Title: Challenges, Barriers, Strengths, and Weaknesses of "Risk-informed Sustainable Development in Emergency and Disasters": A multi-method Protocol Studye

Authors: Hamidreza Khankeh[1,2], Arvin Barzanji[1,3], Mohammad Azim Mahmodi[1], Mobin Ebrahimian[1], Shima Shirozhan[1,4], Mahdieh Motie[5,*]

1. *Health in Emergency and Disaster Research Center, Social Health Research Institute, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran.*
2. *QUEST Center for Responsible Research, Berlin Institute of Health at Charité, Berlin, Germany.*
3. *Department of Health in Emergencies and Disasters, School of Medicine, Kurdistan University of Medical Sciences, Sanandaj, Iran.*
4. *Department of Nursing, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran.*
5. *Student Research Committee, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran.*

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Abstract:

Background: Risk-informed sustainable development (RISD) is crucial for building resilience and achieving a sustainable future. This approach integrates risk assessment into decision-making for flexible and sustainable development plans. Disasters result in substantial human and economic losses, posing obstacles to sustainable development efforts. This study aims to identify knowledge gaps as well as challenges, barriers, strengths, and weaknesses in the path to risk-informed sustainable development, particularly focusing on developed and developing countries.

Materials and Methods: This study adopts a multi-method research design that will be carried out in three distinct stages, including a comprehensive scoping review to explore the existing literature, a qualitative content analysis to gain in-depth insights from relevant stakeholders, and the Delphi method to achieve expert consensus on key findings and recommendations.

Conclusion: We expect that our findings will offer a thorough understanding of RISD, establishing a foundation for a conceptual framework to direct future research. Additionally, these insights are anticipated to support evidence-based policymaking, influence resource allocation choices, and shape research priorities, ultimately contributing to the advancement of scientific knowledge in this important field.

Keywords: Disasters, Sustainable Development, Risk-Informed, Risk-informed Sustainable Development, Disaster Risk Management, Resilience.

Introduction:

Human populations have always faced natural or man-made hazards that have caused widespread disasters and damage (١). Disasters were once viewed as unavoidable natural events; however, over time, our understanding of them has evolved significantly (2-5).

It has been found that the impact depends not only on the characteristics of the risk but also on factors such as infrastructure, population growth, sociocultural context, and the environment (6-8). Related reports show that the incidence of disastrous events has increased in the past two decades, and due to climate change, unbalanced urban development, and changes in land use patterns, their effects have intensified (9, 10).

According to the latest Emergency Events Database (EM-DAT) report, there were 393 disasters worldwide in 2024, resulting in 16,753 deaths, affecting 93.1 million people, and causing economic losses amounting to US$242 billion. We believe that the primary reason for the significant loss of lives and properties during disasters is the lack of integration of disaster risk considerations in developmental plans, particularly in low and middle-income disaster-prone countries (١١), because developed countries often have stronger institutional frameworks, resources, and governance mechanisms that enable them to integrate disaster risk reduction (DRR) measures into infrastructure, health, and social systems. In contrast, many developing countries, despite being more vulnerable to disasters, struggle with limited financial resources, weaker institutions, and different development priorities, leading to inadequate risk-sensitive planning. It is clear that disasters have caused the destruction or severe damage to investments and years of effort by communities and governments (١٢ ,٣).

Because disasters significantly undermine development processes, effective disaster risk management is essential for achieving sustainable development in any society (١٣). In this context, the Sendai Framework for DRR 2015-2030 emphasizes taking action that addresses all aspects of disaster risk, such as hazard, exposure, vulnerability, and capacity, to prevent the emergence of new risks or reduce existing ones (١٤).

On the other hand, the goals of sustainable development are closely linked with the global targets of the Sendai Framework. It can be said that there is a strong relationship between reducing disaster risk and maintaining and promoting sustainable development (٧). Moreover, considering the goals of sustainable development, such as reducing poverty, making sustainable cities and communities, climate action, and other important objectives, the set of positive changes planned globally helps to further reduce the risk factors of disasters (١٦ ,١٥).

