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Flood disaster preparedness, and livelihood change: A conceptual and theoretical review

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Abstract

Flood disasters have become increasingly frequent and severe in recent years, posing significant threats to communities worldwide. The intertwining issues of flood disaster preparedness and its impact on livelihoods call for a deeper understanding of the underlying conceptual and theoretical frameworks. This paper explores and analyzes the fundamental conceptual and theoretical understanding, debates, and discussions underpinning flood disaster preparedness regarding household livelihoods. More than fifty conceptual and theoretical academic literature and book chapters from authentic sources are reviewed to develop the paper. Key debates on flood disaster preparedness and its relation to livelihood are focused on power dynamics, memory, interdisciplinary collaboration, and multidimensional perspectives are key areas highlighted in the previous study. Several theories on disaster management, such as the Pressure and Release (PAR) Model, Access Model, Community-Based Disaster Risk Management (CBDRM) Approach, Resilience Theory, Social Capital, Participation Theory, and World-System Perspectives are beneficial to global communities to enrich knowledge in flood disaster management. The paper also investigates the implication of flood myths across cultures, which serve as narratives incorporating religious symbolism and explaining catastrophic floods. Furthermore, the study found that the unequal distribution of resources leads to varying levels of vulnerability. Structural and non-structural mitigation, climate change and uncertainty, community participation and equity, cultural beliefs, personal experiences, social networks, and technological advancement are also the key debates and discussions associated with flood disaster preparedness.

Similarly, this study found key research gaps in the concept and theories. These gaps are methodological, addressing new hazards, shifting societal norms, technological advancements, globalization, urbanization, migration, intersectional dimensions of gender, socio-economic status, cross-cultural and cross-contextual beliefs and practices, and structural constraints. Finally, this paper contributes to the body of knowledge on flood disaster preparedness and livelihood change in sociology by providing a comprehensive overview of the topic.

Keywords: Flood disaster, Vulnerability, Preparedness, Livelihood, Resilience

Introduction

Globally, flooding is a primary cause of losses and a higher number of destructive occurrences compared to other types of disasters. Data shows that one-third of all losses arising from natural forces can be attributed to floods. In recent decades, flood damage has been remarkably severe, and both the frequency and intensity of floods are on the rise (Wolfgang Kron, 2015) ^[55]. No inhabited region on Earth is protected from flooding. However, the range of vulnerability to flood hazards is notably extensive, even broader than for most other hazards. The flood hazard comprises two aspects. One: The intensification of flood events and their causes, and Two: The increasing exposure to areas prone to hazards. The first one is linked to the heightened likelihood of flood events, while the second one is associated with greater exposure to areas vulnerable to hazards (Smith 1996). Plentiful rainfall leads to severe floods that result in the loss of homes, crops, stores, livestock, and even lives.

An analysis of global loss events from 1900 to 2004 reveals distinct upswings in economic losses, with Asia facing the highest economic and other losses. It consistently claims over 20,000 lives annually and negatively affects approximately 75 million people worldwide (A. Oliver-Smith, 2003) ^[6]. In 2022, the Emergency Event Database EM-DAT documented 387 worldwide natural hazards and disasters, causing 30,704 deaths and affecting 185 million individuals (United Nations Office for Disaster Risk Reduction, 2023). In recent years, as climate change increases weather patterns and intensifies the frequency and severity of floods, understanding the connection between flood disaster preparedness and changes in livelihoods has grown more critical than ever. Floods disrupt not just communities and infrastructure but also have far-reaching consequences for household livelihoods, affecting economic activities, social cohesion, and overall well-being.

The term "livelihood" refers to the means and actions that individuals or households adopt to secure necessities, uphold well-being, and earn a living. It encompasses all the resources, abilities, and engagements that people employ to sustain themselves and their families. The notion of livelihood extends beyond simple income generation; it encompasses the societal, cultural, and environmental aspects of how people live their lives and earn for their daily consumption. Sustainable livelihoods endeavor to ensure that individuals and communities have access to resources, predictions, and skills that empower them to flourish and tolerate shocks and uncertainties. Environmental factors like climate, soil, seed and tool availability, and landscape create opportunities for various livelihood activities while also imposing limitations on some.

The interconnection between flood disaster preparedness and household livelihood is complex and closely intertwined. Flood disaster preparedness significantly affects household livelihood by safeguarding physical assets, diversifying income sources, issuing early warnings, ensuring access to financial services, building capacity, enhancing water management, fostering community support, and strengthening psychological well-being. By integrating disaster preparedness into livelihood strategies, households can be better prepared to mitigate flood events and sustain economic stability, and overall quality of life.

This paper examines the conceptual and theoretical evidence from existing literature concerning flood disaster preparedness and its complex relationship with changes in livelihoods. It underscores the need to integrate these two key factors that shape community capacity to adapt their livelihoods in response to flood hazards. It also examines how conceptual and theoretical frameworks contribute to improved flood management and the enhancement of adaptive capacities, what are the key debates and discussions on the theme, and what are the existing gaps in the studies. Furthermore, it adds to the expanding body of knowledge in disaster risk reduction and livelihood resilience.

Objective

The primary objective of this paper is to investigate the existing conceptual and theoretical foundations of studies focusing on both flood disaster preparedness and livelihoods. By conducting a thorough critical analysis of conceptual and theoretical literature, it aims to shed light on significant discussions and identify areas where the literature lacks comprehensive coverage. The specific objectives of this

paper are:

- Explore the relevant conceptual and theoretical frameworks that relate to flood disasters and their intersections with household livelihoods.
- Analyze the main debate, discussion, and advancements in research concerning flood disaster preparedness.
- Identify the gaps in previous research efforts addressing this subject matter.

