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Disaster insurance and risk transfer mechanisms for natural disasters – challenges and opportunities for a new service discussed in literature reviews

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Abstract

Climate change is increasing the risks, frequency and intensity of disasters related to extreme weather events. In this context, the academic literature has suggested disaster insurance as a potential financial tool. Therefore, the research investigates the challenges and opportunities in developing disaster insurance as a financial service related to disaster risks. The research adopts a systematic literature review in the Scopus and Web of Science, identifying 81 other literature reviews on the theme, resulting in the analysis of 15 papers. The results describe the state of the art in terms of topic, location, disaster and insurance types. The analysis indicates the need for public-private partnerships and the exploitation of new markets/models of insurance, especially in developing countries. Future research may investigate the challenges and opportunities of specific disaster insurance types and locations, discussing the adherence to the findings of this research.

Keywords: disaster insurance, systematic literature review, service innovation, service design

1. Introduction

Disasters are disruptive events related to social change (Perry & Quarantelli, 2005). Moreover, they are complex, severe, and dynamic, with limited resources (human and material) and a high level of information uncertainty (Çelik et al., 2012). These events overwhelm local resources (Altay & Green, 2006) and are classified according to their origin: man-made (e.g., terror attacks, armed conflict, and industrial accidents) and natural phenomenon related (e.g., hurricanes, earthquakes, heat

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waves, floods). Data from CRED (2022) recorded 432 disasters involving natural events worldwide in 2021, which is considerably higher than the average of 357 annual events for the 2001-2020 period, and accounted for 10,492 deaths, affected 101.8 million people and caused approximately 252.1 billion US$ of economic losses.

It is essential to consider that the risk of disasters and such consequent losses are increasing in various regions of the world due to global socioeconomic growth and climate change (Clement et al., 2018; Alam et al., 2020; Lucas et al., 2021). Consequently, this situation highlights the need for policies that help society cope with the impacts of future natural disasters (Clement et al., 2018). In this sense, academics and professionals have developed and discussed Disaster Risk Reduction (DRR), Disaster Risk Management (DRM) as well as frameworks for the engagement of diverse stakeholders in a disaster context (Fontainha et al., 2017; Hochrainer-Stigler & Lorant, 2018; Alam et al., 2020; Orimoloye et al., 2021).

Among these issues, insurance is constantly proposed as a tool to address climate change impacts (Hochrainer-Stigler & Lorant, 2018; Hudson et al., 2019; Reguero et al., 2020). For instance, Reguero et al. (2020) point out that pre-risk mitigation is cost-effective, but both the public and private sectors struggle to finance initial investments and explore a resilience solution that combines risk transfer (e.g., insurance) with risk reduction (e.g., hazard mitigation), which has often been treated as two separate mechanisms in DRM. In this sense, Peng et al. (2019) state that research on the demand for disaster insurance is becoming increasingly essential to ease the financial pressure on disaster victims and the government by supporting reconstruction efforts.

Considering an approach focused on practical applications, Suoheimo et al. (2021) deduce that service designers are the agents of change by bringing transitions and innovations to the wicked problem, for example, public services and sustainability; moreover, the authors also explain that wicked problems are an opportunity to use complex stakeholder management. Thereby, basic Service Design (SD) principles bring the correct stakeholders to processes by sharing holistic views and working collaboratively - which underpins the essence of coping with wicked issues (Stickdorn et al., 2011; Suoheimo 2016, 2019). Thus, SD is critical for service innovation as it brings new ideas to life (Ostrom et al., 2010, 2015). In this sense, the SD approach can be considered and applied to design innovative insurance products that might help society cope with financial loss from disasters – a wicked problem.

Therefore, considering the relevance of disaster insurance and risk transfer mechanisms for natural disasters, this study aims to analyse the challenges and opportunities of disaster insurance as a financial service related to disaster risks. The

research adopts a systematic literature review (SLR) methodology due to its suitability for developing a holistic conceptualisation and synthesis of a new or emerging topic, providing results to reinterpret the previous research or a first step for further research on the topic (Hart, 1998; Torraco, 2005; Seuring & Gold, 2012; Thomé, Scavarda, & Scavarda, 2016). Accordingly, this research investigates the main practices, challenges, and opportunities of disaster insurance and other relevant issues in this topic, synthesising the main findings through a taxonomy – which Torraco (2005) indicated as one of the main results of an SLR.

