

Identifying the causes of floods and assessing the resulting environmental damage to provide a flood compensation model

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Abstract:

Natural disasters can cause significant environmental damage and pollution, including floods that cause significant loss of life and environmental damage. Hence, modeling the compensation of such losses and utilizing specific strategies such as flood insurance can be considered effective solutions for compensation. Accordingly, the present study attempted to first identify flood damages using the Delphi method. Then, the identified criteria were prioritized through Analytic Hierarchy Process (AHP). Finally, the data were analyzed to provide a flood insurance and compensation model using national and international insurance laws and regulations. The results showed that, among the main criteria of flood damage, financial, human, and environmental losses were ranked most important with relative weights of 0.217, 0.191, and 0.178, respectively, and social damages were ranked least important with a weight of 0.108. Moreover, the most important sub-criteria, in order of priority, were building destruction (0.115), loss of life (0.110), and water pollution (0.084). To conclude, understanding the legal challenges associated with compensation is crucial in developing effective flood insurance plans. The legal challenges of natural catastrophe compensation involve a complex interplay of liability laws, both civil and criminal, insurance mechanisms, and the broader socio-economic impacts on affected communities. The distinctive and innovative proposal of providing a flood insurance plan with independent legal, technical, and structural frameworks and indicators based on the environmental insurance development approach is a suitable model for flood compensation. Developing a flood insurance scheme that effectively compensates for natural disaster losses requires addressing numerous legal challenges, including establishing a clear regulatory framework, managing flood risks, designing equitable compensation mechanisms, determining the roles of the public and private sectors, ensuring coordination across jurisdictions, and adapting to the impacts of climate change.

Keywords: Natural disasters; Floods; Damage ranking; Analytic hierarchy process; Flood insurance; Legal challenges

1. Introduction

Natural disasters are events caused by the natural forces of the Earth where great socio-economic and financial damage and, sometimes, loss of life occurs, such as hurricanes, earthquakes, floods, and fires. The impacts of natural disasters are not uniform across various regions and populations (Neumayer and Plümper, 2007). The increasing frequency and severity of natural disasters, partly attributed to climate change, is challenging existing legal and compensation

mechanisms. On the other hand, man-made disasters have an element of human intent, negligence or error, such as industrial accidents, pollution, and conflicts. Although legal frameworks for addressing human disasters may include clear pathways for liability and compensation, complexity arises in cases where the lines and boundaries between natural and human disasters blur. For example, anthropogenic climate change is associated with increased severity and frequency of certain natural disasters, complicating the attribution of liability and compensation (Udalov, 2019).

Damages from natural and man-made disasters in Iran are estimated at an average of \$5 billion annually, placing the country among the 10 most disaster-prone regions in the world and the fourth most disaster-prone region in Asia. Given the complexity of distinguishing the limits and scope of civil liability in the event of natural disasters and determining the causes, factors, scope, and extent of damages on the one hand, and separating the responsibilities of governments and nations on the other, the need to formulate compensation models and laws with a predictive and preventive approach becomes more important than ever. The traditional fault-based liability system limits liability for damage caused by natural events beyond human control. However, the demarcation between natural disasters and events caused by human actions or failures to protect the environment, such as negligence in construction, maintenance, or emergency response, complicates the application of this system. For example, Hurricane Katrina demonstrated how human errors in design, construction, and maintenance could exacerbate the effects and scope of damage caused by natural disasters (Binder, 1996).

Disaster insurance and risk transfer mechanisms are very important and at the same time challenging in disaster risk management. Climate change has increased the severity of natural disasters, causing disaster insurance to be re-evaluated as a financial instrument. The development of natural disaster insurance faces obstacles, including the need for public-private partnerships and the exploration of new insurance models, especially in developing countries (Maduro and Fontainha, 2023). Furthermore, the integration of sustainable development criteria into flood risk management programs highlights the complexity of designing effective and equitable insurance plans and programs (Banihabib et al., 2020). Public-private partnerships, particularly in the insurance industry, have emerged as a strategy to increase community resilience to natural disasters. The goal of these partnerships is to involve the entire community in active and dynamic risk management. However, challenges such as poor knowledge in risk management, poor governance and management, and uncertainties arising from climate change and unsustainable development have hindered the effectiveness of public-private partnerships. Strengthening these partnerships requires greater community involvement and the integration of natural disaster risk management into sustainable development plans (Perazzini, 2020).

