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SOCIAL VULNERABILITY IN FLOOD DISASTER PREPAREDNESS: A NARRATIVE REVIEW

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ABSTRACT

Flood disasters remain among the most common and destructive hazards worldwide, with climate change and rapid urbanization intensifying both hazard severity and susceptibility. This narrative review synthesizes factual and conceptual advancements concerning societal vulnerability in the context of flood catastrophe preparedness. The review integrates peer-reviewed studies and relevant technical and institutional literature, consolidating dominant definitions of vulnerability as a function of exposure, sensitivity, and adaptive capacity, while considering recent developments that situate vulnerability within integrated Social–Ecological–Technological Systems (SETS). This analysis examines key assessment frameworks and tools, including Social Vulnerability Indices (SVIs), the MOVE framework, and the Flood Resilience Measurement for Communities (FRMC), highlighting the use of indicator-based methodologies to pinpoint vulnerability hotspots and inform decision-making. Evidence demonstrates that socioeconomic disadvantage, demographic characteristics, social capital, and institutional capacity consistently affect disparities in flood damage and recovery trajectories, often through intersectional and location-specific mechanisms. The review contends that equitable disaster risk reduction requires the integration of vulnerability metrics into planning and investment, the improvement of methodological transparency and local relevance of indicators, and the strengthening of social protection, inclusive risk communication, and accountable governance to transform assessments into concrete, actionable interventions.

Keywords: Social Vulnerability; Flood Disaster Preparedness; Disaster Risk Reduction; Vulnerability Assessment; Resilience

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Introduction

Flooding remains the most prevalent and economically damaging natural hazard worldwide, with its frequency and intensity intensified by human-induced climate change and fast urban development. The United Nations Office for Disaster Risk Reduction's Global Assessment Report (GAR 2025) indicates that the annual direct economic cost of disasters has risen to around $202 billion, exceeding $2.3 trillion when considering cascading effects and ecosystem losses (United Nations Office for Disaster Risk Reduction, 2025). Floods represent a significant portion of these events; recent data indicates that flood-related disasters have increased by 134% since 2000, accounting for over 40% of all weather-related disasters (United Nations Office for Disaster Risk Reduction, 2025). In 2024, floods constituted over 41% of major natural disasters, directly impacting almost 49 million individuals worldwide (Centre for Research on the Epidemiology of Disasters, 2025). Despite considerable advancements in weather forecasting and hydraulic engineering, the human and economic effects remain. This contradiction is mostly attributed to the "expanding bullseye effect," in which unforeseen urbanization and demographic growth in hazard-prone areas coincide with the intensifying effects of climate change (Pathirana et al., 2013). Researchers increasingly assert that disaster risk is not merely a result of physical exposure but is fundamentally shaped by social vulnerability—the existing social, economic, and political conditions that hinder a population's ability to anticipate, manage, and recover from catastrophic events (Chang et al., 2025; Wisner et al., 2004).

Notwithstanding the extensive research on social vulnerability, the existing literature is fragmented and often limited to specific disciplines, such as geography, sociology, or engineering. There is an absence of comprehensive syntheses that integrate recent theoretical advancements with empirical data from the past decade (2015–2025), particularly regarding the intersectional dimensions of vulnerability and its changing dynamics in the context of rapid climate change. Furthermore, while measurement tools like the Social Vulnerability Index (SVI) are widely utilized, their applicability and adaptation across various geographic and cultural contexts require meticulous examination to align theoretical frameworks with efficient disaster risk reduction (DRR) strategies.

This narrative review seeks to address existing gaps by answering the fundamental question: How has the conceptualization and evaluation of societal vulnerability in relation to flood disaster changed? This review specifically examines: how the social vulnerability now shifts the flood preparedness paradigm.

Defining Social Vulnerability in Flood Disaster

Social vulnerability to flood disasters is a complex concept that assesses the probability of human systems sustaining harm from hydrometeorological hazards. Unlike physical vulnerability, which pertains to the built environment's susceptibility to hydraulic forces (e.g., infrastructure, levees), social vulnerability emphasizes the social construction of risk, asserting that historical, political, and economic processes unevenly allocate risk among populations, often regardless of the physical hazard's intensity (Cutter, 2003; Prall et al., 2024).

Contemporary academic discourse (2015–2025) generally clarifies social vulnerability via three interrelated concepts: exposure, sensitivity, and adaptive capacity (Taganibuos et al., 2025; Reimann et al., 2024). These might be understood as the locations of individuals, prospective victims, and the supports available for coping and healing.

