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Do natural hazard events and disasters trigger political and legislative change? A systematic scoping review of the impacts on commodity production.

Nicholas Kirk[a], Sandra Ricart[b], Jo Fountain[c], Christina Griffin[d], Nicholas A. Cradock-Henry[e].

[a] Manaaki Whenua Landcare Research, 18 Gerald Street, Lincoln 7608, New Zealand. kirkn@landcareresearch.co.nz [corresponding author].
[b] Politecnico di Milano. Environmental Intelligence for Global Change Lab, Department of Electronics, Information and Bioengineering, Via Ponzio 34/5, Milano 20133, Italy.
[c] Lincoln University. Ellesmere Junction and Springs Rd, Lincoln 7647, New Zealand.
[d] University of Melbourne, 221 Bouverie Street, Carlton VIC 3053, Australia.
[e] GNS Science – Te Pū Ao, 1 Fairway Drive, Avalon, Lower Hutt 5040, New Zealand.

Abstract: Food and fibre commodity production is fundamental to global food security and economic development. However, these commodities are vulnerable to different natural hazards. In this systematic scoping review, we assess the natural hazards literature to determine if and how specific natural hazard events that impact food and fibre commodity production have triggered political or legislative change. Bibliometric and thematic analysis methods were used to identify recurrent patterns and themes in the dataset. Bibliometric analysis confirmed robust international cooperation on hazards and political change, but there were still gaps in cooperation across different hazard types. Thematic analysis revealed limited evidence for political and legislative changes triggered by hazard events. However, typical responses included reviewing policies or restructuring institutional responsibility. Our findings suggest a need for greater collaboration across research topics including climate change impacts, risk assessment, and freshwater management to more accurately identify the causal relationships between hazards and political change.

Keywords: Natural hazards; disaster; commodity production; political change; policy; legislative change

Highlights

- Attributing political and legislative change to hazard events is challenging due to the multi-sectoral and multi-scalar nature of disaster impact and response.
- When post-event political change does occur, it is often small-scale and incremental in nature, such as review of existing policy.
- Globally observable trends include either re- or de-centralising institutions responsible for hazard management.
- Ongoing shift in research agenda from ‘resilience-focused’ to ‘risk management’, which may moderate drivers of political change.

1. Introduction

Food and fibre commodity production is exposed and sensitive to various geological, climatic, and hydrological hazards (Bezner Kerr et al. 2022). These commodities are fundamental to food security, but also underpin numerous national and regional economies, with agricultural commodities particularly sensitive to various hazards (Gaupp et al 2020; Kornhuber et al 2023). Impacts on commodity production are also predicted to increase and compound as a consequence of anthropogenic climate change (Hristov et al. 2020; Jia et al. 2023; Lewis and Witham 2012). The significance of this cannot be underestimated: some argue the scale of synchronous hazard impacts

now, and in the future, will increasingly influence global politics and decision making, confounding planning and sustainability efforts (DiBella and Burch 2023; Homer-Dixon et al 2015). However, the causal links between natural hazard events and political change remain contested (Giordono et al 2021; Nohrstedt 2022), particularly in the context of food and fibre commodity production. Some argue that hazard events accelerate political change (Brundiers and Eakin 2018; Farley et al 2007), whereas others argue that such events derail significant change and entrench power dynamics (Gotham 2008; Klein 2007). Despite this uncertainty so far there have been few efforts to synthesise knowledge across different cases, contexts, and hazard types (Nohrstedt 2022).

In this paper, we address this knowledge gap by examining potential political and legislative changes triggered by the impacts of natural hazards events on food and fibre commodity production. The aim is to answer the question: *do natural hazard and disaster events that affect food and fibre commodity production trigger political and legislative changes?* Political change refers to changes in governance, changes in leadership of national or sub-national decision-making institutions, as well as policy changes or innovations; legislative changes refer to the passing of new laws (Bennett and Howlett, 1992). We also examine the context for change, for example, whether hazards occurred under conservative, liberal, or progressive leadership of decision-making institutions. Food and fibre commodities are those produced by industries related to livestock and arable farming, horticulture, forestry, and fisheries. These commodities were deliberately selected due to their sensitivity to geological, climatic, and hydrological hazards and because they support well-being and economic resilience in many rural areas (Cradock-Henry and Fountain 2019; Spector et al. 2019). For example, hazard events will affect how much can be grown and harvested on land and sea, and these impacts will place pressure on local economies, infrastructure, and communities. Recent research has also demonstrated a correlation between commodity prices and political stability (Abaidoo and Agyapong 2022).

To answer the research question, systematic review methods were used to compile a dataset of 99 papers, published between 2011 and 2021, that contain examples of natural hazards that have impacted primary industry commodity production and politics. The dataset was analysed in two ways: first, through a quantitative bibliometric analysis that highlights current publication trends regarding hazards, commodity production, and political and legislative change, and second through qualitative thematic analysis identifying themes related to our research question.

The combined bibliometric and thematic analysis provides an up-to-date understanding of the scope of research on political and legislative responses to natural hazard events that affect food and fibre commodity production. This analysis will assist researchers, policy makers, and planners in better understanding the connections between natural hazards and political processes. The review also identifies current research trends and gaps, highlighting where future studies should focus to further investigate causal links between hazard and disaster events, commodity production, and political or institutional change.

The following section describes methods of data collection and analysis, before presenting the results of the bibliometric (Section 3) and thematic (Section 4) analysis. We conclude with discussion and opportunities to advance current research (Section 5).

2. Methods

2.1 Data collection

A Systematic Literature Review (SLR) was used to identify 99 articles where natural hazards impacted commodity production. The SLR process was chosen for its comprehensive, reproducible, and transparent methodologies, enabling the examination, evaluation, and interpretation of existing literature on a specific topic (Clark et al. 2021; Shaffril, Samah, and Samsuddin 2021). This approach has been applied to studies of disaster management (Li et al. 2023; Oh and Lee 2020; Owen 2020; Ricart, Castelletti, and Gandolfi 2022; Xu et al. 2016), climate change adaptation (Cradock-Henry et al. 2023; Islam et al. 2019; Knox et al. 2012) as well as politics and sustainability transitions (Kanger, Sovacool, and Noorkõiv 2020 et al. 2020). Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, we began by establishing research parameters by developing inclusion and exclusion criteria to identify most accurate and relevant papers (see Table 1).

Table 1. SLR inclusion and exclusion criteria

Inclusion criteria	**Exclusion criteria**
Written in English.	Not written in English.
Published between 1st of January 2011 and the 1st of November 2021.	Published either before the 1st of January 2011 or after the 1st of November 2021.
Indexed on ISI Web of Knowledge.	Not indexed on ISI Web of Knowledge.
Example is published in peer-reviewed journal articles.	Example is published from conference proceedings, book chapters, book sections, government reports or is non-peer reviewed grey literature (e.g. newspaper articles, websites).
Example contains description of either: 1) legislation; 2) governance and decision-making arrangements; or 3) adaptation or mitigation policies, before and after a natural hazard or disaster event.	Example does not contain description of 1) legislation; 2) governance and decision-making arrangements; or 3) adaptation or mitigation policies. Also, exclude papers if they contain description of one or more of these factors but do not describe changes before and after natural hazard or disaster events.
Example sourced from a nation(s) that is a United Nations Framework Convention on Climate Change (UNFCCC) Annex 1 partner(s) (or Taiwan).	Example is not sourced from a UNFCCC Annex 1 partner, or, case study is multi-national and one nation is not a UNFCCC Annex 1 partner.
Example examines the effect of natural hazards and disasters on food and fibre commodity production.	Example examines the effect of natural hazards and disasters on subsistence farming, mining, or non-traded goods.