The adverse socio-economic impacts of natural disasters, particularly in less developed countries, highlight the need for a comprehensive legal and policy response. Studies have shown that corruption and low levels of development increase vulnerability to natural disasters and suggest that improving governance and development indicators can reduce losses and damages. Furthermore, the distribution of directed funding in response to disasters demonstrates the potential for legal mechanisms to address social and environmental justice concerns (Hansel et al., 2017).

The legal challenges in flood compensation and the natural disaster compensation process, particularly in the case of floods, require navigating a complex legal landscape. For example, in New Zealand, insurance and compensation

mechanisms manage financial losses from natural disasters, particularly floods, through a variety of schemes including private insurance capacities, government insurance, the Public Works Act 1981, and council liability. Each mechanism has its own strengths and weaknesses, highlighting the need for a comprehensive framework capable of adapting to new and different natural hazards (Iorns, 2018). Fair risk assessment and management by landowners, insurance industries, and communities can help prevent problems arising from disasters (Burton, 2015).

Natural disasters have profound environmental and socio-economic impacts, especially on vulnerable communities. Legal and policy solutions must take these impacts into account with the aim of improving the quality of governance, development indicators and resilience to reduce losses and casualties. Legal challenges associated with compensation for natural disasters are multifaceted, including civil and criminal liability, insurance mechanisms, public-private partnerships, and broader socio-economic contexts. Accordingly, the present study was conducted with the aim of developing a framework for providing a flood insurance plan and addressing the legal challenges of compensating for damages caused by natural disasters, while also examining relevant laws and precedents to rank flood damage criteria using the Analytic Hierarchy Process (AHP).

2. Materials and methods

In the present study, the Delphi method was used in the first phase to identify the factors affecting the occurrence of natural disasters such as floods and the main criteria and sub-criteria for flood damage. After listing the factors, the results were provided in the form of a questionnaire to 30 experts and specialists to comment on the selection of the main factors. Specifications of the Delphi Panel consisted of expertise in the environmental management and disaster risk assessment. The experts were chosen based on years of experience and relevant publications.

The questionnaire consisted of items and questions in the form of a Likert scale. The study utilized a Likert scale for the questionnaire, which ranges from 1 to 5, as follows:

1. Equally preferred
2. Equally to moderately preferred
3. Moderately preferred
4. Strongly preferred
5. Very strongly preferred

Therefore, the researcher-made questionnaire-based interview method and the Delphi method were used to prepare the questionnaire in order to select the most important factors and criteria affecting the occurrence of floods. The reliability of the questionnaire was calculated by administering it to 30 people from the research environment before the final implementation using the Cronbach's alpha statistical test of 0.85.

In the next step, the above-mentioned factors were weighted and ranked to prioritize criteria related to flood damage

using Analytical Hierarchy Process (AHP) through data collected from completing 30 expert questionnaires (Fataei, 2014). The AHP was chosen for its structured approach in prioritizing criteria based on expert judgment. Since this study relied on qualitative expert opinions, making AHP was suitable for this context. Thus, the degree of importance of parameters and criteria was calculated based on expert opinions using the AHP method and Expert Decision software. In this method, pairwise comparisons of criteria and sub-criteria were ranked using a numerical scale from 1 to 9 (Table 1). Finally, the data were analyzed to provide a flood insurance and compensation model using national and international insurance laws and regulations. Research flow diagram is shown on the figure 1.

3. Results

3.1 Identification of the effective criteria on flood occurrence

Based on the results of the first round of Delphi process in identifying factors affecting flood occurrence, the experts' opinions were summarized and categorized as Table 2, such that the combination of these factors could lead to severe and unpredictable floods.

