Networks of adaptation: Local and translocal social capital as drivers of community adaptive capacity towards coastal hazards in Indonesia

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Summary

Environmental change and natural hazards present significant challenges to urban coastal communities worldwide, particularly in the Global South. These regions often face the dual constraints of limited state action and insufficient financial and human capital, which can exacerbate the vulnerabilities of these communities to environmental threats. In the face of these challenges, the importance of household and community-level adaptation strategies becomes increasingly evident. Such strategies are vital for immediate response to environmental hazards and play a crucial role in the longer-term sustainability and resilience of urban coastal communities.

Social networks and social capital are central to the effectiveness of community-based adaptive strategies. Social capital enables collective action and resource sharing through the networks of relationships among people who live and work in a particular society. It plays a central role in reducing vulnerability and enhancing the resilience of communities by offsetting limitations in financial and human capital. When governmental support and resources are scarce, the bonds within communities, the ability to mobilize collective action, and sharing knowledge and resources become invaluable assets. These community-driven responses, underpinned by strong social capital, can significantly contribute to mitigating the impacts of environmental change and natural hazards, demonstrating the power of localized resilience in the face of global challenges.

Urban communities in the Global South face increasing challenges from coastal hazards, a pressing issue explored in this dissertation through the lens of social network theory and community-based coastal adaptation. This thesis addresses the intricate role of social network structure and dynamics in disaster resilience, focusing on flood-prone urban coastal areas in Indonesia, specifically Padang, Denpasar, and Semarang, as well as Indonesian migrant communities in Europe.

The thesis combines the socio-spatial and institutional contexts of social capital, demonstrating how the structure and dynamics of social networks contribute to a community's adaptive capacity. First, the thesis examines the interplay between local and translocal social networks in urban coastal communities, exemplified by the Indonesian cities Padang and Denpasar. Here, the results reveal a complementary relationship: While local networks provide immediate, practical support during disasters, translocal networks are more likely to provide emotional and financial support. This complementary nature of support systems highlights social capital's multifaceted and dynamic nature in shaping long-term adaptive strategies.

Next, the experiences of Indonesian migrant communities in Europe offer a deep focus on the translocal perspective, illustrating how translocal networks activate diverse forms of support, from practical aid to psychosocial assistance, in response to hazard events in Indonesia. This aspect of the research broadens the understanding of social network dynamics, revealing how migrant communities, though geographically distant, remain integrally connected and influential in hazard response strategies.

Finally, in Semarang, the study explores how community leaders, integral to local social networks, are crucial in mobilizing resources and facilitating collective action in the face of flood events. Their role as

network brokers underscores the significance of social capital embedded in local contexts and its vital role in fostering community resilience.

By integrating these various dimensions of social networks, the dissertation constructs a comprehensive framework highlighting the interdependence of the socio-spatial and institutional contexts that shape social networks, community dynamics, effective leadership, and individual agency. It demonstrates that effective adaptation to coastal hazards is not solely dependent on local contexts but is significantly influenced by the diversity of social networks spanning across social and administrative boundaries. The thesis concludes by offering insights for policy, practice, and future research, emphasizing the need for coastal adaptation strategies that are as dynamic and multifaceted as the social networks they aim to support.

Zusammenfassung

Umweltveränderungen und Naturgefahren stellen Küstengemeinden weltweit vor große Herausforderungen, insbesondere im globalen Süden. Diese Regionen sehen sich häufig mit den doppelten Einschränkungen begrenzter staatlicher Maßnahmen und unzureichendem Finanz- und Humankapital konfrontiert, was die Anfälligkeit dieser Gemeinschaften für Umweltbedrohungen noch verschärfen kann. Angesichts dieser Herausforderungen wird die Bedeutung von Anpassungsstrategien auf Haushalts- und Gemeindeebene immer deutlicher. Solche Strategien sind nicht nur für die unmittelbare Reaktion auf Umweltgefahren unerlässlich, sondern spielen auch eine entscheidende Rolle für die langfristige Nachhaltigkeit und Widerstandsfähigkeit städtischer Küstengemeinden.

Soziale Netzwerke und soziales Kapital sind von zentraler Bedeutung für die Wirksamkeit gemeinschaftsbasierter Anpassungsstrategien. Soziales Kapital ermöglicht kollektives Handeln und die gemeinsame Nutzung von Ressourcen durch die Beziehungsnetze zwischen Menschen, die in einer bestimmten Gesellschaft leben und arbeiten. Es spielt eine zentrale Rolle bei der Verringerung der Anfälligkeit und der Stärkung der Widerstandsfähigkeit von Gemeinschaften, indem es die Einschränkungen des Finanz- und Humankapitals ausgleicht. Wenn staatliche Unterstützung und Ressourcen knapp sind, werden die Bindungen innerhalb von Gemeinschaften, die Fähigkeit, kollektive Maßnahmen zu mobilisieren, und die gemeinsame Nutzung von Wissen und Ressourcen zu unschätzbaren Vorteilen. Diese von der Gemeinschaft ausgehenden Maßnahmen, die durch ein starkes Sozialkapital untermauert werden, können erheblich dazu beitragen, die Auswirkungen von Umweltveränderungen und Naturgefahren abzumildern, und zeigen wie stark die lokale Widerstandsfähigkeit angesichts globaler Herausforderungen ist.

Urbane Gemeinschaften im Globalen Süden sehen sich mit zunehmenden Herausforderungen durch Küstengefahren konfrontiert. Dieses drängende Problem wird in dieser Dissertation mit Hilfe von sozialer Netzwerktheorie und gemeinschaftsbasierter Küstenanpassung untersucht. Diese Arbeit befasst sich mit der komplexen Rolle der Struktur und Dynamik sozialer Netzwerke für die Katastrophenresilienz und konzentriert sich auf überschwemmungsgefährdete städtische Küstengebiete in Indonesien, insbesondere Padang, Denpasar und Semarang, sowie auf indonesische Migrantengemeinschaften in Europa.

Die Dissertation verbindet den sozialräumlichen und institutionellen Kontext des Sozialkapitals und zeigt, wie die Struktur und Dynamik sozialer Netzwerke zur Anpassungsfähigkeit einer Gemeinschaft beitragen. Zunächst untersucht die Arbeit das Zusammenspiel zwischen lokalen und translokalen sozialen Netzwerken in städtischen Küstengemeinden am Beispiel der indonesischen Städte Padang und Denpasar. Hier zeigen die Ergebnisse eine komplementäre Beziehung auf: Während lokale Netzwerke bei Katastrophen unmittelbare, praktische Unterstützung bieten, sind translokale Netzwerke eher eine Quelle für emotionale und finanzielle Unterstützung. Diese Komplementarität der Unterstützungssysteme verdeutlicht die vielschichtige und dynamische Natur des Sozialkapitals bei der Gestaltung langfristiger Anpassungsstrategien.

Die Erfahrungen indonesischer Migrantengemeinschaften in Europa bieten einen vertieften Einblick in die translokale Perspektive und veranschaulichen, wie translokale Netzwerke verschiedene Formen der Unterstützung – von praktischer Hilfe bis hin zu psychosozialer Unterstützung – als Reaktion auf Gefahrenereignisse in Indonesien aktivieren. Dieser Aspekt der Forschung erweitert das Verständnis der Dynamik sozialer Netzwerke und zeigt, wie Migrantengemeinschaften, obwohl sie geografisch weit voneinander entfernt sind, in den Strategien zur Gefahrenabwehr eng miteinander verbunden und einflussreich bleiben.

In Semarang schließlich untersucht die Dissertation, wie Community Leader bei der Mobilisierung von Ressourcen und der Erleichterung kollektiver Maßnahmen angesichts von Überschwemmungsereignissen eine entscheidende Rolle spielen. Ihre Rolle als Netzwerkbroker und integraler Bestandteil lokaler sozialer Netzwerke unterstreicht die Bedeutung des in lokale Kontexte eingebetteten Sozialkapitals und seine entscheidende Rolle bei der Förderung der Resilienz von Gemeinschaften.

