

Embedded social capital in urban flash flood management: Evidence from Kajang, Malaysia

Sarina Yusoff¹, Nur Hafizah Yusoff¹, Chan Kim Ling @ Geraldine¹, Dona Raihana Don Ramli²

¹Anthropology and Sociology Program, Centre for Research in Development, Social and Environment, Faculty of Social Sciences and Humanities, Universiti Kebangsaan Malaysia

²Geography Program, Centre for Research in Development, Social and Environment, Faculty of Social Sciences and Humanities, Universiti Kebangsaan Malaysia

Correspondence: Dona Raihana Don Ramli (email: donaraihana@ukm.edu.my)

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Abstract

Flash floods have become a recurring hazard in many rapidly urbanising cities, including Kajang Town, Malaysia, where urban development has increased pressure on drainage systems and exposed communities to greater flood risk. Although social capital is widely discussed in disaster research, its role in connecting community capacities with formal flood governance remains underexplored in urban Southeast Asia. This study examines how embedded social capital supports flash flood management through a qualitative case study of Kajang Town. Semi-structured interviews were conducted with 10 purposely selected participants representing residents, community organisations and formal institutions, supplemented by document analysis. Data were analysed using reflexive thematic analysis. Reflexive thematic analysis identified three dimensions of embedded social capital: relational, structural and cognitive. Neighbourhood social networks, trust and shared local knowledge supported the exchange of information, early assistance and collective action before, during and after flood events. Residents often identified changing flood conditions before official responders arrived, while community organisations helped coordinate volunteers and communicate community needs. Formal institutions contributed emergency coordination, technical expertise and material resources. Flood response depended on continued interaction between community networks and formal institutions. Embedded social capital developed through everyday relationships and repeated flood experience rather than during emergencies alone. These relationships supported communication, cooperation and local decision-making across different stages of flood management. Recognising embedded social capital as part of urban flood governance highlights the importance of neighbourhood organisations, local knowledge and long-term collaboration between communities and formal institutions in strengthening urban flood resilience.

Keywords: Community networks, disaster governance, embedded social capital, flash flood management, local knowledge, urban resilience

Introduction

Rapid urbanisation has increased pressure on urban environments through land-use change, population growth and the expansion of impervious surfaces, often exceeding the capacity of existing drainage systems. The replacement of natural surfaces with roads, buildings and other impervious materials accelerates surface runoff during heavy rainfall, increasing both the frequency and severity of flash floods. Flash floods are floods that develop rapidly, typically within a few hours of intense rainfall. In urban areas, these events are referred to as urban flash floods that occur when surface runoff overwhelms drainage systems in highly urbanised areas (Hamdy et al., 2023). Climate change has further intensified these challenges by contributing to more frequent and intense rainfall events in many parts of the world (UNDRR, 2023). Consequently, urban flooding has become one of the most significant environmental risks facing cities (Chen et al., 2025; Shah et al., 2024). It disrupts transportation, damages infrastructure, interrupts economic activity and threatens community wellbeing. Although structural measures such as flood retention ponds, drainage improvements and river engineering remain important, recent disasters demonstrate that physical infrastructure alone cannot ensure effective flood management. Increasing attention has therefore been directed towards the social and institutional capacities that enable communities to prepare for, respond to and recover from flood events.

Malaysia reflects many of these global challenges. Rapid urban growth, particularly within the Klang Valley, has altered natural drainage systems through extensive land-use conversion, increasing impervious surfaces and high-density development (DID, 2023; Rosmadi et al., 2023). These changes have significantly increased the occurrence of flash floods in urban areas despite continued investment in structural flood mitigation measures, including the SMART Tunnel, flood retention ponds and river improvement projects (Saad et al., 2024). The severe floods that affected the Klang Valley in December 2021 exposed weaknesses in emergency coordination, risk communication and institutional preparedness, while also demonstrating the importance of cooperation among formal institutions, local communities and civil society organisations (Rosmadi et al., 2023; UNDRR, 2023). The 2021 floods demonstrated that urban flood risk is influenced not only by physical exposure but also by institutional capacity and community responses. Instead, it reflects the interaction between environmental processes, institutional capacity and the ability of communities to organise, exchange information and mobilise collective resources. This broader perspective has shifted disaster research beyond structural measures towards understanding how social relationships contribute to urban resilience.

Kajang provides a suitable setting for examining these issues. Situated within the Langat River Basin, Kajang has experienced repeated flash floods over the past decade, with major flood events reported in 2011, 2014, 2020 and 2021 (Bari et al., 2021; Muhamad & Shaidin, 2022; Rosmadi et al., 2023; Saad et al., 2025; Sabihin & Talib, 2024). Rapid urban expansion, commercial development and increasing population density have placed considerable pressure on drainage infrastructure, resulting in recurring flood incidents during periods of intense rainfall (Rosmadi et al., 2023; Saad et al., 2025). The repeated occurrence of flooding has also encouraged continuous interaction among residents, community organisations and local authorities as they respond to recurring risks. These conditions provide an appropriate context for examining how everyday social relationships influence flood preparedness, emergency response and post-flood recovery. Rather than focusing only on engineering interventions, Kajang offers an opportunity to explore how social processes complement formal disaster management systems in an urban environment.

These local experiences are consistent with broader international efforts to strengthen disaster risk governance through greater community participation. The Sendai Framework for Disaster Risk Reduction 2015–2030 recognises that effective disaster risk reduction depends on shared responsibility among governments, communities and other stakeholders. Similarly, the Sustainable Development Goals (SDGs), particularly SDG 11 (Sustainable Cities and Communities) and SDG 13 (Climate Action), emphasise inclusive governance, community participation and local resilience as essential components of sustainable urban development. These international frameworks recognise that disaster risk reduction depends on more than physical infrastructure. It also requires strong partnerships, effective risk communication and recognition of local knowledge. As a result, understanding how communities organise and cooperate during disasters has become increasingly important for both policy development and disaster research.