3.2 Identification of flood damage using the Delphi method

According to the identified effective criteria for flood occurrence (Table 2), in the second round of the Delphi process, flood damages were determined in terms of the extent and diversity of effects in the form of six criteria (Table 3). Thus, a research expert group consisting of 30 academic experts and specialists in the field of flood studies applied their scores through a questionnaire (Table 4). In the third round of the Delphi process, no factors were eliminated because there were no factors with moderate or lower preference (with an average numerical rating ≤ 3) based on the average expert opinion score. In addition, the list of six factors that were identified as moderately to strongly preferred and higher (with an average numerical rating > 3) by the panel experts in the second round of Delphi in the initial form was made available to all panel experts, along with the average opinion score of the members in the second round and the previous opinion of the same member. In this round, these members expressed their opinion on the impact factor of each of the six selected criteria. They also had to determine the order of importance of the factors in their opinion. Kendall's Coefficient of Concordance (W) was calculated as 0.687 for the members' opinion on the order of the six factors that were moderately to strongly

Table 1. Pairwise comparison scale for AHP preference.

Numerical rating	Verbal judgment of preference
1	Equally preferred
2	Equally to moderately preferred
3	Moderately preferred
4	Moderately to strongly preferred
5	Strongly preferred
6	Strongly to very strongly preferred
7	Very strongly preferred
8	Very strongly to extremely preferred
9	Extremely preferred

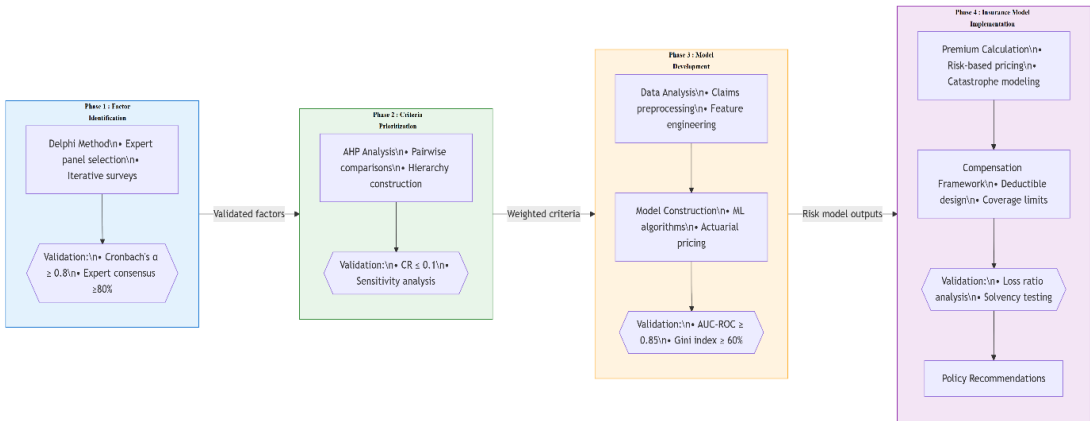


Figure 1. Research flow diagram.

Table 2. Identified criteria affecting flood occurrence.

Criteria	Methods of influence
Atmospheric factors	• Heavy and sudden rains: Continuous rains or heavy rains in a short period of time can lead to flooding.
	• Snowmelt: In mountainous areas, sudden snowmelt in the spring can cause river levels to rise and cause flooding.
	• Hurricanes and tornadoes: These phenomena can cause heavy and prolonged rainfall.
Geological factors	• Soil type: Impermeable soils such as clay soils can prevent water penetration and cause water accumulation on the ground surface.
	• Topography: Steeply sloping areas may direct water downhill more quickly, increasing the risk of flooding.
Anthropogenic factors	• Land use changes: Construction, deforestation, and agriculture can alter water flow and increase the risk of flooding.
	• Improper management of water resources: The lack of proper systems for directing water and controlling floods can contribute to flooding.
	• Pollution and blockage of water channels: Garbage and waste can block water flow and cause water to accumulate.
Climatic factors	• Climate change: Changes in weather patterns can lead to increased intensity and frequency of precipitation.
	• Rising temperatures: Temperature increase can cause faster snow melt and increased evaporation, which ultimately affects precipitation patterns.
Socio-economic factors	• Education and awareness: The level of community awareness of flood risks and preparedness can have a great impact on reducing losses.
	• Infrastructure: The quality of existing infrastructure for water management (such as dams, canals, and drains) plays an important role in the occurrence or reduction of flood severity.

preferred and higher in this round. The results of the three Delphi rounds, including the increasing consensus indices, are summarized in Table 3.