Durch die Integration dieser verschiedenen Dimensionen sozialer Netzwerke wird in der Dissertation ein umfassender Rahmen geschaffen, der die Interdependenz der sozialräumlichen und institutionellen Kontexte hervorhebt, die soziale Netzwerke, Gemeinschaftsdynamik, effektive Führung und individuelles Handeln prägen. Es wird gezeigt, dass eine wirksame Anpassung an Küstengefahren nicht nur von lokalen Kontexten abhängt, sondern maßgeblich von der Vielfalt sozialer Netzwerke beeinflusst wird, die soziale und administrative Grenzen überspannen. Die Arbeit schließt mit Erkenntnissen für Politik, Praxis und künftige Forschung und unterstreicht die Notwendigkeit von Anpassungsstrategien für die Küstengebiete, die ebenso dynamisch und vielschichtig sind wie die sozialen Netzwerke, die sie unterstützen sollen.

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List of abbreviations and Indonesian terms

Arisan	Communal rotating savings and credit association
BNPB	*Badan Nasional Penanggulangan Bencana* (National Disaster Management Agency)
BPBD	*Badan Penanggulangan Bencana Daerah* (Regional Disaster Management Agency
BPS	*Badan Pusat Statistik* (National Bureau of Statistics)
CO	Informal community organizations
DAAD	German Academic Exchange Service
EU	European Union
FA	Fishermen association
Gotong Royong	Communal works
ICT	Information and communications technology
IDR	Indonesian rupiah
IPCC	Intergovernmental Panel on Climate Change
Kecamatan	Sub-district
KEL	*Kelurahan* (Urban village)
Kerja Bakti	Community service
Kota	City / Municipality
KSB	*Kelurahan Siaga Bencana* (Disaster Preparedness Group)
LPMK	*Lembaga Pemberdayaan Masyarakat Kelurahan* (Village Community Empowerment Agency)
Merantau	West Sumatran tradition of migration for entrepreneurial activities
Musrenbang	*Musyawarah Rencana Pembangunan* (Development Plan Deliberation)
NGO	Non-governmental organization
OR	Odds ratio
PI	Principal investigator
PM	Project manager
PKK	*Pemberdayaan Kesejahteraan Keluarga* (Family Welfare Empowerment)
Puskesmas	*Pusat Kesehatan Masyarakat* (Community health center)

RQ	Research Question
RT	*Rukun Tetangga* (Neighborhood association)
RW	*Rukun Warga* (Citizens association)
SNA	Social Network Analysis
UNDIP	Universitas Diponegoro Semarang
UNDRR	United Nations Office for Disaster Risk Reduction
UNP	Universitas Negeri Padang
UNUD	Universitas Udayana Denpasar
VIF	Variance Inflation Factor

1. Introduction

In the face of increasing exposure and vulnerability to natural hazards and environmental change, coastal regions worldwide are confronted with unprecedented challenges (Birkmann et al. 2022; Wong 2014). Natural hazards describe natural processes or phenomena that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage (UNDRR 2016). A significant portion of the global population resides in urban coastal areas experiencing rapid, often unmanaged urban expansion (Birkmann et al. 2022; Dewi et al. 2023). By 2060, the global population in low-elevation coastal zones is expected to be more than one billion (Hauer et al. 2021; Neumann et al. 2015). This expansion, particularly pronounced in the densely populated coastal cities of the Global South, is driven by population and economic growth and an increased demand for resources (Sterzel et al. 2020). Such growth alters coastal environments fundamentally and exacerbates existing socio-economic and environmental vulnerabilities, making adaptation efforts more challenging (Muis et al. 2015; Sterzel et al. 2020). During the 21st century, damages from coastal floods are expected to increase significantly as sea levels rise and socioeconomic development increases the number of people and assets exposed in coastal floodplains (Hinkel et al. 2014).

McGranahan et al. (2007) highlight the acute vulnerability of populations in low-lying coastal areas, where economic activities are highly concentrated. The situation is further complicated by the inadequate technical and financial capacities of national and local governments in the Global South to address critical issues such as urban flooding, a prevalent problem in these rapidly urbanizing settings (Schaer & Hanonou 2017). Insufficient state resources and weak infrastructure in many countries of the Global South have created a substantial need for local communities and civil society to become active in addressing the impacts of natural hazards in coastal regions (Amoako 2018; Bénit-Gbaffou & Katsaura 2014). These challenges highlight the urgent need for effective adaptation strategies to safeguard both lives and livelihoods. The potential of civil society to mobilize and drive social change in response to these challenges is significant, especially where state interventions are limited or insufficient (Bénit-Gbaffou & Katsaura 2014). However, the success of any intervention, whether from the state or civil society, depends on a deep understanding of local social structures. Without this understanding, even well-intentioned top-down measures may fail, further endangering the very communities they aim to protect (Wilkin et al. 2019).

The recognition of social networks' role in shaping community adaptation is central to addressing the challenges created by natural hazards. A social network is a complex set of relationships among members of social systems, such as families, neighbors, local organizations, and associated governance structures (see Barnes et al. 2016; Borgatti et al. 2009; Borgatti et al. 2018). These social networks serve as conduits for information and resources and as the backbone of collective action and support systems in times of crisis (Dapilah et al. 2019; Misra et al. 2017). The role of social networks, encompassing informal community ties and formal civic organizations, becomes a crucial element of investigation, as these networks can mobilize resources, disseminate critical information, and foster

collective action for hazard responses (Bott & Braun 2019; MacGillivray 2018). In this thesis, "community" refers to a group of people living in the same neighborhood who typically have personal relationships with one another and share common views and narratives about their environment. Communities create identity and link their members through shared values and norms. Community membership allows people to organize activities and resources collectively, enhancing their ability to protect themselves from external threats (see Chapter 11; Murphy 2007; Norris et al. 2008).

However, the efficacy of social networks in enhancing adaptive capacities is not uniform but highly influenced by their structure and dynamics (see Adger 2003; Chaudhury et al. 2017; Entwisle et al. 2007). Network structure refers to the arrangement of relationships within a social network, including the roles individuals or organizations play, the density of connections (i.e., how many people are connected to each other), and the presence and interconnectedness of subgroups (Baker & Obstfeld 1999). Consequently, the structural characteristics of a social network affect the distribution of resources and information throughout the network (see Barnes et al. 2017; Ceddia et al. 2017; Long et al. 2013). Network dynamics involve how connections between the parts of the network are made or broken, how interactions between those parts occur, and how being connected affects the parts themselves, for example, through gaining new information or influence (see Chen et al. 2022). Further, network dynamics encompass the processes within social networks, such as how information is shared, how decisions are made, and how support is mobilized in response to coastal hazards (see Lubbers et al. 2020; Tuccio & Wahba 2020). These processes include communication patterns, collaborative efforts, and the overall functionality of the network in adaptive processes (ibid.).

In this thesis, it is argued that the adaptive capacity of households and communities affected by natural hazards and environmental change is profoundly influenced by social networks and the socio-spatial and institutional contexts within which social networks operate (see also Barnes et al. 2017; Carmen et al. 2002; Lubbers et al. 2020). The socio-spatial context encompasses the interaction between social relationships and geographical spaces, influencing community network formation, maintenance, and dynamics (see MacGillivray 2018; Rockenbauch et al. 2019). Geographical space in this context refers not only to physical space but also to relational space, i.e., the fluid, interconnected, and socially constructed nature of space that is constantly being shaped and reshaped by human interactions, social relations, and networks (see Jones 2009; Jones 2010). The institutional context is understood as the rules, norms, and conventions that shape economic behavior and social interactions within specific spatial contexts (see Bathelt & Glückler 2018; Fidelman et al. 2017; Hodgson 2006; MacKinnon et al. 2009). They encompass a wide range of formal laws, informal norms, and social conventions that govern individual and collective actions, influencing the structure and functioning of formal and informal social networks (i.e., government organizations or community groups, respectively; Baker & Obstfeld 1999; Owen-Smith & Powell 2008; Rotberg 2013). The interplay of geographical characteristics, social cohesion, governance frameworks, and community norms can amplify or weaken coastal communities' adaptive capacity (Bott et al. 2019; Wilkin et al. 2019). For example, a well-connected community with strong institutional support may be better able to mobilize resources, share critical information, and implement effective response strategies than a community with fragmented social networks and weak institutional contexts (see Berenschot 2019; Ceddia et al. 2017). Understanding this complex interplay

requires a detailed investigation into how social structures and processes, shaped by their surrounding contexts, influence the adaptive capacity of communities facing coastal hazards.