Given these criteria, we specified the inclusion of papers that contain an example of a natural hazard and disaster event that affected commodity production. As such, papers that modelled or predicted particular political or institutional responses to natural hazards were not included. Following Ford, Berrang-Ford, and Paterson (2011), we focused our analysis on countries experiencing similar levels of economic and industrial development, and selected cases from Annex 1 partners of the United Nations Framework Convention on Climate Change (UNFCC) only (see Table 1). We also included

papers sourced from Taiwan given the similarity between their economic status and the Annex 1 partners.

The literature search was conducted using ISI Web of Science, a platform that provides access to multiple database that contains citation data for a variety of different disciplines (Falagas et al. 2008; Gusenbauer and Haddaway 2019; Kirk and Cradock-Henry 2022; Martín- Martín 2018). We deployed different search chains focused on three different elements – combinations of commodity production (e.g., agricultur* OR farm* OR commodity), politics (e.g., politic* OR legislat* OR polic*) and specific hazards (e.g., avalanche* landslide* sinkhole* volcan* dust* tsunami* flood* cyclon* snow* drought* heat* thunder* lightning* tornado* fire* lahar* ash* hurricane* typhoon* pyroclastic*). This search yielded 12,544 citations. After duplicate removal, the authors screened the abstracts and titles and removed 9,614 studies. After a full-text screening 7 further papers were removed from our selection, with 99 papers eventually included in the final review (see Figure 1).

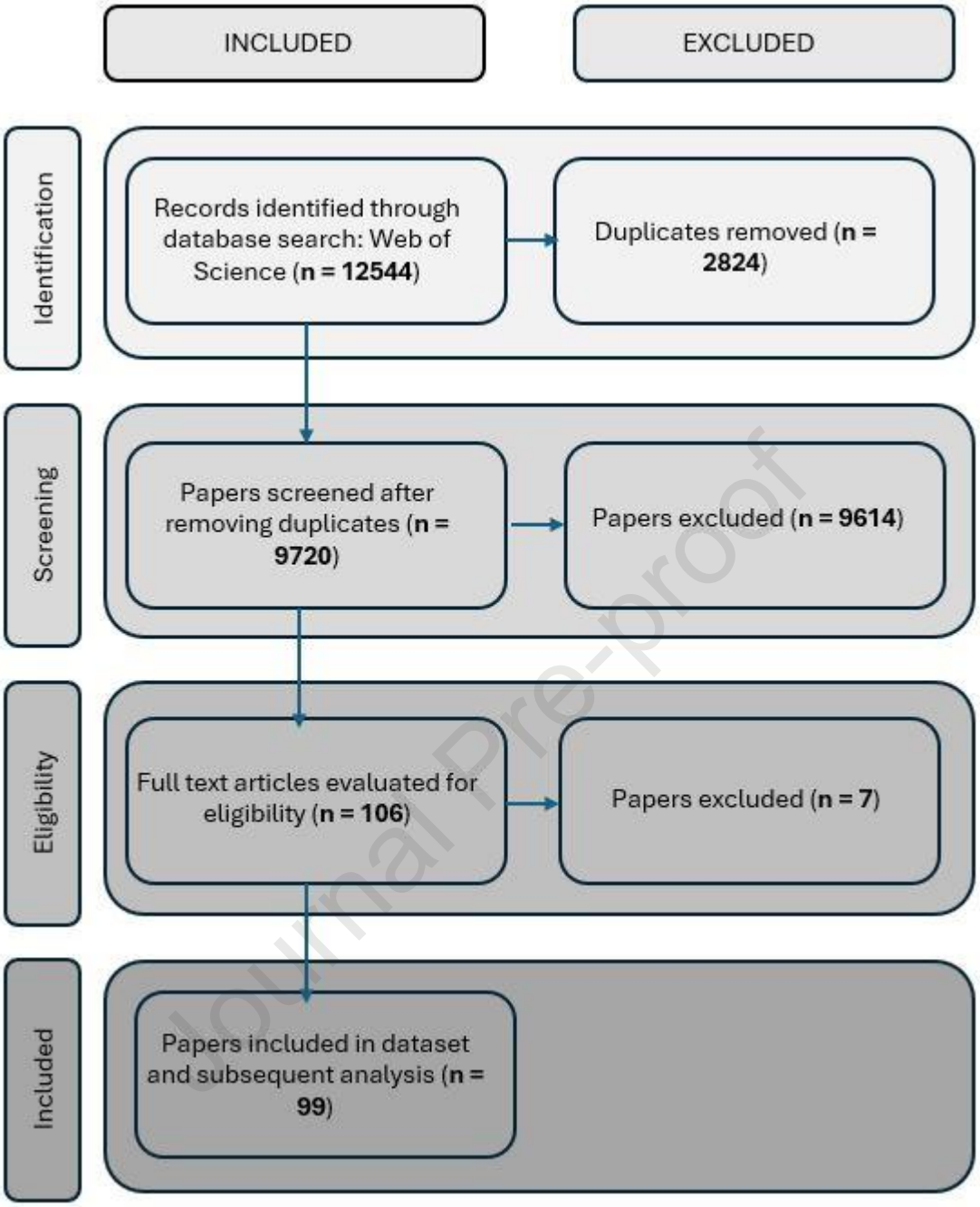

Figure 1. PRISMA flow chart.

Table 2 highlights the country of origin of the papers, with most sourced from either the United States of America or Australia. Table 3 highlights the natural hazard types, following International Disaster Database (EM-DAT) classifications. Drought was the most prevalent hazard while floods and wildfires were also well represented.

Table 2. Country of origin of case studies

Country of origin	**Number of papers**
United States of America	36
Australia	21
Multi-national	8

United Kingdom	7
Austria	4
Switzerland	3
Italy	3
Spain	2
Sweden	2
Japan	2
Taiwan	2
Countries with one paper: Iceland, Greece, Turkey, Romania, New Zealand, Poland, The Netherlands, Ireland, and Belgium.	9
Total	**99**

Table 3. Disaster types of case studies (informed by EM-DAT classifications)

Disaster Type	**Number of papers**
Geophysical (e.g., tsunami, volcanic activity)	4
Hydrological (e.g., floods, landslides, avalanches)	21
Meteorological (e.g., storm, sandstorm, dust storm, windstorm, extreme temperature, fog)	10
Climatological (e.g., drought, wildfire, forest fire, climate change)	60
Multi-hazard	4
Total	**99**

2.2 Data analysis

The authors collaboratively developed a codebook to guide meta data collection to address the research question. Data was collected on the natural hazard or disaster event (informed by Em-DAT classifications), observed impacts on commodity production as well as political and legislative change. Four types of political and legislative change were deductively identified, following distinctions made previously by Bennett and Howlett (1992): 1) legislative changes which included changes to existing laws, or the passing of new laws, in response to a natural hazard or disaster event; 2) governance changes which included changes to the way rules, norms and actions are structured, sustained and regulated; 3) political changes which refer to changes in leadership of national- or sub-national decision making bodies, and 4) policy changes which refer to either incremental shift in existing policies, or new and innovative policies.