3.3 Prioritization of flood damage criteria based on analytical hierarchy process

In weighting to calculate the final weight, the quantity of each criterion’s sub-criteria was multiplied by the criterion’s weight and the final weight was calculated. Finally, the total simplified weight was obtained from the sum of the final weights. The AHP results for the main criteria related to

flood damages from various environmental, financial, human, economic, social, and infrastructure aspects and their sub-criteria for providing a flood compensation model are listed in Table 4.

The results (Table 4) showed that, among the main six criteria of flood damage, financial, human, and environmental losses were ranked most important with relative weights of 0.217, 0.191, and 0.178, respectively, and social damages were ranked least important with a weight of 0.108. Moreover, the most important sub-criteria, in order of priority, were building destruction (0.115), loss of life (0.110), and

Table 3. Results of consensus indices from three Delphi rounds for criteria affecting flood-related hazards.

Criteria	Kendall’s coefficient of concordance (W)		
	Delphi Round 1	Delphi Round 2	Delphi Round 3
Human casualties	0.342	0.497	0.721
Financial losses	0.108	0.710	0.918
Economic damages	0.225	0.513	0.709
Environmental damages	0.213	0.586	0.733
Social damages	0.187	0.527	0.725
Infrastructure damages	0.218	0.667	0.898

Table 4. Weights and rankings of flood damage criteria for presenting a flood compensation model.

Goal	Criteria	Relative weight	Sub-criteria	Relative weight	Ranking
Evaluating the weight of parameters affecting the occurrence of flood damage	Financial losses 7	0.217	• Building destruction: Floods can destroy buildings, houses and public infrastructure.	0.115	1
			• Loss of assets: Household items, vehicles, and industrial equipment can be damaged or destroyed by flooding.	0.053	10
			• Repair and reconstruction costs: The costs associated with repairing and reconstructing infrastructure and buildings can be enormous.	0.049	12
	Human casualties 9	0.191	• Loss of life: Floods can lead to death and injury.	0.110	2
			• Physical and psychological harm: People exposed to flooding may experience physical and psychological harm.	0.081	4
	Economic damages 6	0.156	• Disruption of economic activities: Floods can lead to business closures and reduced economic production.	0.064	7
			• Decrease in income: Farmers may face damage to their crops, which will lead to a decrease in their income.	0.050	11
			• Increased unemployment: The closure of businesses may lead to increased unemployment in affected areas.	0.042	14
	Environmental damages 8	0.178	• Pollution of water resources: Floods can cause pollution of freshwater resources, which has adverse effects on public health.	0.084	3
			• Destruction of ecosystems: Floods may cause damage to natural habitats and reduce biodiversity.	0.036	15
			• Soil erosion: Floods can cause soil erosion and reduce the quality of agricultural land.	0.058	9
			• Displacement of human populations: People may be forced to leave their homes, leading to population displacement and social problems.	0.061	8
	Social damages 7	0.108	• Impact on social services: Health, education and social services may be affected and become difficult to access.	0.047	13
	Infrastructure damages 8	0.150	• Road and bridge destruction: Transportation infrastructure can be damaged by floods, making access to different areas difficult.	0.078	5
			• Public utilities: Electrical, water, and sewage facilities may be damaged, leading to service disruptions.	0.072	6

*Inconsistency Ratio = 0.08

water pollution (0.084). The ranking of indicators based on their final weight is shown in figure 2.

