

AI-Enabled Applications for Disaster Management: Revisiting the Social Construction of Gender Norms in Disasters

Alfred Acanga

Amrita School for Sustainable Futures
Amrita Vishwa Vidyapeetham Kochi,
Kerala, India
am.id.r4ids23039@am.students.amrita.edu
<https://orcid.org/0000-0003-2446-0899>

Sudha Arlikatti

Amrita School for Sustainable Futures
Amrita Vishwa Vidyapeetham
Kolam, Kerala, India
sudhaarlikatti@am.amrita.edu
<https://orcid.org/0000-0002-1214-1500>

Venugopalan Murale

Amrita School of Business
Amrita Vishwa Vidyapeetham
Kochi, Kerala, India
v_murale@asb.kochi.amrita.edu
<https://orcid.org/0000-0002-3851-845X>

Abstract— Feminist scholarship links vulnerability to natural hazards becoming disasters that disproportionately affect women. Recent research regarding global Disaster Risk Reduction strategies appear to disregard social norms that promote male involvement in risky disaster-related activities, increasing disaster losses. Recent technological advances, particularly in Artificial Intelligence (AI), have garnered academic attention due to their disruptive nature. This study's transformative lens of AI examines its ability to improve women's civic engagement in Disaster Risk Management (DRM) to reduce vulnerability and change restrictive social norms that predispose men to disaster risk. This study uses mixed approaches. VOS software was used for a bibliometric analysis of 18,692 Scopus articles along with adoption of the socio-ecological model to improve a previous framework to answer two study questions. The findings reveal that bidirectional processes at micro, meso, and macro levels contribute to disaster outcomes like vulnerability, and shape disaster related activities. These dynamics limit women's civic engagement, while social norms push men to engage in risky disaster roles. The findings indicate that there is a missing direct thematic link between gender and vulnerability across the analyzed data. Despite its limits in disaster study, AI is vital for vulnerability assessment, social vulnerability analysis, GIS, and emergency management. This research highlights the influence of community gender dynamics on DRM. AI-enabled technologies, like blockchain, can potentially improve women's civic engagement and shift obstructive norms through RAN-based educational initiatives aimed at men. The study utilizes findings to propose future policy and research directions.

Keywords— Disaster loss and damage; Transformative masculinities; SDG 5; Artificial intelligence; Social media; Global south

I. INTRODUCTION

Recent scholarly on disasters has focused on damage and loss lives, property and infrastructure especially within the global south [1]. Globally, disaster damage and loss over the past fifty years have been estimated at USD 202m per day [2]. While these revelations have contributed to recent focus on Disaster Risk Reduction and preparedness strategies [3], they add little to earlier feminist scholarly contributions that linked disasters with institutional weaknesses that transformation of hazards into disasters [4]. Earlier studies have linked disaster management sites with Sexual violence and institutionalized discrimination that targets women and other socially vulnerable categories [5]. Women's low leadership engagement and societal norms negatively impact their post-disaster experiences, especially in shelters. Male engagement in risky disaster activities is influenced by social norms of

bravery and risk-taking. Asset loss-induced emasculation has been linked to compensatory actions, including male sexual violence. This paper conceptualizes gender not solely in terms of women, but as a social construct that extends beyond the binary of femininity and masculinity. Incorporating the lived experiences of all social categories impacted by disasters is essential for recognizing their agency, social learning, and creativity in the development of community resilience initiatives [6].

While the fourth industrial revolution and the socially disruptive nature of Artificial Intelligence (AI) have received a lot of scholarly, it has obscured their social transformative capacity. Akin to disasters' alteration of how communities interpret their experiences, their awareness, and their identities [7], AI has been referred to as the "future engine of social change and economic prosperity." [8] Additionally, [9] emphasizes the transformative power of AI when embedded in E-governance frameworks to enhance social inclusion and socio-economic growth. Further evidence is given by [10] whose study indicates that the integration of blockchain technology with Radio Access Networks (RAN) can improve digital access to public services like education programs in remote areas, particularly those affected by natural disasters. AI-driven digital innovations offer the potential for the swift inclusion of historically marginalized groups, such as women, in civic spaces that can help in better understanding of their specific vulnerabilities and responsive policy formulation. They possess the ability to alter norms that promote male participation in risky disaster-related activities. Better access to risk information via AI-enabled methods can assist in extending lead time to address forecast hesitancy and disaster losses [11].