Our review combined quantitative review methods with qualitative thematic analysis. We conducted a bibliometric analysis (BA) of the dataset to provide a statistical, descriptive, and visual evaluation of the dataset to track knowledge patterns, influence, and connections of scientific publications in order to monitor progress and follow the development of a particular research area (Chakraborty et al. 2021). The BA involved merging performance analysis and science mapping techniques. Performance analysis utilizes a variety of techniques – like word frequency, citations, and counting publications – to gather data on research volume and impact (Rosato et al. 2021). Through science mapping, a spatial representation is created to demonstrate the relationship between different elements using first- and second-generation relational indicators like co-citation, bibliographic coupling, and keywords co-occurrence. We extracted diverse components – such as keywords, author information, institutional affiliation, publication sources, and citations – enabling us to

evaluate the academic significance, and topics related to, natural hazards impact and political change. We used the *bibliometrix* R-package (including the *biblioshiny* app) and OriginPro 2022 statistical software in combination with the VOSviewer[1] software (version 1.6.17) (Ricart, Castelletti, and Gandolfi 2022).

We also conducted a thematic analysis (TA) to identify and interpret patterns or themes in the dataset, leading to new insights and understandings. Thematic analysis is considered one of the most suitable analysis methods for SLRs (e.g., Badi and Murtagh 2019; Koberg and Longoni 2019; Shaffril, Samah, and Samsuddin 2021). Following the TA process outlined by Fereday and Muir-Cochrane (2006), we first developed a codebook and then tested the reliability of these deductive codes before summarising data and identifying inductive codes and new initial themes. We then coded the dataset a second time applying both the deductive and inductive codes, finally connecting the codes and identifying three themes (see section 4 for TA results).

3. Bibliometric analysis

The following sections present the bibliometric analysis in detail. First, we synthesize the dataset information (section 3.1) to present the main publication trends regarding the most relevant authors, collaboration network, and core sources (section 3.2). Main keywords and 'keywords+' are identified and harmonized considering keywords' structure and topic clusters from co-occurrence analysis (section 3.3), while the structure of the co-occurrence network of keywords was further analysed using an exploratory factor analysis technique (multiple correspondence analysis) to identify the main topics (section 3.4).

3.1 Basic dataset

Of the 99 papers in the dataset, nearly 80% were published after 2014, and 2018 was the most productive year followed by 2021[2]. Interestingly, the annual production index is somewhat constant: except for the years 2012, 2013 and 2020, the pattern remains relatively uniform throughout the timeline, highlighting sustained interest in, and the relevance of, the research topic. In the dataset, 359 authors from 123 institutions published in 62 journals[3].

Notably, 'keywords+', which refers to keywords used in each paper's references list, are significantly higher than the authors' keywords directly used in each paper, which can be related to a transversal and multifocal research pattern.

3.2. Authors and sources

The bibliometric analysis examined features of the authors in our dataset, as well as trends regarding their citation patterns. Our analysis confirms that authors were frequently collaborating across countries to write papers in our dataset, however few papers cite other papers within the dataset. The results indicate that research on commodity production, natural hazards, and political change is

[1] VOSviewer is a Java programming language that is used to create, visualize, and explore maps based on network data, employing a distance-based method to visualize a network of clusters in which nodes represent various elements systematically organized according to their magnitudes (from higher to lower values) (Van Eck and Waltman 2020).

[2] Figures for 2021 may be skewed given we only included papers published in 2021 up until the 1st of November 2021.

[3] An average of four co-authors per paper, counting international co-authorships, see Appendix 1.

diverse, and the topic remains in the process of maturation as collaborative research clusters form around specific geographic areas.

The 99 articles in our dataset include 359 authors from 21 countries. The co-authors ratio per document of 3.9 confirms the trend towards multi-authored articles evident in the broader scientific literature (Dotson, 2024; Kalhor et al. 2022). Author productivity was analysed using Lotka's Law —a bibliometric measure of authorship concentration that describes the frequency of scientific publication by authors, stating that a small fraction of authors accounts for most published works, while a significant number of authors produce only a few works.

Our calculations show that only 20 authors have written two articles, while the remaining 339 authors (94.4%) have contributed a single article within this dataset, suggesting that there is a small number of core researchers that collaborate with a larger group of early-career contributors. As co-authorship is one of the most visible forms of collaboration and a hallmark of contemporary research (Isfandyari-Moghaddam et al. 2023), it is interesting to consider the fractional authorship to identify which authors provide a higher contribution effort. Fractional authorship quantifies an individual author's contributions to a published set of papers by hypothesising uniform contribution of all co-authors in each paper. For example, a paper with three co-authors would assign 1/3rd fractional weight to each author, with the sum of each fractional weight counted for authors with multiple papers in our dataset. In our collection, those authors with a higher contribution effort are Anita Milman (Consoer and Milman 2018; Paul and Milman 2017), Sarah M. McCaffrey (Schultz, Thompson, and McCaffrey 2019; Steelman and McCaffrey 2011), John D. Pisaniello and Joanne Tingey-Holyoak (Tingey-Holyoak, Burritt, Pisaniello 2013; Tingey-Holyoak and Pisaniello 2015).

Although authors' output peaked in 2018 (Figure 2a), most of the top-10 most relevant authors concentrated their activity between 2016 and 2020 (Figure 2d). Some authors published two papers in one year (e.g., Downard and Endter-Wada 2013, Welsh et al. 2013), but typically there was a gap between publications. For those who published papers in 2011, there was often a gap of seven to eight years before their next publication. In contrast, those who published their first paper in 2016 typically had a shorter gap between publications.

Interestingly, authors engaging in collaborations across countries are frequent in our dataset (see Figure 2b). Authors from Canada, Australia and United Kingdom are the most collaborative, promoting joint works with authors outside this cluster: those from Australia and Canada collaborated with authors from the United States while those from the United Kingdom and Australia work with colleagues from Switzerland. This interaction is further corroborated when considering the corresponding author's affiliation ranking (see Figure 2c). Seven of the ten most dominant institutions in our dataset were from the United States. However, the analysis of the whole collection highlights multiple patterns: authors from the top-10 most relevant affiliations participate in 79% of the collection, while 56% of the authors' affiliations are involved in just one article.