After this introduction, the second section details the research methodology employed in the study. The third section analyses the literature review findings and the existence of the main financial mechanisms for disaster insurance, providing an overview of studies included in the research in terms of bibliometric and content analysis. The fourth section provides a discussion on disaster insurance within the SD approach. The final section summarises the concluding remarks and presents an overview of the main conclusions and a research agenda.

2. Research Methodology

The research adopted the approach offered by Denyer & Tranfield (2009) for SLR, also following the eight steps proposed by Thomé et al. (2016): formulation of the research problem, literature search, data gathering, quality evaluation, data analysis and synthesis, interpretation, presentation of the results, and updating of the review. After formulating the research problem in the previous section, the present section describes the literature search and the other steps.

The second step involves the search in the Scopus and the Web of Science (WoS) databases. Combining different databases is indicated by Thomé et al. (2016) as an approach to ensure the coverage of a broader number of studies related to the topic. The search considered an advanced structure of different keyword groups. The first group refers to the disaster and humanitarian scenarios, which considers the same keywords adopted in the literature review of Fontainha et al. (2017). The second group refers to risks in the context of disasters. The third group refers to the context of insurance mechanisms and risk transfer. The fourth group refers to keywords considered by Thomé et al. (2016) to identify other literature reviews. The combination of these keyword groups results in the following query adopted in the search in the title, abstract, and keywords fields: (disaster OR relief OR humanitarian) AND (risk OR vulnerability OR damage OR hazard OR "loss*") AND (insurance OR "cat bond" OR "financ* protection" OR "risk financ*") AND ("evidence

synthesis" OR "research review" OR "literature review" OR "meta-analysis" OR "meta-synthesis" OR "mixed-method synthesis" OR "narrative reviews" OR "realist synthesis" OR "meta-ethnography" OR "state-of-the-art" OR "rapid review" OR "critical review" OR "expert review" OR "conceptual review" OR "research synthesis" OR "systematic review").

This search was performed on Scopus and WoS in May 2021 and updated in October 2022, selecting only articles from peer-reviewed journals in English. A filter was applied to retrieve only papers classified as Article, Review, and Article in Press due to the academic relevance of peer-reviewed works required to address the research topic (Fontainha et al., 2017). The first exclusion criterion covered the abstract review, and the second exclusion criterion covered the full-text review - both were defined inductively, as discussed by Seuring & Gold (2012), which means that it was derived from the material under analysis itself. Then, the snowball method was applied, which was performed by verifying works cited by the authors and other works citing these papers. Figure 1 shows the process of searching through the literature, including a detail of the exclusion criteria.
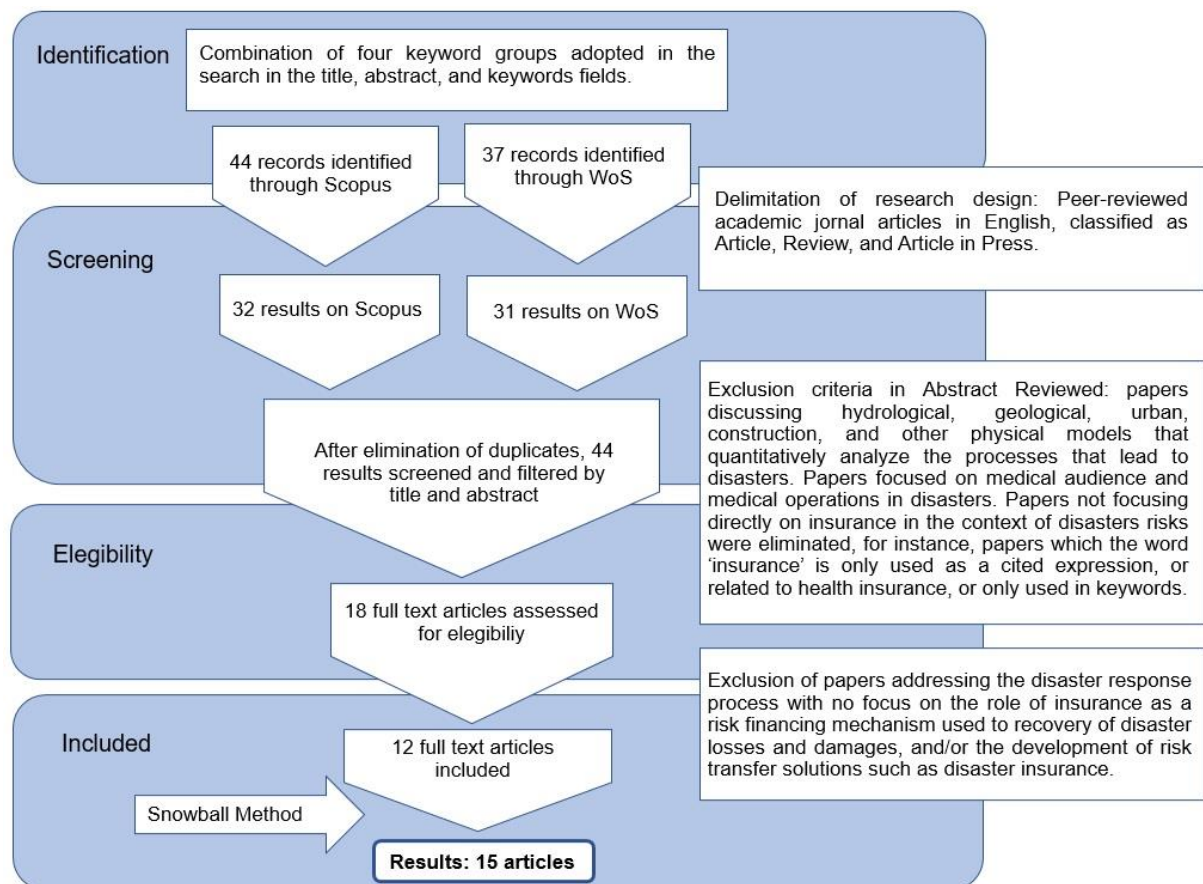