Previous research has shown that women in disaster shelters face sexual violence and menstrual hygiene issues due to their limited role in disaster management and the higher male mortality associated with norm-driven risky behaviors. This article highlights how AI-enabled apps can increase female disaster management engagement and challenge masculinity stereotypes that force men into perilous disaster roles. To do so, we explore the existing literature to answer the following questions;

1. In what ways do societal norms and gender roles shape our understanding and approach to disasters?
2. What impact have recent developments in computer science applications, particularly in AI, had on disaster management?

The next sections will briefly review the literature in line with the questions above, present the methodology and results. Thereafter, we shall draw from the results and literature to suggest pathways for application of AI to deepen women's involvement and shift male attitudes regarding disaster risk reduction will be made.

II. REVIEW OF THE LITERATURE

Comparative studies on post-disaster community resilience by [12], and [13] highlight the catalytic role of social capital and governance in community recovery. However, these studies along with others within the vulnerability-based school, focus on vulnerability and ignore other aspects like agency, social learning and the gendered nature of governance frameworks particularly in the global south. Dominant social norms that undergird governance frameworks constrain the involvement of women in disaster management adversely affecting their disaster related experiences especially within disaster shelters. Consequently, some women have shunned evacuation to shelters as a coping mechanism to avoid sexual violence, inapt hygiene conditions and other discriminatory practices [5], [14]. Additionally, males' compensatory masculinity due to disaster asset losses impact their disaster response behavior, including criminality and sexual violence [7], [15].

Starting from the premise that socialization and social capital are two gendered variables that can either enable or disable disaster experiences, a study of how people form social networks by [16] found that women prefer relational embedding, which enhances bonding social capital, whereas men prefer structural embedding, which bolsters linking and bridging social capital. These findings help to explain why women are susceptible to exclusionary practices with regard to disaster financing stemming from their underrepresentation in leadership [17], and their network embedding techniques [18]. Additionally [19] contend that social norms that delineate domestic roles such as home maintenance and recovery to women encourage post disaster passivity among some males who shun uptake of alternative livelihoods in post-disaster contexts [20].

References [7] and [15] in their studies of masculinities show how social norms not only influence national disaster policy praxis but also set normative expectations of males to be resilient to disaster events. This results in an inherent inability to express their disaster-related emotional needs and discriminatory disaster response strategies that ignore male needs compounding their disaster lived experiences [20]. Similar studies link compensatory masculinity to negative mental and physical health consequences for community members hampering resilience building efforts [5], [15].

An earlier study of the Latur disaster management through a gender lens by [21] linked poverty to higher vulnerability for women exposing them to transactional sex, contractual child marriages, and coerced tubal ligation reversals for families who lost particularly male children. A literature review on the intersection of climate change and socio-economic wellbeing by [22] argues for combining participatory and gender-

inclusive poverty reduction measures with community resilience activities to improve post-disaster outcomes. In this article, we contend that similar outcomes can be attained through embedding of AI enabled technologies into Disaster Management.

Ethnography based studies of youth and adult males by [23], [24] indicate that epistemologies undergirding social norms shape people's ontological realities such as attitudes and actions they adopt. Additionally [25] contends that social constructs of masculinity and femininity serve as stable long-term frameworks that influence disaster-related behaviors and attitudes, such as risk perception, preparedness, and evacuation. A review of literature on gender issues in disasters by [26] noted that while men are more likely to report making physical improvements to strengthen their homes, women prioritized livelihood within the home. Furthermore, the study underscored the conspicuous underrepresentation of women in entities tasked with disaster emergency planning. Additionally, a study by [27] on gender perspectives in disaster response indicates that men's milling behaviour and subsequent exposure to disaster harm was influenced by their need to protect livelihood assets from community looters. These findings align with those from studies of masculinities [7], [15] that indicate that social norms condition males to persist in disaster contexts as an expression of their courage and nationalism [7], [15].

III. METHODOLOGY

This paper adapts a prior framework from the literature and employs bibliometric analysis to address the research concerns. The Scopus database was queried using the search string: *TITLE-ABS-KEY (artificial OR intelligence OR disasters OR risk OR management) AND PUBYEAR > 2015 AND PUBYEAR < 2024 AND (LIMIT-TO (SUBJAREA , "COMP") OR LIMIT-TO (SUBJAREA , "SOCI")) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (EXACTKEYWORD , "Artificial Intelligence")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (SRCTYPE , "j")) AND (LIMIT-TO (OA , "all"))* to locate publications published in English from 2016 to 2023 and restricted to the fields of computer and social sciences. Consequently, we generated 18,692 articles, which were subsequently imported into VOS Viewer version 1.6.20 to create themes and linkages. By analyzing the co-occurrence of key terms and the quantity of linkages, we evaluated the present condition of focal topics within the discourse on disasters.

