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Enhancing disaster resilience through women's self-help groups: A community-based study of Kudumbashree members in Poonjar Thekkekara panchayat, Kottayam, Kerala, India

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ABSTRACT

Effective disaster management relies on equipping local communities, often the first responders, with the necessary skills and resources to reduce the losses. In this context, women-led Self-help groups (SHG) plays a vital role in strengthening community resilience. This study examines the contributions of women's SHGs in a landslide-prone region within Poonjar Thekkekara panchayat – a local self-government unit in Kottayam district, Kerala, India by developing Disaster Resilience Performance Index (DRPI) based on the surveys conducted across different administrative divisions (wards) and phases of disaster management—before, during, and after disasters. The findings highlight that SHGs provide crucial support in immediate response and long-term recovery efforts, offering financial aid, skills training, and psychological assistance. Additionally, these groups contribute to the economic empowerment of women, fostering financial stability and reinforcing community resilience in disaster-prone areas. The study underscores the effectiveness of community-driven initiatives in disaster preparedness and recovery, suggesting that similar models of women-led SHGs could be adapted to enhance resilience in other vulnerable regions worldwide.

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1. Introduction

Disruptions caused by natural hazards and emergencies can lead to widespread economic and social instability, affecting communities at multiple levels (UNDRR, 2017). Those directly impacted are often the first to respond, playing a crucial role in managing the immediate aftermath (Izumi and Shaw, 2012). Strengthening local capacity through proactive planning, skill development, and resource allocation can significantly reduce vulnerabilities and enhance resilience. A community-based disaster management (CBDM) approach empowers local groups to take ownership of preparedness, response, and recovery efforts, fostering self-reliance and sustainable risk reduction (Park and Yoon, 2022). Resilience, in this context, is shaped by tangible factors such as economic security and resource availability, as well as intangible aspects like risk perception, social cohesion, and strong community networks (Adger, 2000). SHGs contribute significantly to this process by fostering local support systems, equipping individuals with skills to take preventive measures, and facilitating collective action during crises. These groups, typically formed by individuals from similar socio-economic backgrounds, serve as platforms for mutual assistance, financial inclusion, and skill development

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(Naik and Murari, 2025). By integrating social capital with disaster preparedness, SHGs help transform vulnerable communities into more adaptive and resilient units capable of withstanding future challenges (Lokesh and Geethanjali, 2023).

Economically, SHGs enhance financial inclusion and create income-generating opportunities for women through collective savings and microcredit initiatives. These financial mechanisms help women achieve economic security and independence. Socially, SHGs provide a strong support network, empowering women to challenge traditional gender norms, gain confidence, and express their views more actively. They also serve as platforms for skill development, improving women's agency and decision-making abilities within their families and communities (Das and Guha, 2019). In this context, Kudumbashree (Malayalam for 'prosperity of the family') was launched by the Government of Kerala on May 17, 1998. It operates under the local self-government department with financial support from the Union Government and NABARD. Unlike other SHG movements in India, Kudumbashree follows a unique grassroots model that extends beyond financial empowerment. Its extensive network plays a crucial role in disaster management, particularly in post-disaster recovery. The initiative has been actively involved in post-flood clean-up, psychological support for disaster victims, running community kitchens, and producing essential supplies like masks and sanitizers during COVID-19. These efforts have positioned Kudumbashree as a key player in disaster response at the community level (Shaji, 2023).

At the grassroots level, women are organized into Neighbourhood Groups (NHGs), each comprising 20 to 40 members and led by a President, Secretary, Infrastructure Volunteer, Community Health Volunteer, and Income Generation Volunteer. These NHGs are further coordinated at the ward level through the Area Development Society (ADS), which brings together 8 to 10 NHGs under a unified structure. At the local self-government level, the Community Development Society (CDS) serves as the apex body overseeing the activities of multiple ADS units (Jose, 2015).

This study examines the role of Kudumbashree in strengthening disaster resilience in Poonjar Thekkekara, a local self-government unit in Kottayam, Kerala, identified as a high-risk landslide-prone area according to the Landslide Atlas published by ISRO in 2023 (Nambudiri, 2024). The study evaluates Kudumbashree's impact by calculating the Disaster Resilience Performance Index (DRPI) and analysing resilience levels across different phases of disaster management and various wards within the study area.

2. Review of literature

The rising frequency and intensity of disasters across the globe necessitated the involvement of NGOs and SHGs in disaster management initiatives since the government alone is not able to manage them properly (Benson et al., 2001; Iizuka, 2018). Research highlights NGOs as catalysts in disaster resilience, enhancing communication and collective action, particularly during response and recovery (Fitzpatrick and Molloy, 2014; Park and Yoon, 2022; Islam and Walkerden, 2015). South Asia, a key region for NGO activities, demonstrates their critical role across various disaster management phases (Izumi and Shaw, 2012). With numerous NGOs involved, the literature advocates unified coordination systems to improve collaboration (Khaledi et al., 2023). NGOs' contributions to environmental sustainability are also explored beyond disaster contexts (Foo, 2018; Saleh and Saifudin, 2017). While technical resilience interventions are well-documented, deeper social and psychological focus needs immediate focus (Carmen et al., 2022).