Within this tripartite paradigm, exposure refers to the actual location of individuals, residences, and essential services (such as educational institutions, healthcare facilities, and transportation) in regions vulnerable to floods. Flood risk is determined by geographical and hydrological elements, while exposure is additionally shaped by socioeconomic factors. Limited housing options, restrictive urban planning, and unfair property markets may restrict marginalized families to low-lying or river-adjacent areas, increasing their risk of direct exposure to floodwaters (Flanagan et al., 2011). Sensitivity explains why some populations experience more severe outcomes than others, even with comparable flood levels or durations. Sensitivity is influenced by age (including both elderly individuals and young children), disabilities, chronic health conditions, and impediments to timely action, such as limited mobility or language barriers, which can hinder evacuation, access to safe shelter, continuity of care, and post-flood well-being (Rufat et al., 2015). Adaptive capacity denotes the resources and agency that enable individuals and communities to anticipate floods, respond during the disaster, and recover subsequently. This include access to early alerts and risk data, savings and insurance, stable livelihoods, secure housing alternatives, resilient social support networks, and responsive institutions. In regions with limited adaptation capacity, floods are more likely to result in lasting consequences, including indebtedness, displacement, and worse health outcomes (Prall et al., 2024; Chang et al., 2025).

Recent research have refined this definition by integrating it into the Social-Ecological-Technological Systems (SETS) framework. This perspective argues that social vulnerability must be analyzed in conjunction with the interaction of social hierarchies, environmental degradation, and declining infrastructure, particularly in rapidly urbanizing contexts (Birkmann et al., 2013).

Transforming the Flood Disaster Preparedness Framework

Flood disaster preparedness has evolved from a hazard-centric model, emphasizing structural defenses and forecasting, to a systems- and people-oriented framework that recognizes the impact of social vulnerability, institutions, and community capacity on disaster outcomes. Recent study defines preparedness not solely as a technical matter, but as a process that must account for vulnerable populations, the factors contributing to the disproportionate impact on specific groups, and the resources and structures that enable swift action and recovery. United Nations Office for Disaster Risk Reduction, 2025.

A significant approach for comprehending this transition is the MOVE framework (Methods for the Improvement of Vulnerability Assessment in Europe). MOVE defines vulnerability through three interrelated components: exposure (the presence of humans and assets in flood-prone areas), susceptibility (the likelihood of damage given exposure), and resilience or adaptive capacity (the ability to anticipate, manage, and recover). This paradigm aids academics and practitioners in moving beyond a singular-index view of vulnerability by encouraging the context-specific selection of indicators spanning social, economic, institutional, environmental, and physical dimensions. MOVE enhances preparedness planning by shifting the focus from the question, "Where will flooding occur?" to inquiries such as "Which demographics face increased challenges to preparedness and response?" and "Which capabilities alleviate harm and accelerate recovery?""""

A supplementary body of work elucidates these principles by specifically addressing urban flood risk as the result of interconnected systems. The Social–Ecological–Technological Systems (SETS) framework conceptualizes urban areas as interrelated systems, where vulnerability and risk emerge from the interaction of social factors (such as inequality or marginalization), ecological dynamics (including land-cover change and watershed degradation), and technological or infrastructural systems (such as drainage, transportation, energy, and essential services). SETS-based research often operationalizes indicators within three domains and identifies hotspots where vulnerabilities converge, thereby aiding preparedness policies in prioritizing integrated interventions such as ecosystem-based strategies, infrastructure redundancy, and social protection, rather than exclusively focusing on emergency response. (Chang et al., 2021; Ariyaningsih & Shaw, 2022).

A growing body of research emphasizes that preparation should be assessed not only by plans and equipment but also by measurable "sources of resilience" inside communities. The Flood Resilience Measurement for Communities (FRMC) provides a systematic tool for assessing community flood resilience through the 5C–4R framework, which combines five capitals (human, social, physical, financial, natural) with four system attributes (robustness, redundancy, resourcefulness, rapidity). This methodology was empirically formulated and evaluated to aid

decision-making concerning targeted investments, such as augmenting risk communication, improving access to secure shelter and essential services, and protecting livelihoods, while also enabling the monitoring of resilience changes over time. (Keating et al., 2017; International Institute for Applied Systems Analysis, n.d.).