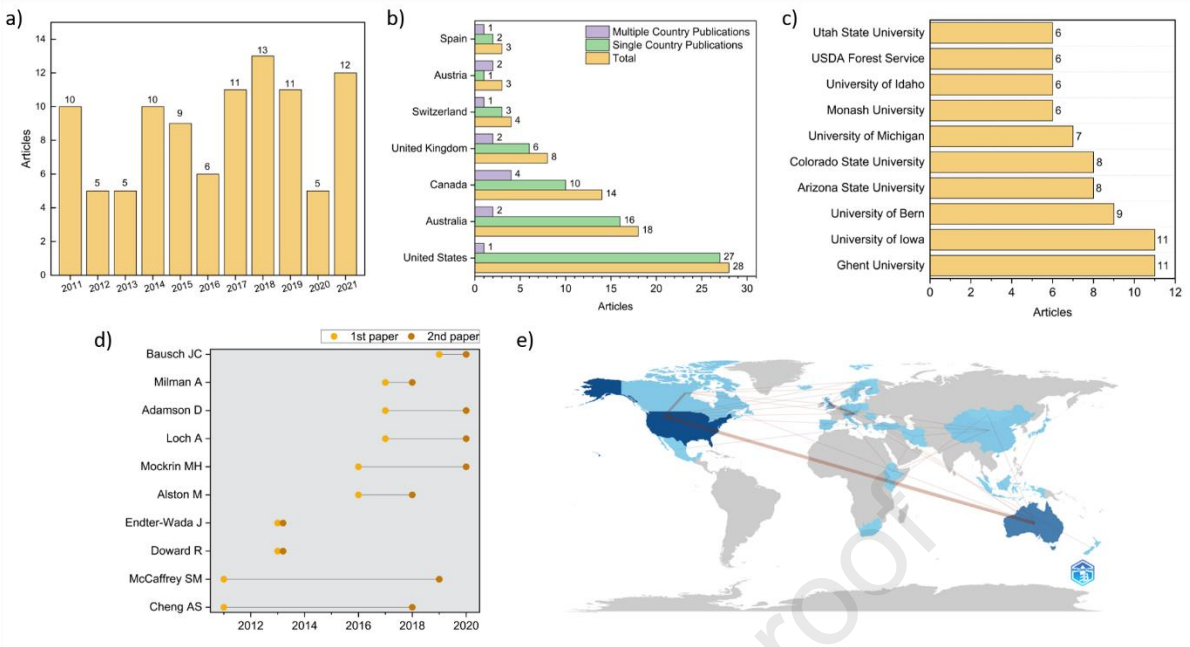

Figure 2. Output by (a) total annual production, (b) most relevant countries, (c) most dominant affiliations, (d) top10 authors by production over time, and (e) total production aligned with country collaboration map. Note (c): including institutions names' homogenization.

The collection covers 62 journals. *Environmental Science & Policy* is at the forefront of productivity with ten articles, making it a 'core' journal. According to Bradford's Law for distribution frequency, journals are organized into zones that have the same number of articles as the 'core', being able to establish different levels of importance. In this regard, the core zone (zone 1) consists of a small group of journals that has the most relevant articles that are widely cited. An additional seven journals are considered core sources (Figure 3a). These are primarily indexed under the Environmental Sciences/Studies or Forestry categories in Clarivate Analytics (2023) and cover topics such as the human and policy dimensions of climate change, sustainable development, and natural resource management, with a particular emphasis on forestry and socio-ecological systems. Source dynamics show only three journals – *Environmental Science & Policy, Global Environmental Change,* and *Journal of Forestry* – published papers in 2011, with *Environmental Science & Policy* publishing the most papers in our sample in the subsequent years. Regarding the citation records, the dataset received 32 'local' citations – whereby papers within the dataset cited each other - and 3946 'global' citations – citations of papers within the dataset from papers outside of the dataset.

However, there is a mismatch between the external and internal relevance of the dataset: all papers except one (Sciulli 2015) received at least one global citation, while only 1/5th of the papers was locally cited, confirming a lack of mutual recognition between papers in our dataset. Furthermore, there is a discrepancy between papers with more local and global citations (see Table 5): the two articles with the highest global citations (Middleton and Kang 2017; Williams 2013) did not obtain a local citation. Likewise, although two of the most frequently cited papers in the dataset were published earlier (Kiem 2013; Steelman and McCaffrey 2011), they were not considered for the collection as foundational articles in the field – articles that provide inspiration for later research or provide a solid base for further explorations and maturation of the topic - because they received less recognition and fewer global citations. In addition, the average number of total (local + global) citations per paper was 26.8 citations, with the highest records obtained in 2013 (57.6 citations) and

2011 (46.9 citations), which aligns with the relevance of the first published works of the collection. However, the pattern slightly changes in terms of the average number of total citations per year: the average was 3.4 citations but the higher values were obtained for publications from 2013 (5.24 citations) together with publications from the second part of the considered period (in 2018, 4.31 citations; in 2019, 4.27 citations).

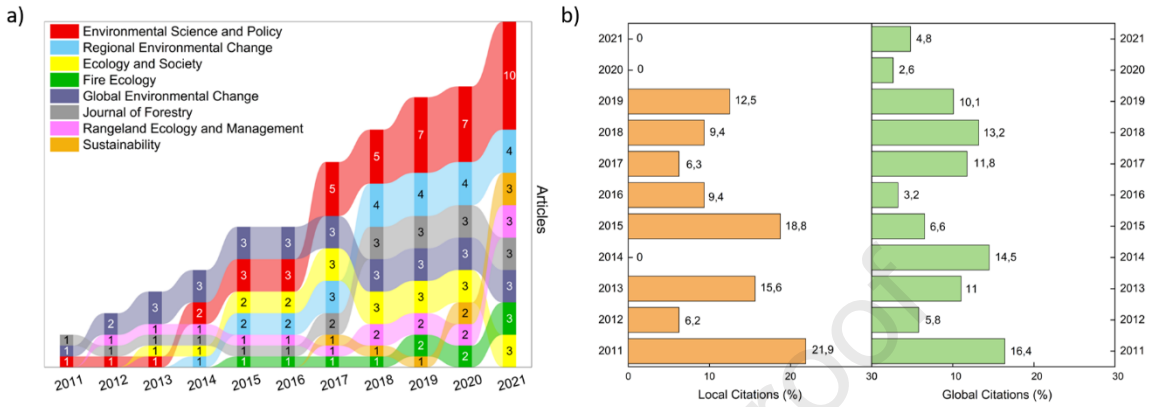

Figure 3. Dynamics by (a) Main source and (b) local/global citations. Note: Global citations have been updated to December 2023.

Table 4. Top10 most cited documents considering local and global citations

Article	**Local citations**	**Article**	**Global citations**
Kiem (2013)	4	Williams (2013)	226
Steelman and McCaffrey (2011)	4	Middleton and Kang (2017)	175
Abrams et al. (2015)	3	Beniston, Stoffel and Hill (2011)	166
Meyer et al. (2015)	2	Kiem (2013)	123
Thompson et al. (2018)	2	Thorne (2014)	119
Sullivan et al. (2019)	2	Thompson et al. (2018)	102

Note: Global citations have been updated to December 2023.

3.3. Keywords

This section examines keywords in our dataset. The results highlight linkages between papers in our dataset as well as trends in research. An exploratory factor analysis identified four topic clusters, however these clusters overlap significantly, highlighting that the dataset keywords are relatively well connected. This hints that research on natural hazard events, food and fibre commodity production, and political change is maturing around topics that have, to date, overlapped significantly with each other.

Content analysis techniques map the strength of association between information items in textual data, dealing directly with sets of terms shared by the selected papers (Shaffril, Samah, and Samsuddin 2021). The analysis identified 603 unique 'keywords+': *climate change* ranked first, followed by *drought*, *risk assessment*, and *adaptation*. Similar results were obtained at the title and abstract level, where keywords were more aligned to specific policy areas and management changes, such as *risk management* (e.g., flood risk management in Sheehan and Brown 2021), *management plans* (e.g., fire management plans in Meyer et al. 2015), and *recovery planning/adaptation*.