Figure 1. Flow chart of the process of searching through the literature

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The data gathering considered the following parameters:

- study descriptors – the year of publication, the number of citations;
- study method – literature review, survey, interviews, case study, direct observation, real process experiments or deployment, data analysis and document analysis;
- disaster type;
- disaster site;
- insurance type.

The quality evaluation is assured by considering only peer-reviewed papers, which is indicated as one of the strategies in this issue by Thomé et al. (2016). Despite the consideration of quality only through a qualitative perspective, the transparency in each step described in this section contributes to the internal validity and construct validity of the analysis and deliverables, reducing the likelihood of a partial review and thus increasing the reliability of the research (Van Aken, Berends, & Van Der Bij 2007).

The data analysis, synthesis, and interpretation stages considered the instructions for content analysis provided in Seuring & Gold (2012), which were developed according to a taxonomy, one of the main deliverables of an SLR, as indicated by Torraco (2005). The taxonomy development involved the full reading of the papers and the registration of the characteristics of each literature review in an auxiliary table structured with columns for the defined parameters in the data gathering step. This table is presented in subsection 3.2, revealing the main issues among these literature reviews. The interpretation step is discussed through the implications for academics and practitioners, discussing the challenges and opportunities of disaster insurance as a service. The presentation of the results is achieved by this current paper. The updating review step was already developed in this research but also suggested for future research.

3. Literature review findings

This section presents the findings by analysing the papers obtained in the SLR. The first subsection provides a bibliometric analysis. The second subsection provides an overview of the studies included in the research concerning study methods used, country focus, disaster and insurance types, insurance characteristics in the insurance context, and other disaster risk finance approaches.

3.1 Bibliometric Analysis

The analysis indicates the timeframe of the publications containing literature reviews for insurance in a disaster context, as shown in Figure 2. The first paper was published in 2012, having a more consistent and regular publication of literature reviews after 2017.
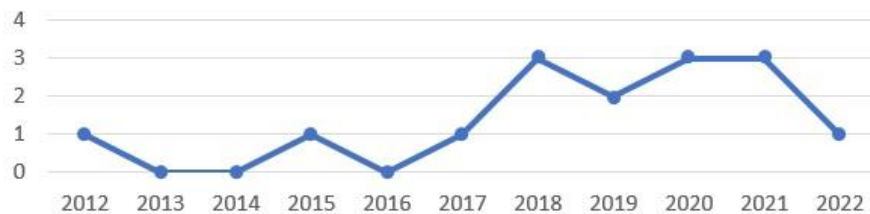

Figure 2. Number of Studies

Insurance is traditionally the subject of financial and economic research; however, Table 1 provides evidence that it interests a broad range of subject areas. A sizeable proportion of papers are in journals covering Environmental Science subject. However, papers can also be found in other journals covering Social Sciences, Engineering and Economic, Econometrics and Finance studies, which reinforces that the theme is multidisciplinary.

