA), an unsupervised topic modeling technique, is applied to analyze the humanitarian aid reports. LDA is based on a Bayesian probabilistic model and can computationally summarize large text into a limited number of topics (Blei et al., 2003). It is a widely used topic model (Blei et al., 2003; Benites-Lazaro et al., 2018) and has been used previously in a variety of studies, e.g., to examine social policy debates on climate change (Benites-Lazaro et al., 2018), technological patents (Wang et al., 2020), review the literature on community forestry (Clare and Hickey, 2019), cancer (Lin et al., 2020), mindfulness (Koe et al., 2019), etc.

The present study uses KNIME (Konstanz Information Miner), an open-source analytics platform, to perform LDA. The workflow followed for the study is presented in Fig. 2. It consists of fifteen KNIME nodes that can perform the various steps required for the analysis. First, the text files are made readable by KNIME (using nodes 1 and 2). Thereafter, the documents are pre-processed such that LDA can yield meaningful outputs. Since many of the humanitarian reports used in the study have been copied from web
removing inflections, e.g., in case of plurals, pronoun case, and verb endings” (KNIME, 2021). To perform the lemmatization, first, the Stanford Tagger node is used to assign part of speech (POS), that is, identify words as noun, pronoun, verb, adjective, etc., in the documents. Then, the ‘Stanford Lemmatizer’ node is used. Various KNIME nodes are deployed to remove punctuations, convert cases, remove stop words (words that may not form meaningful keywords and can be ignored e.g., being, cannot, further, while etc.), short words (consisting of less than 3 letters) and numbers. The node ‘Topic Extractor’ is used to run LDA. For each country, ten topics, each with ten keywords, along with their weightages (indicating their importance), are generated. The weights of keywords generated in LDA are relative to each other, and the average weight of the keywords under a topic is used to identify the top-weighted topics for a country. The contribution of a specific keyword to a country’s topics can also be calculated by taking its weightage as a percentage of the total weights of all the keywords. The higher the average or percentage weightage of a topic or keyword respectively, the higher its prevalence or importance for the country. Through the keywords obtained from LDA, the topics of each country (indicating their experiences) are interpreted and used to obtain insights (described in the next section). Further, using the keywords given by LDA, word clouds are generated through the ‘Tag Cloud’ node. The results (keywords and word clouds) are saved using the nodes ‘CSV writer’ and ‘Image Writer’.

3. Results

In the following sub-sections, the important observations made from the results of LDA are presented. The top three weighted topics that could be identified from the key terms/words for each country are listed in Table 1. As this study is based on aid reports, topics describing humanitarian assistance/support/action/response are present for almost all the countries. The notable and some of the common keywords which were generated for the countries are given in Table 2. This table enables identification of the experiences which were similar among the countries. Fig. 3 shows some examples of word clouds that are generated from the key terms at the end of LDA. The insights presented in the following sub-sections are derived from an amalgamation of these tables and figures.

3.1. Multiple disasters and events together

While the COVID-19 pandemic was in global focus in 2020, many countries experienced multiple crises along with it. COVID-19 is a common top-weighted topic for almost all the countries considered in the study. Therefore, it is also a key term for most countries (Table 2) except Pakistan, Indonesia and Vietnam. The countries with the highest weightage to the
Table 1
Top three weighted topics for the countries.