MOVE, SETS, and FRMC collectively provide the rationale for conceptualizing contemporary flood disaster preparedness as an integrated practice of vulnerability and resilience. Preparedness includes the hazard, the distribution of social hazards, the reliability of infrastructure and ecosystems, and the capacity of institutions and communities to respond effectively during the catastrophe cycle. United Nations Office for Disaster Risk Reduction, 2025.

Methodologies

This narrative study utilizes a targeted keyword methodology to collect evidence from peer-reviewed academic publications, technical reports, and governmental or institutional records, including grey literature, published between 2015 and 2025. Searches were performed using Boolean logic (AND, OR), with keyword variations adapted to the syntax of each platform and field limits such as title or abstract searches.

To ensure comprehensive coverage of the flood context, hazard-related terminology was utilized, including "flood," "flooding," and specific event classifications such as "riverine flood," "flash flood," "pluvial flood," "coastal flood," and "urban flood," alongside risk-oriented terms like "flood hazard" and "flood risk." These were linked to vulnerability concepts that encompass the social dimensions of risk, including "social vulnerability," "vulnerability assessment," "vulnerability index," "community vulnerability," and "socioeconomic vulnerability," as well as commonly used abbreviations such as SVI and SoVI. Many studies define vulnerability through its components rather than a single term, requiring additional language to capture the underlying characteristics, including exposure, susceptibility, sensitivity, adaptive capacity, coping, and recovery.

The investigation associated vulnerability with preparedness by incorporating terminology related to disaster management and disaster risk reduction (DRR), including preparedness, "disaster preparedness," "flood preparedness," mitigation, "risk reduction," DRR, "disaster risk management," adaptation, and "climate adaptation." Operational readiness measures were specified using terms such as "early warning," evacuation, shelter, "risk communication," and "emergency management." To identify studies that explicitly employ or address critical frameworks, framework-specific terminology was included, such as MOVE (and "Methods for the Improvement of Vulnerability Assessment in Europe"), SETS (and "social-ecological-

technological systems"), and FRMC (and "Flood Resilience Measurement for Communities," "community flood resilience," "flood resilience measurement," and "5C-4R").

The review underscores the assessment of vulnerability and resilience, integrating methodological keywords to gather information on equity-sensitive terminology. This approach aims to improve the retrieval of studies focused on groups typically identified as socially vulnerable, including terms such as inequality, equity, "environmental justice," marginalization, poverty, "low-income," "older adults," elderly, disability, "chronic disease," "minority," "language barrier," migrant, and settlement-related expressions like "informal settlement" and "slum."

These terms were consolidated into structured search strings such as ("social vulnerability" OR SVI OR SoVI) AND (flood OR flooding) AND (preparedness OR DRR OR mitigation OR adaptation). Retrieved records were assessed for their pertinence to flood-related social vulnerability and preparedness, incorporating grey literature if it provided conceptual frameworks, methodological guidance, or policy-relevant evidence, including disaster risk management reports and governmental guidance documents.

Factors Influencing Social Vulnerability

Socioeconomic and Demographic Variables

Socioeconomic and demographic factors are consistently associated with flood susceptibility, as they influence both exposure circumstances and the resources available for preparation, response, and recovery. Research frequently correlates elevated impacts with low income, precarious employment, and insufficient education, which can hinder access to secure housing, preparedness resources, evacuation transportation, insurance, and post-flood restoration or relocation, while also diminishing access to risk information and administrative assistance. (United Nations Office for Disaster Risk Reduction, 2025).

Vulnerability also differs based on demographic variables and systemic inequity. Older adults, young children, and individuals with disabilities or chronic illnesses may encounter heightened challenges in evacuation and sustaining continuity of care. Additionally, household composition, such as larger or single-parent households, can exacerbate caregiving responsibilities during alerts and displacements. Minority status, linguistic isolation, and migrant status may hinder access to early warnings and public services, particularly in urban environments where these disadvantages intersect with informal housing and inadequate infrastructure, thereby amplifying risk in specific neighborhoods. Recent studies underscore the importance of intersectionality, illustrating how overlapping disadvantages create compounded risk profiles that are overlooked when indicators are analyzed in isolation.

Community Resilience and Social Capital

Community resilience denotes a community's ability to foresee, endure, adjust, and recuperate from flood effects while maintaining essential functions and minimizing the risk of prolonged disruption. Recent flood-risk literature often associates resilience with social capital, which encompasses the resources inherent in social interactions that promote cooperation, information sharing, and mutual assistance. Empirical evidence demonstrates that social networks and social support—encompassing bonding, bridging, and linking ties—can enhance risk perception, facilitate collective preparedness, and expedite post-flood recovery by augmenting access to resources, services, and informal assistance. (United Nations Office for Disaster Risk Reduction, 2025; Sadri et al., 2023).