Based on the midterm reviews of the Sustainable Development Goals (SDGs) and the Sendai Framework, it is clear that risk-informed sustainable development is essential to ensure a sustainable future for all (١٨ ,١٧). Sustainable development is a dynamic approach that seeks to "address the current needs of human societies without compromising the resources and potential for future generations to meet their needs", striking a balance between the three main elements of economic growth, environmental stewardship, and social inclusion (٢١-١٩). Also, the concept of

RISD is a strategic approach that integrates risk assessment into decision-making processes to enhance the flexibility and sustainability of development plans (۲۲). “The primary objective of risk-informed development is to equip the most vulnerable communities to anticipate future risks, implement preventive strategies to mitigate risks, and foster resilience within the communities and the environments” (۲۳). Achieving risk-informed development necessitates a planning process that is conducted with a clear awareness of risks and a proactive approach to risk reduction (۲۲, ۲۳).

RISD has emerged as a critical paradigm for addressing the growing interdependence between development and disaster risk management. While global frameworks such as the Sendai Framework for DRR and the SDGs emphasize the integration of risk considerations into development planning, significant gaps remain in translating these concepts into actionable strategies. Challenges such as disciplinary silos, inadequate data, short-term policy priorities, and fragmented global efforts have hindered progress in this area.

This study aims to provide a study protocol to identify knowledge gaps, challenges, barriers, strengths, and weaknesses on the path to achieving risk-informed sustainable development, with a particular focus on the contexts of both developed and developing countries. By examining these factors, the study seeks to provide actionable recommendations for enhancing resilience and promoting sustainable development globally.

METHODS

This study will be conducted in a multi-method approach comprising three phases (24, 25).

Phase 1: A Systematic Scoping Review utilizing the five-step approach of Arksey and O'Malley and the extended version of PRISMA for scoping review, will be conducted to identify challenges and solutions related to existing risk-informed sustainable development based on national and international written experiences (26).

Phase 2: Qualitative content analysis method following the approach of Graneheim and Lundman (27), will be used to extract and analyze the perspectives of researchers and experts on the challenges and solutions associated with risk.

Phase 3: The Delphi method (28, 29) will be utilized to gather expert opinions on practical solutions for improving the quality of risk-informed sustainable development. The research team will develop practical solutions and circulate them among field experts. Their feedback will be iteratively collected and incorporated across multiple stages. Thus, the practical solutions developed by the research team will be sent to experts in this field, and their opinions will be reviewed and applied through several stages of receiving feedback (Figure 1).

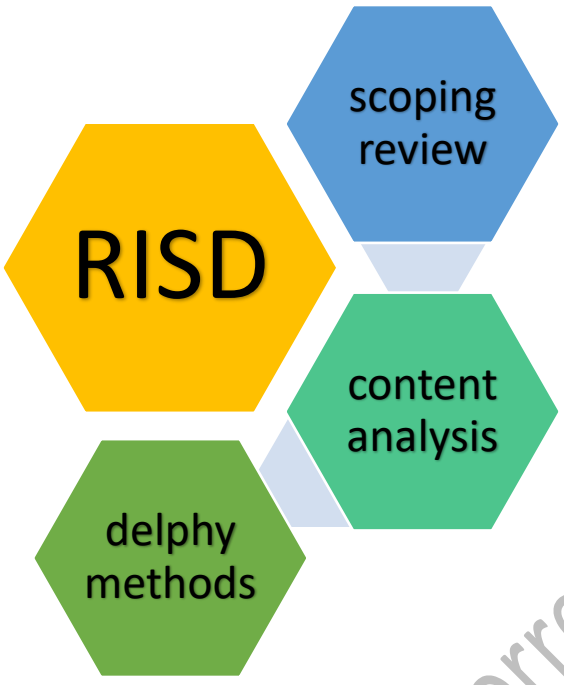

Figure1. methodology phases (30)