Subject area	Journal	Number of papers
Economics, Econometrics and Finance	Journal of Economic Surveys	1
	Journal of Enterprising Communities	1
Engineering	Journal of Flood Risk Management	1
	Risk Analysis	1
Environmental Science	Climatic Change	1
	Journal of Hydrology	1
	Ecological Modelling	1
	Disaster Prevention and Management: An International Journal	1
	Environmental Science & Policy	1
	International Journal of Environmental Science and Technology	1
	Sustainability	1

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Subject area	Journal	Number of papers
Social Sciences	International Journal of Disaster Risk Reduction	2
	Natural Hazards Review	1
	Applied Geography	1

Table 1. Subject area of the papers and journals

3.2 Content Analysis

Table 2 presents the summary of the existing literature review of disaster insurance covering authors, the number of citations on Scopus and WoS, disaster site, disaster type, research methods and insurance type.

Reference	Scopus citations	WoS citations	Disaster site	Disaster type	Study Method	Insurance type
Kalfin et al. (2022)	2	0	More than a local specified (1)	No disaster specified	SLR / scientometric analysis	No insurance type specified
Lucas et al. (2022)	0	0	More than a local specified (2)	No disaster specified	SLR / Mixed-method analysis	Home insurance
Nguyen et al. (2021)	0	1	Vietnam	Flood	SLR / qualitative and mixed-method analysis	Flood insurance
Orimoloye et al. (2021)	1	6	More than a local specified (3)	No disaster specified	SLR / scientometric analysis	No insurance type specified
Alam et al. (2020)	3	1	Malaysia	Flood, Landslides	Literature review / Case study	Agriculture insurance
Sadiq et al. (2020)	3	3	USA	Flood	SLR	Flood insurance
Gradeci et al. (2019)	7	3	More than a local specified (4)	Flood	SLR / quantitative-qualitative analysis	Flood insurance
Robinson & Botzen (2019)	0	0	USA	Flood	SLR / hypothetical	Flood insurance

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Reference	Scopus citations	WoS citations	Disaster site	Disaster type	Study Method	Insurance type
					survey and market data studies	
Valente et al. (2019)	6	6	More than a local specified (5)	No disaster specified	SLR / Data acquisition (OECD) and multivariate analysis	Financial-economic insurance / Ecological Insurance
Zhang & Qian (2018)	2	2	China	Earthquake	Literature review / Interviews	Housing flood insurance
Yiannakoulias et al. (2018)	5	4	Canada	Flood	SLR / Meta-analysis	Flood insurance
Clement et al. (2018)	21	17	No local specified	No disaster specified	SLR / Qualitative analysis	Index-based insurance
Ullah & Khan (2017)	7	8	Pakistan	No disaster specified	SLR / Case study	Microfinance
Koks et al. (2015)	205	200	Netherlands	Flood	Literature review / State-of-the-art method / Case study	Flood insurance
Bubeck, Botzen & Aerts (2012)	447	417	Europe, USA, Japan	Flood	SLR	Flood insurance

Table 2. Refined search results

(1) The paper found the applicable studies focused on researching disasters from a global perspective.
(2) The paper shows the dominance of studies undertaken in the USA - American studies account for more than a third of the literature in the study. Australia, the UK, Germany and the Netherlands are also strongly represented. Interestingly, the research includes many island states—the Caribbean, Seychelles, Mauritius, Fiji, Taiwan and Japan.
(3) The paper found the applicable studies focused on researching disasters from a global perspective.
(4) The research results cite a limited number of countries, including Canada, Denmark, France, Germany, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the USA.
(5) The paper reports data for twenty-nine OECD countries, for which the OECD Insurance Statistics provide reliable financial data, information about the temporal range (1993–2015), and their sources.

The analysis of the authors reveals that the subject is broadly spread among the researchers, except for W. J. W. Botzen with four papers (Robinson & Botzen, 2019; Clement, Botzen, Brouwer, & Aerts, 2018; Koks, Jongman, Husby, & Botzen, 2015; Bubeck, Botzen, & Aerts, 2012) and Jeroen C.J.H. Aerts with two papers (Clement,

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Botzen, Brouwer, & Aerts, 2018; Bubeck, Botzen, & Aerts, 2012). All other authors appear with only one paper.