IV. RESULTS

We adapt an earlier framework by [25] to address the first specific question using nesting instead of linear hierarchical flow. In so doing, we intend to highlight how bi-directional interactions between causative factors at the micro, meso and macro levels affect at-risk communities' lives.

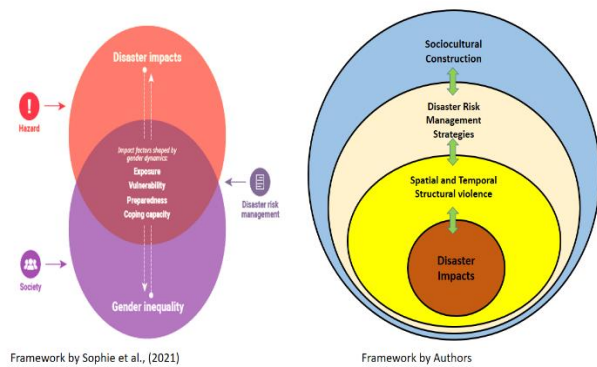


Figure 1: Situating the role of Masculinity Construction and Disaster Impact. Adapted by [25] from [28]

A. Macro level construction and disaster outcomes

Studies that adopt a decoloniality lens corroborate earlier feminist scholarship to contend that vulnerability is a social construction. Taking the case of spatial injustice in Taiwan [29] links colonial and capitalist interests that undergird contemporary development programs with the production and perpetuation of socially vulnerable categories who are disproportionately affected when natural hazards occur as limited capacity forces them to settle in areas with high disaster risk. These findings agree with those of [30] who contend that economic pursuits undergirding colonialism "restricted, appropriated, and eradicated" indigenous knowledge in the Global South. This phenomenon was later named "epistemicide" by [31].

These global macro level processes supplanted trust-based communities with trade-based ones via systemic marginalization, enslavement, and pedagogical reforms [32]. According to [33], these social reforms initially based on economic interest of colonialists, also resulted in the emergence of hierarchical masculinities or "masculine hegemonization" which associated masculinity with (1) economic provisioning or breadwinning and (2) physical protection. These new masculinity norms in the global south aligned with the standards of western masculinity characterized as "white, western middle-class" [20] and "able-bodied, heterosexual, and hyper-masculine" [15]. Ethnographical studies on native communication in Africa [34] find similar erosive outcomes of colonialism on gender identities and relations.

Reference [35] contends that epistemologies and ontologies of the global south acknowledged interdependence among individuals, the environment, and spirituality. Additionally, [36] asserts colonial intrusion, erosion and alteration of masculinity and gender relations was alien, dehumanizing, and inconsistent with communities in the global south. This dehumanization, he contends, arose from moral exclusion that transform individuals and non-human entities into lifeless beings devoid of rights contrary to in-situ beliefs.

In his work of freedom and dominion, [32] contends that super-stratification of society was entrenched by colonial pedagogical systems that systematically replaced indigenous

epistemologies and fostered moral exclusion. Therein, the upper stratum, typically male dominated, was taught to cultivate ambition, arrogance, pride, a sense of superiority, resilience, toughness, and sadism to maintain their dominance. Contrarily, the lower stratum (typically female dominated) was conditioned to exhibit adaptability, submissiveness, servility, timidity, and masochism. This was further reinforced by rational Western science that universalizes human experience.

Recent scholarship has linked western science to creation of "social hierarchies that intensify climate change" [37] and conversion of public goods such as "knowledge, caring for people, entertainment and nature" into commodities by valorizing extractive based production [38]. [39] argues that these framings influence DRM, spatial and temporal violence and overall community disaster resilience.

B. How Gender constructs shape DRM

In agreement with the preceding section, [33] contends that it is the "micro-political social" processes that produce masculine norms and profiles within societies that are "structural, personal, and inherently plural". This corresponds to findings by [40]. These norms, by providing financial rewards, social status, esteem from others, relationships, employment, and autonomy, impact masculine conduct especially DRM [41]. Consequently, [26] argues that disaster risk avoidance strategies like prevention, mitigation, and preparedness are less appealing to males due to their relative obscurity.

This is supported by studies that link DRM with two tiers: the first tier containing police, military, and firefighters, who are mostly male, and the second tier having healthcare professionals and social workers, who are mostly female [20]. According to [7] this might underscore why men are assigned tier one roles (excursions, patrols, rescues, or evacuations) associated with valor, peril, and heroism and women tier two roles that are less prominent and more subdued [42]. Consequently, though there is disconfirming evidence, studies have associated males who cannot reach tier one roles to violence [43], [44] that heightens the vulnerability of women and other vulnerable categories in disaster contexts.