| Country        | Top 3 topics                                                                 |
|----------------|-------------------------------------------------------------------------------|
| Afghanistan    | > Displacement of people                                                        |
|                | > Humanitarian assistance                                                       |
|                | > COVID-19 and health                                                           |
| Bangladesh     | > Aid/support                                                                  |
|                | > COVID-19 and Refugee/Rohingya crisis                                          |
|                | > Support to vulnerable communities, such as refugees and children              |
| Burkina Faso   | > Community crisis and humanitarian action                                      |
|                | > Child and health                                                              |
|                | > Child and education                                                           |
| Cambodia       | > Flood and humanitarian action                                                 |
|                | > Mapping and forecast                                                          |
|                | > COVID-19 and health of the vulnerable                                         |
| Chad           | > Children, COVID-19 and health                                                 |
|                | > Response to flood-affected people                                             |
|                | > Water                                                                        |
| DR Congo       | > COVID-19 and health                                                           |
|                | > Support for flood-affected households                                         |
|                | > Children and health                                                           |
| Ethiopia       | > COVID-19 and health                                                           |
|                | > Humanitarian response                                                         |
|                | > Food and income of households                                                  |
| India          | > COVID-19 and health                                                           |
|                | > Children                                                                     |
|                | > Flood relief                                                                  |
| Indonesia      | > Hygiene kit and health                                                        |
|                | > Volunteer to help affected population                                         |
| Kenya          | > COVID-19 and health                                                           |
|                | > Vulnerable communities (child, refugee, girl)                                 |
|                | > Disasters (locust, flood)                                                     |
| Latin America  | > People and health                                                             |
|                | > Hurricane                                                                     |
|                | > Humanitarian support                                                          |
| Myanmar        | > Response to COVID-19                                                          |
|                | > Humanitarian organizations                                                     |
|                | > Refugees in Bangladesh                                                        |
| Nepal          | > COVID-19 and health                                                           |
|                | > Response to flood                                                             |
|                | > Humanitarian organizations                                                     |
| Niger          | > Humanitarian support                                                          |
|                | > Vulnerable communities (child, girl)                                          |
|                | > COVID-19                                                                       |
| Nigeria        | > Humanitarian support                                                          |
|                | > Food and household                                                            |
|                | > Child and nutrition                                                           |
| Pacific Islands| > Shelter and support                                                           |
|                | > WASH and health                                                                |
|                | > Children and school                                                           |
| Pakistan       | > Cause of flood (river and dam)                                                |
|                | > Impact of flood and response                                                   |
|                | > Humanitarian operation                                                         |
| Philippines    | > Disaster management                                                            |
|                | > Families                                                                      |
|                | > Humanitarian support                                                          |
| Somalia        | > COVID-19 and health                                                           |
|                | > Child and health                                                              |
|                | > Displacement due to flood                                                      |
| South Sudan    | > Access to food                                                                |
|                | > Humanitarian response                                                         |
|                | > Child, COVID-19 and health                                                     |
| Sudan          | > Food and health                                                                |
|                | > COVID-19 and health                                                           |
|                | > Impact of flood and response                                                   |
| Tanzania       | > COVID-19 and health                                                           |
|                | > Vulnerable communities (child, refugee)                                       |
|                | > Humanitarian operation                                                         |
| Uganda         | > Children, COVID-19 and health                                                 |
|                | > Food and household                                                            |
|                | > People and diseases                                                            |
| Vietnam        | > Humanitarian organizations                                                     |
|                | > Support to flood victims                                                      |
|                | > Children and health                                                            |

Table 2
Notable key terms for countries/regions according to LDA.

| Term                              | Countries                                                                 |
|-----------------------------------|---------------------------------------------------------------------------|
| COVID-19                          | Afghanistan, Bangladesh, Cambodia, Chad, DR Congo, Ethiopia, India, Korea, Latin America, Myanmar, Nepal, Niger, Nigeria, Pacific Islands, Philippines, Somalia, South Sudan, Sudan, Tanzania, Uganda |
| Locust                            | Kenya, Somalia, Tanzania and Uganda                                        |
| Cholera                           | DR Congo and Ethiopia                                                     |
| Malaria                           | Burkina Faso                                                              |
| Ebola                             | DR Congo                                                                  |
| HIV                               | Uganda                                                                    |
| Conflict                          | Afghanistan, Burkina Faso, Myanmar and Nigeria South Sudan                |
| Violence                          | Latin America, Pacific Islands, South Sudan and Tanzania                  |
| Refugee                           | Bangladesh, Burkina Faso, DR Congo, Ethiopia, Kenya, Myanmar, Niger, Pakistan, Sudan, Tanzania, and Uganda |
| Migrant                           | Bangladesh, India, Nepal and Somalia                                       |
| Food                              | Afghanistan, Burkina Faso, Cambodia, Chad, DR Congo, Ethiopia, India, Kenya, Latin America, Myanmar, Niger, Nigeria, Pacific Islands, Pakistan, Philippines, Somalia, South Sudan, Sudan, Tanzania, Uganda, Vietnam |
| Nutrition                         | Burkina Faso, Kenya, Myanmar, Nepal, Niger, Pakistan, Tanzania             |
| Women                             | Bangladesh, Pacific Islands and Vietnam                                   |
| Female                            | Tanzania and Uganda                                                       |
| Child                             | Afghanistan, Bangladesh, Burkina Faso, Chad, DR Congo, Ethiopia, India, Kenya, Latin America, Myanmar, Niger, Nigeria, Pacific Islands, Pakistan, Philippines, Somalia, South Sudan, Sudan, Tanzania, Uganda, Vietnam |
| Disability                        | Pacific Islands                                                           |
| WASH                              | Afghanistan, DR Congo, Indonesia, Latin America, Pacific Islands and South Sudan |
| Hygiene                           | Chad, DR Congo, Indonesia, Latin America and Myanmar                      |
| Health                            | Afghanistan, Bangladesh, Burkina Faso, Cambodia, Chad, DR Congo, Ethiopia, India, Kenya, Latin America, Myanmar, Niger, Nigeria, Pacific Islands, Pakistan, Philippines, Somalia, South Sudan, Sudan, Tanzania, Uganda, Vietnam |
| Agriculture                       | Niger                                                                      |
| Farm                              | Kenya                                                                      |
| Farmer                            | Philippines                                                                |
| Crop                              | Bangladesh, Niger, Philippines, Somalia, Sudan and Tanzania                |
| Harvest                           | Uganda                                                                     |
| Famine                            | South Sudan                                                                |