The citation number of the papers is considered low among the papers. Nevertheless, the two most cited articles, Koks et al. (2015) and Bubeck et al. (2012), are the oldest and are focused on flood insurance, indicating that the topic of risk insurance due to this disaster type is still actively being researched.

The type of natural disaster differs by region in the world, which influences the discussion of disaster insurance. Thus, regarding the disaster type, six papers do not specify a disaster type or do not focus on a single disaster type (Kalfin et al., 2022; Lucas et al., 2021; Orimoloye et al., 2021; Valente et al., 2019; Clement et al., 2018; Ullah & Khan, 2017). Despite flood insurance being unavailable in many countries (Lucas et al., 2021), Table 2 shows a predominance of research focusing on floods. Table 2 shows an overall focus on the risk of floods, which reveals that eight papers, almost half of this literature reviewed, have a focus on this disaster type (Nguyen et al., 2021; Alam et al., 2020; Sadiq et al., 2020; Gradeci et al., 2019; Robinson & Botzen, 2019; Yiannakoulias et al., 2018; Koks et al., 2015; Bubeck et al., 2012). There is evidence that several factors could increase future flood risks, such as global warming and ongoing socioeconomic development in flood-prone areas (Bubeck et al., 2012). Lucas et al. (2021) highlight that the predominance of research on flood has grown since 2012, rising to 73% of all papers in their SLR on home insurance in 2018, and shows a bias toward research on floods. The increasing number of publications produced during the past decade suggests an increased interest in using insurance data to assess flood risk (Gradeci et al., 2019).

Regarding the disaster site, the results confirmed an initial assumption that research on insurance within the disaster context is scarce in developing countries. The main countries are the USA, Canada, Australia, the UK, Germany, Norway, the Netherlands and other European countries. Four papers focused on countries in the Asia-Pacific region, such as Vietnam, Malaysia, China and Pakistan (Nguyen et al., 2021; Alam et al., 2020; Zhang & Qian, 2018; Ullah & Khan, 2017). Only two papers include study sites from developed and developing countries (Kalfin et al., 2022; Clement et al., 2018).

Based on the collected database of scientific publications, qualitative-quantitative analysis and multi-methodological analysis are the main methods used in the literature reviews. Besides the SLR method presented in all papers, mixed-method approaches are the most frequently used method. For instance, Lucas et al. (2021) adopted a mixed-method analysis to present the results of quantitative analysis showing disciplinary, conceptual, geographical and temporal patterns and foci of the

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literature reviewed, and Nguyen et al. (2021) also considered a mixed-method analysis to describe the main features of flood risk assessments in Vietnam to evaluate the current status, persisting gaps, and challenges regarding the understanding and assessment of flood risk in the country. Orimoloye et al. (2021) used the scientific visualisation of scientometric analysis, and the result from this analysis supported several important views about the patterns in global research evolution on DRR.

Statistical approaches are mainly considered to analyse the factors influencing the purchase of certain types of insurance, calculate index risk and predict flood insurance uptake. Among the studies applying a statistical approach, several statistical analyses are commonly used, such as regression or multivariate analysis. Kocks et al. (2015), for example, implemented a mixed-methods approaches, including flood damage models and statistical analyses, from flood hazard zones, demographic data, flood exposure, and social vulnerability index, and used statistical methods such as regression analysis, descriptive statistics, to composite risk indices. Another study combined data acquisition from OECD and multivariate analysis to analyse the temporal trends of the total Gross Insurance Premium and Meteorological and extreme climatological events in 29 OECD countries (Valente et al., 2019). Zang & Quian (2018) adopted a qualitative analysis, including fieldwork and interviews in two earthquake-prone counties in China, and adopted a statistical approach to analyse the factors affecting WTP for HEI.

Robinson & Botzen (2019) develop an SLR of insurance demand against low-probability/high-impact risks and contrast the results of experimental and survey studies to findings from market data. Some papers used another combination of methods, including hydrological models and modelling approaches using socioeconomic data (Bubek et al., 2012); and a meta-analysis approach to generate a pooled prediction of flood insurance uptake (Yiannakoulias et al., 2018).