Given the significant role of social networks against the backdrop of increasing natural hazards, compounded by rapid urbanization and governance challenges in coastal areas, particularly within the context of the Global South, this thesis aims to address the following main research question: ***How do the structure and dynamics of social networks influence household and community adaptive capacity towards coastal hazards?*** In doing so, the thesis seeks to contribute to a more detailed and context-sensitive understanding of social networks. This dissertation highlights the essential role of social networks in enhancing community adaptation to natural hazards in coastal regions, emphasizing the necessity of understanding network dynamics and structures to develop effective adaptation strategies. The investigation into how social networks shape adaptive capacities offers valuable insights for policymakers and stakeholders aiming to strengthen community preparedness and response to environmental changes, thereby mitigating potential losses and improving overall community well-being.

To this end, the thesis combines the findings of three individual studies, presenting original, mixed-methods social science research. The data for these studies was collected in the three fast-developing Indonesian cities Padang in West Sumatra, Denpasar on Bali, and Semarang on Java, and through online research in Indonesian migrant communities in Europe and especially Germany. Padang, Denpasar, and Semarang are suitable for the study as they are secondary Indonesian cities with significant exposure to coastal hazards, where rapid urbanization, diverse governance, and unique socio-cultural and economic conditions provide vital contexts to explore the role of social networks in adapting to natural hazards (see Roberts et al. 2016; Dewi et al. 2023; Garschagen & Romero-Lankao 2015). Moreover, Indonesian migrant communities in Europe provide a practical context for examining how translocal support networks are activated in response to natural hazards, allowing for an exploration of the perspective of support providers to better understand emergency responses and adaptation mechanisms (see Cahyanto et al. 2023; Muhidin & Utomo 2016; Saksela-Bergholm et al. 2019; Setijadi 2017).

2. Coastal hazards and urban communities in Indonesia

Understanding the interplay between natural hazards, human exposure, and vulnerability is essential for effective hazard risk management. Natural hazards represent potential interactions between humans and extreme natural events, which means that the hazard itself is not the actual occurrence but the potential for such events. Natural hazards become disasters when they result in significant human and economic losses, impeding social and economic development (Cui et al. 2021). The understanding of natural hazards has evolved from viewing them primarily as the result of geophysical processes to recognizing the significant role human systems play in turning these hazards into disasters (see Montz et al. 2017). Thus, while hazards may result from natural processes and phenomena, they are outcomes of human actions, reflecting the inherent vulnerability of those affected (Mavromatidi et al. 2018).

Coastal hazards encompass a range of environmental phenomena that pose significant risks to coastal areas, affecting both natural ecosystems and human populations (Nichols et al. 2019). Coastal hazards can be broadly categorized into meteorological, geological, and anthropogenic factors (see Wang et al. 2020). Meteorological hazards include storm surges, high winds, and heavy rainfall, typically associated with cyclones and severe weather events, which can lead to flooding and extensive property and infrastructure damage – in Indonesia especially during the monsoon season (Nadal-Caraballo et al. 2020; Yamamoto et al. 2021). Geological hazards such as tsunamis, coastal erosion, and landslides are primarily driven by tectonic activities and natural erosion processes (Khomarudin et al. 2010; Mardiatno et al. 2017; Marfai 2011). Additionally, anthropogenic hazards arise from human activities, including coastal development, pollution, and resource exploitation, which degrade coastal environments, exacerbate risk and increase vulnerability to the above-mentioned coastal hazards (Wang et al. 2020). For example, land subsidence is a common problem for most cities along the north coast of Java in Indonesia, causing a relative sea level rise of several centimeters per year (Bott et al. 2021; Yastika et al. 2019)

Climate change and sea level rise are projected to further exacerbate the exposure to and impact of coastal hazards in coastal zones (Birkmann et al. 2022; Oppenheimer et al. 2022; Wong et al. 2014). Next to rising sea levels, the potential effects of climate change include increasing temperatures, changing rainfall patterns, saltwater intrusion, and a higher probability of extreme weather events that could aggravate the impact of present coastal hazards (Laino & Iglesias 2023; Oppenheimer et al. 2022). Further, the intensity and frequency of extreme precipitation events are highly likely to increase over many areas (UNDRR 2019). Climate change influences coastal regions through shifts in wind patterns, storm surges, wave dynamics, and sea levels, significantly affecting these areas over time. (see Ayyam et al. 2019; Griggs & Reguero 2021).

Indonesia's urban coastal regions, including major cities like Padang, Denpasar, and Semarang are highly susceptible to coastal hazards such as tidal flooding, land subsidence, tsunamis, coastal erosion, and sea level rise (see Gaborit 2022; Widantara & Mutaqin 2024; Zikra et al. 2015). With its extensive coastline, Indonesia faces unique challenges due to its geographic and climatic conditions. Urban centers, such as Jakarta, are highly susceptible to flooding, exacerbated by factors such as land subsidence, inadequate drainage, and the impacts of high tides (Bott et al. 2021; Marfai et al. 2015). The threat of tsunamis is also pronounced in Indonesia due to its location along the Pacific ‘Ring of Fire’, which predisposes the country to seismic activities that can trigger these large-scale events (Khomarudin et al. 2010; Mardiatno et al. 2017). Further, storm surges and flooding are common occurrences, especially during the monsoon season (Yamamoto et al. 2021).

The socio-economic impacts of coastal hazards on urban communities in Indonesia are profound – posing a growing concern for the livelihoods of communities living in coastal areas. Infrastructure damage from such events disrupts economic activities, causing substantial economic losses to households and firms, particularly in critical areas like ports and industrial sectors (see Bott & Braun 2019; Neise & Revilla Diez 2019). Livelihoods that depend on coastal and marine resources, such as fishing and tourism, face declines, impacting income and employment (see Amin et al. 2019; Cinner et al. 2018). Further, health and safety risks often accompany flooding events, with increased incidences

of waterborne diseases, injuries, and psychological impacts such as trauma (Bott & Braun 2019; Pacoma & Delda 2019). Moreover, rapid urbanization in Indonesian coastal cities is the main driver of future flood risk further exacerbating the effects of coastal hazards (Muis et al. 2015). For example, converting ecologically critical areas such as mangroves to urban land uses diminishes natural defenses against flooding and erosion, thereby increasing the susceptibility of these areas to hazards (Triyanti et al. 2017).

The vulnerability of Indonesia's coastal urban areas to coastal hazards is aggravated by inadequate urban planning, limited state resources, and governmental action in facing environmental challenges (Saputra et al. 2017; Zikra et al. 2015). Rapid post-independence urbanization into coastal zones has led to significant demographic shifts, with a large portion of the population now residing in coastal areas (Salim & Hudalah 2020; World Bank 2012). While this shift has been economically beneficial, coastal populations face increasing exposure and vulnerability to coastal hazards and environmental change (Zikra et al. 2015). This situation is further aggravated by inadequate provision of basic services and prevailing urban poverty, which limits the communities' capacity to respond to and recover from negative events such as flooding (Beard 2019). Inadequate spatial planning and coordination are a consequence of unsuitable plans, frequent policy changes and deficient enforcement (Salim & Hudalah 2020; World Bank 2012). The weak enforcement of coastal zone management and urban planning regulations allows for continued risky developments and diminishes the effectiveness of hazard risk reduction strategies (ibid.).