One perspective that provides useful insight into these processes is embedded social capital. Building on Granovetter (1985) concept of embeddedness, embedded social capital views social relationships as resources that develop through repeated interaction within specific social, institutional and spatial contexts. Unlike conventional approaches that often treat social capital as a relatively stable community asset, embedded social capital emphasises the quality of social relationships. It also focuses on the social processes through which trust (Nicholas et al., 2026), reciprocity and cooperation develop through repeated interaction. These relationships influence how individuals exchange information, access resources and coordinate collective action when facing environmental hazards (Behera, 2023; Pazhuhan, 2023; Uekusa et al., 2022). This perspective is particularly relevant in urban disaster management because effective flood governance depends not only on the presence of social networks but also on sustained interaction between residents, community organisations and formal institutions.

Previous research consistently demonstrates that social relationships play an important role in disaster preparedness, emergency response and post-disaster recovery. Trust, reciprocity and community networks facilitate information sharing, encourage mutual assistance and strengthen collective action during times of crisis (Aldrich & Meyer, 2021; Flecha et al., 2023). Other studies have highlighted the contribution of institutional collaboration, social infrastructure and community participation in improving adaptive capacity and disaster governance (Fox et al., 2023; Sharpe, 2021). Within Southeast Asia, informal community networks and locally grounded knowledge have become increasingly important as rapidly urbanising cities experience more frequent climate-related hazards (Rahman & Wong, 2020). Although this literature demonstrates the value of social capital, much of the existing research continues to examine social capital as a broad community attribute rather than investigating how social relationships become embedded through repeated interaction among communities, community organisations and formal institutions. Moreover, empirical evidence from rapidly urbanising secondary cities in Southeast Asia remains relatively limited, with many studies focusing either on rural communities or large metropolitan areas. The processes through which embedded social capital contributes to urban flash flood management and supports disaster governance remain insufficiently understood.

In response to these gaps, this study examines how embedded social capital shapes urban flash flood management in Kajang Town, Malaysia. It explores how neighbourhood networks, trust, shared local knowledge and interactions with formal institutions influence disaster preparedness, emergency response and post-flood recovery (Waseem et al., 2024). The study explains how everyday social relationships complement formal governance arrangements in managing urban flash floods. In doing so, it provides empirical evidence on how socially embedded relationships contribute to disaster governance in rapidly urbanising cities.

Literature review

Urban flash floods have become a recurring challenge in rapidly urbanising cities, exposing the limits of flood management strategies that rely primarily on structural measures. Although structural measures remain essential for reducing flood risk, recent flood events have shown that physical infrastructure alone cannot prevent severe social and economic disruption. Rapid urban growth, changing land use and more frequent extreme rainfall have increased pressure on existing drainage systems, making effective flood management dependent on more than structural measures. This has prompted researchers to examine how social relationships, institutional arrangements and local capacities influence community resilience alongside physical infrastructure (Aldrich & Meyer, 2021; Sun et al., 2025). Recent studies increasingly describe flood resilience as an outcome of interactions between physical infrastructure, social relationships and institutional capacity (Carmen et al., 2022; Xu et al., 2026).

Among the concepts used to explain differences in disaster resilience, social capital has received sustained attention. Social capital refers not only to social networks but also to the trust, reciprocity and cooperation that enable information sharing, resource mobilisation and collective action. Studies consistently show that communities with stronger social relationships respond more effectively during emergencies because information flows more rapidly, assistance is organised locally and residents are better able to coordinate immediate actions before external support arrives (Aldrich & Meyer, 2021; Flecha et al., 2023). During urban flash floods, neighbourhood networks often complement formal warning systems by providing timely information on local flood conditions, evacuation routes and vulnerable households. Similar patterns have been reported in Malaysia, where informal communication and neighbourhood cooperation facilitate volunteer mobilisation and community-based responses during flood events (Ahmad et al., 2025; Rahman & Wong, 2020). Together, these studies indicate that everyday social relationships remain an important source of resilience in urban communities (Carmen et al., 2022).

Yet social capital alone does not fully explain why some communities recover more effectively than others. Strong neighbourhood relationships may improve local coordination, but they cannot replace the resources, authority and technical expertise provided by formal institutions. This has redirected attention towards disaster governance. From this perspective, resilience is understood as the outcome of collaboration among communities, formal institutions and civil society organisations rather than the responsibility of a single actor (Skrimizea et al., 2021). Hybrid governance approaches have emerged from this perspective by integrating community participation with institutional planning and technical expertise (OECD, 2022). Despite these developments, studies across Southeast Asia continue to report fragmented coordination, uneven public participation and limited use of local knowledge in flood management planning (Chan et al., 2022; Pandya, 2025). These findings suggest that effective flood governance depends not only on institutional capacity but also on the quality of relationships between communities and formal institutions.

A related line of research highlights the contribution of local knowledge to community resilience. Residents exposed to recurring floods gradually develop practical understanding of local environmental conditions through repeated observation and experience. This knowledge enables communities to recognise changing flood behaviour, identify vulnerable locations and adapt their responses to local circumstances. Shared experience and local knowledge complement scientific information by providing context-specific understanding that is often unavailable through technical assessments alone (Hermans et al., 2022; Prayitno et al., 2022; Sharpe, 2021).

Evidence from Malaysia likewise shows that accumulated flood experience strengthens preparedness by helping residents anticipate risks, coordinate evacuation and organise recovery activities (Ahmad et al., 2025). Local knowledge therefore complements formal risk information by enabling residents to interpret hazards within their own environmental context.