term 'COVID-19' are Kenya, Ethiopia and Tanzania, and those giving the least weightage are Latin American countries, the Philippines and Cambodia. The presence of COVID-19 as a weighted topic or as a key term signifies that the pandemic has been a challenge or a key concern for the humanitarian agencies in the country, irrespective of whether the country has experienced large or few Covid cases. For example, it may be noted that some countries, such as Vietnam and those in the Pacific Islands, did not experience a significant number of Covid cases in 2020. Hence, COVID-19 is not a highly weighted topic for these countries. However, COVID-19 is a key term (Table 2) even for the Pacific Islands probably because, in accordance with WHO (World Health Organization) mandates, necessary precautions had to be taken to prevent it while providing aid and consequently was a frequently occurring term in the reports.

Apart from hydrometeorological disasters and COVID-19, countries in East Africa experienced locust attacks. The countries for which 'locust' is one of the terms (resultant of topic modeling) are Kenya, Somalia, Tanzania and Uganda. This suggests that locust attacks were frequently discussed and on the radar of humanitarian organizations in those countries. Some countries experienced other epidemics such as cholera, malaria and Ebola. Cholera is a key term for DR Congo and Ethiopia, malaria for Burkina Faso and Ebola for DR Congo. Another communicable disease, that is, HIV is a key term for Uganda.

Next, amidst natural disasters, countries have experienced conflict (key term for Afghanistan, Burkina Faso, Myanmar, Nigeria and South Sudan) and violence (key term for Pacific Islands, Latin America, South Sudan
| (a) Bangladesh | (b) India |
|---------------|----------|
| ![Word cloud for Bangladesh](image1.png) | ![Word cloud for India](image2.png) |
| (c) Latin America | (d) Pacific Islands |
| ![Word cloud for Latin America](image3.png) | ![Word cloud for Pacific Islands](image4.png) |
| (e) Philippines | (f) Somalia |
| ![Word cloud for Philippines](image5.png) | ![Word cloud for Somalia](image6.png) |
| (g) South Sudan | (h) Uganda |
| ![Word cloud for South Sudan](image7.png) | ![Word cloud for Uganda](image8.png) |

Fig. 3. Word clouds for the countries (a) Bangladesh, (b) India, (c) Latin America, (d) Pacific Islands, (e) Philippines, (f) Somalia (g) South Sudan, and (h) Uganda. Larger the words, the higher the weightage.
and Tanzania). For many countries (that is, Bangladesh, Burkina Faso, DR Congo, Ethiopia, Kenya, Myanmar, Niger, Pakistan, Sudan, Tanzania, and Uganda), their ‘refugee’ crisis was converging with floods/cyclones and the COVID-19 pandemic. Further, ‘migrant’ is a key term for Bangladesh, India, Nepal and Somalia. These politically driven circumstances have made humanitarian response extremely challenging in these countries.