4. Discussion

Based on the results, financing was identified as the most important criterion in flood damage compensation, which is also considered one of the fundamental challenges in determining financial resources to compensate for extensive losses caused by floods and storms in the insurance industry, see Table 4. Ensuring financial security and the sufficiency of insurance companies in facing and compensating for huge losses caused by floods and storms are important criteria that lead to financial and tax challenges (Taheri and Mosaedi, 2023). These issues emphasize the need for legal

frameworks to address legal imbalances and promote socio-legal sustainability through recovery strategies and return to the pre-disaster situation (Azzam et al., 2022). These challenges highlight the importance of adopting appropriate legal and political measures to manage and compensate damages caused by floods and storms. A comparative analysis of flood insurance schemes and legal frameworks in different countries shows that each region has a unique strategy for flood risk management (Burton, 2015). Based on a comparative analysis of flood insurance schemes and legal frameworks in countries such as the United States, the United Kingdom, the Netherlands, Japan, and Australia, it was determined that each country had a unique strategy for flood risk management and its legal models and

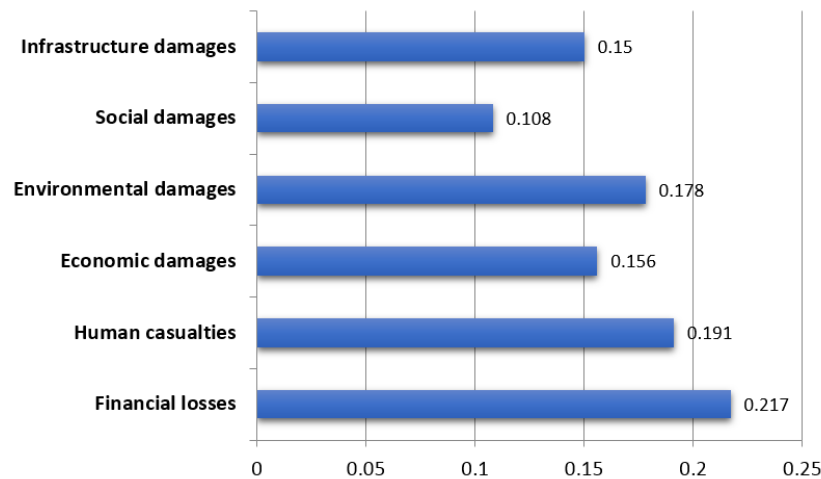


Figure 2. Ranking of indicators based on their final weight.

frameworks, depending on its geographical, economic, and social contexts. For example, the National Flood Insurance Program (NFIP) operates in the United States, which is a federal program created to provide flood insurance to property owners, renters, and businesses. National Insurance encourages communities to adopt and implement floodplain management regulations, which help reduce the impacts of flooding. However, the program has faced challenges including sustainability and financial viability due to reduced price risk and increased debt from catastrophic flood events. Recent discussions have focused on expanding the role of the private sector in providing flood insurance to address these issues (Born and Klein, 2019). In the UK, flood insurance is generally provided by the private sector, but the government plays a key role in ensuring affordability and availability through the Flood Re scheme. The scheme is a Catastrophe insurance package that allows insurers to transfer flood risk of high-risk homes to Flood Re, which is funded through a tax on insurers. The goal of this approach is to keep premiums affordable for high-risk individuals while preserving the principle of private insurance provision (Alharbi and Coates, 2018). The Netherlands, with a significant portion of its land below sea level, focuses heavily on flood prevention and management rather than insurance. The Dutch approach emphasizes large-scale infrastructure projects such as dams and flood barriers to prevent flooding. However, there is also a system for flood compensation through a combination of public funding and private insurance, reflecting a balance between prevention, preparedness, and financial risk sharing and distribution (Maagdenberg et al., 2022). The flood insurance system in Japan is characterized by a public-private partnership, in which the government supports private insurance companies by providing catastrophe insurance. This model allows for flood risk sharing between the government and policyholders. This approach in Japan also includes significant investment in flood prevention infrastructure, such as river embankments and flood control basins, representing a comprehensive strategy that combines and links insurance with physical risk reduction (Ridzuan et al., 2023).