Methodology

Fundamentally, this paper adopts a secondary and descriptive-explanatory approach. The development of the paper follows a logical and rigorous methodology through a systematic review process. A careful selection process identified over seventy relevant conceptual and theoretical academic sources, drawing from diverse fields and well-established platforms such as online journals, university libraries, archives, Google Scholar, and JSTOR. The literature is accurately categorized based on its significance, value, and practicality. The reading list is narrowed down to fifty relevant conceptual and theoretical articles centered on the paper's subject. This process concludes in an annotated bibliography that concisely captures and summarizes the authors' key arguments relating to concepts and theories. The authors' insights are consistent and based on empirical evidence, highlighting the ongoing debates and discussions. Simultaneously, a matrix is developed to systematically categorize and summarize both the similar and dissimilar viewpoints among authors. Subsequently, a comprehensive synthesis of the literature joins the research findings into a coherent narrative. This synthesis involves the analysis of evidence, entailing the identification of shared themes, recurring patterns, noticeable gaps, and emerging trends within the literature. The data is precisely organized to separate vital concepts, themes, interrelationships, and areas of gaps, which in turn forms the basis for drawing informed conclusions.

In parallel, a rigorous process of sifting through the assembled articles is conducted, methodically checking each title and abstract to eliminate duplicates or articles that are contrary to the research. Furthermore, to facilitate systematic content analysis and the potential development of an ontological framework in the future, a review table is strategically designed. The table serves as a tool for extracting and documenting key information from each article, including five primary categories: publication details, research context, methodological framework, results and conclusions, and relevance.

Conceptual underpinning in flood disaster preparedness

Flood disasters have emerged as one of the most pressing challenges facing societies worldwide, with their devastating impacts on human lives, infrastructure, and economy. The frequency and intensity of floods have increased in recent decades due to various factors, including climate change, urbanization, and environmental degradation (Madan & Routray, 2015) ^[35]. The consequences of these floods extend beyond immediate damages; often leading to significant disruptions in the livelihoods of affected communities. Flood disaster preparedness is the proactive and strategic approach to reduce the adverse effects of floods on lives, properties, and livelihoods. It involves a range of measures and actions aimed at enhancing a community's capacity to anticipate, cope with, and recover from flood disasters. However, flood

disaster preparedness is not a one-size-fits-all approach; it must be tailored to specific contexts aligning with the particular challenges faced by each community.

The conceptual framework of flood disaster preparedness includes a comprehensive understanding of the various components that contribute to an effective disaster management strategy. It involves the identification of flood-prone areas, assessing vulnerabilities, understanding community dynamics, and developing early warning systems (Diez-Herrero & Garrote, 2020) ^[21]. In addition, it involves the establishment of robust infrastructures and the formulation of evacuation plans to ensure the safety of people during flood events.

The sociology of flood disaster preparedness and livelihood change explores the social dimensions of how individuals, communities, and societies cope with and adapt to floods. This field of study recognizes that floods are not just natural disasters, but also social phenomena shaped by human actions and social structures (Albrecht, 2017) ^[3]. The sociology of flood preparedness examines how socioeconomic factors, such as poverty, inequality, and social marginalization influence people's vulnerability to floods. Certain groups, such as the poor, elderly, and marginalized communities, are often more vulnerable due to limited resources, inadequate infrastructure, and social exclusion. Sociologists analyze how individuals and communities perceive and interpret flood risks. Factors such as cultural beliefs, personal experiences, and social networks shape people's understanding of floods and their preparedness efforts and interactions between different stakeholders and power dynamics within the institutions. The field also explores how information about flood risks is communicated and how it influences individual decision-making processes related to preparedness and response.

The effect of a flood depends on how humans interact with and reside in the affected areas. Human activities such as urbanization, deforestation, or poor land management practices can intensify the impact of floods (Madan & Routray, 2015) ^[35]. The social dynamics of power, inequality, and vulnerability play a significant role in determining who withstands the worst of flood impacts and how communities respond and recover. The ability of communities to adapt and recover from these impacts is influenced by social factors such as social capital, community networks, access to support systems, and the availability of resources for rebuilding and resilience-building measures (Aldrich & Meyer, 2015) ^[4]. By considering these social dimensions, floods can be understood as more than just natural events. They are complex phenomena that involve the interactions between the natural environment, human activities, social dynamics, and the subsequent impacts on communities.

Flood disasters have occurred throughout history and have had a significant impact on human settlements and the environment and it can be traced back to ancient civilizations. Many ancient civilizations, such as the Egyptians, Mesopotamians, and the Indus Valley civilization, developed advanced irrigation systems to manage water resources and control floods (Kim, 2023) ^[29]. Kim highlighted that these civilizations built levees, canals, and reservoirs to divert floodwaters and store water for irrigation during dry seasons. Floods were often seen as both a blessing and a curse. While they brought fertile soil for agriculture, they also caused widespread destruction. During the Middle Ages, cities in Europe began constructing flood defenses, including

embankments, dikes, and floodgates (Bender, 2012). Venice, Italy, developed an extensive system of canals, floodgates (such as the famous MOSE project), and raised walkways (called "fondamenta") to mitigate the impact of floods in the city (Mel et al., 2020). In the 19th and 20th centuries, urbanization and industrialization led to increasing flood vulnerability due to factors such as inadequate drainage systems and encroachment on floodplains. Major flood disasters occurred, such as the Great Mississippi Flood of 1927 in the United States and the North Sea Flood of 1953 in Europe, which resulted in significant loss of life and property (Gerritsen, 2005; Randolph, 2018) ^[26]. These disasters stimulated the development of early warning systems, flood mitigation infrastructure, and improved floodplain management. In the modern era, flood disaster management has evolved significantly, focusing on a comprehensive and integrated approach. Advanced technologies and data collection systems are used to monitor rainfall, river levels, and weather patterns to forecast floods accurately. Early warning systems help alert communities in advance, allowing for evacuation and preparation measures to be implemented (Essamuah-Quansah, 2010) ^[25]. Governments and local authorities regulate land use in flood-prone areas, restricting or prohibiting certain types of development. Floodplain zoning and mapping are employed to identify high-risk areas and guide development away from vulnerable zones. Sustainable land management practices, such as preserving wetlands and natural buffers, are encouraged to reduce flood risk. Structural measures such as levees, flood walls, dams, and reservoirs help regulate water flow, divert floodwaters, and provide temporary storage to mitigate the impact of flooding. Similarly, non-structural measures, risk communication, emergency response plans, climate change adaptation, and nature-based solutions are the approaches that focus on reducing vulnerability and increasing resilience at the individual, household, and societal levels. Flood disaster management in the modern era emphasizes a proactive and multi-dimensional approach, combining forecasting, infrastructure development, land-use planning, community engagement, and climate change adaptation (Lilai et al., 2016) ^[34].