Reference [45] also found that social norms that portray males as 'strong, autonomous, and resourceful' fuel their optimism bias, which predisposes them to milling behavior that increases disaster injury risk [27]

C. Current Diffusion of AI applications in DRM

Taking the co-occurrence of author keywords that occurred at least 10 times in the dataset, this subsection presents the results from the Bibliometric analysis of the current uptake of Computer Science in Disaster Management, serving as a foundation for identifying areas for its utility to this study.

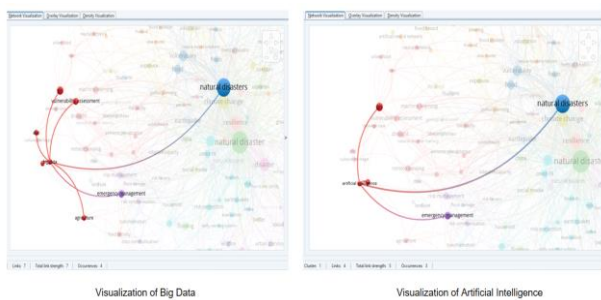


Figure 2: Co-occurrence of author keywords and linkages for AI use in recent disaster literature

According to the information illustrated in figure 2, AI appeared three times, had four connections to other themes, and a cumulative link strength of five. Conversely, big data, associated with AI, appeared 4 times, possessed 7 linkages, and exhibited a total link strength of 7. The results indicate the utility of AI and big data in vulnerability assessment, Geographic Information Systems (GIS), natural disasters, emergency management, and agriculture. These findings agree with those of [46].

Three distinct streams of conceptualization of vulnerability have emerged within the literature: vulnerability assessment, social vulnerability, and vulnerability itself. Among these, only the latter was not directly associated with AI. The vulnerability assessment has been previously mentioned. Its utility is evident in the domains of big data, information systems, decision modeling, flood management, and disaster risk reduction for natural disasters. Conversely, social vulnerability was associated with social media, specifically X (formerly Twitter), in relation to hurricanes, climate change, and natural disaster recovery.

The theme of vulnerability appeared 25 times in the dataset, with 35 connections and a total link strength of 59, underscoring its significance in contemporary disaster scholarship. Key themes in the literature linked to it include risk management, drought, floods, disaster risk management, adaptation, evacuation, social capital, and quality of life. In the context of this study, the dataset from Scopus reveals no correlation between gender and vulnerability.

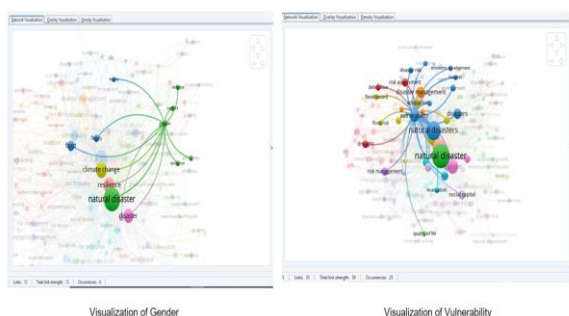


Figure 3: Linkages between gender and vulnerability in the disasters literature

The Gender theme appeared six times in the dataset, with twelve links and a total link strength of thirteen. This theme was associated with violence, equity, exclusion, conflict, climate change, resilience, and natural disasters, predominantly originating from scholarly contributions in the Philippines. Figure 3 below illustrates network extractions related to vulnerability and gender.

In the review of studies on geospatial technologies and collaborative data, [47] highlight the utility of AI in DRM phases of mitigation, preparedness, response, and recovery. The study found that (1) Earth Observation satellites are crucial for land use zoning, early warning systems for drought and flood-prone areas, damage assessment, and emergency response teams' access to high-resolution satellite imagery with reduced turnaround times. (2) Real-time weather monitoring by the Citizen Weather Observation Program, GPS base station data, buoys, and satellite data improve coastal tsunami forecasting. (3) Mobile phone technology has improved geo-tagging for videos, images, and SMS messages via Frontline SMS, OpenStreetMap, and Open GeoSMS. These tools facilitate DRM through faster search and rescues, modelling evacuations that are critical in reducing fatalities and disaster losses thereby reducing vulnerability.