Phase 1: A scoping review

This phase of the study will be conducted to synthesize existing evidence and knowledge on sustainable development through a risk-informed lens. The goal of this scoping study is to identify and map the available evidence and understanding of knowledge and gaps related to risk-informed sustainable development. These studies address broad research questions and employ a methodology that maintains the same level of accuracy and rigor as systematic reviews (31, 32).

we will conduct this scoping review using Arksey and O'Malley's methodology (26) and will be drafted using the preferred reporting items for systematic reviews and meta-analysis with the extension for scoping reviews (PRISMA-SCR) (33). This phase of the study will go through six stages:

Stage 1: identifying the research question

Stage 2: identifying relevant studies

Stage 3: study selection

Stage 4: charting the data

Stage 5: collating, summarizing, and reporting the results

We also consult experts as a parallel element to inform and confirm the findings (26).

Stage 1: Identifying the Research Question

The questions of this study are derived from our primary goal, which is to examine the available evidence regarding sustainable development informed by risk considerations. To achieve this goal, the following questions will be addressed:

- What are the main influencing factors, essential components, and measurable indicators of risk-informed sustainable development at both national and international levels? What are the challenges and barriers to implementing risk-informed approaches to sustainable development in disaster scenarios?
- What is the existing national and international knowledge on the strengths and weaknesses of "risk-informed sustainable development in emergencies and disasters"?

Stage 2: Identifying Relevant Studies

In this study, we will check PubMed, WOS, Embase, and Scopus databases until September 2025 to find related studies. Also, Google, Google Scholar search engine, and explore relevant gray literature associated with the target organization, such as the World Health Organization (WHO) and FEMA websites, UNDRR, and other related websites to find related studies and documents will be used. In addition, national and local databases such as SID, Magiran, IranDoc, and Civilica will be searched to include relevant domestic studies and documents. It should be mentioned that we will not have any time limits for the search.

The search strategy we use for searching is according to Table 1.

Table1. Search strategy	
Database	**Search strategy**
PubMed	((((((((((risk[Mesh]) OR (risk[Title/Abstract])) OR ("risk informed"[Title/Abstract])) OR ("risk based"[Title/Abstract])) OR ("risk sensitive"[Title/Abstract])) OR ("risk oriented"[Title/Abstract])) OR ("risk averse"[Title/Abstract])) OR ("risk adjusting"[Title/Abstract])) OR ("risk reduction"[Title/Abstract])) OR ("risk information"[Title/Abstract])) OR ("risk aware"[Title/Abstract])) AND ((((((((("Sustainable Development"[Mesh]) OR ("Sustainable Development"[Title/Abstract])) OR ("sustainable practices"[Title/Abstract])) OR ("sustainable management"[Title/Abstract])) OR (sustainable growth[Title/Abstract])) OR ("resource efficiency"[Title/Abstract])) OR ("sustainable use"[Title/Abstract])) OR ("sustained growth"[Title/Abstract])) OR ("long term development"[Title/Abstract])) OR ("consistent growth"[Title/Abstract]))
WOS	(TS=(('Risk' OR 'risk informed' OR 'risk based' OR 'risk sensitive' OR 'risk oriented' OR 'risk averse' OR 'risk adjusting' OR 'risk reduction' OR 'risk information' OR 'risk aware'))) AND TS=(('Sustainable Development' OR 'Sustainable Development' OR 'sustainable practices' OR 'sustainable management' OR 'sustainable growth' OR 'resource efficiency' OR 'sustainable use' OR 'sustained growth' OR 'long term development' OR 'consistent growth'))
Embase	("Risk" OR "risk informed" OR "risk based" OR "risk sensitive" OR "risk oriented" OR "risk averse" OR "risk adjusting" OR "risk reduction" OR "risk information" OR "risk aware") AND ("Sustainable Development" OR "Sustainable Development" OR "sustainable practices" OR "sustainable management" OR "sustainable growth" OR "resource efficiency" OR "sustainable use" OR "sustained growth" OR "long term development" OR "consistent growth")
Scopus	(TITLE-ABS-KEY("Risk" OR "risk informed" OR "risk based" OR "risk sensitive" OR "risk oriented" OR "risk averse" OR "risk adjusting" OR "risk reduction" OR "risk information" OR "risk aware") AND ("Sustainable Development" OR "Sustainable Development" OR "sustainable practices" OR "sustainable management" OR sustainable growth OR "resource efficiency" OR "sustainable use" OR "sustained growth" OR "long term development" OR "consistent growth"))
other	Google, Google scholar, site: .org, .gov, .int and file type: .pdf, .doc, .docx