Conceptualizing the types of flooding the author (Augustine & Akinyemi, 2015) reveals that flooding can occur in various forms, depending on the cause and the characteristics of the affected area. Riverine flooding, flash flooding, coastal flooding, urban flooding, pluvial flooding, and catastrophic flooding are the major forms of flooding. Riverine flooding occurs due to heavy rainfall, snowmelt, or a combination of both, causing an excess of water that the river channel cannot contain. Flash flooding occurs rapidly and with little warning, typically within a few hours or even minutes after heavy rainfall. It commonly happens in urban areas with poor drainage systems, or regions prone to intense thunderstorms. Coastal flooding, also known as tidal flooding or storm surge, occurs along coastlines or low-lying areas adjacent to oceans, seas, or large lakes. It is often caused by tropical storms, hurricanes, or tsunamis, which generate powerful winds and push large volumes of water inland. Urban flooding happens in densely populated areas, primarily due to inadequate drainage systems and impervious surfaces that prevent water absorption into the ground. Heavy rainfall overwhelms the drainage capacity, leading to water accumulation on streets, basements, and low-lying areas of cities. Pluvial flooding occurs when intense rainfall exceeds the capacity of the local

drainage system, resulting in surface water accumulation. It typically affects urban or suburban areas with poor drainage infrastructure, inadequate stormwater management, or rapid urbanization. Similarly, catastrophic flooding refers to exceptionally severe and widespread flooding events that cause extensive damage and loss of life. These events are often associated with intense and prolonged rainfall, the failure of major dams or levees, or the convergence of multiple flood sources. The characteristics and impacts of flooding can vary depending on the geography, climate, and infrastructure of the affected area.

The studies by Ogie, Adam, and Perez (2020)^[37], and Hegger et al. (2016)^[28] collectively highlight that effective flood risk management requires an integrated approach that combines structural methods like sea walls and drains with non-structural measures such as early warning systems and community-based adaptation. The conventional reliance on structural strategies alone is insufficient to mitigate intensifying flood risks from climate change and urbanization (Ogie et al., 2020; Hegger et al., 2016)^[28, 37]. By accepting a diversified framework that includes ecological and social elements like wetland restoration and community engagement, flood resilience can be significantly enhanced. Social networks play a critical role in disaster management, helping to identify key actors and their relationships. It requires an understanding of how networks change in a disaster situation, and how to promote positive changes that allow the networks to function during a disaster. Social network analysis is used to build community resilience by identifying social resources and gaps, enhancing communication and coordination among actors, and facilitating information sharing and decision-making (Applications of Social Network Analysis for Building Community Disaster Resilience, 2009). Interdisciplinary collaboration and standardized methods for data collection and analysis to advance the use of social network analysis in disaster management plays a significant role. Crevello (2021)^[19] sees the importance of preserving and revitalizing rural communities as a way of promoting resilience in the face of economic, environmental, and social challenges. Rural communities have unique individualities that make them vulnerable to these challenges, such as limited access to resources and services, aging populations, and a lack of economic diversity (Crevello, 2021)^[19]. Crevello proposes a holistic approach to preserving historic buildings and cultural landscapes, supporting the promotion of local agriculture and small businesses, and capitalizing on sustainable infrastructure and technology.

This paragraph investigates various research frameworks and perspectives aimed at improving community flood preparedness and response. It begins by introducing Dufty's (2021) research framework, which consists of three vital components: understanding the community's social and cultural context, identifying barriers and enablers to flood preparedness, and implementing effective interventions. Trust in authorities and access to information emerge as significant social and cultural factors that influence the design of interventions for enhancing flood preparedness and response. The paragraph then shifts to the insights provided by Rufat et al. (2015)^[41], who argue that social vulnerability to floods is complicated and dynamic, influenced by diverse factors like socioeconomic status, gender, age, race, ethnicity, and cultural beliefs. The importance of considering both physical and social dimensions, as well as context-

specific approaches, is highlighted. Staube-Delgado & Kruke (2018)^[47] present preparedness as a dynamic, context-specific process involving risk anticipation, capability development, resource management, and resilience building. This dynamic approach to preparedness includes various attributes that contribute to its effectiveness. Christopher et al. (2001)^[18] contribute to the discussion by suggesting a shift in perceiving risk as a dynamic and socially constructed concept, rather than a static and objective one. This reframing allows for a better understanding of risk within the evolving disaster context. Lastly, the paragraph touches upon the collaborative nature of risk management, involving stakeholders such as local communities, government agencies, and non-governmental organizations. The selection of perspectives presented emphasizes the multifaceted nature of flood preparedness and response.

A systems thinking approach in flood disaster preparedness refers to a holistic and comprehensive way of understanding, analyzing, and addressing the complexities and interdependencies within a flood-prone area's social, environmental, and infrastructural systems. Instead of viewing the components of flood management in isolation, it seeks to understand how these components interact and influence each other, both directly and indirectly. This approach recognizes that a flood event is not just the result of a single cause but arises from a combination of various interconnected factors. Dzulkarnain, Suryani, and Aprillya (2019)^[22] identified two main problems: illustrating the risk and mitigation of flood-threatened agriculture production and establishing the relationship between the factors and the behavioral pattern. A systems thinking approach can address these problems by identifying the key components of the flood system and analyzing their causal relationships and feedback loops (Dzulkarnain et al., 2019)^[22].