The quality of institutional relationships, in addition to the quantity of social bonds, also influences resilience. Confidence in public institutions and reliable risk communication can enhance early-warning adoption, involvement in evacuation or sheltering, and collaboration with response and recovery initiatives, thus diminishing preventable losses and facilitating the expedited normalization of livelihoods. Empirical research in flood-impacted areas indicates that communities exhibiting robust social capital and elevated institutional trust are more likely to engage in coordinated hazard management practices and experience improved recovery outcomes, although the effects may differ across preparedness, response, and long-term adaptation based on context and loss severity. (xiong, et al, 2024; Curtis, et al, 2024).

An intersectionality viewpoint contends that "vulnerable groups" must not be regarded as static or uniform categories, since vulnerability arises from the interplay of social positions and power dynamics that differ among locations, institutions, and hazard contexts. This indicates that the identical flood may produce varying restrictions and coping mechanisms inside and among communities, contingent upon the intersection of identities and resources with housing markets, labor circumstances, service accessibility, and risk governance. Empirical applications in flood-risk contexts illustrate that intersectional analysis can uncover both explicit and latent vulnerabilities that might be neglected in affluent or seemingly well-served regions, thereby enhancing the precision of preparedness and recovery assistance by shifting focus from group labels to mechanisms of marginalization and exclusion. (Kuran, et al, 2020; Nielson, et al, 2023).

Institutional and Structural Influences

Recent flood-risk literature increasingly highlights that vulnerability is not solely determined by exposure and socioeconomic factors, but is also generated through institutional and governance frameworks that influence the anticipation, management, and distribution of risks. Institutional factors generally encompass socio-cultural norms, socio-political power dynamics, fiscal-economic

capabilities, and legislative-regulatory frameworks, all of which affect the availability, accessibility, and efficacy of disaster risk management (DRM) strategies. In contexts of coherent and accountable governance, institutions can facilitate risk-informed planning, equitable access to early warning systems and protective infrastructure, and prompt recovery assistance. Conversely, fragmented, under-resourced, or contested governance can exacerbate vulnerability by hindering service delivery, undermining the enforcement of land-use regulations, and diminishing public trust and compliance. These processes are especially pronounced in low- and middle-income contexts, where limitations in administrative capacity and difficulty in multi-level coordination can weaken preparedness and response, thereby exacerbating disparities among social groups (Biswas & Nautiyal, 2023).

Political-economic perspectives contend that vulnerability is intrinsically linked to disparities in access to resources and decision-making authority, rather than being an inherent characteristic of individuals or communities. From this viewpoint, disasters expose and exacerbate structural problems such as poverty, marginalization, and unequal development, which determine individuals' capacity to evade high-risk areas, obtain safer housing, access information and public services, and restore livelihoods following floods. Limited entitlements, inadequate social protection, and exclusion from formal planning processes can subject certain populations to "compulsory exposure" and restrict adaptive capacity, resulting in enduring vulnerability despite the availability of hazard information and technical solutions (Wisner et al., 2004; Biswas & Nautiyal, 2023). Thus, enhancing flood preparedness necessitates not only advancements in engineering and forecasting but also institutional reforms that bolster accountability, enhance inter-agency coordination, and broaden equitable access to resources and protective public services (Wisner et al., 2004; Biswas & Nautiyal, 2023).

Implications for Policy

Research on social vulnerability significantly influences disaster risk reduction and climate adaptation by transitioning preparedness and response from a standardized hazard-management framework to an equity-focused governance model. From this perspective, vulnerability assessment is not a supplementary analytical task but an essential component of risk governance, allowing decision-makers to understand that similar flood exposure can result in disparate impacts due to varying capacities, obstacles, and institutional access among populations. (United Nations Office for Disaster Risk Reduction, 2025)

Consequently, the incorporation of socioeconomic vulnerability measurements into hazard mitigation planning is increasingly regarded as a need for equitable disaster policy, rather than an optional enhancement. For instance, in the United States, the U.S. The Federal Emergency Management Agency (FEMA) currently anticipates that states will integrate social vulnerability factors into State Hazard Mitigation Plans, therefore formalizing the focus on communities who may be disproportionately impacted by flood hazards and their associated cascading effects. Simultaneously, urban resilience policies have started to incorporate social vulnerability into comprehensive strategies for water management, climate adaptation, and infrastructure planning, acknowledging that technical solutions alone are inadequate when structural inequalities hinder preparedness and recovery. (United Nations Office for Disaster Risk Reduction, 2025)