3.2. Is physical distancing during evacuation a priority due to COVID-19?

LDA results show that physical or social distancing is neither a key term nor a topic for any of the countries. This may indicate that maintaining social distancing has not been one of the priorities, and other necessities of disaster response may have preceded this obligation. However, if we scrutinize some of the individual country reports, we find that many countries (that is, Bangladesh, India, Latin America, Kenya, Nepal, Philippines, Pacific Islands, Somalia, Sudan, Tanzania and Uganda) recognize maintaining social distancing as a challenge. It seems that appropriate measures to socially distance evacuees could not be adopted primarily because of space/fund/resource crunch and lack of adequate time for preparing the required infrastructure.

3.3. Impact of lockdown

Most countries went into lockdown at the beginning of the pandemic. However, it is not a topic or a key term for any of the countries in this study, indicating precedence of other concerns associated with disaster response. Nevertheless, the response reports of the countries show that the lockdown slowed down access to aid, medical services and agricultural supplies. In Somalia, the lockdown hampered the implementation of locust control strategies as well due to difficulty in transporting the required resources. In almost all countries, lockdown impacted livelihoods and remittances, which aggravated the vulnerability of flood/cyclone-impacted communities. Further, it was seen that, in Bangladesh, migrants returning to their own (coastal) community (due to lockdown and job loss from urban areas) were being quarantined in cyclone shelters. This created space insufficiency (during cyclone Amphan) and challenged social distancing norms.

3.4. Food and nutrition

Food is one of the top-weighted topics for the African countries of Ethiopia, Nigeria, South Sudan, Sudan and Uganda. Also, it is one of the key terms for the majority of the countries (Table 2). Further, nutrition is a key term for some of the countries in Africa and Asia. This shows that providing food as aid is a priority during disaster response.

3.5. Variable focus on vulnerable sections

During disasters, some of the most vulnerable sections of the population are women and children. Although humanitarian organizations put forward considerable efforts toward women worldwide, ‘women’ is a key term for a limited number of countries, namely, Bangladesh, Vietnam and those in the Pacific Islands. Additionally, the term ‘female’ arises during LDA only for Tanzania and Uganda. Further, the disabled seem to be an obscure group as ‘disability’ is a key term solely for the Pacific Islands. On the other hand, ‘child’ is a high-weighted topic and key term for most countries (Tables 1 and 2), except for Indonesia and Nepal. This reveals that children are focused upon during disaster management and are provided significant assistance across countries.

3.6. Hygiene and sanitation

‘WASH’ which stands for Water, Sanitation and Hygiene, is a common term among the countries of Afghanistan, DR Congo, Pacific Islands, Latin America, Indonesia and South Sudan. However, the weightage of the term for most countries is less than 1%, except for DR Congo and the Pacific Islands, where the weightages are 2.4% and 2.8%, respectively. Hygiene is a key term for Chad, DR Congo, India, Indonesia and Myanmar. Again, except for Indonesia (term weightage is 3.7%), the term has a low weightage (~0.5–1%) among all key terms for the countries. This observation is concerning, especially during a pandemic that requires a high standard of hygiene and sanitation for its restraint.

3.7. Health

Health is a common key term except for the countries of Nigeria and Pakistan (Table 2). Some of the countries/regions giving the highest weightage to the term are DR Congo, Tanzania, Latin America, Ethiopia and Sudan. On the other hand, countries giving it the least weightage are Cambodia, Burkina Faso, Chad, the Philippines and Bangladesh. Table 1 shows that it is also a part of the highly weighted topics for most countries, and is usually present along with the keywords COVID-19 or children. This suggests that there has been a focus on the health of disaster victims because of the COVID-19 pandemic. Further, children, who are one of the vulnerable sections of the population, are important beneficiaries of health-related assistance during disasters. Overall, the presence of the term ‘health’ for most countries highlights that health aid is a vital dimension of disaster management. However, it seems that the aid is largely for responding to the physical ailments of disaster victims, and not to the mental or psychosocial impacts of the event. This can be concluded from the absence of these terms for almost all countries except Tanzania, DR Congo and Niger. This is because physical health assistance is urgent and is an important short-term response after a disaster. Treatment of mental health issues is a long-term process and hence, is usually not a part of immediate humanitarian response.