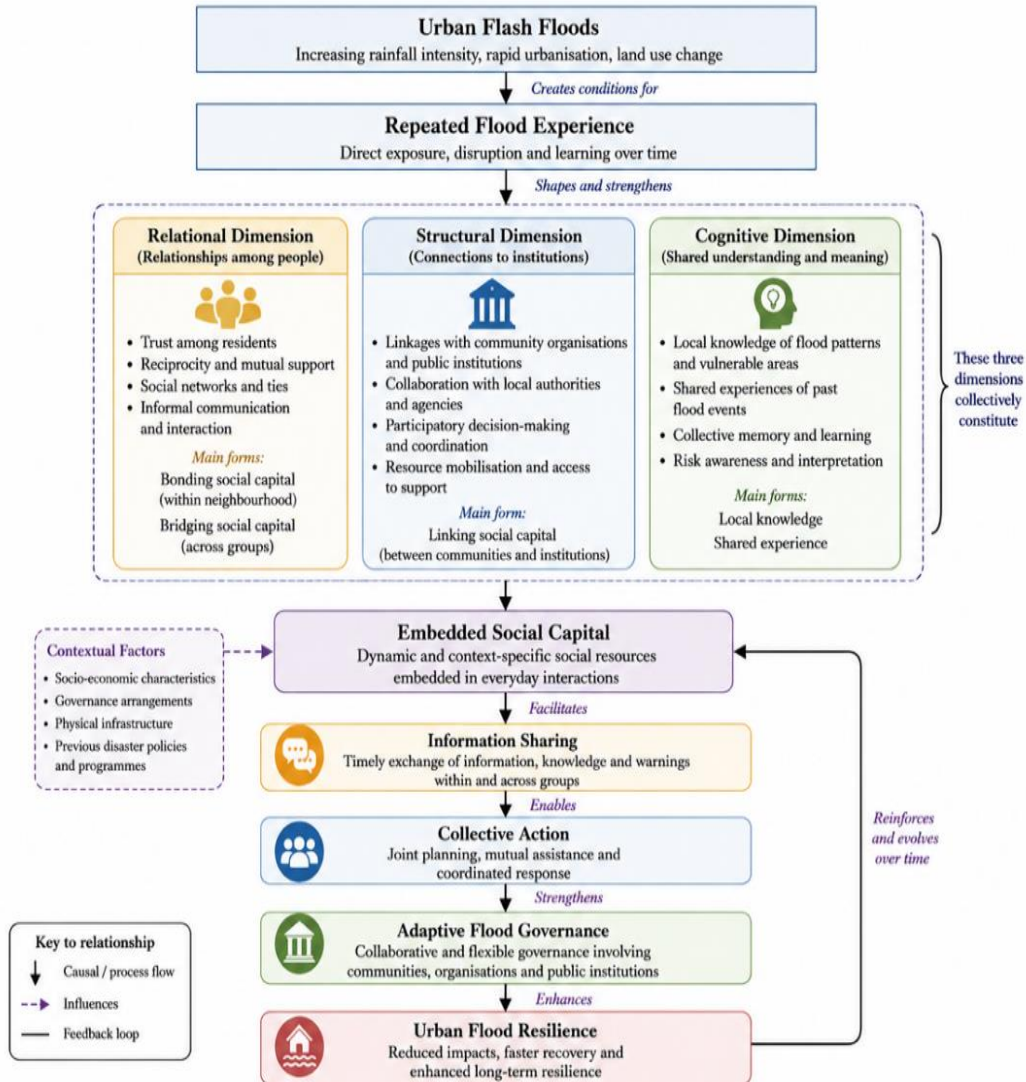
These developments have renewed interest in the concept of embedded social capital. Drawing on Granovetter's (1985) concept of embeddedness, embedded social capital suggests that trust, cooperation and reciprocity develop through repeated interaction within specific social, institutional and spatial contexts. Unlike conventional approaches that often treat social capital as a relatively stable community resource. This perspective focuses on how relationships are created, maintained and activated through everyday social practice (Bixler et al., 2021; Pazhuhan, 2023; Uekusa et al., 2022). It is particularly relevant to urban flood management because effective responses depend on sustained interaction between residents, community organisations and formal institutions. From this perspective, resilience is understood as a fixed characteristic, embedded social capital explains how communities build adaptive capacity through continuous engagement, shared experience and institutional collaboration.

Embedded social capital, however, is not without limitations. Strong neighbourhood ties often strengthen trust, cooperation and mutual support. They may also reinforce social exclusion, restrict access to external information or concentrate resources within relatively closed networks (Abunyewah et al., 2023; Zhao et al., 2025). Likewise, community networks cannot substitute for formal institutions when disaster management requires specialised expertise, financial resources or coordinated policy intervention. Recent studies instead argue that community capacity and institutional capacity are most effective when they reinforce one another within broader socio-technical systems that combine infrastructure, governance and public participation (OECD, 2022). This perspective highlights the need to balance locally embedded relationships with wider institutional connections capable of extending community capacity beyond neighbourhood boundaries.

Despite these advances, several important questions remain unanswered. Existing research continues to examine social capital largely as a broad community characteristic while paying relatively little attention to how social relationships become embedded through everyday interaction within urban governance. Empirical evidence from Southeast Asia also remains limited, particularly in secondary urban centres experiencing recurrent flash floods. Most studies focus on rural communities, post-disaster recovery or general indicators of resilience, leaving everyday urban governance less well understood (Waseem et al., 2024). In addition, relatively little research has examined how the relational, structural and cognitive dimensions of embedded social capital operate together across different phases of flood management. These limitations point to the need for research that examines how community relationships, institutional collaboration and local knowledge interact within everyday urban flood governance.

Against this background, the present study examines how embedded social capital shapes urban flash flood management in Kajang Town, Malaysia. Building on the preceding literature, the study develops a conceptual framework that integrates the relational, structural and cognitive dimensions of embedded social capital to explain how these dimensions interact to influence preparedness, emergency response and post-flood recovery. As illustrated in Figure 1, the framework illustrates that trust-based social relationships, institutional linkages and locally embedded knowledge collectively facilitate information sharing, collective action and adaptive flood governance, thereby strengthening urban flood resilience.

Rather than treating social capital as an isolated community attribute, the framework conceptualises it as a dynamic process embedded within everyday interactions between residents, community organisations and formal institutions. This framework provides the theoretical foundation for the empirical analysis and guides the interpretation of the study findings.



Source: Developed based on Granovetter, 1985, Aldrich and Meyer, 2021, Skrimizea et al., 2021 and the literature review

Figure 1. Conceptual framework of embedded social capital for urban flash flood management

Method and study area

This study adopted an interpretivist qualitative case study to examine how embedded social capital shapes urban flash flood management in Kajang Town, Selangor. The study focused on the relational, structural and cognitive dimensions of embedded social capital and explored how these

dimensions influence everyday social interaction, collective action and engagement with formal institutions. A qualitative case study was appropriate because it enabled these processes to be examined within their real-world setting (Yin, 2022).