Only two studies combined SLR and the case study method. Alam et al. (2020) analysed the potential effects of agriculture insurance for DRR in Malaysia based on primary and secondary sources of information and a literature review. Koks et al. (2015) applied a case study methodology in The Netherlands, following a rich amount of literature to present a state-of-the-art for assessing the social vulnerability of flood risks.

This SLR identified several types of disaster insurance, which include home insurance, agricultural insurance, flood insurance, house earthquake insurance, ecological and/or financial-economic insurance and microfinance as an insurance mechanism. Table 2 indicates a higher predominance of studies on flood insurance

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(Nguyen et al., 2021; Alam et al., 2020; Sadiq et al., 2020; Gradeci et al., 2019; Robinson & Botzen, 2019; Yiannakoulias et al., 2018; Koks et al., 2015; Bubeck et al., 2012).

The available insurance in a given country differs according to geographical conditions. For example, considering the earthquake insurance context, Zhang & Qian (2018) investigated the relationship between potential affecting factors and the local communities' willingness to pay (WTP) for housing earthquake insurance (HEI) in China. The predominant type of insurance related to flood insurance is reflected by most of the research being located in places like the USA and Europe.

Concerning the type of disaster insurance, Zhang & Qian (2018) and Lucas et al. (2021) researched home insurance and critically reviewed the literature about interactions between household insurance and extreme weather events. Two papers are related to Agricultural Insurance. First, Clement et al. (2018) state that Index-based insurance products are primarily used to mitigate the negative impacts of agriculture and livestock mortality risks and are especially attractive for developing countries; however, the demand for index insurance products is lower than expected, and there is limited empirical evidence to suggest that index insurance products are risk reducing. The second, Alam et al. (2020) analyse the potential effects of agriculture insurance for DRR.

Meanwhile, another paper related to microfinance as a financing source for vulnerable populations before and after disasters in underdeveloped areas of Pakistan (Ullah & Khan, 2017). For these authors, microfinance is a critical tool to inject capital into the community through various services, such as microcredit, household loans, business loans, emergency relief and rehabilitation loans, and these products can enhance the financial capacity of vulnerable communities in pre-disaster stages such as mitigation and prevention and post-disaster situations. Only one article dealt with the integration between financial-economic and ecological insurances: Valente et al. (2019) present a study based on data from OECD countries, which analyses the main research topics of the scientific literature on ecological and/or financial-economic insurance to face natural disasters.

4. Challenges and opportunities of disaster insurance as a financial service for the post-disaster community

This section concentrates on analysing insurance as a risk financing service related to natural disasters, such as a financial tool for flood risk management (Koks et al.,

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2015). The literature analysed in this research provides some discussion on challenges and opportunities for the development of disaster insurance.

In this sense, Alam et al. (2020) state that risk insurance can emphasise risk mitigation and provide coverage for the residual risks not covered by other DRR mechanisms. Lucas et al. (2021) also highlight that insurance, as a financing mechanism for household security, is increasingly significant for individuals and global finances. These authors state that, while other forms of insurance (i.e., disaster bonds or index insurance) are essential concerning extreme weather, the social dimensions of household insurance make it distinct from these and worthy of independent research. Clement et al. (2018) point out that some strategies for effectively managing climate-related disasters include index-based insurance products, which are increasingly offered as alternatives to traditional insurance, particularly in low-income countries. In addition, according to Alam et al. (2020), agricultural insurance helps farmers overcome their losses and damages. Then, overcoming the problem of economic losses and damages from a disaster may occur through protection by having a financial service such as a disaster insurance product.

Considering a propositive approach related to SD, Orimoloye et al. (2021) present disaster risk insurance (DRI) as an innovation that influences risk-informed behaviours and decision-making in DRR. According to Orimoloye et al. (2021), DRI promotes financial compensation for the loss of life; though not able to reduce the loss of life, it can be linked to environmental protection, and it is applicable at global and regional levels. Lucas et al. (2021) also discuss the opportunities for new markets/models of insurance in countries where household insurance for extreme weather damage is less common. Valente et al. (2018) highlight that few studies on insurance, environment, and economics have investigated its role in providing ecosystem services, which could represent insurance against disasters related to meteorological events.