Consequently, local governments in Indonesia are increasingly faced with trade-offs when selecting specific interventions and neighborhoods or districts to prioritize to the detriment of others (Salim & Hudalah 2020). Government-led adaptation strategies in Indonesia encompass a range of engineering solutions and policy measures. Engineering options include both hard (e.g., sea walls) and soft (e.g., mangrove restoration) solutions aimed at mitigating immediate physical threats (Nurhidayah & McIlgorm 2019; Triyanti et al. 2017). Policy and governance play crucial roles, with national and local policies addressing coastal hazard mitigation and climate adaptation. Nevertheless, the general focus lies on structural measures, and challenges in implementing and coordinating adaptation strategies remain, often due to a complex array of trade-offs. These include, but are not limited to, resource allocation, prioritization of interventions, administrative capacities, stakeholder interests, and long-term sustainability (Gaborit 2022; Nurhidayah & McIlgorm 2019; Salim & Hudalah 2020). Overall, the current government coping strategies are insufficient to reduce, respond to, and recover from hazard impacts. As a result, the populations in the urban coastal areas, specifically the poor in unplanned settlements, have a high exposure and vulnerability to coastal flooding (Gaborit 2022). Thus, there is an urgent need for improved coastal management strategies. These strategies should focus on mitigation and adaptation and consider the socio-economic dimensions of resilience, including the role of local communities and the importance of household-level adaptation strategies (Ferrol-Schulte et al. 2015; Nurhidayah & McIlgorm 2019).

Recognizing the limitations of top-down strategies in Indonesia’s coastal management, there is an increasing emphasis on community-based approaches that leverage social networks to build adaptive capacity for responses to coastal hazards (Misra et al. 2017; Waters & Adger 2017; Wilkin et al. 2019).

This perspective highlights the importance of community engagement in resilience-building measures, underscoring the role of social cohesion and collective action in enhancing hazard responses (Bott & Braun 2019). For example, local knowledge and community engagement in resilience-building measures have demonstrated potential for effective adaptation (Islam & Nursey-Bray 2017). Further, community-based planning is useful in addressing urban poverty (Beard 2019). It follows that integrating community-driven initiatives into broader coastal management policies can help to optimize local and national resilience strategies and increase the agency of those affected (see McNamara et al. 2020; Purnomo et al. 2024).

In the face of increasing exposure and vulnerability of coastal urban communities, informal social support is increasingly recognized as central to bottom-up hazard responses. Scholars have highlighted that informal social mechanisms often outpace formal support systems in effectiveness during such crises, given the latter's propensity for slow and sometimes ineffectual responses (Cope et al. 2018; Elliott et al. 2010). This insight underlines the critical role of community and individual-based initiatives in hazard management and adaptation, challenging the traditional reliance on top-down emergency management strategies.

3. Social networks and adaptive capacity to natural hazards

Adaptive capacity is essential for communities to effectively manage natural hazards and environmental changes. The concept is broad, encompassing the mobilization of both social and physical elements to enable adaptation and reduce vulnerability (Smit & Wandel, 2006). It includes enabling conditions (e.g., legal and economic frameworks), assets (both tangible, such as infrastructure, and intangible, such as knowledge), and processes (e.g., emergency planning and adaptation strategies; Siders 2019). Its purpose is to prepare for, mitigate, and recover from environmental impacts while also seizing new opportunities, such as economic diversification or the adoption of new technologies (Cinner et al. 2018). The goal is to align community efforts towards common objectives and implement successful adaptation strategies, enhancing resilience and sustainability in the face of environmental challenges (Cinner et al. 2018; Siders 2019). The underlying assumption is that groups with greater adaptive capacity are expected to be in a better position to reduce their vulnerability and mitigate the adverse effects of environmental hazards (see Siders 2019).

However, possessing a high adaptive capacity does not guarantee a high level of adaptation (Mortreux et al. 2020). Identifying the indicators of adaptive capacity reveals an assumption that certain conditions – such as high human capital, advanced information systems, robust infrastructure, strong social networks, and wealth – typically associated with wealthy liberal democracies, result in greater adaptive capacity (Mortreux & Barnett 2017; Siders 2019). Nonetheless, adaptive capacity does not inherently lead to adaptation actions, a point highlighted by examples in the literature (Cinner et al. 2018; Harrison et al. 2016; Mortreux et al. 2020). Moreover, given the difficulty in measuring adaptive capacity directly, research has shifted towards understanding *latent* adaptive capacity, focusing on the preconditions necessary for enabling adaptation and the ability to mobilize resources in anticipation of environmental

changes (D'agata et al. 2020). This approach recognizes that adaptive capacity entails not just the possession of resources but the willingness and ability to deploy them effectively (Cinner et al. 2018; Mortreux et al. 2020).

Accordingly, adaptive capacity is not a static attribute; it varies significantly across different populations and systems, highlighting the inequality in the distribution of adaptive capabilities (see Dapilah et al. 2019; Mortreux & Barnett 2017). Therefore, while the components of adaptive capacity have been extensively studied, identifying and quantifying the contextual drivers of adaptive capacity remains a priority research gap (see D'agata et al. 2020). The direction and relative effects of these drivers are critical to understanding how adaptive capacity can be developed and utilized effectively. Thus, the exploration of adaptive capacity in the context of natural hazards and environmental change needs to consider a complex interplay of resources, social dynamics, and psychological factors.

The literature consistently emphasizes the vital role of social networks in fostering adaptive capacity (inter alia Barnes et al. 2017; Cinner et al. 2018; Cinner & Barnes 2019; Dapilah et al. 2019; Schramski et al. 2018; Wongbusarakum et al. 2021). Social networks facilitate critical functions in disaster response, including information sharing, resource distribution, and collective action, directly influencing a community's adaptive capacity to natural hazards (ibid.). Social relationships between individuals and groups are deemed crucial for building this capacity, facilitating the sharing of information, resources, and mutual support essential for adaptation (Adger 2003; Cinner et al. 2018; Dressel et al. 2020; Waters & Adger 2017).

3.1. Social capital as a fundamental resource of social networks in community adaptation

Building upon social networks' importance in building community adaptive capacity, it is essential to explore the concept of social capital. The concept of social capital is central to understanding the dynamics of social interactions, resource accessibility within networks, and the overall function of societies. It is a multifaceted notion, essentially revolving around the values and resources that are embedded in social networks and can be mobilized by members of the network (Lin 2001). Bourdieu (1986) lays the foundational conceptualization of social capital as the sum of resources an individual or group gains through their network of relationships. He emphasizes the strategic value of social networks in providing access to resources, thus facilitating advantage in various social fields (Bourdieu & Wacquant 1992). This perspective positions social capital as a key asset in social mobility and stratification. Expanding upon Bourdieu's work, Putnam (1993; 2001) associates social capital with features of social organization such as trust, norms, and networks that can enhance societal efficiency by facilitating coordinated actions. Unlike Bourdieu's more individualized view, Putnam presents a communal understanding, arguing that social capital is integral to fostering civic engagement and cooperation within a society. Burt (2000) diverges from the resource-based interpretations by focusing on the structural properties of social capital. He suggests that the configuration of social networks – particularly their size, density, and hierarchy – affects individual performance and access to resources, advocating for the benefits of less dense networks that enable bridging between disparate groups. Lin

(2001) introduces a differentiation within the network paradigm, distinguishing between network resources and contact resources. This means that understanding the depth (quality and utility of resources) and breadth (range and diversity of contacts) of one's social capital can provide insights into how individuals use their social networks to achieve specific goals (ibid.). In other words, this distinction helps to understand not just what resources are available through one's network, but also who within the network provides access to these resources.