Interestingly, keywords have shifted over time. Initial keywords were linked to *climate change*, *drought* adaptation (Engindeniz and Cosar 2012), and water storage needs (Tingey-Holyoak et al. 2013). However, more topics were progressively incorporated, such as *risk assessment* (Rouillard et al. 2015) and *adaptive management* (Ceddia et al. 2017) to address the effects of natural hazards and extreme events on the agricultural systems (*agriculture*) (Yihdego, Salem, and Muhammed 2019). These were particularly linked to *wildfire* risks (Stasiewicz and Paveglio 2018), encouraging *fire management* (Allen, Chhin, and Zhang 2019) and *disaster management* strategies in general (Yeo, Haupt, and Kapucu 2021).

A relevant point in co-occurrence analysis is the intensity and diversity of the interlinkages between the most relevant keywords+. Figure 4 provides a clustering map to highlight the research frontiers and hotspots by considering to what extent two keywords co-occur in multiple manuscripts (Ricart, Gandolfi, and Castelletti 2023). The density map unsurprisingly identifies the most robust cluster around the term *climate change*, which frequently co-occurs with *drought*, *water management*, and *policy making* (Botterill 2021). Aligned to this, complementary clusters consist of more specific subjects and interactions: such as the need to develop adaptive disaster management strategies, particularly in response to extreme events (e.g., floods) (Kuroishi 2021); the concern for wildfire risk and fire management as a response (Wollstein, Wardropper, and Becker 2021); the nexus between *risk assessment*, *agriculture*, and *stakeholder engagement* to inform policy action for particular hazards (e.g., droughts) (McEwen et al. 2021).

A further exploratory factor analysis from a clustering perspective identifies four main topic clusters (see Figure 4). Of note, most of the research field is well connected. Clusters focus on risk management and adaptation planning, either in a concrete way by detailing the most challenging natural hazards (e.g., *flooding* and *wildfire* as part of the red cluster, and *drought* included in the green cluster) or in a more abstract way by referring to *vulnerability* (yellow cluster) and *disaster* (blue cluster). The red cluster is primarily focused on two issues: strategies and criteria for managing climate change risks (e.g., Elvan et al. 2021); local participatory processes and stakeholders' engagement as mechanisms to reinforce policy changes, which minimizes vulnerabilities and improves response and adaptation capacities (Weber et al. 2018). Stakeholder engagement links the red cluster with the green cluster which contains research examining water planning and management practices (e.g., Mallawaarachchi et al. 2020). The linkages between water supply (Thompson et al. 2019) and water management and governance (York, Sullivan, and Bausch 2019) are at the core of the interaction between the green and the yellow cluster. The blue cluster is more future-oriented given promotion of adaptive management (Taiban, Lin and Ko 2020) and, more specifically, disaster management (Thaler et al. 2018), as a way to improve decision-making processes. In the blue cluster there is an emphasis on strategies for transformation by re-envisioning community engagement as part of policy and planning processes (Abrams et al. 2016) or by investigating more transparent governance structures (Alston et al. 2016).

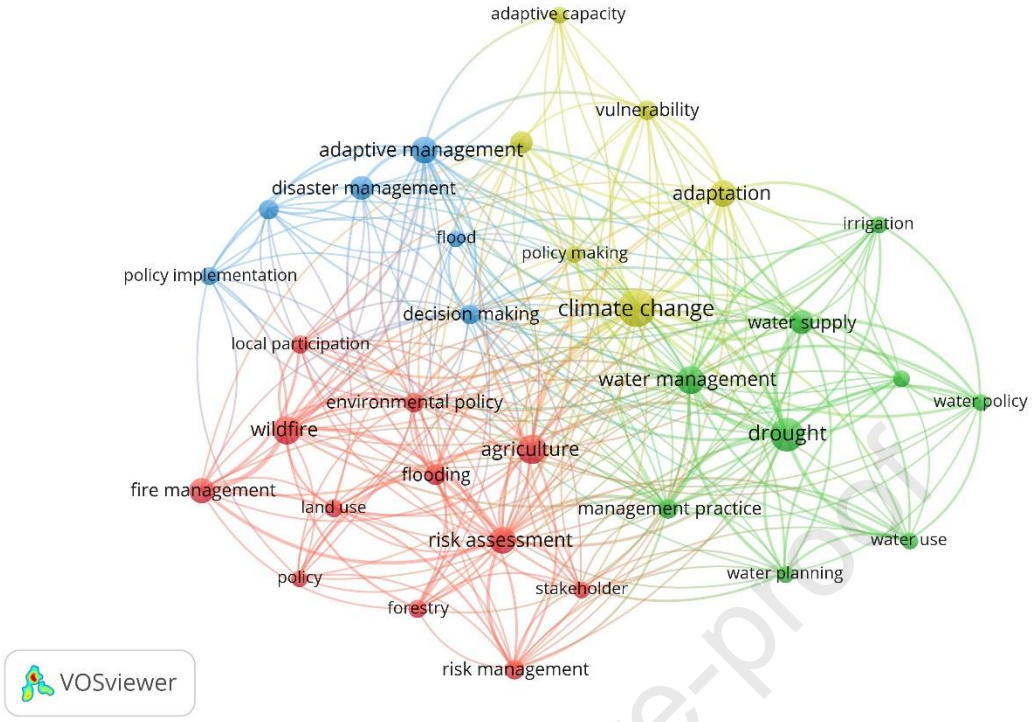

Figure 4. Clusters map with keywords+ co-occurrence relevance and interlinkages. Methodological note: full counting, min. num. of occurrences of a keyword=5, keywords deleted=article, priority journal.

3.4 Main topics

The final step in the bibliometric analysis was to analyse the keywords to see if they could be clustered into specific topics. These topics we identified hint at a change in research focus between 2011 and 2021, with earlier research focusing on climate change and resilience, and later research exploring the extent to which risk management and assessment can influence policy responses to hazard events. The analysis identifies an emerging research field based around water management, risk assessment, and climate change impacts.

The structure of the co-occurrence network of keywords was further analysed by applying exploratory factor analysis to track the extent to which features (in this case keywords) of entities (in this case papers) are interdependent. Some combinations of keywords appear frequently, but some of these common combinations are unlikely to occur together. Figure 5 depicts the results of this analysis, in which three clusters are derived from the two multiple correspondence analysis dimension object scores. The most discriminant variables for dimension 1 hierarchically were related to land resources (*landscape*, *land management*); regarding dimension 2, the most discriminant variables related to water resources (*water economics*, *water planning*, *water supply*).

The clustering analysis with object scores method was then used to identify groups sharing similar characteristics within each dimension. It shows three clusters of frequent keyword combinations that are not normally found together in research. The red cluster is a niche cluster focusing on the nexus between climatological hazards (*wildfire*, *flood*) and strategic political responses (*risk assessment*, *adaptive management*). The blue cluster focuses on water management alongside specific risks (*drought*) and strategies (*cost-benefit analysis*). The blue and green clusters have more peripheral

keywords than the red cluster. This suggests that the blue and green clusters are less consolidated, but the red cluster is more interconnected and varied.