Kousky (2010) investigated that individual perceptions of flood risk are influenced by experiencing extreme flooding events and lead to increased protective behaviors, such as purchasing flood insurance. However, personal experience may not always accurately reflect the risks faced by individuals. In summary, flood disaster preparedness involves comprehending flooding diversity, interplay of factors, and integrated approaches. It requires acknowledging social aspects, promoting community resilience, and accepting dynamic perspectives.

The theoretical foundation for flood disaster preparedness

Theoretical perspectives provide the intellectual foundation for understanding the complexities of flood disaster preparedness. It helps to investigate a deeper understanding of the underlying causes that influence disaster preparedness and livelihood change. From the very beginning, authors have developed and tested several theories on flood disaster preparedness. Blaikie and Brookfield (1994) have approached a Pressure and Release (PAR) model in the study of vulnerability. The basic idea of the PAR approach is a disaster as an outcome of two opposing forces: the process generating vulnerability on one side and the hazard on the other side (Wisner et al., 2004). Root causes, dynamic pressure, and unsafe conditions together create vulnerability. The state of the unsafe condition can be traced back through dynamics like social and economic pressure to the underlying root cause. In PAR, normal pressures in global, regional, and national systems of economic, social, and political power contribute to vulnerability to disaster. This approach provides

a theoretical framework to study vulnerability and describe different root causes and pressure points of vulnerable livelihoods. It does not explain how human normal lives transfer into abnormal at the time of disaster. In addition, it does not explain about causes of differential disaster impacts within the same community or family. To fulfill these gaps in the PAR model, authors theorize the access model to determine the vulnerability as a complementary model of PAR. It provides details about what happens at the pressure level between natural events and longer-term social processes. Therefore, access to assets and resources is the major cause of unsafe livelihood conditions that must be analyzed in analysis.

The access model defines that resources are free for all, but they are controlled by a socio-political system of the society (Leach et al., 1999). The access model explains how a social system creates unsafe conditions in society with differential hazard impact. The model believes that unsafe condition is the consequence of the weak access profile of a household. In other words, this model explains how a political system allocates assets, income, and other resources among households, which determines their level of unsafe conditions (ibid). Similarly, Burton et al. (2018) ^[14] defined social vulnerability theory. It examines how social factors influence the different impacts of disasters. It recognizes that vulnerability to floods is not just determined by physical exposure but is shaped by social dynamics, power relations, and inequalities. The basic idea is that people intensify hazards through behaviors such as developing in floodplains and translating risk perception into action. The social vulnerability perspective has its roots in the domains of political economy and political ecology. Political economy researchers generally focus on how political, economic, social, historical, and institutional factors produce differential exposure and vulnerability, with particular attention paid to cross-scalar interactions. Political ecologists extend the analysis by examining how these structural determinants generate, intensify, and reduce environmental hazards. From both perspectives, disasters result from failures of political and economic systems, producing inequality, marginality, and differential constraints on individual action (Burton et al., 2018) ^[14].

Referencing Durkheim's division of labor concept and Mills' Social Conflict Theory (2004), Van Niekerk et al. (2017) ^[52] formulated the Community Based Disaster Risk Management (CBDRM) approach. This approach entails active community involvement in recognizing, evaluating, and planning for hazards and vulnerabilities. CBDRM, characterized by its inclusive and participatory nature, focuses on addressing the drivers of disaster risk, reducing risks, and enhancing societal resilience. The core of CBDRM is the consistent engagement of vulnerable communities in decision-making for disaster risk reduction, acknowledging the importance of local and indigenous knowledge alongside scientific expertise. This approach emphasizes that context-specific solutions contribute to sustainable community development through grassroots efforts. The CBDRM process encompasses seven stages: community selection, establishing rapport and understanding, participatory disaster risk assessment, community-oriented risk management planning, capacity building, community-driven implementation, and ongoing monitoring and evaluation (Van Niekerk et al., 2017) ^[52]. CBDRM not only enhances understanding of disaster risk dynamics but also facilitates

the resolution of complex challenges and the promotion of societal resilience.

Resilience theory is most popular in disaster management. The theory explores the capacity of individuals, communities, and systems to effectively handle, adjust to, and bounce back from disruptive events such as floods. According to Carlson et al. (2012) ^[16], resilience is defined as the capability of entities, assets, organizations, communities, and regions to foresee, withstand, absorb, respond to, adapt to, and recover from disturbances. Actions related to anticipating, withstanding, and absorbing are taken before an unfavorable event occurs, while responses, adaptations, and recoveries take place afterward (Carlson et al., 2012) ^[16]. The authors highlight three main aspects of resilience: the systems-based approach to evaluating resilience, an enhanced framework for evaluating and assessing resilience at the level of facilities, and a model for appraising resilience at the community and regional scales. Analyzing the resilience of an organization or system involves considering three key elements: robustness, resourcefulness, and swift recovery. Likewise, the resilience of communities and regions is shaped by the resilience of various subsystems, which can include but are not limited to, the economy, civil society, crucial infrastructure, supply chains, and governance.