Social capital is a complex phenomenon that can manifest in different ways (see Azad & Pritchard 2023). One of the most common approaches in hazard research to describe different manifestations and functions of social capital is the distinction between three forms of social capital – bonding, bridging, and linking – each playing a distinct role in societal cohesion and individual well-being (Adger 2003; Aldrich & Meyer 2014; Hess 2017). Bonding social capital refers to the close connections within a group, characterized by a high degree of similarity and interconnectedness among its members (ibid.). This form is a central source of social support but can have negative outcomes due to its exclusive nature (Poortinga 2012; Sabatini 2009). Bridging social capital involves weaker, more diverse connections that extend beyond one's immediate network. These relationships offer access to external resources, skills, and information, facilitating social mobility and broader community integration (Poortinga 2012; Klerkx & Proctor 2013). Linking social capital describes relationships across explicit power gradients, vital for communities to engage with institutions and political structures, enhancing the community's navigational capacity within societal structures (Szreter & Woolcock 2004; Kyne & Aldrich 2020).

Social capital, through its various forms and structural characteristics, enables communities to support each other, access diverse resources, and engage effectively with societal institutions (Cinner et al. 2018; Rockenbauch et al. 2019; Wood et al. 2013). It lays the necessary foundation for societal adaptation and resilience and significantly contributes to fostering proactive behavior in the face of environmental hazards (Jia et al. 2020). Moreover, social capital often offsets limitations in other areas important for adaptation such as financial and human capital (see Azad & Pritchard 2023; Bott 2020; Rockenbauch et al. 2019). Empirical studies have substantiated the link between social capital and disaster preparedness, demonstrating that community participation and trust enhance the effectiveness of preparedness efforts (Bernados Jr et al. 2020; Pfefferbaum 2017; Sadeka et al. 2020). Contrasting with traditional top-down disaster management approaches, social capital and adaptive capacity research advocates for a larger focus on bottom-up strategies that empower individuals and communities to play a proactive role (Bott 2020; Murphy 2007; Nakagawa & Shaw 2004).

However, while the literature presents a compelling case for the importance of social capital in disaster preparedness and adaptation strategies, the research on social capital often fails to consider its varying distribution across social strata and geographical spaces and how institutional frameworks shape resource mobilization for resilience building comprehensively (see Barnes et al. 2017; Lubbers et al. 2020). The composition and effectiveness of social capital in enhancing hazard responses are not uniform but intertwined with human agency, geography, and the wider socio-political and economic contexts (Carmen et al. 2022; Misra et al. 2017). Recently, scholars increasingly call for a more profound appreciation of local socio-cultural contexts and an understanding of the intricate interplay between social networks, institutional arrangements, and socio-political structures in shaping community

adaptation (Carmen et al. 2022; Mubaya & Mafongoya 2017). While acknowledging the importance of social capital in fostering resilience and adaptive capacity, this also points to the necessity of further empirical investigation, especially in the Global South, to fully understand and leverage these social dynamics in the face of environmental change (Dapilah et al. 2019).

Social network theory can provide a more comprehensive conceptual framework to approach the discourse around social capital and community adaptation by providing a broader context to the understanding of how social support develops and takes place (MacGillivray 2018; Wilkin et al. 2019). The qualitative dynamics of social interactions – encompassing norms, perceptions, stories, and beliefs – play a critical role in shaping community resilience (MacGillivray 2018). Chaudhury et al. (2017) suggest that there is a clear connection between the adaptive capacity of a household and its position in its surrounding social network. However, the causality between connectivity and adaptive capacity remains uncertain. Wilkin et al. (2019) further argue that without a nuanced understanding of local social structures, top-down implementations of preparedness policies, such as the formation of community disaster committees, are likely to fail. This observation points to the necessity of grounding disaster preparedness efforts in a deep comprehension of the social and communal fabrics of the affected areas, particularly in the Global South.

However, despite the recognized importance of how the structure and dynamics of social networks shape hazard responses, they have received limited attention in the literature, highlighting a gap that needs addressing to better understand the mechanisms behind how social dynamics influence community resilience (Carmen et al. 2022; Dapilah 2019). Thus, understanding the socio-spatial and institutional contexts of social networks is crucial for grasping their influence on adaptive capacity, especially in the context of coastal hazards.

Accordingly, examining social networks within their social, spatial, and institutional contexts is crucial to understanding how they affect the ability of households and communities to respond to coastal hazards. Integrating the study of adaptive capacity, social networks, and their wider socio-spatial and institutional contexts not only informs theory but can also guide practical interventions and policies in disaster risk reduction and community development, aiming for a holistic understanding of community adaptation that encompasses both structural and qualitative dimensions of social interactions in the context of natural hazards and environmental change. Furthermore, it highlights the interaction between local practices and wider socio-political structures, illustrating the strategies communities use to confront obstacles and capitalize on opportunities for adaptation.

3.2. Socio-spatial context of social networks

Recent scholarship has increasingly recognized the socio-spatial context as a relevant factor shaping the structure and dynamics of social networks, particularly within the domain of social capital (Carmen et al. 2022; Doreian & Conti 2012). While social networks are often studied as independent entities, the wider social and spatial context has been shown to have a substantial influence on their formation and functions (Doreian & Conti 2012). Especially social capital and hazard studies can benefit from considering underlying socio-spatial patterns (Elliot et al. 2010; MacGillivray 2018; Rockenbauch et al.

2019). The spatial dimension of social capital has gained increasing attention in research, indicating that the structure and efficacy of social capital are influenced by geographical variables and the distribution of resources (MacGillivray 2018; Small & Adler 2019; Waters & Adger 2017). For example, the spatial properties of neighborhoods, such as communal spaces or mixed-use amenities (e.g., local shops and restaurants), have been shown to influence the development of local community networks (Bott et al. 2019; Cabrera & Najarian 2015). Further, high residential density is associated with less neighbor familiarity, lower bridging trust, and reduced community involvement (Muzayanah et al. 2020). Conversely, socio-economic attributes such as the level of education of an individual strongly predict the geographic dispersion of their personal support networks (Drouhot 2017).

The concept of translocality further expands the understanding of the socio-spatial context by pointing out that social networks often cross geographical and socio-political boundaries, enabling the exchange of ideas, resources, and support beyond local confines (Bott et al. 2020; Greiner & Sakdapolrak 2013; Mikami 2022; Rockenbauch et al. 2019). This perspective challenges the previously local-biased focus of social capital research, opening up considerations of translocal phenomena where social ties and structures are spatially patterned (Bott et al. 2020; Cope et al. 2018; Elliot et al. 2010; Steinbrink & Niedenführ 2017).

Despite the evident importance of these translocal connections, much of the hazard research has predominantly focused on local and regional aspects of social capital. This local bias overlooks the crucial role of translocal networks in providing support and resources in times of need (Bott 2020; Bott et al. 2020; Chaudhury et al. 2017; Rockenbauch et al. 2019). The need for a broader perspective that includes both local and translocal ties becomes apparent when considering the adaptive capacities of communities facing environmental and social challenges. Local networks are indeed crucial, especially in the immediate aftermath of disasters, providing necessary support due to their proximity. However, as situations evolve, the significance of translocal ties grows, offering resources that might not be available locally and are essential for long-term recovery and adaptation (Elliott et al. 2010). The distinction between local and translocal social capital underlines the different roles these ties play in coping and adaptation processes, with translocal networks possibly linked to more innovative and long-term responses (Bott et al. 2020). However, the capacity to leverage translocal social capital is not uniformly distributed. Studies have shown that poorer households and communities, particularly in the Global South, often lack strong translocal networks, impairing their adaptive capacities in the face of environmental threats (e.g., Bott et al. 2020; Elliot et al. 2010; Rockenbauch et al. 2019). This disparity highlights the need for a wider understanding of how social capital functions across different socio-spatial contexts and the barriers that inhibit certain groups from accessing or forming effective translocal networks.

In sum, the socio-spatial context can be expected to significantly influence the structure and dynamics of social networks, with profound implications for community adaptive capacity. Understanding the interplay between local and translocal social capital, and the barriers to accessing these resources, is crucial for enabling effective responses to environmental and social challenges. This perspective underlines the need for further research that transcends traditional spatial boundaries, integrating insights from translocality and the spatial patterning of social relationships.