Self-Help Groups (SHGs), informal associations without a formal organizational structure, typically focus on improving women's socioeconomic status through mutual support, skill enhancement, financial aid, health assistance, and capacity building.(Atieno et al., 2024; Kavitha et al., 2011). Their transformative role in rural India's socio-economic development is well-documented, highlighting their impact on savings accumulation and entrepreneurial opportunities (Basak and Chowdhury, 2024; Das and Guha, 2019; Khaledi et al., 2023; Vijayalakshmy et al., 2023), thereby reducing financial vulnerability (Biju and Tantia, 2023). Members of SHGs typically share a common economic, social, or health challenge, supporting each other in coping and recovery (Ghosh et al., 2022). Studies globally have explored the relationship between SHGs, climate change mitigation, and sustainable livelihoods, highlighting their role in reducing firewood dependency, mitigating deforestation, and promoting alternative energy sources

(Atieno et al., 2024). Additionally, Datta et al. (2012) emphasized SHGs' significance in community-based mangrove management (CBMM).

Social taboos have historically rendered women, along with children and the elderly, more vulnerable. However, countries like Nepal and Taiwan have demonstrated a strong commitment to integrating women's empowerment into Community-Based Disaster Risk Management (CBDRM) measures (Lee et al., 2022). Women-led and women-assisted humanitarian architecture which goes beyond conventional *addressing* by integrating DRR has been explored by Martins et al. (2021). In Nepal, Women's Empowerment Centres (WECs) play a vital role in reducing physical vulnerability and ensuring socioeconomic stability (Dhungel and Ojha, 2012). Such economic strategy has resulted in the social and gender liberation of women which has been identified by Larson et al. (2015) through a study on the intense activities of SHGs in response to the 2004 Tsunami in Tamil Nadu. Studies on emergency response efforts in the Global South post-pandemic highlight the spontaneous mobilization of local SHGs worldwide (Basak and Chowdhury, 2024). While SHGs' role in women's empowerment is extensively studied (Brody et al., 2015; Hossain et al., 2022; Dhungel and Ojha, 2012; Vinodhini and Vaijayanthi, 2016), their contribution to disaster resilience remains underexplored in literature.

Drolet et al. (2015) emphasized the significance of women-led collective actions in building resilience, reducing disaster risks, and promoting sustainable development. Community resilience is continuously shaped through the organization, disorganization, and reorganization of local resources and capital (Kais and Islam, 2016). Comparative studies between SHG member households and non-SHG households indicate that the former excels in social and human capital (Naik and Murari, 2025). The utilization of existing networks proves to be more advantageous during the immediate disaster response phase than relying on NGOs deployed from external sources (Kilby, 2008). Such social networks are easily available and readily activated and can bring much more resilience (Joseph et al., 2020). Research on local social networks highlights that bridging and bonding networks are crucial in geographically isolated areas while linking networks enhances livelihood opportunities. Strengthening linking networks through institutional interventions like SHGs improves accessibility (Naithani and Saha, 2020). However, a significant research gap remains regarding Kudumbashree's role in building disaster resilience in Kerala, necessitating both quantitative and qualitative investigations. This study seeks to fill this gap by creating performance indicators for disaster resilience at the individual level, ward level, and across various phases of disaster management, which are designed to quantify and assess the disaster resilience capacity.

Generally, resilience indicators help in characterising various disaster management aspects for monitoring progress and recognising success (Cutter, 2016). Resilience monitoring studies particular to a region has widely used Community Disaster Resilience Index – CDRI (Joerin et al., 2012) which is based on five components physical, social, economic, institutional, and natural, which has later undergone modifications in order to fit into the requirements of study area, e.g., Vietnam (Giang et al., 2024), Mauritius (Neerunjun, 2023) New Delhi (Prashar et al., 2012). While indices like CDRI (Cutter, 2016), the Australian Disaster Resilience Index (ADRI) developed by (Parsons et al., 2021), the Disaster Preparedness Index (DPI) developed by Rohith et al. (2017), and the Resilience Inference Measurement (RIM) model developed by Lam et al. (2016) focussed on measurement at a state scale, DRPI meant for measuring the resilience at hyper-local community-driven institutions like SHGs by incorporating the SHG specific dimensions like microfinance utilizations, networking, training, etc.

3. Methodology

To evaluate the impact of SHGs in building disaster resilience in Poonjar Thekkekara panchayat (Fig. 1), a mixed-method approach was adopted, integrating both quantitative and qualitative data collection and analysis techniques. This exploratory study examines the role of SHGs in CBDM, focusing on their contribution to strengthening community capacity and resilience.

3.1. Data collection

Because of the exploratory nature of the study, various methods were employed to gather both qualitative and quantitative data. Both primary and secondary data sources were utilized.