Kajang Town was selected because it is one of the most flood-prone urban centres in the Klang Valley. Rapid urbanisation, increasing population density and changing land use have placed considerable pressure on the drainage system, resulting in frequent flash floods. Situated within the Langat River Basin and influenced by both the Langat and Jelok Rivers, the town experiences frequent flooding. Kajang Town has active neighbourhood associations, community organisations and established collaboration between residents and local authorities. These characteristics make the study area an appropriate setting for examining how embedded social capital develops through repeated flood experience and supports urban flood governance.

Participants were selected through purposive sampling based on their direct experience of flash floods and involvement in community preparedness, emergency response or local flood management (Campbell et al., 2020). The study involved ten participants, comprising six long-term residents, two community leaders, one municipal officer and one representative from a non-governmental organisation (NGO). The participants represented both community and institutional perspectives on local flood governance. In qualitative case study research, sample size is determined by information richness rather than statistical representation (Malterud et al., 2016). Interviews continued until no substantially new themes emerged, indicating that thematic saturation had been reached. Saturation was assessed when successive interviews produced no new codes or meaningful variations in the developing themes.

Fieldwork was conducted between April and June 2026 using face-to-face semi-structured interviews. The interview guide was developed from the conceptual framework presented in Figure 1 and covered trust, reciprocity, neighbourhood networks, institutional collaboration, local knowledge and collective action. Interviews were conducted in Malay and lasted between 45 and 60 minutes. With participants' consent, all interviews were audio-recorded and transcribed verbatim. Documentary sources, including municipal flood reports, local development plans, disaster management guidelines and official publications from the Kajang Municipal Council (MPKj) and the Department of Irrigation and Drainage (DID), were reviewed to provide contextual information and support the interpretation of interview findings.

The data were analysed using reflexive thematic analysis (Braun & Clarke, 2021). Analysis began with repeated reading of the transcripts, followed by inductive coding to identify patterns across participants' accounts. Related codes were grouped into broader themes. These themes were then interpreted using the relational, structural and cognitive dimensions of embedded social capital as a sensitising analytical framework. This approach allowed the themes to remain grounded in participants' experiences while maintaining consistency with the study's conceptual framework. Comparisons across interviews were used to identify both recurring patterns and contrasting perspectives.

The trustworthiness of the findings was strengthened through triangulation of interview and documentary data, member checking and an audit trail (Flick, 2022). Reflexive memos were maintained throughout the analysis to document analytical decisions and the researcher's interpretations. Ethical approval was obtained before fieldwork commenced. Participation was voluntary and all participants provided informed consent. Pseudonyms were used to protect participants' identities and confidentiality. To provide a clearer overview of the methodological procedures, Figure 2 summarises the research process adopted in this study.

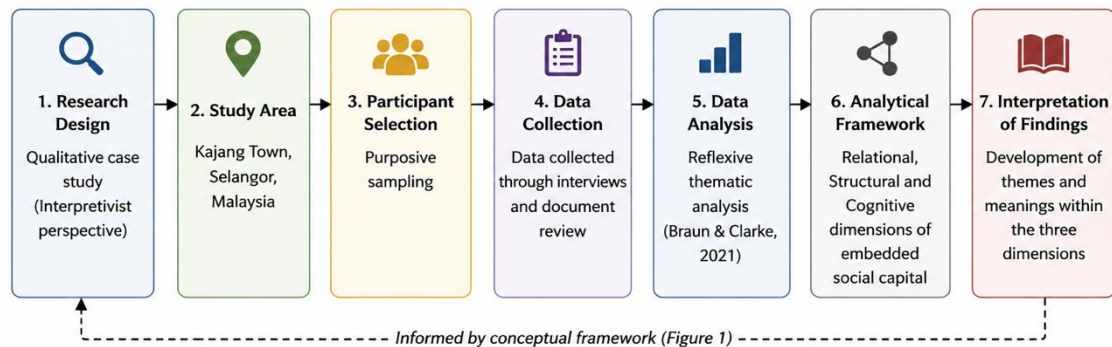


Figure 2. Overview of the research design and analytical process

Results

Participant characteristics

A total of 10 participants were purposely selected to represent key community and institutional actors involved in urban flash flood management in Kajang Town, Selangor. The sample comprised six long-term residents, two community leaders, one municipal officer and one representative from a non-governmental organisation (NGO). Together, they represented both community and institutional perspectives on flood preparedness, emergency response and recovery. The participants provided information-rich accounts across the stakeholder groups included in the study.

As shown in Table 1, participants ranged in age from 29 to 60 years and had lived or worked in Kajang for between 8 and 35 years. Participants differed in the length of time they had lived or worked in Kajang, ranging from 8 to 35 years. This variation corresponded with different levels of flood experience and familiarity with local conditions. Participants also came from diverse occupational backgrounds, including local government, community leadership, education, business and informal employment. Participants came from a range of occupational and community backgrounds, providing perspectives from different parts of local flood governance.

Although participants differed in occupation and community roles, all had experienced recurring flash floods and were familiar with local response practices. These differences provided a broad range of perspectives on neighbourhood relationships, institutional interaction and local knowledge discussed in the following sections.

Table 1. Participant characteristics

Participant	Gender	Age	Occupation	Years of residence/ work	Role
P1	Male	55	Retired	30	Resident
P2	Female	42	Teacher	18	Resident
P3	Male	38	Business owner	12	Resident
P4	Female	50	Homemaker	25	Resident
P5	Male	60	Community leader	35	Community leader
P6	Female	33	Clerk	10	Resident

P7	Male	45	NGO representative	15	NGO representative
P8	Female	29	Private sector employee	8	Resident
P9	Male	52	Municipal officer	20	Municipal officer
P10	Female	40	Food vendor	14	Resident

Source: Authors' fieldwork, 2026

Role of embedded social capital

a. Neighbourhood social networks

Neighbourhood social networks were the first source of support during flash floods in Kajang Town. Residents described these networks as part of everyday life, maintained through regular interaction with neighbours, community organisations and religious institutions. These existing relationships became especially important when flooding occurred.