3.3. Institutional context of social networks

The discourse surrounding the interplay between institutional contexts and community-level social networks in adapting to natural hazards and environmental change is both complex and critical for understanding adaptation strategies (Carmen et al. 2022; Harrison et al. 2016; Mondal et al. 2024). At the heart of this discussion is the notion that institutional contexts – comprising policies, regulations, and norms that govern community interactions, environmental management, and hazard responses – play a substantial role in shaping how social networks function and respond to natural hazards. Thus, investigating the relationship between social networks and institutions is a promising research direction (Owen-Smith & Powell 2008).

First, institutions provide the legal and regulatory framework within which communities operate and respond to coastal hazards (McGuire 2018). Effective governance systems can facilitate coordinated action, resource allocation, and implementation of adaptation strategies (Ceddia et al. 2017; Chaudhury et al. 2017; Cinner & Barnes 2019). For example, institutions that favor decentralized decision-making tend to empower local communities, enabling them to leverage their social networks for resource sharing, knowledge exchange, and collective action, thereby enhancing their capacity to adapt to environmental changes (Agrawal 2010). Conversely, rigid, top-down legal and regulatory frameworks may limit community autonomy and hinder the potential of social networks to mobilize resources effectively (Chaudhury et al. 2017). Further, institutions often dictate how resources are mobilized and allocated within communities facing coastal hazards (van Voorst 2016). This includes funding for infrastructure projects, such as sea walls or elevated homes, and for emergency response and recovery efforts (Nurhidayah & McIlgorm 2019; Verschuuren & McDonald 2012). The efficiency and fairness with which institutions manage these resources can significantly impact a community's adaptive capacity (Adger et al. 2005; Gupta et al. 2010).

Second, the institutional context significantly influences the flow of information within social networks. The dissemination of information is vital for a coordinated and effective community response (Misra et al. 2017; Harrison et al. 2016). Institutions promoting transparency and inclusivity are likely to enhance communication flows, ensuring that critical information about natural hazards and adaptation strategies reaches all community segments, including marginalized populations. For instance, institutions often regulate the dissemination of information about coastal hazards, such as educational programs. Such programs can include construction practices, early warning systems, and evacuation plans (Termeer et al. 2012).

Third, the support structures provided by organizations, such as funding, training, and technical assistance, are crucial for reinforcing community-level social networks. These supports bolster the networks' capacity for innovation and adaptation, enabling effective responses to environmental challenges (Taylor et al. 2014). Moreover, the institutional recognition of traditional knowledge and practices enriches adaptation strategies by integrating scientific and indigenous knowledge systems, thereby enhancing the overall resilience of communities to natural hazards and environmental change (Ley 2019).

Fourth, institutions play a key role in the formation and operation of social networks by creating access to linking social capital. This includes facilitating connections between community members and external actors, such as government agencies, NGOs, and experts, which are especially important in the beneficial long-term community development outcomes (Harrison et al. 2016). Both formal and informal key individuals within social networks play significant roles, with trust, respect, and accessibility being essential attributes of these individuals. Positive formal and informal linkages to organizations that provide income-generation opportunities are also highlighted as beneficial for strengthening social networks (Rotberg 2013).

Fifth, institutions also encompass informal norms and cultural practices that can influence community responses to coastal hazards (Neef et al. 2018). Local formal and informal institutions play a central role as they structure household risk-mitigation activities (Agrawal 2009). Social norms regarding cooperation, community engagement, and mutual aid can strengthen social networks and collective action in disaster response and recovery (Agrawal & Perrin 2009; Neef et al. 2018). Communities with strong self-organized local institutions are better able to adapt to the adverse effects of climate-driven environmental change without substantial loss of well-being compared to communities where these institutions are weak or absent (Berman et al. 2020). For example, in Indonesia, many flood-affected communities rather rely on informal channels instead of accepting aid and support from formal political institutions (van Voorst 2016). These informal institutions can be critical in mobilizing community resources and fostering solidarity and support among community members.

However, while the existing literature provides a foundational understanding of the role of institutional contexts in shaping community-level social networks for adaptation to natural hazards, further research is necessary to unpack the mechanisms behind these interactions. Key areas include examining the determinants of community empowerment and initiative, the impact of institutional arrangements on information flow and inclusivity, and the types of support that enhance social networks' adaptive capacity. Investigating the role of formal and informal linkages to external actors and organizations in strengthening social networks is also crucial. Especially the role of key actors in social networks that bridge formal and informal institutions, such as community leaders, is still insufficiently understood. Addressing these aspects will contribute to the theoretical understanding of how social networks and institutions interact. This knowledge can be useful for designing institutions that bolster community resilience and adaptability, leading to more effective and sustainable responses to environmental challenges.

4. Research objectives and structure of the thesis

Building upon the conceptual understanding from the literature review, the overarching aim of this thesis is to analyze the influence of social networks on the adaptive capacity of households and communities to coastal hazards and the complex interplay with the socio-spatial and institutional contexts these networks are embedded. At the core of this investigation is the argument that the structural and dynamic aspects of social networks – ranging from the immediate community to broader, translocal connections

– play a significant role in shaping social capital and adaptation strategies in the face of environmental challenges. To address all these aspects comprehensively and in detail, the thesis posits research objectives that are structured into three core areas:

1. **Local and translocal support and long-term adaptation**: Examine the role of local and translocal support during and after flood events, assessing how these different forms of support complement each other and contribute to long-term adaptation efforts (Chapter 7).
2. **Translocal support network dynamics**: Analyze the emergence of translocal support in response to natural hazards, identifying the factors that influence its utilization and its impact on community adaptation strategies (Chapter 9).
3. **Local leadership and community adaptive capacity**: Investigate the influence of community leadership on enhancing adaptive capacities, focusing on the mechanisms through which leaders can foster resilience against natural hazards (Chapter 11).

Collectively, these objectives aim to construct a comprehensive picture of how social networks serve as fundamental components in the adaptive processes of communities facing coastal hazards. By combining insights into the interplay between local and translocal networks, the dynamics of support networks, and the role of leadership, this thesis aims to develop an empirically-based expansion of the theoretical discourse on community adaptation to natural hazards and environmental changes.

The overarching research question of this study is: ***How do the structure and dynamics of social networks influence household and community adaptive capacity towards coastal hazards?***

To comprehensively explore the multifaceted dimensions of the main research question, six distinct research questions are formulated, each targeting a specific aspect for in-depth examination. The contribution of each research question to the overall research objective is visualized in the conceptual model (Figure 4-1).

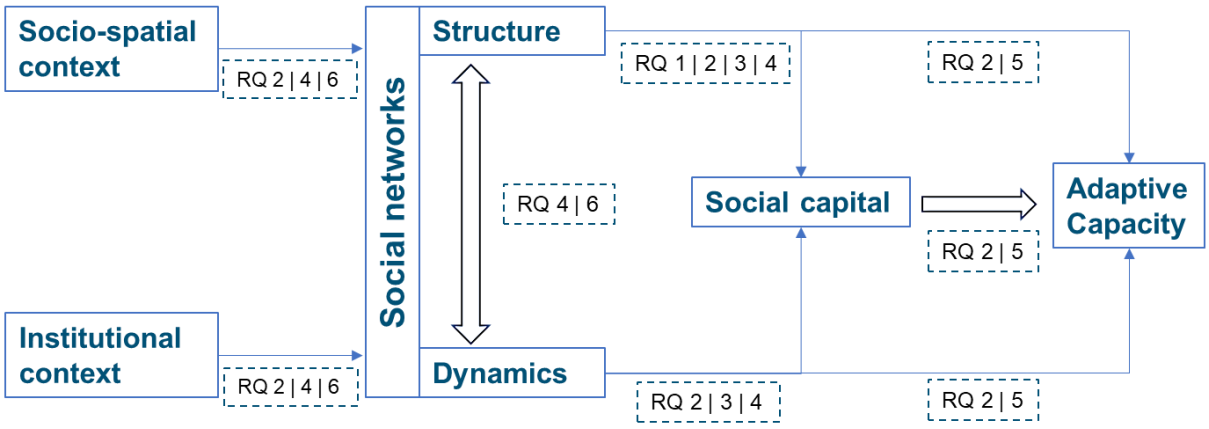


Figure 4-1. Conceptual model of the thesis referencing the main research questions

RQ 1: How does support during and after flood events differ between local and translocal social contacts, and to what extent do they complement each other?