- Primary data

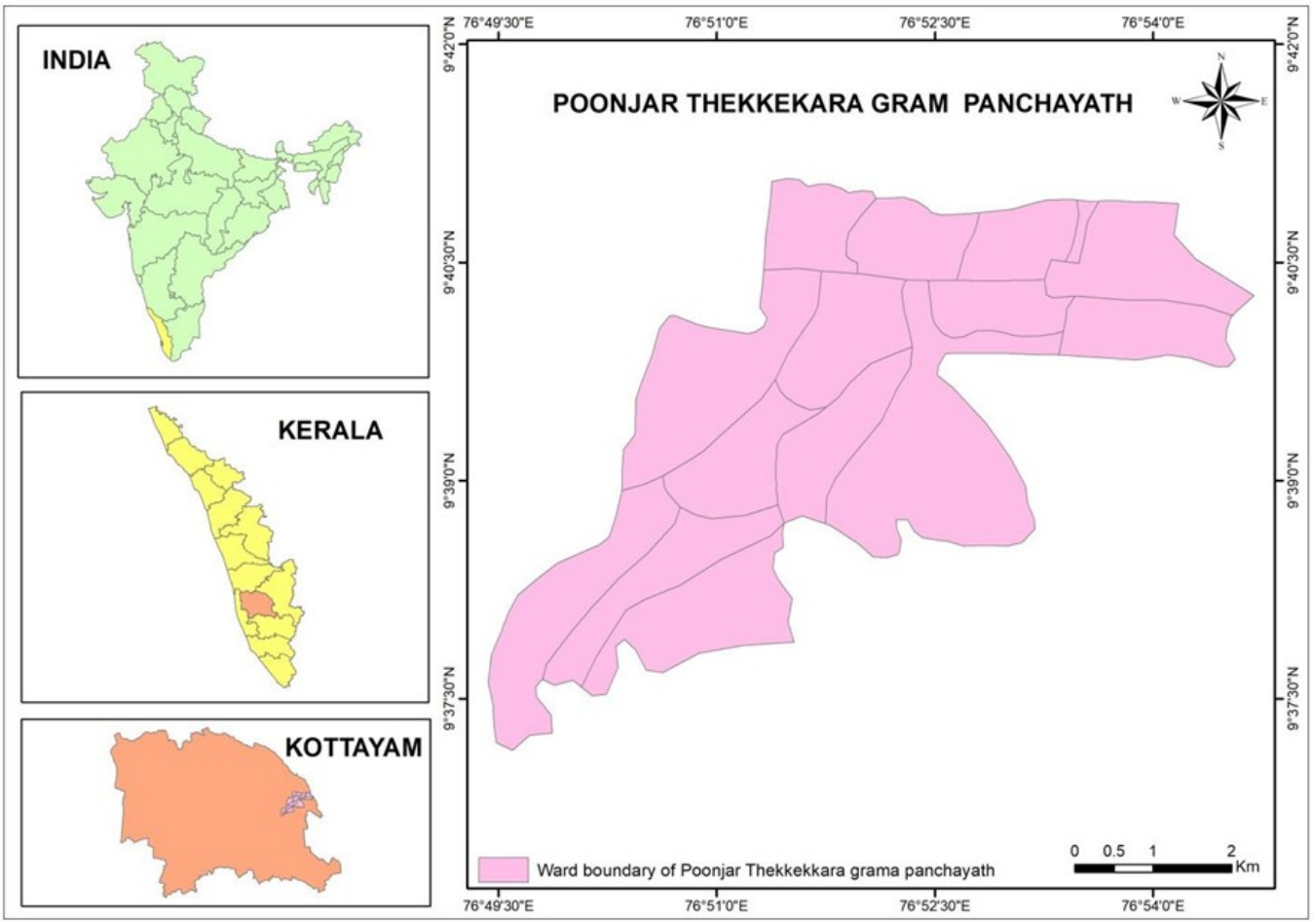

Fig. 1. Location map of the study area – Poonjar Thekkekara Grama panchayat.

Primary data was collected from SHG members, ward representatives, community members, and key informants, including Kudumbashree representatives, local government officials, community leaders, and disaster management experts. Multiple data collection methods were adopted:

- Surveys: Structured surveys were conducted using a pre-designed questionnaire administered to SHG members in the study area.
- Interviews: Both formal key informant interviews and informal discussions were conducted to gain in-depth perspectives.
- Focus Group Discussions (FGDs): FGDs facilitated interactive discussions among SHG members and other community stakeholders.
- Observations: Field-based observations were conducted to capture contextual factors influencing disaster resilience.
- Transect Walks & Group Discussions: Additional participatory methods such as transect walks and group discussions were carried out to enrich data collection (Narayanasamy, 2009).

- Secondary data

  Secondary sources included Panchayat Disaster Management plans, project reports, policy documents, relevant websites, and prior studies. These sources provided a contextual background and supplemented primary data analysis.

3.2. Sampling strategy

A stratified random sampling method was employed, which is a probability sampling technique

Table 1. Methodological framework for the DRPI: Key indicators and operational definitions.