A study by [48] examining how GIS and remote sensing intersect with DRM governance frameworks to enhance resilience revealed that AI-based technologies can enhance participation and voluntary spatial information by community members who use hand-held devices. This participatory approach is critical for lowering social vulnerability. Similar studies by [49] highlight the utility of Web-GIS in enhancing DRM especially for flood and landslide hazards arising from its participatory nature. Aligned with the current focus on DRR, studies focused on anticipatory action like [50] found that integration of blockchain technology into DRM frameworks improves disaster anticipatory response efficacy and timeliness.

A study by [51] among fishing communities in Kerala, noted fishing communities that typically have entrenched and exploitative patron-client relationships, blockchain embedded transactions were able to stabilize the earnings of local fishermen and disrupting the dominance of fish cartels. This innate ability of blockchain to reverse structural and spatial vulnerability is reinforced by a study by [10] who contend that integration of blockchain technology with Radio Access Networks (RAN) enhances delivery of public services like delivery of education. However, as noted by [52], restricted access to digital technology among fishing communities and most rural citizenry can be a serious drawback to the above benefits reifying the need to create appropriate digital ecosystems to improve household income, enable wider information dissemination, and strengthen participatory community resilience to natural disasters.

In their study of the utility of blockchain technologies in the sustainability of operations management, [53] concluded that it enhances decision-making, contract execution, secures data sharing, and asset transfers. Arising from its innate openness, traceability, and accountability, blockchain, when leveraged in DRM, can be pivotal for pre- and post-disaster currency

transactions that are essential for community recovery through restoration of livelihoods.

V. DISCUSSION

In this section we discuss the findings above within the broader context of providing pathways in which AI-enables applications can be leveraged to deepen civic engagement of women and to shift inhibiting norms that encourage males to engage in risky DRM activities.

Drawing from the findings that colonial social (re)construction was attained through pedagogical or epistemological transformations, counter measures based on AI-enabled need to mimic this approach at the very least. Awareness is crucial to changing deep-rooted attitudes and norms, which takes time. Blockchain and RAN integration has been shown to improve teaching. Through deep learning and big data algorithms, social media can be used to increase women's civic engagement, disaster communication and risk perception, lead times for disaster response and evacuation behavior, and inhibitive masculinity construction.

AI-based applications combined with unmanned aerial vehicles and remote sensing can improve early warning systems and reduce direct disaster risks, especially for men.

In a review of recent disaster scholarship, [54] highlights how PhotoKwento played a critical role in women's co-construction of their disaster recovery narratives. Similarly [55] shows how youth used Photo Voice as a research tool to enhance their activism and agency thereby influencing place-based environmental policy in the Philippines. These platforms, especially when encoded to local dialects, can integrate in-situ disaster vulnerabilities of women and men as well as ecological perspectives to enhance DRM.

From the findings, it is imperative that AI-based interventions transcend mere shifting of inhibitive masculinity norms that cause men to mill and guard property during disasters. Countering community masculinity narratives that emphasize individuality, violence perpetration and creation of safe spaces for men to express their unique disaster needs are essential for promotion of gender ally-ship, promoting their mental health and overall community resilience.

The results also indicate that DRM outcomes are enhance through the integration of blockchain with GIS, Remote Sensing, big data, and machine learning. Additionally, blockchain enabled financial models can augment national and local social protection initiatives like financial transfers that are critical in recovery of livelihoods by fostering access to productive assets. The findings also highlight that through blockchain integration in RAN, communities are able to access a variety of alternative livelihood skills trainings. This upskilling enhances the capacity of especially women to face external shocks but also men to find alternative income streams that lowers rates of sexual violence during disasters. All these enhance a community's overall disaster resilience

VI. CONCLUSION

This study underscores the need for more emphasis to be paid to the intersection between gendered dynamics embedded in social construction and their role on shaping community participation in disaster management and overall limiting of loss and damage. The study also reifies the need to urgently address drivers of structural violence that create and entrench social vulnerable categories. The study further argues integrating Artificial Intelligence (AI) and other technological advancements offer an opportunity to leverage the transformative potential of AI to reshape disaster management through deeper female participation and challenging harmful masculine norms that often exacerbate risks during disasters.

The study also highlights the need to reform normative governance frameworks that neglect gendered nature of disaster experiences, leading to inadequate responses that fail to address the unique needs of both women and men. Consequently by adopting the proposed pathways that utilize AI and blockchain, it is hoped that through fostering inclusive participation and shifting societal attitudes towards masculinity, communities will be made more resilient to disasters. For these aims to be attained, the study advocates for the uptake of holistic approaches that combine technological innovation with gender-sensitive strategies to improve disaster risk reduction efforts.

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