This question contrasts the support provided by local versus translocal social contacts during and after flood events, analyzing the extent to which these supports complement each other. This inquiry is essential for understanding how differences in the structure of social networks – in this case exemplified by local and translocal support networks – contribute to the types of support manifested as social capital and their accessibility for flood-affected households. This narrow focus helps to establish first evidence of the relationship between social network structure and social capital.

RQ 2: How can local and translocal support contribute to long-term flood adaptation and what factors shape their influence?

Expanding on the previous question, this inquiry examines how both local and translocal supports contribute to long-term adaptation to flooding, focusing on a broad range of factors that influence their effectiveness. This question helps to build the empirical foundation of the conceptual model, covering the internal processes of social networks, how networks are shaped by their socio-spatial and institutional contexts, how different network configurations influence the effectiveness of social support, and how social networks and the resulting social capital contribute to adaptive capacity and long-term adaptation.

RQ 3: What forms of translocal support emerge in the context of responding to natural hazards and environmental change?

This question identifies the types of translocal support that emerge in response to natural hazards and environmental changes, providing a detailed investigation of the contributions of translocal support networks for flood-affected households and communities. The focus lies in determining the potential range and applications of translocal support and how this support is shaped by the characteristics of translocal ties.

RQ 4: What factors determine the use of different forms of translocal support and how do they shape translocal responses and adaptation measures?

This question investigates the factors influencing the selection and utilization of different forms of translocal support. It further includes the socio-spatial and institutional contexts of social networks, specifically focusing on how translocal social capital is activated and employed. Further, this inquiry gives more insights into the interdependency between social network structure and dynamics.

RQ 5: How can community leaders positively influence community adaptive capacity to natural hazards and environmental change?

This question addresses the role of community leaders in fostering adaptive capacities within communities facing natural hazards and environmental changes. Understanding the mechanisms through which local community leaders can foster adaptive capacity, provides a specific example of how social network structure and dynamics shape community adaptation.

RQ 6: What factors shape the effectiveness of community leaders in influencing community adaptive capacity?

Following up on the role of leadership, this question seeks to identify the factors that enable or hinder community leaders in their efforts to enhance adaptive capacities. This examination provides a deeper focus on the socio-spatial and especially the institutional contexts at play within social networks. Focusing on local leadership gives valuable insights into the role of social network structure and position and the ways in which the formal and informal institutional contexts of social networks shape leadership roles in terms of their power, capabilities, and legitimacy.

In summary, each specific research question addresses a segment of the main research question, enabling a detailed examination of the multifaceted relationships between social networks' structure and dynamics and community adaptation to coastal hazards. This layered approach not only addresses the main research question from multiple angles but also builds a comprehensive understanding of the factors that influence the adaptive capacity of households and communities.

The following chapters of this thesis are organized as follows: Chapter 5 details the research design, describing the research areas and methodology. Moving forward, Chapters 7, 9, and 11 comprise individual research papers, each contributing unique insights into the thesis. Chapters 6, 8, and 10 connect the three research papers by providing more relevant context and linking them to the overarching research objectives. Chapter 7 explores the impact of both local and translocal social capital on the coastal adaptation strategies of flood-prone households in Padang and Denpasar, Indonesia. This study shows how local and translocal social capital facilitates access to different support types, underlining their distinct benefits for adaptation at household and community levels. This chapter demonstrates the necessity of integrating a translocal perspective into adaptation strategies, advocating for a transition from a local-centric approach to a broader, more interconnected perspective. Chapter 9 extends this translocal perspective by investigating the nature and determinants of support provided by Indonesian migrant communities in Germany and other European countries to their kin affected by natural hazards in Indonesia. This study reveals the diverse forms of translocal responses to natural hazards and the individual and contextual factors of migrants shaping them. It highlights the complex nature of translocal support and the importance of recognizing both the providers' and recipients' perspectives in understanding the role of social networks in hazard responses. Chapter 11 focuses on local community leadership in Semarang, offering an empirical analysis of previously underexplored linkages between community leadership and adaptive capacity. It underscores the critical role of community leaders in fostering, maintaining, and mobilizing adaptive capacity within communities. Further, it introduces a novel, empirically grounded framework to assess community leadership effectiveness with a particular emphasis on the role of social networks in fortifying community adaptive capacity. Finally, Chapter 12 synthesizes the empirical and theoretical contributions of the preceding chapters, discusses policy implications, acknowledges the limitations of the presented studies, and outlines an outlook for future research.

5. Research design

This thesis examines how social networks help communities in Indonesia adapt to natural hazards. It does so by using a case study method (see Yin 2018) that combines three separate studies. This method provides a detailed look into various aspects of social networks, specifically how the socio-spatial and institutional context shapes the structure and dynamics of social capital and social support. By analyzing multiple case studies together, the thesis can explore different settings, gaining a deeper understanding of how social networks aid community adaptation. This approach enables a comparison across different contexts, improving the reliability of the results and making them more widely applicable.

5.1. Research areas and case studies

In line with the objectives and research questions of this thesis, three fast-developing and flood-prone second-tier Indonesian cities, Padang, Denpasar, and Semarang, have been selected as case studies. Additionally, Indonesian migrant communities in Europe and especially in Germany were chosen as case study to find out more about the potential of translocal networks and what role they play in the flood responses of their families in Indonesia. In the following, each research area will be briefly introduced and their contribution to addressing the proposed research questions from Chapter 4 will be discussed.

5.1.1. Flood-prone second-tier cities in Indonesia

Despite their critical role in urbanization and development, secondary cities have received limited scholarly attention (Birkmann et al. 2016; Rodríguez-Pose & Griffiths 2021). Urban hazard research – especially in a Global South context – has a large focus on megacities and large metropolitan areas (Birkmann et al. 2016). Second-tier cities typically have a population of around 1 million and are sub-national centers of “administration, manufacturing, agriculture, trade or social and cultural services” (Roberts et al. 2016, p.134). Nonetheless, many secondary cities lack the resources available to national capitals and larger cities that are required for effective action, especially in lower- and middle-income countries. Further, local governments are often highly dependent on financial support from central governments because of their limited authority and capacity to mobilize resources and generate the revenue necessary for adequate public service delivery (Roberts 2014). Consequently, the actions of secondary cities toward natural hazards are often reactive (Adelina et al. 2020).

Investigating social networks in the context of community adaptation to natural hazards gains particular relevance in second-tier Indonesian cities like Padang, Denpasar, and Semarang (see Roberts 2014). These urban areas, characterized by rapid urbanization, diverse governance, and environmental challenges, notably flooding vulnerability, provide a critical setting for understanding how social networks contribute to adaptive capacities to coastal hazards. The transition of Indonesia from a rural to an urban economy has not only resulted in considerable urban growth but has also led to the emergence of unplanned settlements amidst inadequate urban governance, thereby increasing the risk of flooding disasters (Dewi et al. 2023). However, while urban growth accentuates vulnerability to natural hazards,

it simultaneously creates opportunities for enhancing adaptive capacity (Garschagen & Romero-Lankao 2015), primarily through the development of dense social networks (Bott 2020; Pelling & High 2005; Sørensen 2016).