Sl. No.	Phase	Indicator	Direction to DRPI
1	Pre-disaster	Livelihood affected by disaster	Negative
2		Multiple sources of income	Positive
3		Health insurance coverage	Positive
4		Insurance for houses or buildings	Positive
5		Consideration of relocation due to disaster vulnerability	Negative
6		Participation in disaster preparedness training	Positive
7		Participation in livelihood-related training	Positive
8		SHG funds are used for housing construction or renovation	Positive
9		Livelihood support	Positive
10		Financial security provided by the SHGs	Positive
11		Availability of SHGs for assistance	Positive
12		Basic knowledge of handling a disaster	Positive
13	During-disaster	Use of phone and social media	Positive
14		Receiving disaster notifications and guidelines through SHGs or social media channels	Positive
15		Direct involvement of the SHGs in disaster activities (emergency funding, distribution of essentials, relocation, rescue, etc.)	Positive
16		Ease of obtaining a loan or financial assistance from the SHGs in urgent situations	Positive
17		Loans or financial assistance from the group during emergencies	Positive
18	Post-disaster	Financial assistance from SHGs for disaster recovery	Positive
19		The feeling of safety within the SHGs (social security)	Positive
20		Collaboration with Kudumbashree members in other wards or panchayats for disaster assistance	Positive
21		Role of SHGs in fostering cooperation, trust, solidarity, mutual support, love, and social connections among neighbours	Positive

ensuring that the sample represents the population by dividing it into different strata based on shared characteristics (Robson, 1993). Each of the fourteen wards of Poonjar-Thekkekara panchayat was considered as a distinct stratum, with samples drawn proportionally from each. This method enhances the generalizability of findings by accounting for shared community characteristics.

While the study includes all fourteen wards, special emphasis was given to six highly landslide-prone wards, which have a history of frequent hazards: Peringulam (Ward 3), Adivaram (Ward 4), Kaippilli (Ward 5), Kunnonni (Ward 8), Pathapuzha (Ward 9), and Muringapuram (Ward 11). To ensure the inclusion of at-risk populations, purposive sampling was used in these wards. This approach helps in capturing the complexities of people's subjective opinions, practices, and outcomes, thereby strengthening the depth of analysis (Vahanvati and Beza, 2017). Additionally, field visits were carried out in these wards to document local vulnerabilities and resilience-building efforts.

3.3. Questionnaire design

The structured instrument was developed and administered in Malayalam (the local language) to align with respondents' linguistic proficiency and later systematically translated into English to ensure analytical clarity and accessibility. Comprising 24 items alongside a demographic profiling section, the questionnaire was organized thematically across the three phases of disaster management: pre-disaster, during-disaster, and post-disaster (Table 1). The items were structured to assess four domains: (a) sociodemographic attributes of SHG members, (b) SHG-led initiatives contributing to community disaster resilience, (c) participatory engagement levels of SHG members in resilience-building activities, and (d) SHGs' operational roles in disaster phase-specific interventions. Responses were captured using a closed-ended format utilizing a categorical response scale—binary (yes/no) and ternary (moderate)—to quantify resilience-related perceptions and practices. This design facilitated standardized data aggregation while minimizing interpretive ambiguity.

To ensure validity and consistency, a pre-test survey was administered to an initial sample of 20 participants from the Pathampuzha ward, which was subsequently integrated into the final study sample.

3.4. Data analysis

A weighted scoring framework was employed to compute a composite DRPI from the survey responses. Each question was assigned an ordinal scale of 1–3, corresponding to resilience levels: 3 (high

resilience), 2 (moderate resilience), and 1 (low resilience). Individual scores were aggregated to operationalize three hierarchical metrics:

- Individual-Level Disaster Resilience Performance Indicator: Reflects personal resilience capacities derived from summed scores per respondent.
- Phase-Level Disaster Resilience Performance Index (DRPI): Calculated by averaging scores across respondents for each disaster management phase (pre-, during, and post-disaster).
- Ward-Level Disaster Resilience Performance Index (DRPI): Determined by aggregating individual scores at the ward level to assess geographic disparities in resilience outcomes.

The Individual-Level Disaster Resilience Performance Indicator quantifies the resilience capacity of each SHG member by aggregating their responses to all 24 survey questions. Each question was scored on a 3-point ordinal scale (3 = high resilience, 2 = moderate resilience, 1 = low resilience), yielding a cumulative individual score ranging from 21 (minimum) to 63 (maximum).

To assess resilience across disaster management (DM) phases, questions were categorised into pre-disaster, during-disaster, and post-disaster domains. The Phase-Level DRPI was computed by summing an individual's scores for all questions within a specific phase and converting this total into a percentage of the maximum achievable score for that phase (Eq. 1). This normalization ensured standardized cross-phase comparability.