Iran is known as one of the countries vulnerable to natu-

ral disasters, so a culture of institutional responsibility and a model of civil liability insurance should be provided to help reduce damage to society, public property, and the environment. Liability for damages caused by natural disasters and events beyond human control is typically limited. However, insurance is basically the primary tool for managing the risks of natural disasters, including floods, but distinguishing between purely natural events and those influenced by human actions, such as inadequate infrastructure maintenance or poor response in times of crisis and emergency, the evolving nature of natural disasters caused by climate change challenges existing traditional insurance models. The development of effective and equitable insurance mechanisms requires innovative approaches, including public-private partnerships (Udalov, 2019).

Legal frameworks for natural disaster compensation are essential for the development of effective flood insurance schemes and disaster management strategies. These frameworks vary across legal jurisdictions and include laws, regulations, and insurance mechanisms. Some jurisdictions, for example in Vietnam, have specific legal provisions for non-contractual environmental compensation, which aim to address the consequences of environmental damage and climate change mitigation strategies (Thien, 2023). Some countries, such as South Korea, have disaster management laws that aim to protect people from life-threatening hazards during natural disasters. However, these laws may lack coherence and a unified systematic organization for effective response to disaster. Therefore, there is a need for a law that clarifies the concepts related to disasters and safety and systematically organizes safety-related laws (National Public Law Review and Kim, 2023). Developed countries have developed flood control and disaster risk reduction strategies, including flood insurance, reservoir and rainfall management, and the development of relevant laws and regulations. These measures are part of a broader flood risk management strategy (Shu, 2000). As a result of disasters such as superstorms, recovery efforts are governed by a set of laws, including the Coastal Area Management Act (CAMA), the National Flood Insurance Program (NFIP), and the federal Coastal Barrier Resources

Act (CBRA). These regulations seek to reduce vulnerability to future coastal hazards through adjustments in the siting of structures and other measures (Platt et al., 2002). In disaster-prone areas, formal risk-aversion mechanisms in insurance have limited scope. Addressing the assessment and adequacy of compensation amounts and their symmetry in the insurance market is crucial to improving efficiency (Kanwal and Sirohi, 2021).

Given the increasing frequency and severity of natural disasters caused by climate change, existing legal and insurance frameworks need to be reassessed to ensure they remain effective and equitable, and strengthening public-private partnerships, particularly with the insurance industry, is essential to increase society's resilience to natural disasters. The legal frameworks of most countries do not take into account the socio-economic impacts of natural disasters, especially on vulnerable communities. Therefore, the implementation of flood insurance in Iran requires a comprehensive approach that takes various factors into account. These factors include determining premiums, the availability of insurance coverage, the impact of natural phenomena, and cost-benefit analysis for risk mitigation strategies. Premiums should be set in a way that provides sufficient income for policyholders while being acceptable to policyholders.

5. Conclusion

In order to improve the level of natural disaster crisis management programs, especially floods, which lead to various human, financial, economic, environmental, social, and infrastructural losses, this effort was made to identify and introduce the factors affecting the occurrence of these risks to compensate for the losses, which resulted in the presentation of an appropriate insurance plan. The results showed that the challenges in implementing an effective legal system for flood insurance require a shift from a reactive approach to a proactive and proactive approach to flood risk management, addressing deterrent factors to reduce risk, and overcoming financial barriers. Therefore, comprehensive modeling, measures, and systematization for these challenges require coordinated efforts between the government, insurance companies, and other stakeholders to create a coordinated and codified legal framework that can lead to reduced flood damage risk. Therefore, cooperation between the public sector and private insurance companies can help manage risk and pool resources to manage flood disasters.

On the other hand, given the increasing importance of environmental risks caused by global warming, there is a need to formulate laws that are compatible with climate change and to incorporate climate change predictions into flood risk assessments and insurance models to adjust premiums and to cover future risks. Active cooperation and interaction between the Central Insurance Organization and the Environmental Protection Organization of the Islamic Republic of Iran in the field of insurance coverage available for environmental damages, including floods, can create active legal, technical, and environmental structures in the field of creating various types of insurance products