Wenger (2017) ^[53] investigates the incorporation of resilience concepts into strategies and activities targeted at disaster management. Despite its widespread use in policy discussions, the term 'resilience' remains unclear in meaning and can pose implementation challenges. While 'resilience' has gained popularity in policy discourse, its precise definition remains intangible, and its practical application can prove problematic. Wenger employs the comparison of two metaphors, 'The Oak and the Reed,' to describe distinct approaches to resilience within disaster management. The 'oak' symbolizes stability and resistance to change, whereas the 'reed' embodies adaptability and flexibility. Effective disaster management policies should encompass both of these metaphors, striking a harmonious equilibrium between stability and adaptability. Flood myths are narratives present in diverse cultures and religious traditions globally, recounting catastrophic flood events that devastate the world and often lead to the downfall of civilizations. These myths frequently involve a deity or supernatural entity as the cause of the flood or as the one who alerts and rescues a chosen few individuals or animals. According to Author and Frazer (1916) ^[10], these flood myths have likely been influenced by actual historical floods, which significantly affected the development of early civilizations. The authors suggest that floods were frequently interpreted as acts of divine revenge or justice, leading to the infusion of religious symbolism into flood narratives. These myths played a substantial role in shaping religious and cultural identities, offering societies a means to comprehend natural disasters and assert their beliefs and principles (Author & Frazer, 1916) ^[10].

Similarly, the urban resilience theory is a framework aimed at comprehending how cities can adequately prepare for, respond to, recover from, and adapt to various shocks and stresses, including natural disasters, economic downturns, social tensions, and environmental challenges. Liao (2012b) ^[33] presents a theoretical framework for urban resilience in the context of floods, offering a foundation for alternative planning practices. Urban resilience to floods can be achieved through three pivotal dimensions: adaptive capacity, absorptive capacity, and restorative capacity (Liao, 2012) ^[33].

Adaptive capacity refers to the capability of individuals, communities, organizations, or systems to effectively adapt, learn, and respond to changes, or disruptions in their environment. This capacity empowers entities to navigate uncertainties and shocks while sustaining functionality and potentially enhancing their overall state. Absorptive capacity relates to an entity's ability to acquire, assimilate, and employ new knowledge, information, or technologies to enhance its performance, capabilities, and effectiveness. This concept is frequently discussed in innovation management, organizational learning, and technology adoption contexts. Lastly, restorative capacity refers to an entity's capacity to recover and restore its functions, systems, and well-being after experiencing a disruption, stress, or shock. This notion is particularly relevant to disaster management, ecological resilience, and the recovery of social systems.

From a civic perspective, social capital refers to the contribution of social connections and networks to the functionality of a community or society as a whole. Häuberer (2011a) ^[27], in discussing the civic viewpoint on social capital, emphasizes the significance of civic involvement and participation in nurturing social capital and enhancing the well-being of communities. Häuberer explains Robert Putnam's interpretation of social capital, encompassing its diverse manifestations such as bonding, bridging, and linking, along with the advantages they offer to both individuals and communities. The decline in social capital is attributed to factors such as the rise of television, urbanization, and the societal shift towards greater individualism (Häuberer, 2011) ^[27]. Kreps (1984) ^[32] conducted a study in which he explored how disasters can disturb and reshape social structures and interactions. He discussed how disasters challenge established norms and traditions that govern everyday life, potentially resulting in shifts in power dynamics, social roles, and relationships between individuals and institutions. Kreps also emphasizes the importance of comprehending how the social context influences responses to disasters, and conversely, how disaster situations can impact the social environment. To gain a deeper understanding of the complex dynamics of disasters and their effects on social systems, an interdisciplinary approach is advocated, involving insights from fields such as psychology, economics, and engineering (Kreps, 1984) ^[32]. Social capital and participation theories are intertwined concepts that explain how individuals interact within social networks to achieve shared objectives. Social capital encompasses resources like information, trust, and social norms that individuals access through their social connections. Participation theory, conversely, focuses on how individuals engage with their communities and societies to influence decision-making processes (Social-Capital-and-Participation-Theories, 2004). Social capital plays a role in fostering democratic participation, economic progress, and social unity.

Spiekermann, K. et al. (2015) ^[46] introduce the Disaster-Knowledge Matrix framework, designed to reevaluate the knowledge challenges confronted in disaster risk reduction. The conventional approach to disaster risk reduction has been overly possessed with technical solutions while neglecting the social and cultural aspects of disasters. The disaster knowledge matrix offers a fresh outlook by underscoring the significance of local knowledge and social networks in strengthening disaster resilience. The framework is organized into four dimensions: knowledge content, knowledge

sources, knowledge application, and knowledge actors (Spiekermann et al., 2015) ^[46]. Ashley et al. (1999) and Tauzer et al. (2017) discuss a vulnerability research framework. They argue that the effective development of early warning systems for floods necessitates a vulnerability research framework that considers hazard exposure, vulnerability, and community capacity. The framework involves five stages: identifying hazard exposure, vulnerability, capacity, potential early warning indicators, and designing the early warning system.

Debates and discussion

The discourse on flood disaster preparedness has evolved. Throughout history, various stakeholders, including institutions, academia, researchers, and development agencies, have actively contributed to this discourse, resulting in a wealth of academic literature. Debate and discussion evolved that early civilizations settled near rivers and trusted structural measures like dikes and levees to control water levels and prevent floods. In medieval Europe, the focus shifted to managing water for agriculture, leading to canal and drainage systems (Al-Ansari et al., 2020) ^[2]. Later periods, particularly the 18th to 19th centuries marked by industrialization, urbanization, and population growth, heightened flood vulnerability in cities. This stimulated a shift from solely structural solutions to a combination of structural and non-structural approaches (Sayers & Asian Development Bank., 2013a) ^[43]. This transition led to discussions about land use planning, zoning, and disaster response. In the 20th century, a deeper understanding of meteorological, hydrological, and societal factors influencing floods emerged (Arnbjerg-Nielsen et al., 2014) ^[8]. This prompted comprehensive floodplain management strategies, such as the US National Flood Insurance Program of 1968, aiming to provide insurance and effective floodplain management. The late 20th and 21st centuries brought increased awareness of climate change's impact on floods, demanding reevaluations of flood management. This led to sustainable practices like ecosystem-based approaches and adaptive management. The evolution of flood preparedness studies expanded from traditional to modern perspectives, considering socio-economic and political factors. In the modern era, the discourse on flood disaster management shifted from structural interventions to holistic, community-centered methods (Osti, 2017) ^[38]. The evolution of flood management discourses showcases the progression from simple engineering interventions to multidimensional strategies that consider environmental, social, and economic factors. It reflects the evolving relationship between humans and water, and the ongoing journey to strike a balance between connecting water resources and managing the risks associated with floods. The key debates and discussion areas on the topic are highlighted as follows:

▪ Structural vs. Non-Structural Measures on Flood Disaster Preparedness

The discourse concerning the dichotomy between structural and non-structural measures in flood disaster preparedness gained substantial prominence during the latter half of the 20th century. As societies became increasingly conscious of the limitations essential in exclusive reliance upon structural interventions, scholars and experts advocated for a paradigm shift towards a more holistic approach that encompasses non-structural measures, including practical land use planning,

robust early warning systems, and active community engagement. This transition was drawn to attention by the establishment of the International Strategy for Disaster Reduction in the 1990s, a pivotal milestone that underscored the imperative for comprehensive risk mitigation strategies transcending the conventional domain of engineering-centric methodologies. In the 1980s the United Nations put forward the concept of sustainable development (UN, 1987) and supported some national governments in moving away from flood management solutions based solely on structural approaches, towards providing a mix of nonstructural and structural responses (Sayers & Asian Development Bank., 2013b) ^[44]. The ongoing debate regarding the effectiveness of conventional structural measures, such as the construction of dams and levees, in comparison to the effectiveness of non-structural interventions like roll-out land-use planning and early warning systems, remains at the crux of contemporary discussions.

The synthesis of both modalities emerges as a prevailing perspective, advocating for the incorporation of structural and non-structural strategies to realize a truly comprehensive framework for flood risk reduction. Central to this argument is the profound dilemma of determining whether structural engineering solutions, encompassing elements like dams, levees, and floodwalls, or non-structural measures characterized by thoughtful planning, well-crafted policies, early warning systems, and community engagement, have greater effectiveness about flood risk management. Researchers involved in this discourse are tasked with a careful exploration of the merits and demerits inherent to each approach, reinforced by considerations spanning cost-effectiveness, enduring sustainability, environmental consequences, and the adaptability to accommodate uncertainties inclusive of shifting climatic patterns. The ongoing dialogue and debate concerning the dichotomy between structural and non-structural measures in flood management have shown an evolutionary route, reflecting evolving perspectives, technological advancements, and an enriched comprehension of the complicated dynamics integral to flooding phenomena.

▪ **Climate Change and Uncertainty**

The phenomenon of climate change has emerged as a subject of profound academic discourse, stimulating extensive debates. The rising unpredictability of weather patterns, attributed to climate change, introduces a layer of complexity to flood management. These discussions turn on the imperative to not only existing strategies to accommodate shifting conditions but also to engender adaptable frameworks capable of navigating an uncertain array of future scenarios. A fundamental aspect of flood disaster preparedness discourse breaks upon an understanding of the consequences of climate change on flood dynamics, a domain that holds paramount significance (Klijn et al., 2015) ^[30]. The core debate in this context refers to the transformative effects of climate change on the frequency and intensity of flood occurrences, thereby potentially rendering traditional flood management approaches inadequate. Central to this discourse is the pressing necessity for adaptive strategies encompassing flexible infrastructure, anticipatory land use planning adjusted to evolving conditions, and policy formulations geared towards fostering resilience within the situation of uncertainty. A salient argument within this discourse pertains to the extent to which observed climate change can be

attributed to anthropogenic activities, particularly the emission of greenhouse gases such as carbon dioxide (Adedeji et al., 2014) ^[1]. While a consensus prevails among a majority of scientists regarding human activities constituting the principal catalyst for recent global warming, debates continue concerning the role of distinctive variability in shaping climatic trends.

The foundation of climate models, essential for forecasting future climatic scenarios based on diverse emission trajectories, is surrounded by an ongoing discourse encompassing their accuracy, reliability, and the associated uncertainties inherent in their projections. Analogously, debates encompass the reasonable consequences of climate change across multifarious sectors, ecosystems, and geographical locales (Adedeji et al., 2014) ^[1].

The Inter-governmental Panel on Climate Change (IPCC), commencing in 1988, initiated issuing assessment reports underscoring the nexus between climate change and extreme weather occurrences, floods included. The Fourth Assessment Report of IPCC (2007) highlighted the imperative of embedding climate change considerations within the framework of strategies for disaster risk mitigation. In the contemporary setting, the effects of climate change on flood occurrences have arisen as a central theme of debate and research within the realm of flood management. The paradigm has shifted towards an emphasis on revising existing strategies to accommodate evolving climatic patterns and to integrate uncertainty into flood risk assessments. As climate change continues to constitute an intractable global challenge, dialogues concerning its impact on flooding and the essential strategies to navigate these risks are dignified to continue as focal points within the sphere of flood management.

▪ **Community participation and Equity (Community at the center)**

The role of communities in flood preparedness and management is a significant point of discussion. This includes debates on how to engage and empower local communities in decision-making processes, as well as ensuring that vulnerable and marginalized populations are not disproportionately affected by flood events (The Associated Programme on Flood Management (APFM) Is a Joint Initiative of the World Meteorological Organization (WMO) and the Global Water Partnership (GWP). Integrated Flood Management Tools Series No.4 Version 2.0, 2023). The debate addressed questions about the equitable distribution of resources, access to information, and the incorporation of indigenous knowledge and local perspectives in flood management strategies. The formal debate and discussion on community involvement and equity in flood disaster management emerged gradually over time as societies recognized the importance of engaging local communities and addressing social disparities in disaster preparedness and response. In the late 1980s, a shift in disaster management paradigms from a top-down, technocratic approach to a more inclusive and community-centered approach. During this time, disaster researchers and practitioners started recognizing that communities own valuable local knowledge and resources that can contribute to effective disaster preparedness and response (Ehlert, 2007) ^[23]. From the 1990s, a growing emphasis on participatory approaches in disaster management. Initiatives like the Hyogo Framework for Action (HFA) and the Yokohama Strategy advocated for

involving local communities in disaster risk reduction efforts. These efforts flagged the way for discussions on community involvement and equity in various aspects of disaster management, including floods.