The Ward-Level DRPI was derived by aggregating individual scores within each administrative ward and expressing the cumulative total as a percentage of the ward's theoretical maximum score (Eq. 1). This hierarchical framework enabled multiscale analysis of resilience, from individual capacities to geographic disparities, while maintaining methodological consistency.

$$\text{DRPI} = \frac{\text{Total score obtained}}{\text{Maximum scores could have been obtained}} \times 100 \quad (1)$$

Descriptive statistical analysis was conducted using Microsoft Excel to characterise the distribution and variability of the DRPI scores. Central tendency was assessed through the arithmetic mean, while dispersion was evaluated using standard deviation, variance, and range. Distribution characteristics, including minimum and maximum values, were analysed to contextualize the score boundaries. The coefficient of variation was calculated to quantify relative variability across the dataset.

4. Results

Poonjar Thekkekara panchayat comprises 14 wards, each with varying levels of disaster risk. A total of 157 Kudumbashree units operate across these wards. This study focuses on 51 units, with 111 participants.

4.1. Demographic and socioeconomic profile of respondents

The study area, Poonjar Thekkekara panchayat, spans 14 administrative wards characterized by heterogeneous disaster risk levels. From a total of 157 operational Kudumbashree units, a purposively sampled cohort of 51 units (111 participants) was analysed to assess disaster resilience dynamics.

Respondents exhibited a pronounced demographic predominance in the 40–49 and 50–59 age cohorts, collectively constituting 63% of the sample. This reflects the active engagement of middle-aged individuals within SHGs, suggesting their pivotal role in leveraging experiential knowledge and labour capacity for collective resilience-building.

Educational attainment levels among participants were predominantly basic, with 68% possessing qualifications at or below the secondary school level (SSLC/high school). This limited formal education may constrain livelihood diversification and access to technical disaster preparedness training. Occupational stratification revealed a socioeconomic reliance on informal and community-oriented roles: housewives formed the largest subgroup (29.7%), followed by members engaged in Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) initiatives (16.2%), Haritha Karma Sena (environmental task forces, 9.9%), daily wage labour (8.1%), and Accredited Social Health Activist (ASHA) roles (6.3%). This composition underscores the intersection of gendered labour patterns and localized economic dependencies within SHG frameworks.

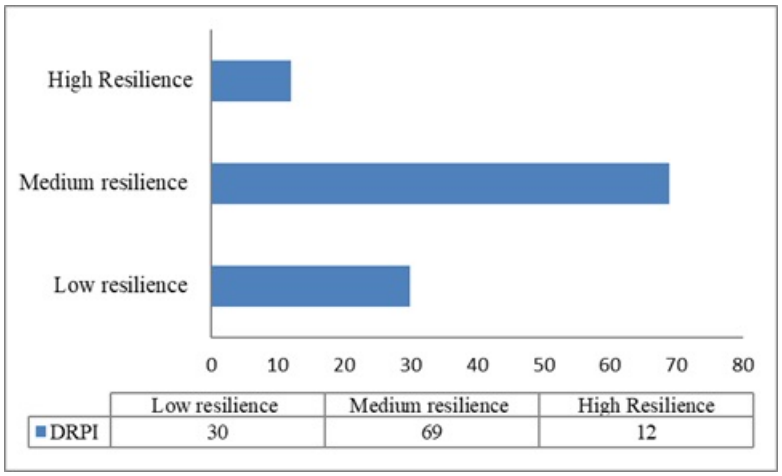

Fig. 2. Proportional distribution of respondents across DRPI resilience categories.

Table 2. Descriptive statistics of DRPI value.

Mean	49.75676
Standard Deviation	4.22808
Sample Variance	17.87666
Range	20
Minimum	39
Maximum	59
Coefficient of variation	0.084975

Table 3. Resilience classification based on DRPI intervals.

Resilience Categories	Range	No of respondents	Percentage
Low resilience	39–47	30	27.03
Medium resilience	48- 54	69	62.16
High Resilience	55–59	12	10.81

4.2. Analysis of Disaster Resilience Performance Indicator (DRPI)

The DRPI scores ranged from 39 to 59 (M = 49.76, SD = 4.23), with a sample variance of 17.88, indicating moderate heterogeneity in disaster resilience capacities across SHGs. While certain SHGs demonstrated robust preparedness (near-maximum scores), others exhibited comparatively lower resilience, underscoring disparities in resource access, training, or risk awareness. A coefficient of variation (CV) of 8.50% further revealed limited relative variability, suggesting that most SHG resilience scores clustered closely around the mean, with only modest dispersion. This implies baseline homogeneity in community-driven disaster management practices, despite localized outliers. Descriptive statistics are detailed in Table 2.

4.2.1. Categorisation and distribution of DRPI

The DRPI scores were classified into three equal intervals to stratify resilience levels: Low (39–47), Medium (48–54), and High (55–59) (Table 3). As illustrated in Fig. 2, over half of the respondents (50%+) fell within the Medium resilience category, reflecting moderate disaster preparedness and adaptive capacities. A smaller proportion of participants demonstrated High resilience (maximum score = 59), while the remainder were categorised as Low. This distribution underscores a predominant trend of intermediate resilience among SHG members, with limited extremes at either end of the spectrum.