Flood-related information was exchanged rapidly through neighbourhood WhatsApp groups. Residents explained that messages, photographs and videos were often shared before official warnings were issued, allowing households to prepare and respond earlier. P2 explained:

“When it rains heavily, people don't wait for official announcements. Someone will post a message, sometimes with photos or videos and within minutes everyone knows what is happening. It creates a shared sense of urgency because the information comes from people we trust.”

Residents explained that they acted quickly because the information came from people they already knew and trusted. Participants consistently linked this trust to their everyday interactions within the neighbourhood. P6 and P10 described how photographs, videos and live updates helped residents check local conditions, monitor rising water levels and identify areas that needed assistance. WhatsApp groups supported these efforts by making it easier to share information across the neighbourhood.

Face-to-face interaction remained important, particularly when flood conditions became more serious. P4 and P5 explained:

“If the situation looks serious, we go from house to house, especially for the elderly. We make sure they are aware and prepared.”

Daily encounters at neighbourhood shops, mosques and food stalls also provided opportunities to exchange information about rainfall, blocked drains and previous flood events. As P3 noted:

“We see each other almost every day at shops, at the mosque or by the roadside. It is easy to share information because everyone already knows each other.”

Residents also watched the actions of those living nearby. As P6 explained:

“When you see your neighbour moving things like a car or motorcycle, you already understand that the situation might get worse.”

Participants described these observations as informal warning signs. Seeing neighbours move vehicles or household belongings encouraged others to prepare before official warnings were received. They reported that these observations often prompted households to prepare before official warnings were issued. Participants also described differences across age groups. Long-

term residents generally preferred direct communication, while younger residents relied more on digital platforms. P8 explained:

“Even when I am working in the city, I can monitor the situation at home through messages. It makes me feel connected and prepared even from a distance.”

Despite these differences, participants used both digital communication and face-to-face interaction. Online platforms were commonly used to exchange information quickly, while face-to-face communication remained important for confirming local conditions and coordinating assistance. Participants described these networks as helping residents exchange information quickly, organise assistance and respond to changing flood conditions.

b. Trust and reciprocity

Trust and reciprocity shaped how residents responded to flash floods in Kajang Town. Interviewees described trust and reciprocity as developing through everyday interaction rather than during emergencies. Helping neighbours, sharing responsibilities and responding quickly were regarded as normal community practices whenever flood risks increased.

Residents often acted without waiting for instructions from local authorities or community leaders. Having experienced repeated floods, many residents already knew who needed assistance and what should be done. As P1 explained:

“During floods, we don't wait for instructions. People already know what to do because we trust each other. If someone needs help, we respond without thinking twice.”

Similar views were expressed by P4, P5 and P10, who described flood response as a collective effort based on familiarity with local conditions and previous flood experience. They explained that residents often organised assistance before official support arrived.

Many interviewees associated trust with years of living in the same neighbourhood. P5 explained:

“Most of us have lived here for many years. We have gone through many floods together. That experience builds trust; it is not something that can be created quickly. When another flood comes, we already know who will need help and who we can depend on.”

P1 and P4 also described how repeated flood experience increased confidence in one another and encouraged collective action.

Reciprocity was also part of everyday community life. Helping others was seen as a responsibility rather than an exceptional act. As P2 explained:

“Helping each other is not just a necessity, it is about caring. When you see your neighbour struggling, you feel responsible to help.”

Support included sharing food, helping with post-flood clean-up, checking on older residents and offering temporary shelter. Assistance often extended beyond family members and close friends. As P6 noted:

“Even if we are not very close, people will still help. There is a shared understanding that everyone is facing the same risk.”

Participants explained that assistance often extended beyond close friends and family members, even where strong personal relationships did not exist.

Residents and organisational representatives described trust from different perspectives. Residents associated trust with helping one another during floods, whereas organisational representatives linked trust to coordination. As P7 explained:

“In areas where trust is strong, coordination is much easier. People don't question instructions or hesitate to cooperate.”

P9 also observed that neighbourhoods with stronger social relationships coordinated flood management activities more smoothly. Reciprocity continued beyond individual flood events. Participants described mutual assistance as creating an expectation that support would be returned when needed. As P10 explained:

“People help without expecting anything immediately, but there is an understanding that if you help today, someone will help you in the future.”

P2 and P4 expressed similar views. Residents described mutual assistance as an ongoing part of community life that continued after floodwaters had receded and remained important during subsequent flood events.

c. Shared local knowledge

Local knowledge was an important source of information for residents preparing for flash floods in Kajang Town. Years of experience with recurring floods helped residents recognise early signs of rising water and decide when to take action. Instead of depending solely on official warnings, they combined weather forecasts with their own observations of local conditions.

Several residents described prolonged rainfall, muddy river water, overflowing drains and traffic congestion as signs that flooding was becoming more likely. These observations were used to decide when to move belongings, relocate vehicles and begin preparing for possible flooding. As P5 explained:

“After experiencing so many floods, we know when the situation is becoming dangerous. We can usually recognise the signs before any official warning is issued. Once the drains start overflowing and the river turns muddy, we know it is time to prepare. By then, most families have already started moving their belongings to higher places.”

P1 and P6 reported similar experiences. They explained that these observations allowed residents to move vehicles, protect household belongings and assist older neighbours before floodwaters reached residential areas. Participants also described early preparation as helping households respond more calmly when floodwaters began to rise.

This experience was passed from one resident to another through everyday conversations. Long-term residents regularly advised newcomers about roads that flooded first, safer routes and places to avoid during heavy rainfall. As P8 explained:

“People who have lived here longer will always tell newcomers which roads flood first and where it is safer to move during heavy rain. They also explain which areas should be avoided because the water rises much faster there.”

P2 and P10 described learning in the same way. Newer residents learned through conversations with neighbours, observing how others responded and taking part in community activities. These experiences helped them become familiar with local flood conditions. Over time, participants explained that these interactions helped newer residents become more familiar with local flood patterns.