Social Vulnerability Indices (SVIs) are widely utilized to prioritize resource allocation, inform emergency preparedness and evacuation strategies, and facilitate the development of tailored interventions for vulnerable groups. Recent research highlights the enhanced utility of integrating social vulnerability datasets with flood hazard and exposure models to pinpoint areas of compounded risk, thereby strengthening the evidentiary foundation for policy decisions concerning managed retreat, insurance structuring, and public assistance distribution. (United Nations Office for Disaster Risk Reduction, 2025; Pathirana et al., 2013).

Discussion

The analyzed evidence suggests that socioeconomic and demographic factors are essential for understanding disparate flood consequences, albeit their effect is moderated by localized institutional and infrastructural contexts. Low income, precarious employment, and insufficient education consistently act as barriers to protective options (such as safer housing, preparedness resources, or post-flood repairs), while age demographics, disabilities, chronic illnesses, and caregiving responsibilities influence sensitivity and complicate evacuation and continuity of care. Notably, recent research underscores that these factors should not be viewed as merely additive "risk labels"; instead, intersectional combinations of disadvantage can create compounded vulnerability profiles that remain hidden when indicators are considered in isolation.

A second crucial conclusion is that community resilience is significantly influenced by the presence and quality of social capital, encompassing bonding, bridging, and linking ties that facilitate information dissemination, mutual assistance, and access to institutional support. Systematic and empirical research indicates that robust social networks and institutional trust can enhance early-warning adoption, promote coordinated response actions, and facilitate expedited recovery, although the extent of these effects varies with the severity of loss and governance structures.

Intersectionality-focused analyses reveal that resilience resources are inequitably allocated within communities, potentially obscuring "hidden vulnerabilities," thereby highlighting the necessity to transcend uniform community assumptions in preparedness planning.

Third, the institutional and structural literature emphasizes that vulnerability is perpetuated through governance capacity, regulatory enforcement, and political-economic disparities that influence entitlements, access to services, and involvement in risk governance. In contexts characterized by fragmented or inadequately funded institutions, the provision of early warning systems, land-use regulations, and recovery support may be erratic, exacerbating disparities and eroding public confidence. This observation corresponds with political-economic analyses suggesting that disasters expose and perpetuate structural marginalization, whereby "compulsory exposure" and limited adaptive capacity endure despite the availability of hazard information and technical remedies.

Collectively, these findings suggest that policy strategies focused exclusively on structural flood barriers are improbable to mitigate unequal consequences. Instead, vulnerability-informed flood governance should combine (1) risk-informed and equity-sensitive planning that explicitly targets barrier reduction for high-risk groups, (2) investments that strengthen social protection and livelihood security alongside critical services, and (3) risk communication and preparedness programs that cultivate institutional trust and leverage local networks.(United Nations Office for Disaster Risk Reduction, 2025)(Sadri et al., 2023) Operationally, the growing integration of social vulnerability metrics into hazard mitigation planning and the coupling of SVIs with flood hazard/exposure models can support more transparent prioritization and the identification of compounded-risk hotspots, but this requires improved data quality, methodological transparency, and participatory validation to ensure that indicators reflect local realities and translate into implementable interventions.(United Nations Office for Disaster Risk Reduction, 2025; Pathirana et al., 2013)

Conclusion

In the past decade, societal vulnerability has transitioned from a supplementary concept to a fundamental perspective in flood catastrophe research and practice. This review synthesizes evidence indicating that disproportionate flood impacts result from both physical exposure and the interplay of socioeconomic, demographic, and institutional factors that influence sensitivity and adaptive ability. Recent frameworks and measurement tools have enhanced the capacity to delineate these patterns and pinpoint compounded-risk hotspots; however, significant challenges

persist, including methodological transparency, context-sensitive indicator selection, and the necessity to regard vulnerability as dynamic and intersectional.

To effectively mitigate flood risk, it is essential to integrate vulnerability assessments into planning and decision-making processes, while also investing in social protection, inclusive risk communication, and resilient key services. Enhancing community involvement and institutional responsibility is crucial for ensuring that vulnerability measures result in specific, actionable solutions. Incorporating social vulnerability into flood risk management enables policymakers and practitioners to effectively allocate resources, mitigate preventable damage, and foster equitable and resilient communities. (United Nations Office for Disaster Risk Reduction, 2025)

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