4.3. Phase-level DRPI

The Disaster Resilience Performance Indicator is measured for each phase of the disaster management cycle—pre-disaster, during disaster, and post-disaster—based on the total score obtained per question. Findings indicate that resilience is strongest during the post-disaster phase, as reflected by the highest index score (Fig. 3). This is largely due to Kudumbashree SHGs focusing their core activities, such as micro-financial services, emergency loans, and financial assistance, on the recovery phase. These financial interventions play a crucial role in post-disaster rehabilitation efforts.

4.4. Ward-level DRPI

Analysis of ward-level DRPI scores reveals significant spatial disparities in disaster resilience across Poonjar Thekkekara panchayat (Fig. 4). Wards 2 (Kallekulam), 13 (Payyanithottam), and 1 (Poonjar Town) demonstrated the highest resilience capacities, attributed to advantageous geomorphological conditions (e.g., lower landslide susceptibility) and enhanced resource accessibility due to proximity

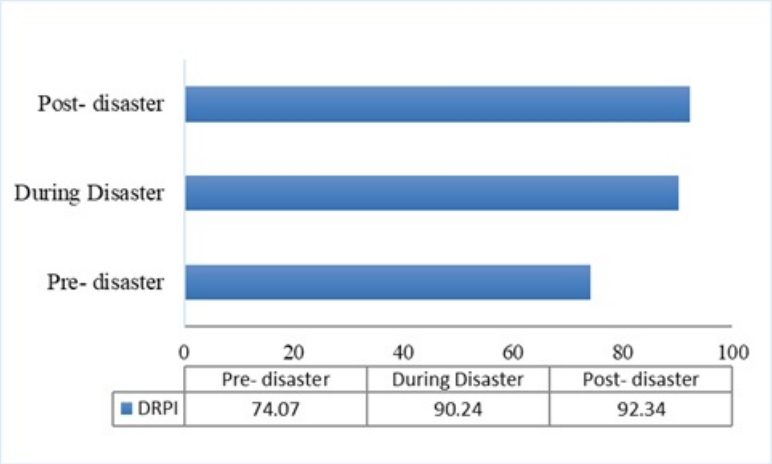

Fig. 3. Phase-level DRPI across the disaster management cycle.

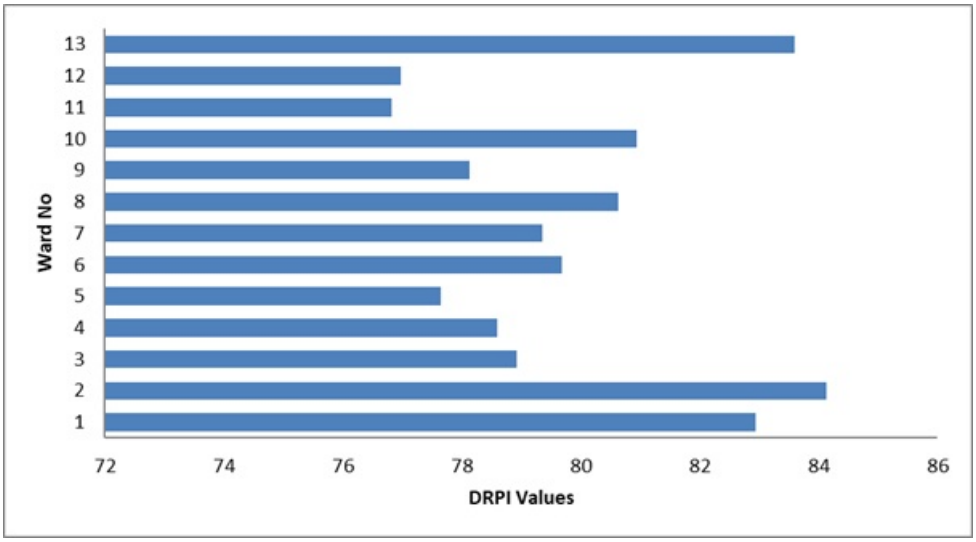

Fig. 4. Spatial distribution of Ward-Level DRPI across Poonjar Thekkekara panchayat.

to urban infrastructure. This geographic advantage facilitates shorter travel distances to panchayat-led training programs and community meetings, fostering consistent engagement in preparedness activities.

Conversely, Wards 11 (Muringapuram), 12 (Kadaladimattam), and 5 (Kaippalli) exhibited the lowest DRPI scores, aligning with their designation in the panchayat's Disaster Management Plan as high-risk landslide zones. The compounded vulnerabilities in these areas stem from geographical isolation, steep elevations, and limited transportation networks, which restrict access to training sessions and Kudumbashree unit meetings. These structural barriers diminish participation in resilience-building initiatives, exacerbating disaster susceptibility among SHG members.

The DRPI framework underscores a baseline of moderate resilience across the panchayat, with critical gaps identified in high-risk wards. Targeted interventions—such as decentralizing training programs, improving rural connectivity, and prioritizing landslide mitigation—are essential to bridging these disparities. By integrating DRPI insights into policy revisions, Poonjar Thekkekara panchayat can enhance equity in disaster preparedness and foster community-wide resilience.