Stage 3: Study Selection

In this research, after searching the databases, the retrieved studies are imported into EndNote software. Duplicate studies are then removed. The studies are selected based on the inclusion criteria outlined in Table 2, and the titles, abstracts, and full texts are reviewed sequentially. The selection process involves two referees who independently read the titles of the studies, selecting articles related to the study objectives. In the next stage, the abstracts of the selected articles are read and screened. Finally, the full texts of the relevant articles are reviewed.

If any articles are ambiguous or doubtful, a third referee is consulted to determine whether the article should be included or excluded from the study. Additionally, study journals that are relevant to the objectives of this research are reviewed to discover related studies.

With expert recommendations in the field of risk, other available sources and documents are also utilized. These selected studies explain concepts, definitions of factors, tools, models, challenges, solutions, recommendations, and indicators of risk, and also discuss sustainable development based on risk information (Table 2).

Table 2. Inclusion criteria

1. Scope and Focus: Articles, reports, and documents that explicitly address the concept of risk-informed sustainable development. Literature that integrates risk assessment and management within the context of sustainable development.
2. Type of Publications: Peer-reviewed journal articles, book chapters, theses, and dissertations. grey literature sources such as WHO guidelines, checklists, reports, technical guidance documents, national guidelines or tools, conference papers, government and NGO reports, as well as pertinent policy documents and guidelines.
3. Methodology: Empirical studies (quantitative, qualitative, mixed methods). Theoretical and conceptual papers that provide frameworks or models. Case studies and best practice examples.
4. Interdisciplinary Approaches: Inclusion of literature from various disciplines (e.g., environmental science, economics, social sciences, engineering) to capture a holistic view.
5. There are no limitations based on the country of origin or publication date.
6. Geographical Scope: Global perspective, including studies from various regions to capture diverse contexts and applications. Inclusion of both high-income and low- to middle-income countries to understand different approaches and challenges.
7. Articles and documents in the English or Persian language

Stage 4: Charting the Data

During this phase, a thorough review of studies focusing on risk-informed sustainable development will be conducted. Data extraction will follow a structured form created and validated by the researchers. By selecting each study, the necessary data is recorded according to the following table 3.

Initially, two independent reviewers will extract data from the first two and three papers using this form to assess alignment with research objectives and inquiries, and if needed, the data extraction tables/ forms will be modified. Once the final chart/form is confirmed, data extraction from additional studies will proceed. Reviewers will then meet to discuss the consistency of their methodologies and research objectives. This type of analysis identifies gaps in previous studies, and the combined data from previous studies help identify contradictions, consistencies, and recommendations for future research.

Table 3: Extracted studies

	Authors	Year	Country Of Origin	Study Populations	Methodology	Influencing Factors	Component	Indicators	Challenges And Barriers	strengths and weaknesses
1										

Stage 5: Collating, Summarizing, and Reporting the Results

In this stage, we will do data analysis, report results, and explain findings. First of all, I will report quantitative data and attributes of studies, like the number of studies reviewed, the number of articles by origin, methodology, and other relevant characteristics. After that, we will explore the Challenges, Barriers, Strengths, and Weaknesses of Risk-informed Sustainable Development in Emergencies and Disasters. Extracted Challenges, Barriers, Strengths, and Weaknesses will be reported in tables and figures. Finally, we will integrate data and provide a comprehensive outcome that improves the credibility of our conclusions

By systematically gathering and analyzing data from various sources, this review will offer a detailed overview of the current landscape of risk-informed sustainable development, pinpointing both strengths and areas needing improvement.