common in the international insurance market in the environmental insurance sector, employing and providing activity licenses for official environmental damage assessors, as well as the dynamism and presence of specialized environmental litigation lawyers, while compensating for damages and repairing damage in order to preserve the environment, protect the rights of future generations, and have a major impact on sustainable development. Insurance companies can design flood insurance policies and their private and public terms to compensate victims for physical damage, financial damage, and civil liability (especially environmental damage). Insurance companies can also utilize the government's catastrophe insurance mechanism and the basic insurance mechanisms of state insurance funds to compensate for natural disaster losses and complementary methods and to provide excess capacity for their losses. In this way, active cooperation and partnership are established between government catastrophe insurance coverage, intermediate flood insurance coverage issued by private insurance companies, and mandatory coverage by natural disaster insurance funds. In this case, in addition to compensation, the necessary platforms are provided for the disaster risk management and the institutionalization of predictive and preventive approaches to floods, along with the possibility of claiming and compensating the culprits and those responsible for the damage. Given that the laws related to the Natural Disaster Insurance Fund in Iran specifically address financial losses and human casualties of residential buildings and do not cover environmental damages (such as ecosystem destruction, water pollution, or reduction of ecosystem services), the fund is required to invest in prevention projects (such as wetland restoration or embankment reinforcement) to reduce environmental damages in cooperation with the Environmental Protection Organization to identify environmentally sensitive areas. The results of this research bridged environmental science, law, and insurance, fostering collaboration across disciplines. This study showed the integration of legal frameworks with flood insurance models presents a novel perspective in disaster management. Also, it offers actionable insights for policymakers and disaster management professionals, contributing to improved resilience against floods. The proposed flood insurance model can be addresses existing gaps in disaster compensation mechanisms, potentially influencing future policies. Regarding the limitations of the research, it can be noted that the findings may primarily reflect conditions in Iran, which may not be generalizable to other area.

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Authors contributions

Mohammad Zahednia: Conceptualization, Funding acquisition, Investigation, Visualization, and Writing. Shirin Shirazian: Formal analysis. Mohammad Reza Miri Lavasani: Methodology, Project administration, and Supervision. Hanie Nekoomaram: Resources, and Supervision. Mansour Pournouri: Software and Validation.

Availability of data and materials

The data that support the findings of this study are available from the corresponding author, upon reasonable request.