The Disaster Management (DM) Plan of Poonjar Thekkekara panchayat identifies that the majority of residents are traditional farmers, with daily wage labour serving as the primary source of livelihood. Survey findings reveal that most households belong to middle-class families, making them particularly vulnerable to disaster impacts.

- Livelihood disruptions: 30% of respondents reported that disasters completely disrupted their

livelihood, while 46% experienced partial disruptions.

- Relocation due to landslide risks: 37% of respondents had to relocate due to landslide threats; however, many remain in high-risk areas due to emotional ties, community bonds, and livelihood constraints.
- Insurance coverage: Despite residing in high-risk zones, only 9% of respondents have insurance coverage for their land, homes, or assets. A significant portion of the community lacks the financial capacity to afford insurance.
- Role of Kudumbashree in financial assistance: Given the financial constraints, Kudumbashree's support mechanisms play a critical role in providing financial security. In emergencies, Kudumbashree SHGs offer immediate, collateral-free loans with minimal procedural requirements, ensuring swift financial assistance.
- Effectiveness of SHG financial aid: 95.5% of SHG members reported that they found it easier to access loans or financial aid through their groups during crises, highlighting the significance of SHGs in strengthening financial resilience within the community.

4.5. Preparedness strategies and SHG participation

The correlation coefficient revealed a negative relationship ($r = -0.30$) between the age of SHG members and their DRPI, suggesting that older members exhibit lower resilience scores. This trend may reflect age-related barriers to participation, such as reduced mobility, health constraints, or limited engagement in training programs and emergency drills, which are critical for building adaptive capacities.

Disaster preparedness training programs—conducted at panchayat and ward levels—were attended by 56.8% of respondents. Non-participation (43.2%) was attributed to geographic isolation (e.g., remote residency), logistical challenges (e.g., long travel distances to training venues), and age-related limitations. Despite Kudumbashree's primary focus on socioeconomic empowerment, 93.7% of SHG members reported that their Neighbourhood Groups (NHGs) actively contributed to disaster response initiatives, highlighting their emergent role in crisis management.

Notably, 93.7% of participants perceived enhanced safety through SHG membership, while 82.9% reported collaborative engagement with members across multiple wards and panchayats. This cross-ward networking fosters social capital—evidenced by 96.4% of respondents emphasizing strengthened trust, solidarity, and mutual aid—which underpins collective resilience. These findings underscore the necessity of decentralizing training programs to improve accessibility and leveraging SHGs' existing social networks to amplify disaster preparedness outreach.

5. Discussion

Kudumbashree has emerged as a pivotal institution for women's empowerment in Kerala, driving socioeconomic welfare through targeted initiatives (Usman and Kocheril, 2021). Its family-centric model positions women as mediators of development, fostering progress from households to broader communities (Jose, 2015). While CBDM is increasingly recognized for enabling localized vulnerability assessments and decision-making (Suharini et al., 2020), operational challenges persist. Islam and Walkerden (2015) underscore the critical role of bonding and bridging social networks in crisis contexts, a finding echoed in this study: 93.7% of SHG members reported enhanced safety and neighbourly cohesion through group activities, while 82.9% engaged in cross-ward collaborations—a testament to the bridging networks that amplify collective resilience.

Livelihood-centered strategies are integral to disaster risk reduction (Iwasaki, 2016), and Kudumbashree's micro-loan programs directly address economic vulnerability (Naithani and Saha, 2020). Women, as primary livelihood drivers (Khatri et al., 2023), face disproportionate risks, particularly given that 68% of respondents had only basic education, limiting livelihood diversification. This aligns with Liu et al.'s (2022) assertion that income stability bolsters resilience. Kudumbashree's financial interventions, such as emergency loans, mitigate these vulnerabilities, as 56.8% of participants accessed training programs, though 43.2% cited geographic and age-related barriers—highlighting inequities in resource access.

Individual risk perceptions profoundly shape disaster responses (Iwasaki, 2016). Interviews revealed that residents often minimized local landslide risks

despite prior experiences, driven by fears of depreciating property values and compromised marital prospects. This reflects not ignorance but strategic avoidance of socioeconomic stigma, particularly among middle-aged respondents (63% aged 40–59), who dominate SHG membership and may prioritize familial stability over risk acknowledgment. Age and geography significantly influenced participation in resilience activities. Consistent with Anjugam and Ramasamy (2007), older individuals exhibited lower engagement (negative correlation: $r = -0.30$), likely due to mobility constraints. Geographically isolated wards (e.g., Muringapuram, Kadaladimattam) with lower DRPI scores faced compounded barriers—steep terrain and poor transport—that restricted access to training. Conversely, urban-proximate wards (e.g., Poonjar Town) leveraged shorter travel distances to achieve higher DRPI scores, underscoring spatial inequities in preparedness.