Stage 6: External Consultation:

The findings from the scoping review will be shared, discussed, and interpreted during a focus group with a multidisciplinary research team and experts, fostering collaboration and integrating diverse perspectives.

Phase 2: Content Analysis

In the second phase, the experiences of experts and practitioners in the field of risk-informed sustainable development will be explored through a conventional content analysis study by utilizing the Granheim and Landman approach, and the challenges, barriers, strengths, and weaknesses in this field will be explained. The solutions they express will also be extracted (24, 27, 34).

- ✓ Sampling

Participants for the qualitative content analysis will be selected purposefully. We will invite individuals who have professional expertise and practical experience either in emergencies and disasters or in risk-informed sustainable development. Those with a background in disaster and emergency management bring unique strengths such as hands-on crisis response, teamwork under pressure, and rapid decision-making. In contrast, participants with expertise in sustainable development contribute valuable perspectives on long-term planning, resilience building, and policy integration. Bringing together these diverse experiences will enrich the study by offering complementary viewpoints. In addition, participants must be willing to take part in the study and able to clearly share their experiences.

✓ Participants

In qualitative research, it is not possible to determine the number of participants in advance. Data collection continues until data saturation is achieved. Saturation ensures that emerging categories sufficiently represent the intended concepts and are explored in adequate depth, and that new data no longer lead to the creation of new categories. Participants in this study will include policymakers, experts, and academic professors in the field of emergencies and disasters, as well as individuals with direct hands-on experience in disaster management and developmental processes. This combination of theoretical, policy-oriented, and practical perspectives will enrich the study and provide a more comprehensive understanding of the subject matter. Data Collection

Data collection will be carried out through semi-structured in-depth interviews. To conduct semi-structured interviews, an interview guide will first be developed by the research team using their background knowledge and the results of the scoping review, and a few interviews will be conducted as a pilot to evaluate the developed interview guide. Interviews based on the developed guide will begin with initial questions. Then, the main questions will be asked of the participants, and related issues will be followed up through confirmatory and follow-up questions. For example, the participant will be asked,

- "What challenges are there in implementing risk-informed sustainable development strategies in disaster risk management in our country?"
- "In your opinion, what obstacles are there in the way of risk-informed sustainable development?"
- "What are the solutions appropriate to the country's conditions for developing risk-informed sustainable development strategies?"
- "What are the most important dimensions and components of this area?"

Initial interviews will employ more general questions. After three to four interviews, the interview guide will be refined and updated regularly to incorporate new information gathered in subsequent interviews. In order to conduct interviews, after obtaining the necessary permissions, coordination will be made with the interviewee to conduct the interview at a time and place convenient for them. Before starting an interview, the researcher will introduce themselves to the interviewee and explain the purpose of the research. Then, by explaining the possibility of recording the participant's voice, respecting the principle of confidentiality of information, and the participant's ability to withdraw from the study at the research stage, informed consent will be obtained in the form of a written or oral form (along with recording the participant's voice). The researcher considers himself obliged to obtain informed consent during the research process from the beginning of an interview, during and after an interview until the end of the research, if necessary, and to ensure the participant's willingness to continue the research. Data collection and conducting interviews will continue until the so-called data saturation occurs. This means that the categories are enriched and have sufficient depth, and no new categories are created.

✓ Data Analysis Methodology

The analysis of the findings from the second phase will be conducted using the approach proposed by Graham and Lundman (2004). The data collection process will involve conducting interviews and simultaneously analyzing the collected data. The researcher will transcribe each recorded interview verbatim, paying close attention to the participant’s tone. After an initial reading for context, the analysis will involve a line-by-line examination of the text, breaking it into meaningful units aligned with the study’s objectives.