The current research reveals that some governments' public policies in developed countries offer social financial services to protect citizens against disasters, subsidising flood insurance through National Flood Insurance Program (NFIP) in the USA and its newer counterpart Flood Re in the UK (Lucas et al., 2021). On the NFIP, for example, the US government serves as a primary insurer, helping to underwrite the cost of insurance in some communities, and requires the purchase of insurance for some homeowners with federally backed mortgages (Yiannakoulias et al., 2018). In this regard, Alam et al. (2020) point out recommendations considering the perspectives of agriculture insurance in Malaysia, which involves the interaction of various stakeholders, such as the government acting as a reinsurer against agricultural losses, protecting agricultural crop and livestock insurance initiatives if

local insurers and international reinsurers are unwilling to provide excess-of-losses; public insurance companies could develop public-private partnerships with the domestic private insurance sector, NGOs, and other agriculture insurance schemes; insurance companies could share their technical knowledge in designing and implementing agricultural insurance products. However, there are still challenges to developing agriculture insurance in this country, such as a lack of experience from international practices, limited products, lack of necessary data, limited financial capacity, and high administrative operational costs (Alam et al., 2020).

Regarding disaster insurance research, the relationship between government policies and private insurance is an exciting and well-discussed topic. In this sense, recent papers emphasise the need to proactively engage in DRR and establish new partnerships between the private and public sectors to decrease current and future risks (Hochrainer-Stigler & Lorant, 2018). In this sense, Orimoloye et al. (2021) state that effective cooperation between stakeholders such as government, academia, NGOs and the private sector is crucial for applying technology and innovation in DRR practice. For Alam et al. (2020), risk insurance can reduce the burden on government resources (i.e., subsidisation) for post-disaster relief and reconstruction. In this sense, the fundamental challenge is to protect the vulnerable while avoiding subsidising residences in high-risk, unmitigated environments (Green & Olshansky, 2012). According to Koks et al. (2015), Dutch homeowners can insure flood risk as part of a broader disaster insurance policy; however, the uptake of this service is low because its premium is high relative to limited coverage, and the market penetration of flood insurance may be low among low-income households or other vulnerable groups.

Thereby, the introduction of several flood insurance arrangements has been debated in the Netherlands to expand coverage, which includes establishing public-private flood insurance and a national flood insurance pool (Koks et al., 2015). In this way, Suoheimo et al. (2021) state that the fundamental nature of SD is in the co-creation and participatory methods, and the holistic view must be applied and bring the user or community to the centre of the problem.

5. Concluded remarks

As extreme weather events and disasters become more frequent and intense, disaster insurance appears as a tool that can help people to reduce financial losses. This paper identifies directions on disaster insurance and other risk transfer

mechanisms adopted by key stakeholders in the context of natural disasters based on an SLR of other literature reviews on the topic.

The results discuss how the literature explores disaster insurance and how it contributes to DRM by analysing traditional post-disaster financial arrangements, such as government compensation, and pre-disaster financial instruments, such as index-based insurance, flood insurance, home insurance, and agricultural insurance. This research discussed how risk financing could be seen as a financial service, a complement measure and contribute to DRR. This paper also discusses insurance for disasters as a service, summarising its challenges and opportunities.

The present research delivers a critical topic that demands the combination of economic and financial interests in public-private partnerships in the search for more effective solutions to disaster issues. In this sense, the research proposes that innovation in insurance services could increase new markets and models of disaster insurance and help society cope with financial loss from disasters. To establish new or improved insurance services for natural disasters, several stakeholders' engagement is fundamental to achieve a high market penetration rate, stimulating willingness to pay insurance even in countries where disaster risk losses are subsidised. In this regard, the government needs to take responsibility for part of the (extreme) damage in order to keep an insurance system financially viable and affordable; at the same time that private insurance companies should participate in a public-private insurance scheme by selling and administering policies and by covering medium-sized losses. Also, from a SD perspective, the co-creation with the stakeholders seems suitable to the problem context, such as disaster insurance.

The traditional concept of risk mitigation in financial protection can be innovated by recognising the role played by insurance that, in the case of disasters, can be analysed as a financial service within SD theory and enable other forms of innovation.

As future research, the paper suggests the investigation of how disaster insurance might contribute to the availability of information to support innovation in the area, expanding and reinforcing the present research results. Moreover, future research might consider other research methods, such as case studies or surveys, to explore different stakeholders' perspectives on challenges and opportunities in implementing disaster insurance as a financial service for specific disaster types and locations (e.g., disaster floods in a developing nation).

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