5.1. Phase-wise disaster resilience performance analysis

The post-disaster phase demonstrated the highest resilience scores (mean DRPI = 49.76), aligning with Kudumbashree's focus on relief operations and camp management over pre-disaster mitigation. This mirrors broader trends where NGOs prioritize rapid response partly due to the ease of financial disbursement in emergency situations (Islam and Walkerden, 2015). However, integrating preparedness into SHGs' mandates is critical for sustained resilience, as only 56.8% attended training programs, with high-risk wards lagging furthest. Notably, women's innate capacity to recover from crises, even without formal training (Alam and Rahman, 2017), underscores their pivotal role in DRR. SHGs, as platforms for inclusive engagement can amplify this potential, particularly given that 96.4% of respondents emphasized strengthened social bonds through SHGs—a key driver of community resilience.

6. Conclusion

As global efforts intensify to meet the Sendai Framework for Disaster Risk Reduction (SFDRR) targets, this study reaffirms the critical role of community-driven institutions like SHGs in bridging resilience gaps within disaster-prone regions. Focused on Kerala's Kudumbashree model, the findings demonstrate that SHGs serve as vital intermediaries in disaster management, leveraging localized social networks to enhance preparedness, response, and recovery. The DRPI framework revealed moderate baseline resilience (M = 49.76) across the study area, with pronounced disparities between high-risk, geographically isolated wards and urban-proximate communities. Phase-level analysis underscored the predominance of post-disaster resilience, aligning with SHGs' structured focus on relief operations, financial aid, and livelihood rehabilitation—interventions that address immediate recovery needs but highlight gaps in pre-disaster mitigation strategies.

The study further identifies age and geography as key determinants of resilience capacity. A moderate negative correlation (r = −0.30) between age and DRPI scores reflects barriers faced by older members in accessing training and participating in preparedness activities. Concurrently, geographic isolation exacerbated vulnerabilities in high-risk landslide zones, where limited mobility and resource accessibility hindered engagement. Despite these challenges, SHGs fostered robust social capital, with 96.4% of respondents reporting strengthened trust and collaboration through cross-ward networks—a critical asset for rapid resource mobilization during crises.

By situating SHGs within the disaster management cycle, this research illustrates their dual function as socioeconomic safety nets and resilience amplifiers. While Kudumbashree's post-disaster interventions align with community priorities, the integration of proactive risk reduction strategies remains essential to address systemic vulnerabilities. These insights contribute to a growing discourse on the synergies between grassroots social capital and institutional frameworks in achieving equitable, sustainable disaster resilience.

6.1. Recommendations

- Digital capacity building for inclusive preparedness

  Develop hybrid training modules combining digital platforms (e.g., mobile apps, webinars) and community workshops to address age- and geography-related barriers. Prioritize localized content on landslide risk mitigation, early warning systems, and financial literacy, tailored to the needs of older members and remote populations.

- Decentralized resilience hubs

Establish ward-level training centres equipped with mobile technology to ensure geographically isolated SHG members can access disaster preparedness programs. Partner with local governments to co-locate these hubs with existing Kudumbashree units, leveraging their social networks for wider outreach.

- Formalized SHG roles in disaster governance

  Integrate Kudumbashree NHGs into panchayat and state disaster management plans by mandating their participation in emergency response teams. Assign specific roles, such as resource coordinators or community liaisons, to capitalize on their localized knowledge and trust networks.

- Strengthened communication frameworks

  Implement a hierarchical communication chain within SHGs using low-cost mobile technologies (e.g., WhatsApp groups, SMS alerts) for rapid dissemination of warnings and updates. Train designated SHG members as "resilience ambassadors" to lead information-sharing during crises.

- Subsidized insurance and financial safeguards

  Collaborate with state agencies and insurers to design affordable, disaster-specific microinsurance products for high-risk wards. Bundle these with Kudumbashree's existing micro-loan programs to incentivize uptake and buffer economic shocks.

6.2. Limitations

This study has some limitations. Self-reported data may reflect response bias, as participants in landslide-prone areas often underreported risks to avoid stigmatization or perceived threats to property values, underscoring the need for qualitative methods (e.g., participatory mapping) to uncover latent vulnerabilities. The DRPI prioritizes quantitative metrics (e.g., training attendance) over sociocultural factors like traditional knowledge or gendered decision-making dynamics, potentially oversimplifying resilience. The cross-sectional design limits causal inferences regarding SHGs' long-term impact on disaster outcomes. Additionally, focusing on a single panchayat restricts generalizability to regions with differing hazard exposures or institutional frameworks. Future research should integrate mixed-method approaches to capture contextual socio-cultural dynamics and employ longitudinal studies to assess resilience evolution.

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CRediT statement

Sivan S: Conceptualization, Investigation, Formal Analysis, Writing–Original Draft. **Nair M N:** Conceptualization, Methodology, Validation, Formal Analysis, Writing–Original Draft, Editing. **Mani S K**: Supervision, Project Administration, Funding Acquisition, Writing–Review & Editing. **Baiju K R:** Funding Acquisition, Supervision.

Declaration of competing interest

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

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