Conflict of interests

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

References

- Alharbi M., Coates G. (2018) An investigation of small and medium-sized enterprises' flood preparation and insurance coverage using agent-based modelling. *Urban Water Systems and Floods II*. 184:143–152. DOI: <https://doi.org/10.2495/FRIAR180141>.
- Azzam M., Graw V., Rienow A. (2022) Challenges and Innovations of Real Estate for Achieving Spatial Balance in Post-Disaster Countries. *Land* 11 (5): 737–759. DOI: <https://doi.org/10.3390/land11050737>.
- Banihabib M. E., Chitsaz N., Randhir T. O. (2020) Non-compensatory decision model for incorporating the sustainable development criteria in flood risk management plans. *SN Applied Sciences* 2:6. DOI: <https://doi.org/10.1007/s42452-019-1695-6>.
- Binder D. (1996) Act of God? Or Act of Man?: A Reappraisal of the Act of God Defense in Tort Law. *Review of Litigation* 15 (1): 27. <https://ssrn.com/abstract=821414>
- Born P., Klein R. W. (2019) Privatizing Flood Insurance in the United States: Options, Challenges, and Pitfalls. DOI: <https://doi.org/10.2139/ssrn.3337700>.
- Burton C. G. (2015) A Validation of Metrics for Community Resilience to Natural Hazards and Disasters Using the Recovery from Hurricane Katrina as a Case Study. *Annals of the Association of American Geographers* 105 (1): 67–86. DOI: <https://doi.org/10.1080/00045608.2014.960039>.
- Fataei E. (2014) Feasibility Study of Border Industrial Town Using AHP and TOPSIS. *Geography and Development* 12 (37): 181–194. DOI: <https://doi.org/10.22111/gdij.2015.1827>.
- Hansel T. C., Osofsky H., Baumgartner E., Bradberry S., Brown L., Kirkland K., Langhinrichsen-Rohling J., Osofsky J., Speier A. H., Goldstein B. D. (2017) Social and Environmental Justice as a Lens to Approach the Distribution of \$105 Million of Directed Funding in Response to the Deepwater Horizon Oil Disaster. *Environmental Justice* 10 (4): 119–127. DOI: <https://doi.org/10.1089/env.2016.0039>.
- Jorns C. (2018) Case Studies on Insurance and Compensation after Natural Disasters. *Victoria University of Wellington Legal Research*, DOI: <https://doi.org/10.2139/ssrn.3685502>.
- Kanwal V., Sirohi S. (2021) Coping with Agricultural Income Risks from Natural Disasters: Efficacy of Formal and Informal Mechanisms in Vulnerable Region of India [Preprint]. DOI: <https://doi.org/10.21203/rs.3.rs-175072/v1>.
- Maagdenberg H., Stam M., Vreugdenhil T., Böcker K., Groeneveld I. (2022) PP119 Results and lessons learned from the cyclic appropriate care program from national health care institute of the Netherlands. *International Journal of Technology Assessment in Health Care*. 38 (S1): S79–S80. DOI: <https://doi.org/10.1017/S0266462322002410>.
- Maduro C., Fontainha T. (2023) Disaster insurance and risk transfer mechanisms for natural disasters -challenges and opportunities for a new service discussed in literature reviews. *Entanglements and Flows Conference: Service Encounters and Meanings Proceedings, Rio de Janeiro, Brazil*, 1653–1671. DOI: <https://doi.org/10.3384/ecp203082>.
- National Public Law Review, Kim J. H. (2023) Review of the Disaster Management Laws after (the Itaewon Disaster) *National Public Law Review* 19 (1): 193–233. DOI: <https://doi.org/10.46751/nplak.2023.19.1.193>.
- Neumayer E., Plümper T. (2007) The Gendered Nature of Natural Disasters: The Impact of Catastrophic Events on the Gender Gap in Life Expectancy. *Annals of the Association of American Geographers* 97 (3): 551–566. DOI: <https://doi.org/10.1111/j.1467-8306.2007.00563.x>.
- Perazzini S. (2020) Public-Private Partnership in the Management of Natural Disasters: A Review. DOI: <https://doi.org/10.48550/ARXIV.2006.05845>.
- Platt R. H., Salvesen D., Li G. H. B. (2002) Rebuilding the North Carolina Coast after Hurricane Fran: Did Public Regulations Matter? *Coastal Management* 30 (3): 249–269. DOI: <https://doi.org/10.1080/08920750290042192>.
- Ridzuan M. R., Razali J. R., Ju S. Y., Md Yusof N., Kong L. K., Nabihah Manas N. H., Abd Rahman N. A. S. (2023) Mitigating Flood Risk in Malaysia through Flood Insurance: Exploring the Feasibility of the United States and Japanese Approaches *International Journal of Academic Research in Business and Social Sciences* 13 (9): 240–260. DOI: <https://doi.org/10.6007/IJARBS/v13-i9/18337>.
- Shu L. Y. (2000) Analysis of Development Trend of Overseas Flood Control and Disaster Mitigation. *Advances in Science and Technology of Water Resources*
- Taheri S. M., Mosaedi A. (2023) Review of Flood Risk Management Strategies and Legal and Practical Challenges. *Journal of Water and Sustainable Development* 10 (3): 35–50. DOI: <https://doi.org/10.22067/jwsd.v10i3.2309-127>.
- Thien N. P. (2023) Legal Strategies and Challenges in Climate Change Mitigation in Vietnam: The Role of Non-Contractual Damages Compensation. *Vietnamese Journal of Legal Sciences* 9 (2): 74–89. DOI: <https://doi.org/10.2478/vjls-2023-0010>.
- Udalov V. (2019) The Impact of Natural Disasters on Individuals' Choice Between Economic Growth and Environmental Protection: Empirical Evidence from the World Values Survey. In: *Behavioural Economics of Climate Change*. Springer Briefs in Climate Studies. Springer, DOI: https://doi.org/10.1007/978-3-030-03532-7_3.