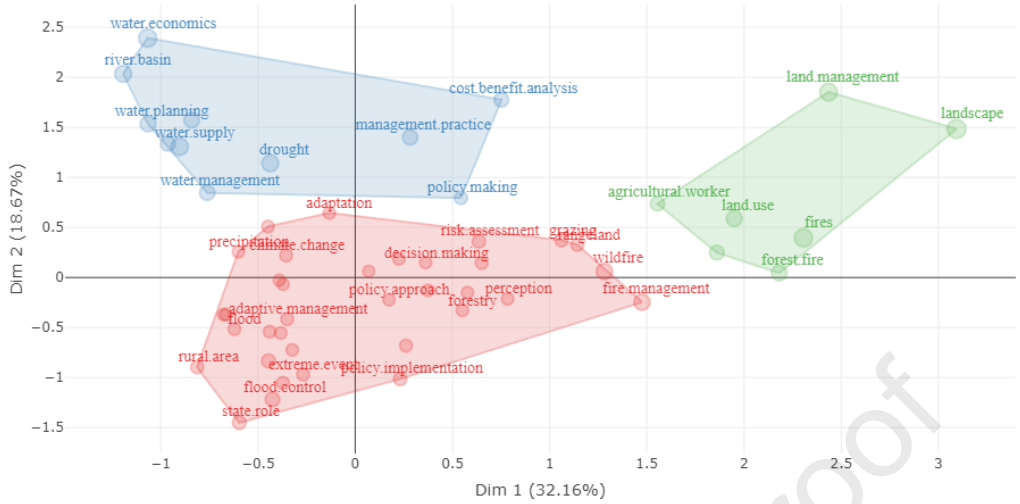

Figure 5. Conceptual structure map using multiple correspondence analysis. Note: automatic clustering based on the 100 most frequent keywords. The distance between any row points or column points gives a measure of their similarity (or dissimilarity). Row points with similar profile are closed on the factor map. The same holds true for column points. Colours are not related to clusters identified in Figure 4 right.

By incorporating Callon's centrality and density indexes, we assess the level of interconnectedness between a designated community (in our case, specific keywords+) and other communities (Callon, Courtial, and Laville 1991). Callon's centrality measures the degree of interaction of a theme (keyword+) with other themes, therefore, this metric can be used to describe the theme's importance to the development of other themes and the overall research field. Callon's density measures the internal strength of a collection and can be represented as a measure of the theme's development, where a theme with high internal strength is well developed (Yu, Jin, and Qiu 2021). Both metrics can be used to map the research themes in two-dimensional space, representing proxy measures for a theme's importance and interconnection in a collection of literature, such as our dataset.

Results depict a matrix in which seven clusters can be identified (see Figure 6). Four clusters – extreme events, water resources management, risk assessment and climate change impacts – are evolving together as *motor themes* (well-developed topics used for structuring a research field). The remaining three clusters – relating to conservation and ecology practices, interest in, and assessment of, natural hazards – are weakly developed and peripheral to the advance of the research topic (*emerging or declining themes*). Pioneering studies focused on climate change impacts provide evidence for a more resilience-focused agenda, but once the relevance of the climate change impacts-risk assessment nexus was established (with particular attention to drought and wildfire risks), the focus shifted to understanding and exploring the extent to which water resources management and risk assessment can be developed to reinforce policy action. Considering that *basic themes* (transversal topics with high expectancy in short-term development) and *niche themes* (issues of marginal importance and lack of external feedback) have not been identified, the research field can be considered robust in terms of scientific consolidation. However, there remains a gap in research examining the influence of extreme events on transformative adaptation.

The bibliometric analysis provided evidence that a gradual shift is occurring from a resilience-focused research agenda towards one more focused on risk assessment and mitigation. One potential explanation is that resilience-focused political initiatives will typically require institutional restructure and negotiations over governance responsibilities, while risk assessment and mitigation policies could be deployed within existing institutional and political arrangements without necessarily promoting radical changes or power shifts.

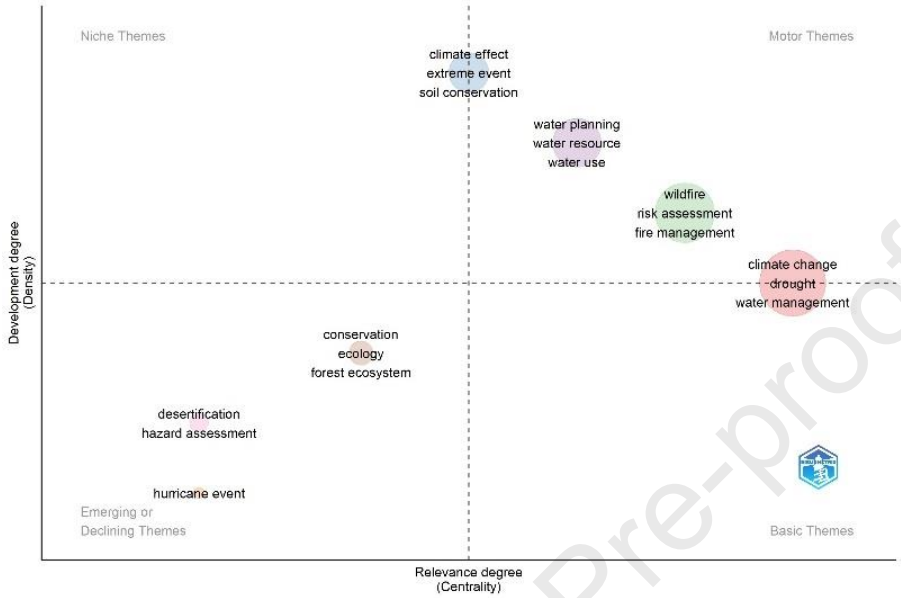

Figure 6. Callon's centrality and density matrix

4 Qualitative thematic analysis

Here, we present the results of the qualitative thematic analysis. We analysed the 99 papers in the dataset and in our codebook collected evidence on the type of natural hazard and disaster event, observed impacts on food and fibre commodity production, as well as examples of legislative, governance, political, and/or policy change. From this analysis, three themes were developed by the lead author, and these themes were subsequently reviewed and agreed on by co-authors: first, that some hazards led to change while others did not; second, natural hazard policies reviewed post-event, but no political or legislative change is necessarily made; and third, centralising or decentralising hazard responsibilities following an event. These three themes are explored below.

4.1. Theme 1 – Some hazards led to change, while others did not

Two events in the dataset had a significant impact on food and fibre commodity production and resulted in political and legislative change: the Millennium Drought in Australia (Kiem 2013; Mallawaarchchi et al. 2020 Thompson et al. 2019; Wei et al. 2011), and the United Kingdom floods of 2007 (Benson and Lorenzoni 2017).

The Millenium drought began in the late 1990s under the leadership of then Prime Minister John Howard, representing the centre-right Liberal Party of Australia. By 2007, Howard's government had initiated major water policy reforms, culminating in the passage of the 2007 Water Act. These reforms laid the groundwork for the Murray-Darling Basin Plan, later implemented under the subsequent centre-left Labor Party government of Julia Gillard. The Plan introduced a national water trading system and involved a significant multi-billion dollar buy-back of irrigation rights to ensure

maintenance of environmental flows (Ballard, Garland, and Foreman 2014). This bipartisan progression suggests that while initial reform momentum came from a conservative administration, the broader transformation in water governance required sustained political will across ideological lines.