The Sendai Framework for Disaster Risk Reduction (2015-2030) acknowledged the critical role of local communities and the importance of addressing social vulnerabilities. The concept of community-based disaster risk reduction gained prominence, highlighting the need for inclusive decision-making processes and recognizing the specific needs of disadvantaged and marginalized groups. In recent years, discussions have further evolved to emphasize not only the involvement of communities but also the importance of addressing equity and social justice (Rasul et al., 2010). The disproportionate impacts of disasters on marginalized populations and the recognition of historical injustices have led to calls for more equitable distribution of resources, decision-making power, and disaster response efforts.

▪ **Technological advancements in flood disaster management**

The discourse on technological progress in flood management has evolved through the gradual development and integration of innovative technologies. The mid-20th century marked a pivotal period, introducing radar and meteorological modeling to flood prediction and early warning systems. Meteorological agencies and real-time data availability enhanced flood forecasting capabilities. Concurrently, Geographic Information Systems (GIS) emerged for spatial data organization in flood management. The 1990s saw remote sensing and satellite imagery for flood monitoring and assessment, enhancing data capture. The 21st century brought swift technological advances, especially in communication. The internet and mobile tech-enabled early warning systems, bolstering disaster readiness. Contemporary debates emphasize incorporating advanced modeling, big data analytics, and artificial intelligence (AI) into flood management (Chatterjee et al., 2022) ^[17]. These enable precise predictions, real-time monitoring, and improved decision-making. The discourse highlights optimizing flood management through technology.

Debates within this discourse focus on several key areas like remote sensing's accuracy, data integration, ethical concerns, and so on. Social media and crowdsourcing's real-time sharing raise questions about their reliability and verification. Conversations also revolve around empowering local communities through technology for flood preparedness and response. The role of technology in community-driven early warning systems and resilience-building is examined. Digital communication's effectiveness in conveying flood risks, tailored to diverse audiences, is deliberated.

Technology's data collection raises concerns about privacy, security, and misuse. Balancing technological benefits with ethics leads to ongoing discussions. Recognizing that technology availability doesn't guarantee effective use, the discussion focuses on building technical capacity in governmental agencies, local entities, and communities for proficient technology utilization in flood management.

Livelihood and Flood Disaster

The notion of livelihoods has gained widespread recognition as a valuable tool for realizing the factors that impact individuals' lives and well-being, particularly among the economically disadvantaged in developing nations (Carney,

1998; Davies, 1996). A livelihood encompasses the capacities, resources, and activities necessary for sustaining a means of subsistence. A flood disaster does not merely affect local livelihoods within its locality but also extends its consequences to surrounding areas. Due to the economic losses experienced during a disaster, residents might find themselves with reduced funds to allocate towards non-essential consumer items (Wisner & Nivaran, 2004).

A livelihood is believed sustainable when it can sustain and recover from stresses and shocks, while simultaneously preserving or enhancing assets in both the present and future, without reducing the natural resource foundation (Chambers and Conway, 1992). Following Bebbington (1999) ^[12], the analysis of rural livelihoods necessitates an understanding of five categories of capital assets: human, physical, social, natural, and financial (Bebbington, 1999) ^[12]. Human capital stands for the education, skills, and health of individuals, enabling them to carry out their livelihood strategies. Physical capital encompasses privately or publicly owned assets that support household livelihoods. Social capital relates to networks and affiliations that individuals engage with to follow livelihood goals, such as social networks or safety nets. Financial capital includes savings and credit, vital for recovery during times of disaster, as these resources are essential for restoring their livelihood systems. Similarly, natural capital signifies the natural resources utilized by local communities for their livelihoods, encompassing forests, land, water, air, and more. The extent of reliance on primary natural capital varies among households; for instance, households reliant on agriculture place greater dependence on natural capital than households relying on remittances do.

Sanderson (2000a) ^[42] conducted research that demonstrates a strong correlation between urban poverty and vulnerability to disasters. The involvement of local communities in the formulation and execution of disaster mitigation policies, along with efforts to enhance the livelihoods of urban populations, can enhance city resilience and minimize the impact of disasters. An inclusive approach to disaster mitigation, encompassing social and economic considerations, is emphasized, along with the necessity to address the foundational social and economic elements contributing to disaster vulnerability (Sanderson, 2000) ^[42]. In instances of flood disasters, communities often undergo changes in their livelihoods, which might encompass alterations in occupations, migrations, or the adoption of alternative income sources. The livelihoods framework is a conceptual tool for understanding how individuals and households obtain their sustenance and encounter vulnerabilities. It highlights the multifaceted nature of livelihoods, spanning economic, social, human, natural, and physical assets. Within the context of floods, livelihood studies explore the impacts on income-generating activities, resource access, and opportunities. Sustainable livelihoods (SL) relate to a lifestyle that allows individuals, families, and communities to meet their basic needs and ensure the long-term well-being of natural resources and the environment. Emerging from the domain of development studies, SL integrates economic, social, and environmental factors to attain long-term prosperity and quality of life. Twigg (2001) ^[50] introduces a comprehensive framework for understanding sustainable livelihoods, encompassing five fundamental elements: assets, institutions, livelihood strategies, vulnerability, and sustainability. Enlightening robust and diversified asset bases, establishing supportive institutions,

accepting adaptable livelihood strategies, reducing vulnerability, and ensuring the continuing sustainability of livelihoods are essential approaches within SL (Twigg, 2001)^[50].