3.8. Agriculture is a peripheral topic

The hydrometeorological disasters have also affected the agriculture and farming community. Hence, terms such as agriculture, farm, farmer, crop, harvest and famine appear for some countries (Table 2), mostly belonging to the African continent. However, only the term ‘crop’ is shared by multiple countries. Further, these terms have less than 1% weightage for the countries. Agriculture is also not a highly weighted topic for any of the countries (Table 1). The low frequency and weightage of agriculture-related words is despite the locust attacks (which affected crops) in Africa. This must be because humanitarian organizations have not focused on providing long-term assistance to revive livelihoods (particularly agriculture) affected by disasters. This suggests that special programs for livelihood recovery of agricultural communities are required.

4. Conclusion

During a pandemic, disaster management can be extraordinarily challenging. The present study aims to understand the experiences of countries while responding to disaster impacts in the time of an ongoing pandemic. It identifies the important topics of discussion in humanitarian reports using LDA (a form of topic modeling), which consequently enables the derivation of some noteworthy insights.

It is found that countries experienced different kinds of disasters/crises along with the pandemic. This includes floods, cyclones, locust attacks, epidemics of cholera, malaria and Ebola, conflict and violence. Hence, it is crucial that governments initiate special policies and plans for managing multi-hazards during such times. The topics of the countries failed to contain issues related to social distancing and lockdown. However, some of the reports of countries indicate that there have been challenges in accommodating disaster victims while maintaining social distancing. Further, there have been hurdles in transporting and accessing relief materials because of the lockdown. This suggests that, in the next few months, where the pandemic is still existent,
governments need to be prepared to address these challenges for upcoming hydrometeorological disasters. Provisions for larger evacuation centers should be made. Special permissions allowing free movement of volunteers and vehicles related to disaster relief need to be granted. Next, food and nutrition are important topics for many countries, indicating them to be a priority during relief work. Disaster management efforts are focused upon children, while other vulnerable groups such as women and the disabled do not seem to be topics of concern. This highlights that disaster management plans are yet to be inclusive and should be revised to give attention to the needs of women and especially the disabled. Many countries share the topic of hygiene and sanitation, but it is low on weightage or importance. Maintaining hygiene and sanitation is extremely important to curb COVID-19 infections. Hence, the low significance of these topics suggests major limitations in the disaster management plans of humanitarian organizations. Health is of very high importance for most countries, which is notable, particularly due to the COVID-19 pandemic. Lastly, agriculture is a topic for many African countries, but with low-weightage. This is because aid is mainly provided for short-term recovery, and long-term revival of livelihoods would need different and greater efforts by humanitarian organizations.

The results of the present study are limited by the subjective interpretation of the topics by the authors (Szekely and Brocke, 2017). This is an inevitable shortcoming that exists for all studies using topic modeling. Further, as the study could not consider documents in languages other than English, the results of topic modeling may have been different for a few countries (that is, DR Congo, Chad and Niger) if the entire corpus of documents in all languages would have been included in the dataset. This can be because the documents in the other languages may have covered other aspects of the disaster. It is also to be noted that the prevalence of documents from specific humanitarian agencies in some countries may have also made the results a bit biased. The results of topic modeling are entirely dependent on the available and selected dataset, and hence they may change with different document corpora. Furthermore, the present study is limited in assessing the extent of correlation between the actual consequences of the hydrological disasters on the ground and the topics. This is because of challenges in identifying — relevant indicators for the impacts/topics (such as displacement and health) and the availability of data for the same for all the countries. However, the broad observations from the study may assist researchers and policy-makers in identifying the gaps in disaster management efforts during a pandemic. This can initiate the necessary actions, such as further bottom-up/field research and policy dialogues, to reduce the perils of disasters during a pandemic.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References

Ahsan, A., 2021. Lessons learned from COVID-19 response for disaster risk management. Nat. Hazards 107, 2027–2032. https://doi.org/10.1007/s11069-021-04658-0.