In the United Kingdom, flooding during 2007 occurred under a Labour-led (centre-left) government. A comprehensive review of flood management (Pitt 2007) recommended increased coordination and resourcing for flood risk management. These recommendations informed the new Flood and Water Management Act in 2010. Across our dataset, we also found various other instances of political change associated with fire hazards (Abrams et al. 2016) and tropical storms (Taiban, Lin and Ko 2020).

In contrast to the Millennium Drought, two major drought events in the United States of America that had substantial impacts on food and fibre commodity production did not result in significant new political or legislative change. First, the 1950s droughts in mid-and south-western US were more severe than the infamous Dust Bowl of the 1930s (Wiener, Pulwarty, and Ware 2016), yet existing policy frameworks – many of which had been established under Franklin Roosevelt's New Deal – helped buffer the agricultural sector. These included the Agricultural Adjustment Act and Commodity Credit Corporation loan programs. Under Roosevelt's left-leaning administration, drought policy focused on debt relief and rural support. In contrast, during the 1950s drought, the Eisenhower administration, which leaned right, viewed agricultural surpluses as a more pressing issue than drought relief (Peterson 1979, as cited in Wiener 2016). As a result, the federal response was more limited. Second, during the Colorado River Basin drought that began in the late 1990s (Sullivan, White and Hanemann 2019; York, Sullivan, and Bausch 2019), water levels in Lake Mead declined, raising fears of water shortages in downstream states. In response, a drought contingency plan was written in 2016 to address the issue, highlighting some form of policy development and change. However, once the plan was completed in late 2016 water levels began to increase, member states stopped committing to the contingency plan. Thus, no significant political or legislative change was enacted.

In some contexts, then, natural hazard events that affect commodity production *are* windows of opportunity for political and legislative change. Conversely, these events can also further entrench pre-event patterns of politicking. We could not find any specific trends related to one type of hazard event, or the speed of hazard event onset. For example, rapid onset hazards such as flooding, or slow onset events like droughts, were both seen to trigger change and to hinder change.

Previous political and legislative responses to natural hazards events may help food and fibre commodity producers to be resilient to ongoing and contemporary hazards. Wiener et al (2016) explain how changes initiated by the previous Dust Bowl droughts of the 1930s ensured commodity producers were supported and resilient to the 1950s droughts. Thus, political and legislative change in response to natural hazards ought to be understood within the context of previous hazards, how these previous hazards impacted on commodity production, and whether there was political and legislative change in response to these events. More in-depth examination and analysis of political changes prior to hazard events that are not necessarily linked with previous hazards – such as electoral changes – ought to be conducted to see if these pre-hazard changes open new windows of opportunity for post-hazard change.

4.2. Theme 2 – Hazard events trigger review of policies, but not of significant change

The Colorado River Basin drought and its impact on Lake Mead discussed above, demonstrates the ways in which a hazard event can trigger policy or legislative review, but not necessarily lead to any substantial changes. We found examples of these kind of reviews across hazards such as floods (Sciulli 2015; Smith et al. 2011), wildfire (Allen, Chhin, and Zhang 2019), and drought (Sullivan, White and Hanemann 2019). For example, a review of policies instigated following a one-in-one-hundred-year flood event in New Zealand found that, despite the event's significant impact on a productive rural region, no substantial policy changes were implemented (Smith et al. 2011). The authors argued that this outcome reflected the broader 'hollowing out' of state investment in rural development, a trend rooted in a sequence of neoliberal reforms introduced by both left- and right-leaning governments between 1984 and 1997 (Boston et al. 1996; Kelsey 2015). These reforms led to a significant reduction in public agencies' responsible for flood risk management and rural infrastructure, leaving them less equipped to respond effectively to extreme events.

Similarly, Sciulli (2015) reports on smaller rural authorities and a lack of capacity for building long-term flood resilience. In response to a devastating flood in Victoria Australia, policies were reviewed, but neither federal, state, or local authorities made any changes as a result. This aligns with the findings of Giordono et al. (2021) who reviewed local mitigation responses to extreme weather events in the United States of America and found that local authorities struggled to implement significant mitigations and policy changes while also re-building resilience after a damaging event. The authors highlight that the fragmented nature of governance across local, state, and federal authorities, creates a challenging intergovernmental environment, which can hinder the ability to enact meaningful post-disaster policy change.

In summary, a typical response to hazard events is for authorities to review their policies and procedures. But the multi-scalar and multi-institutional impact of such events makes it difficult to pinpoint which authorities need to change, and if greater resourcing is required, how authorities will obtain these resources. These difficulties may help explain an observed tendency towards entrenching existing institutional arrangements, even after reviews of policies have been written and published.

4.3. Theme 3 – Hazard events trigger re-scaling of responsibility and governance of disaster management

Natural hazards and disaster response are typically undertaken by multiple authorities and agencies across different scales, complicating management. While the benefits of decentralised versus centralised disaster management are widely discussed in the literature (e.g., Blackburn 2014; Das and Luthfi 2017), our results show disasters can accelerate a bi-modal shift in management: either towards greater decentralisation, or more a more centralised response.

Examples of disasters that reinforce centralisation were discussed by various authors (Alston et al. 2016; Ceddia et al. 2017; Kuroishi 2021). Commenting on the response to the Millennium Drought in Australia, Alston et al. (2016) argued that the political and legislative response saw a return to 'top-down' management, which ended a prioritisation of agricultural commodity producers in favour of environmental flows. However, the authors note this was a contested and contentious process due to the various opinions among stakeholders about water management priorities, traditional neglect of social outcomes for water, and conflicts over de-prioritising agricultural water use.

In Ceddia et al. (2017), the authors highlight the role of the European Union as a key external driver of policy change. Specifically, they note that the EU Floods Directive required all member states to develop and implement Flood River Management Plans, which prompted Austria to reconsider and

formalise its approach to flood response. In this example, the impact of recurrent flood events has shifted flood risk management in Austria from poorly coordinated and resourced regional institutions to a centralised authority, as "the different legislative and administrative acts dealing with flood risk were poorly harmonised across the regions and the federal government" (Ceddia et al. 2017: 142). While this change is argued to be positive, the authors acknowledge a top-down approach only involves a narrow set of actors and does not incorporate local knowledge. Kuroishi (2021) examined tsunami recovery planning for port cities in Japan, and noted that after a 2011 disaster, the national government established a 'Ministry of Recovery' to collaborate with local governments regarding recovery and future planning. The scale of destruction was so vast that a top-down hierarchy was established, however, a proposed tidal wall along the coastline proved divisive within local communities who argued they had developed a distinctive disaster-resilient way of life, grounded in local traditions and historic practice.

Our dataset also contained various examples of institutional decentralisation as a response to hazard events (Paul and Milman 2017; Ritzema and Loon-Steensma 2018; Smith et al. 2011). Paul and Milman (2017) describe difficulties in implementing top-down flood mitigation policies as these policies lacked flexibility to enable local communities to address concerns specific to them. In response to these top-down federal policies, local level flood mitigation programs have been developed that include online mapping tools and flood resilience checklists.

Ritzema and Loon-Steensma (2018) discuss the development of 'room for the river' policies in the Netherlands. An evacuation of inhabitants near the Rhine River in 1995 due to extremely high water levels led to the development of 'room for the river' policies nearly a decade later, under the government of the conservative Christian Democratic Appeal Party. In this example, an initial top-down approach to policy making led to resistance from local inhabitants, but once a dialogue was created between policy makers and inhabitants, the formerly consultative approach evolved into a participatory approach. By 2016 nearly all the 'room for the river' projects were supported by local communities and successfully implemented.