Knutsson (2023)^[31] explores the development of a knowledge integration framework within the sustainable livelihood approach, encompassing five key areas: integrating diverse applications of the approach, clarifying the purpose of knowledge integration, formulating pertinent integration theories, selecting suitable methodologies, and tailoring integration based on the nature of science and knowledge production (Knutsson, 2023)^[31]. The application of this assessment framework emphasizes the potential of human ecology to establish standards for knowledge integration, thus contributing to more holistic approaches to resolving sustainable development challenges in research, education, policy, and practice.

De Haan (2012)^[20] presents a critical evaluation of the livelihood approach within the realm of development studies. This approach seeks to understand how individuals secure their livelihoods, the methods to navigate poverty and vulnerability, and the resources they own to enhance their well-being (De Haan, 2012)^[20]. Criticisms directed at this approach underscore its neglect of power dynamics and the structural elements that shape individuals' livelihoods. Consequently, a more nuanced comprehension of the livelihood approach is imperative, one that acknowledges the complex nature of people's livelihood strategies and the constraints forced by structural factors. The document titled "Sustainable Rural Livelihoods: Practical Concepts for the 21st Century" underscores the significance of sustainable rural livelihoods. These livelihoods are defined as the capacity of rural communities to sustain their well-being in a manner that aligns with environmental sustainability, social equity, and economic viability. Elements such as natural resources, market access, infrastructure, and social and cultural aspects all impact rural livelihoods. The paper also emphasizes the need for all-encompassing and participatory approaches in development planning. Such approaches recognize the diversity of rural livelihood strategies and draw upon the local knowledge and expertise of rural inhabitants.

Research gaps

By synthesizing various conceptual and theoretical academic literature related to flood disaster preparedness and livelihood change, it was found that several issues are missing, less focused, or overlooked. These gaps present opportunities for further investigation and scholarly exploration. In the realm of research, as new tools, methodologies, or ideas emerge, research gaps that apply to these innovative concepts become apparent. The balance between quantitative and qualitative research methods when studying flood disaster preparedness and livelihood change might yield the benefits of integrating both approaches. Evolutions in the real world, such as shifts in societal norms, technological advancements, or global events, have generated new questions and gaps in the existing research. Challenges resulting from globalization, urbanization, and migration have affected individuals in ways that were either overlooked or given insufficient attention in the study. The integration of comprehensive theoretical frameworks that interconnect flood disaster preparedness and livelihood change, such as incorporating concepts from diverse disciplines like sociology, economics, psychology, and environmental studies, received inadequate focus. The

intersectional dimensions of gender, socioeconomic status, age, and other identity indications within the context of flood disasters and livelihood changes were also found less focused in the study. There is a need to identify gaps in understanding how these intersecting factors influence the vulnerabilities and adaptive capacities of individuals and communities.

A gap was found in exploring how cross-cultural and cross-contextual beliefs and practices influence flood preparedness, and how these factors present variations across different cultures and geographical contexts. Post-traumatic stress, emotional resilience, and psychological preparedness, pivotal in disaster recovery, are aspects that could significantly enrich the research but were disregarded in the study. The gaps encompass a comparative analysis of flood management strategies and approaches among different countries or regions. Similarly, a more in-depth exploration of how cultural and religious beliefs impact disaster preparedness, response, and recovery strategies could yield valuable insights into community behavior during floods, an area that lacked prominence in the study. Furthermore, the exploration of power relations and structural constraints, examining how power dynamics and socio-political factors shape vulnerability and resilience, particularly among marginalized groups, was also insufficiently addressed. Research gaps persist in understanding urban livelihood vulnerability to disasters.

Conclusions

Based on the reviews of available literatures on flood disaster and livelihood change and synthesis of arguments this paper concludes that flood disaster preparedness and livelihood change are interconnected. Addressing these challenges requires a comprehensive grasp of conceptual and theoretical foundations. Integration of knowledge from various fields and community-driven approaches can develop effective strategies for disaster resilience, sustainable livelihoods, and community empowerment against flood disasters. This multifaceted approach considers not only physical aspects but also social, cultural, economic, and environmental factors influencing vulnerability, response, and recovery. The evolving understanding of flood preparedness emphasizes a shift towards integrated solutions, involving technological advancements, ecological restoration, community engagement, risk communication, and governance reforms (Esper et al., 2009). It recognizes that floods are linked to human actions and societal structures. The sociological aspect acknowledges vulnerability disparities among social groups and the role of community networks and shared understanding in enhancing resilience. Flood preparedness is dynamic, requiring continuous adaptation. A systems thinking approach grasps interconnections within flood management and intervention effects (Rehman et al., 2019). Past experiences, education, health, culture, and social networks shape flood risk perceptions and preparedness actions. Exploring theoretical perspectives in flood preparedness provides insights into disaster management complexities. Theories and perspectives like PAR, access, social vulnerability, resilience, game theory, and CBDRM emphasize socioeconomic factors, power dynamics, and vulnerability interplay, emphasizing root causes and social systems. The exploration of livelihood vulnerability in the context of flood disaster preparedness and management underscores the complexity of human-environment interactions and the need for a multidimensional approach

(Alexandra et al., 2021).

Debates and discussions in flood management encompass structural and non-structural measures, climate-flood interplay, community roles, equity, and technology's significance. These debates reflect flood preparedness's dynamic nature, demanding adaptable strategies acknowledging interconnections among environmental, social, economic, and technological factors to mitigate impacts and safeguard vulnerable populations. Sustainable livelihoods are pivotal for reducing vulnerability, especially for marginalized groups. Individual and community vulnerability shaped by exposure, sensitivity, coping, and adaptability collectively requires consideration.

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