Amussen, C.B., Møller, C., 2019. Smart literature review: a practical topic modelling approach to exploratory literature review. J. Big Data 6, https://doi.org/10.1186/s40537-019-0255-7.

Benites-Lacayo, L.L., Giatti, L., Giarolla, A., 2018. Topic modeling method for analyzing social actor discourses on climate change, energy and food security. Energy Res. Soc. Sci. 45, 318–330.

Blei, D.M., Ng, A.Y., Jordan, M.I., 2003. Latent Dirichlet allocation. J. Mach. Learn. Res. 3, 993–1022.

Clare, S.M., Hickey, G.M., 2019. Modelling research topic trends in community forestry. Small-scale For, 18, 149–163. https://doi.org/10.1007/s11842-018-9411-8.

Goyal, N., Howlett, M., 2021. “Measuring the mix” of policy responses to COVID-19: comparative policy analysis using topic modelling. J. Comp. Policy Anal. Res. Pract. 23, 250–261. https://doi.org/10.1080/13678988.2021.1880872.

Guo, Y., Wu, Y., Wen, B., et al., 2020. Floods in China, COVID-19, and climate change. Lancet Planet Health 4, e443-e444. https://doi.org/10.1016/S2542-5196(20)30205-5.

Heidenreich, T., Lind, F., Ebel, J.M., Boomgaarden, H.G., 2019. Media framing dynamics of the “European refugee crisis”: a comparative topic modelling approach. J. Refug. Stud. 32, 1172–1182. https://doi.org/10.1093/jrs/feb025.

Ishiwatari, M., Koike, T., Hiroki, K., et al., 2020. Managing disasters amid COVID-19 pandemic: approaches of response to flood disasters. Prog. Disaster Sci. 6, 100096. https://doi.org/10.1016/j.pdisas.2020.100096.

Kee, Y.H., Li, C., Kong, L.C., et al., 2019. Scoping review of mindfulness research: a topic modelling approach. Mindfulness (N Y) 10, 1474–1488.

Kishore, K., 2020. Managing tropical storms during COVID-19: early lessons learned and reflections from India. World Bank. https://blogs.worldbank.org/climatechange/managing-tropical-storms-during-covid-19-early-lessons-learned-and-reflections-india. (Accessed 5 September 2021).

KNIME, 2021. Stanford Lemmatizer. KNIME Hub. https://hub.knime.org/knime/extensions/org.knime.features.ext.textprocessing/latest/org.knime.ext.textprocessing.nodes.preprocessing.stanfordlemmatizer.StanfordLemmatizerNodeFactory. (Accessed 5 July 2021).

Liu, H.L., Shen, P.C.Y., Tsai, J.J.P., et al., 2020. Text mining in a literature review of urothelial cancer using topic model. BMC Cancer 20, 1–7. https://doi.org/10.1186/s12885-020-06951-0.

Phillips, C.A., Caldas, A., Cleruti, R., et al., 2020. Compound climate risks in the COVID-19 pandemic. Nat. Clim. Chang. 10, 586–588. https://doi.org/10.1038/s41558-020-0604-2.

Pramanik, M., Szabo, S., Pal, L., et al., 2021. Population health risks in multi-hazard environments: action needed in the Cyclone Amphan and COVID-19-hit Sundarban region, India. Clin. Dev., 1–6 https://doi.org/10.1007/s11750529.2021.1889948.

ReliefWeb, 2021. All Disasters. ReliefWeb. https://reliefweb.int/disasters. (Accessed 5 April 2021).

Simovic, S.P., Kundraevic, Z.W., Wright, N., 2021. Floods and the COVID-19 pandemic—a new double hazard problem. Wiley Interdiscip. Rev. Water 8, 1–18. https://doi.org/10.1002/wat2.15109.

Szekely, N., Brocke, J. vom, 2017. What can we learn from corporate sustainability reporting? Deriving propositions for research and practice from over 9,500 corporate sustainability reports published between 1999 and 2015 using topic modelling technique. PLoS One 1–27.

Wang, X., Yang, X., Wang, X., et al., 2020. Evaluating the competitiveness of enterprise's technology based on LDA topic model. Technol. Anal. Strateg. Manag. 32, 208–222. https://doi.org/10.1080/09537325.2019.1648799.