Residents also used local information to make decisions during flood events. Updates from people already in affected areas helped identify flooded roads, safe routes and places where assistance was needed. These updates often reached nearby residents before official announcements were available. As P9 and P7 explained:

“Sometimes local information is more useful because people can immediately tell us which roads are already flooded and which routes are still safe. We trust those updates because they come from people who are actually on the ground. That helps us decide more quickly where to send our response teams.”

P9 noted that this information was also useful to the local council, particularly when flood conditions changed quickly and official information was still limited. P9 reported that this information helped the local council identify priority locations and deploy assistance more efficiently. Participants described local knowledge as complementing official information during the early stages of flood response.

Residents described local knowledge as developing through repeated flood experience and everyday interaction with neighbours. Information continued to be shared before, during and after flood events, and many participants regarded these exchanges as part of everyday community life.

d. Community–institutional collaboration

Flood response in Kajang Town depended on cooperation between residents, community organisations and local authorities. Residents often responded first, while formal institutions coordinated rescue, relief and recovery activities. This pattern of cooperation had developed through repeated flood events and was familiar to residents living in flood-prone neighbourhoods. Many participants described this pattern of cooperation as part of their normal response whenever flash floods occurred.

Residents monitored local conditions, checked on vulnerable households and shared information with local authorities. These updates helped emergency responders identify affected locations and prioritise assistance. As P9 explained:

“Local residents usually know which areas are affected first because they experience the situation directly. Their information helps us respond more quickly and prioritise the areas that need immediate attention.”

Several residents explained that local information was often available before official updates, particularly when flood conditions changed rapidly. Participants described using this information to prepare before emergency services arrived.

Community leaders and non-governmental organisations linked neighbourhoods with formal institutions. They communicated local needs, organised volunteers and helped distribute relief. As P7 explained:

“Our role is to connect the community with the authorities. We help communicate local needs and organise volunteers so that assistance reaches the right people. We also make sure that no affected family is overlooked during the response.”

P4 and P8 shared similar experiences. Information delivered through community leaders was generally well accepted because residents already knew and trusted them.

Local authorities were not always able to reach every affected area immediately. During this period, neighbours helped move belongings, checked on older residents and assisted families waiting for emergency services. As P6 explained:

“We understand that the authorities cannot reach every place immediately, so the community helps first until assistance arrives.”

Residents described these early actions as part of their usual response while waiting for emergency services to arrive.

Participants reported that repeated flood events changed how communities and local agencies worked together. Both sides became more familiar with each other's roles, making coordination easier during subsequent floods. As P10 explained:

“Every flood teaches us how to work better together. The community and the agencies understand each other much better now than before. Now we already know who to contact and how to coordinate when the flood starts.”

P2 and P9 shared similar views, noting that previous flood experience made communication smoother because residents and local agencies had become more familiar with each other's roles.

Participants consistently described cooperation between residents, community organisations and local authorities as a routine part of flood response in Kajang Town. They explained that information was shared early, local needs were communicated quickly and assistance was organised while emergency services were responding.

Discussion

Embedded social capital was evident throughout the flood experiences described by participants in Kajang Town. Relationships built through daily interaction, repeated flood exposure and long-term residence shaped how residents shared information, organised assistance and interacted with local institutions. These findings are consistent with recent studies showing that social capital develops through everyday interaction and becomes an important resource during disasters (Abunyewah et al., 2023; Liu et al., 2024).

Neighbourhood social networks formed the basis of local flood response. Residents relied on face-to-face interaction alongside WhatsApp groups to exchange information on rainfall, drainage conditions and affected locations. Similar patterns have been reported in recent studies showing that neighbourhood communication networks improve situational awareness and support faster community responses during flood events (Chen et al., 2024; Flecha et al., 2023). In Kajang Town, these networks also helped residents to identify priority areas and organise assistance before emergency responders arrived. This finding supports recent qualitative evidence that communities with strong local networks are better able to coordinate actions during rapidly changing flood conditions (Curtis et al., 2024; Liu et al., 2024).

Trust and reciprocity were closely linked to repeated interaction and shared flood experience. Residents described helping one another without waiting for formal instructions because they already knew who required assistance and who could provide support. This is consistent with Nguyen-Trung et al. (2024), who argue that trust develops through ongoing interaction and shared experience rather than existing as a fixed community attribute. Similar patterns have also been reported in Ghana (Abunyewah et al., 2023) and Iran (Savari et al., 2024), where social capital significantly improved flood preparedness and community resilience. Although previous research has cautioned that tightly bonded networks may exclude less-connected groups or reduce access to external resources (Abunyewah et al., 2023; Zhao et al., 2025), such patterns were not prominent in Kajang Town. This finding indicates that the effects of embedded social capital depend on local social and institutional conditions.

Local knowledge represented another important resource for flood management. Repeated exposure enabled residents to recognise flood-prone locations, interpret environmental cues and anticipate changing flood conditions before official warnings were issued. Instead of replacing

scientific information, residents combined their local experience with weather forecasts and government warning systems when deciding how to respond. Similar findings have been reported in recent disaster studies, where experiential knowledge complements formal risk information and improves household preparedness and adaptive decision-making (Liu et al., 2024; Xiong & Li, 2024). Knowledge was also shared through everyday interaction, allowing newer residents to learn from neighbours with longer flood experience and maintaining preparedness across the community.

Collective action grew from these established social relationships. Residents organised evacuations, transported vulnerable neighbours, shared food and equipment, and participated in post-flood clean-up through existing neighbourhood networks. These activities did not depend solely on formal emergency coordination but reflected relationships that had developed long before flooding occurred. Similar observations have been reported by Abunyewah et al. (2023), who found that collective social capital increased both flood preparedness and community resilience. Digital communication, particularly WhatsApp, further improved coordination by allowing requests for assistance and local updates to circulate quickly. Digital communication appeared to reinforce existing social relationships rather than replace them, a pattern also reported by Chen et al. (2024).

The findings also point to the complementary roles of communities and formal institutions. Formal institutions remained responsible for emergency coordination, technical expertise and resource mobilisation, while residents contributed local knowledge, early action and rapid communication. Community leaders, NGOs and local officials connected these different actors by communicating local needs, coordinating volunteers and supporting relief distribution. Similar conclusions have been reached in recent resilience research, which argues that effective disaster governance depends on cooperation between local communities and formal institutions rather than relying on either one independently (Liu et al., 2024).