- ✓ Following summarization, the researcher will code the summarized units by labeling them. The codes will then be organized into subcategories or themes based on their similarities and differences. Each category will be named according to its content. The researcher will compare these categories, revising subcategories and categories as needed. As the analysis continues, the focus may shift to analyzing latent content and identifying overarching themes. Trustworthiness

Based on Guba and Lincoln's Trustworthiness, which encompasses four key components: credibility, transferability, dependability, and confirmability, will be considered in this study (24, 27).

Phase 3: Delphi method and policy brief development

This phase will integrate the findings from the first phase (systematic scoping review) and the second phase (qualitative content analysis), and the data integration will be carried out by all members of the research team. Following this integration and consensus building, a Delphi study will be conducted using data collection protocols to formulate a policy brief. A group of experts, including specialists and faculty members in the field of disasters, as well as professionals in disaster risk management, public health, nursing, emergency medicine, health policy, and sustainable development, will be selected. Experts will be purposively recruited based on their academic background, professional experience, and contributions (e.g., research publications or practical involvement) in the field. We will invite them to participate in multiple Delphi sessions, anticipated to consist of two to three iterative rounds, to discuss and exchange ideas. These experts can share the challenges, barriers, strengths, and weaknesses of "risk-informed sustainable development in health and disasters" and present corrective solutions (28). With this method, we can collect different perspectives and conduct a deeper analysis of risk-informed sustainable development in health and disasters.

A policy brief is also a short document that prioritizes a specific policy issue and presents evidence in simple and understandable language for everyone (35, 36). These documents are usually designed to present key information and practical recommendations in a concise and clear manner. Since decision-makers at the micro and macro levels need concise and complete information, and policymakers are usually busy people and do not have sufficient expertise in all areas, it is interesting and helpful for them to receive concise but important information for decision-making and providing solutions. These summaries should be able to provide key insights and practical recommendations in the shortest possible time in an organized and understandable manner. For example, when facing an issue such as "risk-informed sustainable development in accidents and disasters" and providing corrective solutions, a policy brief could include challenges, obstacles, strengths, weaknesses, and corrective solutions. An effective policy brief should also present valid and up-to-date evidence and help its audience quickly understand the pros and cons of different options. The document should also be attractive in terms of design and appearance to attract the audience's attention and encourage them to read it. The use of charts, tables, and bullet points can help to better and faster understand the content. These types of documents serve as a powerful tool to facilitate communication between researchers and policymakers and play an important role in translating scientific knowledge into practical and effective actions. After collecting information from the first and second stages and holding an expert panel, a policy brief will be written.

Discussion:

Over the past few decades, RISD has garnered increasing attention, yet significant gaps remain in the availability of sufficient information, criteria, and well-defined conceptualizations in this field. This scoping review aims to address these gaps by focusing on clarifying the influencing factors, components, and

indicators of sustainable development based on risk-informed practices, as well as the challenges and barriers associated with RISD in disasters. Our study will systematically examine the existing evidence database, assessing study designs, types of RISD methods applied, and influential factors that shape RISD practices. We anticipate that our findings will provide a comprehensive understanding of RISD, laying the groundwork for a conceptual framework to guide future research. Moreover, these insights are expected to inform evidence-based policymaking, resource allocation decisions, and research priorities, thereby advancing scientific knowledge in this critical area.

To ensure practical impact, the findings will be disseminated to policymakers and practitioners through targeted policy briefs, stakeholder workshops, and presentations at relevant professional conferences. Additionally, open-access publications and summaries will be made available to facilitate knowledge translation and practical application in disaster risk management and health sectors. Potential limitations of the multi-method approach include challenges in achieving data saturation during Phase 2 (qualitative content analysis) and reaching consensus in Phase 3 (Delphi study). These limitations will be addressed by careful participant selection, iterative data collection, and employing structured protocols for data integration and consensus building, thereby enhancing the credibility and applicability of the results.

Ethical Considerations: This study has been reviewed by the USWR Ethics Committee and has received the ethics approval code IR.USWR.REC.1404.104.

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