Definitively answering whether or not political and legislative change is triggered by natural hazard events' effects on food and fibre commodity production is difficult, primarily due to the distributed, multi-scalar, and multi-institutional nature of hazard response observed in our analysis. If these institutions are criticised for poor response, there is some evidence of both centralisation of management responsibility and decentralisation. Decentralisation was often initiated when policies developed top-down were difficult to implement in a local context, and re-centralisation was initiated when smaller authorities – often in rural areas – did not have the resources or capacity to respond to significant hazard events. These changes were observed across both conservative and left-leaning governments. For example, Australia's water reforms of the Murray-Darling Basin began with the conservative Liberal party, while neoliberal reforms of New Zealand's agricultural sector can be traced to both Labour (left-leaning) and National (right-leaning) government policy reforms. Further work could therefore focus on better understanding how political ideologies of different governments shape political response to hazards.

5 Discussion

Our research question asked if natural hazard and disaster events that affect food and fibre commodity production trigger political and legislative change. We specifically analysed research published between 2011 and 2021, selecting cases sourced from Annex 1 partners of the UNFCC and Taiwan. Our results confirm that while political and legislative changes can occur in the aftermath of a disaster, this is not always the case. We found that when changes occurred, they were often small-

scale and incremental in nature, such as reviewing policies or shifting responsibilities for hazard response. Attributing any sort of political or legislative change to a disaster event is complicated by the multi-sectoral and multi-scalar nature of institutions involved in disaster response. While disasters often do affect some sort of change, this does not necessarily occur across all scales of institutions involved.

The bibliometric analysis, particularly the clustering analysis presented in Section 3.4, provides evidence of a gradual shift from a resilience-focused research agenda toward one that emphasises risk assessment and mitigation. One potential explanation is that resilience-focused political initiatives will typically require institutional restructure and the shifting of power and responsibilities, whereas risk assessment and mitigation tactics are conducted within existing institutional and political arrangements without necessarily promoting radical change. As noted in our results, reviews of policies were common, whereas there were fewer examples of significant political and legislative change following hazard events. We suggest that further research could examine the trend towards risk assessment and reviews of policy. Specifically, this research should explore explores whether the growing popularity of risk assessment and policy reviews is because these types of response pose less of a threat to existing power relations, or if there are other explanations – such as lack of resourcing, or difficulties responding to events and making political and legislative changes simultaneously (e.g., Giordono et al. 2021) – that better explain this emergent trend.

Coherent and well-developed research fields have formed around the topics of climate change impacts, risk assessment, extreme events, and water resources management. Strong international cooperation between co-authors was also noted. However, despite these trends, few of the papers in our dataset cited one another. One potential explanation is that our dataset collected papers across various natural hazards in different locations. For example, researchers working on water management and risk assessment may not cite work occurring in other hazards, such as geo-hazards or wildfires. However, it also suggests that any lessons learned by hazard-specific studies of disaster management and response may not be transferred to researchers working in aligned but separate fields. Thus, similar to Nohrsted (2022), we argue that in order to better identify the causal links between hazard events and political change, greater cross-hazard cooperation with a focus on analysing different actors operating at different scales will be needed. We are encouraged by the international cooperation currently underway, but this collaboration must also be fostered across key topics such as water management, risk assessment, climate impacts, and fire hazards. We call for specific interdisciplinary collaborations that bring together researchers with expertise in different hazards and geographic contexts. The increasing frequency and severity of these hazards due to climate change, and their growing impact on various commodities may serve as a key driver for enhanced cross-hazard collaboration.

We also acknowledge certain limitations of our research. First, because the analytical focus was often elsewhere, for example on the economic impacts of events, the papers collected through the SLR did not always contain detailed descriptions of the nature of political and legislative changes. In some cases, political and legislative changes may have occurred after a paper in our dataset was published. Even in papers where the political and legislative context is addressed, there may be factors helpful for our analysis that were not mentioned or omitted, for example, a critical change of government that opened a window of opportunity for change. Second, our search chain omitted earthquakes, so there may be further evidence from political and legislative response to earthquakes that could provide greater clarity in addressing the research question. These limitations also hint at potential future research opportunities, either through a more granular case-study based analysis of hazard

event response - including more thorough examination of pre- and post-event politics - or through a close examination of earthquakes and their impact on political and legislative change.

6 Conclusion

We found evidence that natural hazard events and disasters, which affect food and fibre commodity production, can trigger political and legislative changes. However, these changes are not always large-scale and more often include incremental policy reviews, or revisions to disaster management and preparedness responsibilities. Disentangling the causal links between hazards, commodity production, and political change is also complicated by the fact that multiple institutions across multiple scales are responsible for different elements of hazard response. Furthermore, although there is good international cooperation among researchers in our dataset, the bibliometric analysis hints at more opportunities to collaborate across different research contexts – such as climate impacts, risk assessment and mitigation, and freshwater policy – to further untangle the causal links between these events and politics.

Our findings have implications for policy makers and future research on the resilience of food and fibre commodity production to natural hazards. Policy makers ought to consider if typical responses to disaster events – such as re- or de-centralising institutional responses – will rationalise and clarify decision making responsibilities across various institutions acting at multiple and sometimes overlapping scales, or if these reforms simply introduce more complexity and uncertainty. Future research should critically examine whether the shift from a 'resilience-focused' research agenda to a 'risk management' agenda, as identified in this paper, dampens the impetus for fundamental political change, thereby entrenching and reinforcing existing power dynamics. Overall, our study demonstrates that disasters impacting food and fibre commodity production can trigger political and legislative changes to disaster management practices. However, leveraging this opportunity for positive change will require coordinated and interdisciplinary collaboration across scales.

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Appendix 1. Dataset characteristics

Main information	Description	Value
Collection	Total number of papers	99
Sources	Frequency distribution of sources (e.g., journals)	62
Timespan	Period of publication	2011-2021
Authors' keywords	Total number of keywords used in the collection	361
Keywords+	Total number of keywords contained in the references list of the collection	603
Authors	Total number of authors	359
Authors' countries	Total number of countries represented by contributing authors	21
Authors' affiliations	Total number of institutions according to the authors' employment	133
Single-authored papers	Number of papers with single-authorship	13
Co-authors per paper	Average number of authors per paper	3.9
Average citations per paper	Total number of citations divided by the total number of papers of the collection	26.8
International co-authorship (%)	Percentage of papers with international collaboration	20.6

Table 5. Top10 most cited documents considering local and global citations

Article	**Local citations**	**Article**	**Global citations**
Kiem (2013)	4	Williams (2013)	226
Steelman and McCaffrey (2011)	4	Middleton and Kang (2017)	175
Abrams et al. (2015)	3	Beniston, Stoffel and Hill (2011)	166
Meyer et al. (2015)	2	Kiem (2013)	123
Thompson et al. (2018)	2	Thorne (2014)	119
Sullivan et al. (2019)	2	Thompson et al. (2018)	102

Note: Global citations have been updated to December 2023.

Declaration of interests

☐ 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.

☒ The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

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