This study contributes to disaster resilience research by showing how embedded social capital supports urban flood management through everyday social relationships. Communication, trust, local knowledge and collective action developed through everyday interaction before flood events occurred. These relationships supported community responses when flooding took place. Recent resilience research similarly argues that investment in social networks, community participation and collaboration with formal institutions should complement structural measures if cities are to strengthen long-term flood resilience (Liu et al., 2024; Xiong & Li, 2024). Although this study is based on a single case, the processes observed in Kajang Town may provide useful insights for other rapidly urbanising communities experiencing recurrent flash floods.

Conclusion

This study examined the role of embedded social capital in urban flash flood management in Kajang Town, Malaysia. Everyday relationships, repeated flood experience and long-term residence shaped how residents exchanged information, organised assistance and interacted with local institutions during flood events. Neighbourhood social networks, trust, local knowledge, collective action and community-institutional collaboration were closely connected and supported timely responses to recurring floods. These findings highlight that urban flood resilience depends not only on physical infrastructure and emergency planning but also on the social relationships that enable communities to respond collectively.

The findings suggest that embedded social capital functions as a form of urban risk infrastructure. Unlike physical infrastructure, it develops through routine interaction, shared experience and continued cooperation within the community. These social relationships supported communication, mutual assistance, knowledge sharing and coordination between residents and formal institutions during different stages of flood management. Viewing embedded social capital in this way broadens discussions of urban flood governance by recognising social relationships as part of local disaster capacity.

The findings also have practical implications for flood governance. Strengthening neighbourhood communication, supporting community organisations and incorporating local knowledge into flood planning can improve coordination between residents and public agencies. These measures should complement structural flood mitigation and emergency management while contributing to Sustainable Development Goal 11 (Sustainable Cities and Communities) and Sustainable Development Goal 13 (Climate Action). The study draws on evidence from a single qualitative case study in Kajang Town. Rather than treating embedded social capital as a background community characteristic, this study demonstrates its operational role in supporting communication, coordination and collective action during urban flash floods. Comparative research across different cities and governance settings would help clarify how embedded social capital operates under different social and environmental conditions. Longitudinal studies would also provide a better understanding of how social relationships evolve over time and influence community resilience before, during and after disasters.

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References

- Abunyewah, M., Erdiaw-Kwasie, M. O., Okyere, S. A., Thayaparan, G., Byrne, M., Lassa, J., Zander, K. K., Fatemi, M. N., & Maund, K. (2023). Influence of personal and collective social capital on flood preparedness and community resilience: Evidence from Old Fadama, Ghana. *International Journal of Disaster Risk Reduction*, 94, 103790.
- Ahmad, N., Ng, C. P., Ismail, N., Wong, M. M. R., Abbas, F., Law, T. H., Bahari, A. N. A. Z., & Mohd Rofi, M. F. (2025). A review of major flood events in Malaysia between 1970–2024. *Jurnal Kejuruteraan*, 37(2), 909–921.
- Aldrich, D. P., & Meyer, M. A. (2021). Social capital and community resilience. *American Behavioral Scientist*, 59(2), 254–269.
- Bari, A., Alam, L., Alam, M. M., Rahman, L. F., & Pereira, J. J. (2021). Estimation of losses and damages caused by flash floods in the commercial area of Kajang, Selangor, Malaysia. *Arabian Journal of Geosciences*, 14(3), 195.
- Behera, J. K. (2023). Role of social capital in disaster risk management: A theoretical perspective in special reference to Odisha, India. *International Journal of Environmental Science and Technology*, 20(3), 3385–3394.

- Bixler, R. P., Paul, S., Jones, J., Preisser, M., & Passalacqua, P. (2021). Unpacking adaptive capacity to flooding in urban environments: Social capital, social vulnerability, and risk perception. *Frontiers in Water*, 3, 728730.
- Braun, V., & Clarke, V. (2021). *Thematic Analysis: A Practical Guide*. SAGE Publications.
- Campbell, S., Greenwood, M., Prior, S., Shearer, T., Walkem, K., Young, S., Bywaters, D., & Walker, K. (2020). Purposive sampling: Complex or simple? Research case examples. *Journal of Research in Nursing*, 25(8), 652–661.
- Carmen, E., Fazey, I., Ross, H., Bedinger, M., Smith, F. M., Prager, K., McClymont, K., & Morrison, D. (2022). Building community resilience in a context of climate change: The role of social capital. *Ambio*, 51(6), 1371–1387.
- Chan, F. K. S., Yang, L. E., Mitchell, G., Wright, N., Guan, M., Lu, X., Wang, Z., Montz, B., & Adekola, O. (2022). Comparison of sustainable flood risk management by four countries—the United Kingdom, the Netherlands, the United States, and Japan and the implications for Asian coastal megacities. *Natural Hazards and Earth System Sciences*, 22(8), 2567–2588.
- Chen, X., Huang, R., Zhang, X., Zhang, Y., Yu, Y., Otaki, T., & Shaw, R. (2025). Synergies and gaps in ESG, climate disasters, and social inequality: A literature review. *Climate*, 13(12), 241–262.
- Chen, Y., Lui, H., Lin, S., Wang, Y., Zhang, Q., & Feng, L. (2024). The impact of social capital on community resilience: A comparative study of seven flood-prone communities in Nanjing, China. *Land*, 13(8), 1145–1160.
- Curtis, A. G., Allred, S. B., Murphy, R. C., & Roberts, B. A. (2024). Exploring the role of social capital in community flood resiliency in Binghamton, NY. *International Journal of Disaster Risk Reduction*, 104, 104322.
- Department of Irrigation and Drainage Malaysia (DID). (2023). Flood management—Programme and activities. Ministry of Energy Transition and Water Transformation. <https://www.water.gov.my/index.php/pages/view/419>
- Flecha, A. C., Bandeira, R. A., Campos, V. B. G., Silva, A. V. C., & Leiras, A. (2023). Social network analysis in disaster management. *Production*, 33, e20220046.
- Flick, U. (2022). *An Introduction to Qualitative Research*. SAGE Publications.
- Fox, A., Ziervogel, G., & Scheba, S. (2023). Strengthening community-based adaptation for urban transformation: Managing flood risk in informal settlements in Cape Town. *Local Environment*, 28(7), 837–851.
- Granovetter, M. (1985). Economic action and social structure: The problem of embeddedness. *American Journal of Sociology*, 91(3), 481–510.
- Hamdy, O., Abdelhafez, M. H. H., Touahmia, M., Alshenaifi, M., Noaime, E., Elkhayat, K., et al. (2023). Simulation of urban areas exposed to hazardous flash flooding scenarios in Hail City. *Land*, 12(2), 353. <https://doi.org/10.3390/land12020353>
- Hermans, T. D., Šakić Trogrlić, R., van den Homberg, M. J., Bailon, H., Sarku, R., & Mosurska, A. (2022). Exploring the integration of local and scientific knowledge in early warning systems for disaster risk reduction: A review. *Natural Hazards*, 114(2), 1125–1152.
- Liu, L., Cao, X., Li, S., & Jie, N. (2024). A 31-year (1990–2020) global gridded population dataset generated by cluster analysis and statistical learning [Dataset]. *Scientific Data*, 11(1), 124.
- Malterud, K., Siersma, V. D., & Guassora, A. D. (2016). Sample size in qualitative interview studies: Guided by information power. *Qualitative Health Research*, 26(13), 1753–1760.

- Muhamad, N., & Shaidin, H. A. (2022). The assessment of flood events in Selangor, Malaysia. *Journal of Advanced Geospatial Science and Technology*, 2(2), 42–55.
- Nguyen-Trung, K., Uekusa, S., & Matthewman, S. (2024). Locked into a permanent position of vulnerability? Farmers' trust and social capital with the government from critical disaster studies perspectives. *Natural Hazards*, 120(5), 4463–4483.
- Nicholas, J. P., Donovan, A., Oppenheimer, C., Bell, L., & Van Wyk de Vries, M. (2026). How trust shapes individual resilience to natural hazards: A systematic review. *Natural Hazards*, 122(2), 1–27.
- OECD. (2022). Global outlook on financing for sustainable development 2023: No sustainability without equity. OECD Publishing.
- Pandya, V. (2025). Disaster governance: Evolution, measurement, determinants, and future directions. *International Journal of Business and Administration Research Review*, 12(3), 10–22.
- Pazhuhani, M., Amirzadeh, M., Värnik, R., Pietrzykowski, M., Lopez-Carr, D., & Azadi, H. (2023). The impact of social capital on the resilience of flood-prone communities: The case study of northern Iran. *Environmental Development*, 48, 100902.
- Prayitno, G., Hayat, A., Efendi, A., Auliah, A., & Dinanti, D. (2022). Structural model of community social capital for enhancing rural communities' adaptation against the COVID-19 pandemic: Empirical evidence from Pujon Kidul tourism village, Malang Regency, Indonesia. *Sustainability*, 14(19), 12949.
- Rahman, M. M., & Wong, S. F. (2020). Effectiveness of flood barriers and levees in Malaysia: A case study. *Journal of Flood Risk Management*, 13(3), e12568.
- Rosmadi, H. S., Ahmed, M. F., Mokhtar, M. B., & Lim, C. K. (2023). Reviewing challenges of flood risk management in Malaysia. *Water*, 15(13), 2393.
- Saad, M. S. H., Ali, M. I., Razi, P. Z., Ramli, N. I., & Doh, S. I. (2025). Strategic identification of flash flood risk in Malaysian construction: Integrating stakeholder perspective for enhanced resilience in pre-construction and construction phases. *Construction*, 5(1), 39–55.
- Sabihin, N. A., & Talib, I. F. A. (2024). Damages and losses on critical infrastructure from flooding in Kajang using PLS-SEM. *Journal of Water Resources Management*, 2(2), 1–11.
- Savari, M., Jafari, A., & Sheheytavi, A. (2024). The impact of social capital to improve rural households' resilience against flooding: Evidence from Iran. *Frontiers in Water*, 6, 1393226.
- Shah, A. A., Khan, A., Ullah, A., Khan, N. A., & Alotaibi, B. A. (2024). The role of social capital as a key player in disaster risk comprehension and dissemination: Lived experience of rural communities in Pakistan. *Natural Hazards*, 120(5), 4131–4157.
- Sharpe, J. (2021). Learning to trust: Relational spaces and transformative learning for disaster risk reduction across citizen-led and professional contexts. *International Journal of Disaster Risk Reduction*, 61, 102354.
- Skrimizea, E., Bakema, M., McCann, P., & Parra, C. (2021). Disaster governance and institutional dynamics in times of social-ecological change: Insights from New Zealand, the Netherlands and Greece. *Applied Geography*, 136(2), 102578.
- Sun, Y., Weightman, R., Shi, A., Dogan, T., & Samaranayake, S. (2025). A review of urban resilience frameworks: Transferring knowledge to enhance pandemic resilience. *Urban Resilience and Sustainability*, 3(4), 271–292.

- Uekusa, S., Matthewman, S., & Lorenz, D. F. (2022). Conceptualising disaster social capital: What it is, why it matters, and how it can be enhanced. *Disasters*, 46(1), 56–79.
- United Nations Office for Disaster Risk Reduction (UNDRR). (2023). Global assessment report on disaster risk reduction 2023. United Nations. <https://www.undrr.org>
- Xiong, A., & Li, Y. (2024). The role of social capital in building community disaster resilience: Empirical evidences from rural China. *International Journal of Disaster Risk Reduction*, 110, 104623.
- Xu, C., Liu, W., Zhang, S., Wu, H., & Ju, M. (2026). Research on the socio-spatial resilience evaluation and evolution of the central area of Chengdu in transitional China. *Scientific Reports*, 16, 11427.
- Yin, R. K. (2022). *Case Study Research and Applications: Design and Methods*. SAGE Publications.
- Zhao, G., Hui, X., Zhao, F., Feng, L., Lu, Y., & Zhang, Y. (2025). How does social capital facilitate community disaster resilience? A systematic review. *Frontiers in Environmental Science*, 12, 1496813.