Padang and Denpasar represent particularly useful case studies for investigating the dynamics of local and translocal support mechanisms in the face of flood events and within the broader scope of long-term flood adaptation strategies. Their distinct geographical, socio-cultural, and economic landscapes provide contexts for addressing research questions 1 and 2. Padang is exposed to significant coastal hazards, including high tsunami risk and coastal erosion, with a notable coastal retreat rate of about two meters per year (Khomarudin et al. 2010; Wisha et al. 2022). Additionally, the city's geological composition composed of volcanic, alluvium, and marine fields alongside high rain intensity, heightens its susceptibility to flooding and sea-level rise (Ananda et al. 2020; Ikhvan & Mera 2021; Nofrizal et al. 2019). Denpasar's geography is characterized by flat terrain and high rainfall intensity, making coastal, fluvial, and rain flooding commonplace (Kusmiyarti et al. 2018). The National Disaster Management Agency (BNPB) has identified Denpasar as a multi-hazard area, facing coastal hazards from floods, extreme weather, and tsunamis (see Agustianingsih et al. 2023; BNPB 2016). The city's complex geological configuration, including diverse coastal features and the presence of unplanned settlement areas in flood-prone regions, heightens its vulnerability to natural hazards (Gunawan et al. 2015; Widantara & Mutaqin 2024). This vulnerability is compounded by human activities, such as inadequate waste management and construction practices that exacerbate flooding and pollution issues (Ariyaningsih et al. 2023).

Both cities are expected to demonstrate diverse networks of local and translocal support, shaped by their respective migration patterns and socio-cultural values (see Table 5-1). Padang's socio-cultural landscape is characterized by its matriarchal society, where property and significant familial roles are inherited through female lineage and the common practice of Merantau, i.e., the migration of (mostly) young men for entrepreneurial activities (Iman & Mani 2013; Rahman 2016). This unique socio-cultural setup, characterized by strong family ties and significant out-migration, offers a distinct setting to explore how local and translocal social contacts provide support during floods (RQ 1). Denpasar's socio-cultural landscape is shaped by Hinduism and a patriarchal social order, where belonging to one's birth village and family plays a significant role (Putra & Creese 2016; Wade et al. 2018). The city's booming tourism industry drives high immigration rates from across Indonesia, leading to rapid urban growth and a diverse demographic makeup (Prajnawrdhi et al. 2015). This mix of traditional socio-cultural values and a dynamic, multi-ethnic population offers a rich terrain for studying how social order and migration patterns influence the mobilization of support in flood events (RQ 1). In sum, Padang's *Merantau* tradition and Denpasar's diverse demographic profile, fueled by tourism and high immigration rates, provide contrasting yet complementary contexts for analyzing how support varies between local and translocal contacts in hazard response efforts and what factors determine the likelihood of social support to contribute to successful long-term adaptation (RQ 1 & 2).

Table 5-1. Overview of the Padang's and Denpasar's socio-cultural characteristics and most relevant coastal hazard.

	Denpasar	**Padang**
Location	Bali	West Sumatra
Main religion	Hinduism	Islam
Social system	Patriarchal	Matriarchal
Social networks	Belonging to both the community of birth and of residence & family ties	Family networks
Population mobility	Strong immigration	Tradition of out-migration
Main coastal hazard	Flooding of flat terrain	Coastal erosion

Moving on to Semarang, community leaders, and formalized neighborhood organizations play a central role in disaster preparedness and response in the city, making it a valuable choice to investigate the role of institutional contexts on social networks and adaptive capacity (RQ 5 & 6). Semarang faces a variety of coastal hazards, such as tidal inundation, river floods, land subsidence, saltwater intrusion, shoreline change, erosion, land use change, and flash floods (Andreas et al. 2017; Bott et al. 2021; Gunawan et al. 2015; Marfai 2011; Marfai et al. 2008). These hazards, while not immediately life-threatening, frequently disrupt daily life, damage infrastructure, and negatively affect the long-term livelihoods of coastal communities (Bott & Braun 2019). The situation in Semarang exemplifies the challenges and strategies associated with living in hazard-prone coastal areas. Faced with limited government action, communities in Semarang Bay have developed a range of self-help strategies (Bott et al. 2020; Bott & Braun 2019; Gunawan et al. 2015; Harwitasari & van Ast 2011). The community's adaptive measures reflect a pragmatic approach to risk management, leveraging local knowledge and social capital. However, while effective in the short term, these strategies often fall short of addressing the long-term implications of environmental changes (Aldrich et al. 2016; Bott & Braun 2019).

Community life on Java is characterized by a formal hierarchical structure of neighborhood organizations in Java with various tiers facilitating community-government interaction led by leaders in key network positions (see Berenschot 2019; Wannewitz & Garschagen 2024). These organizations, led by elected community members or appointed officials, play a central role in local governance, resource distribution, and the coordination of community initiatives (see Chapter 11). These institutionalized neighborhood organizations are deeply embedded in everyday life in the coastal communities of Semarang (Wannewitz & Garschagen 2024). Through these organizations, community members mobilize information exchange, mutual support, informal loans, and flood prevention measures such as collective river cleaning (Bott & Braun 2019; Buchori et al. 2022). Community leaders are embedded in these organizational and communal structures shaped by formal and informal institutional rules. Well-connected community leaders can act as social network brokers, providing access to bridging and linking ties that individual community members are often not able to establish and maintain (see Berenschot 2019; Wannewitz & Garschagen 2024). The actions, legitimacy, and capabilities of

community leaders in Semarang reveal how social and administrative mechanisms are intertwined and how they influence communities' ability to respond to environmental hazards more effectively (RQ 6).

5.1.2. Translocal network support from Indonesian migrant communities in Germany and other European countries

In order to complement the Indonesian case studies and to explore a distinct translocal perspective on the emergence and determinants of translocal support in the context of natural hazards and environmental change (RQ 3 & 4), Indonesian migrant communities in Germany and other European countries have been chosen as an additional case study. For practical reasons, particularly the constraints posed by the COVID-19 pandemic, the research primarily focuses on migrant communities in Germany and other European countries. Indonesia's geographic susceptibility to natural hazards provides a suitable background to understand in what ways migrant communities respond to the impacts of natural hazards in their homeland. The Indonesian diaspora is estimated at about 8 million people globally (see Setijadi 2017). Indonesian migrants provide a diverse sample for examining how translocal support networks are activated in response to environmental crises due to their multi-ethnic composition, which at the same time is bound by a common national identity (Muhidin & Utomo 2016; Setijadi 2017).

The established networks of the Indonesian diaspora in Europe (Saksela-Bergholm et al. 2019) present a useful context for examining how these ties can be mobilized as resources in times of crisis. For instance, the substantial mobilization of the Indonesian diaspora's response during the COVID-19 pandemic, which severely impacted Indonesia's tourism industry, exemplifies the critical role diaspora communities play in crisis relief efforts (see Cahyanto et al. 2023). This directly relates to the research objective of identifying the forms of translocal support that emerge in response to natural hazards (RQ 3).

While the active engagement of diaspora communities in both crisis relief efforts and the development of their communities of origin has received increasing scholarly attention, its underlying dynamics and outcomes are still insufficiently understood (see Brinkerhoff 2019; Esnard & Sapat 2016; Khairu Roojiqien Sobandi 2019; Shivakoti 2019). The literature highlights a gap in climate change and hazard research, where individual migrants' perspectives have been largely overlooked (Dalgas 2018; Head et al. 2019; Platte 2019). Migrants blend pre-migration practices with post-migration norms, offering a distinct opportunity to disrupt the status quo and identify beneficial outcomes in response to environmental changes. Focusing on the translocal ties of individual Indonesian migrants can address this oversight, offering valuable insights into how individuals perceive and respond to natural hazards, thus addressing research questions 5 and 6 on the emergence and determinants of translocal support.

In sum, the investigation into Indonesian migrant communities in Germany and other European countries is well-suited for addressing research questions 3 and 4. It leverages the significant and diverse Indonesian diaspora, the critical role of translocal ties, the documented engagement of the diaspora in crisis relief and development, and the potential for uncovering novel insights into adaptation mechanisms.

5.2. Methods

This thesis employs a mixed-methods approach across three individual studies. Each study, detailed in Chapters 7, 9, and 11, applies quantitative, qualitative, or a combination of both methodologies. By integrating quantitative data analysis with qualitative in-depth insights from personal experiences and perceptions, this approach facilitates a detailed examination of the research questions outlined in Chapter 4 (see also Figure 5-1). This chapter focuses on the overarching methodological framework, underscoring how the integration of diverse methods enriches the research findings and contributes to addressing the research objectives.

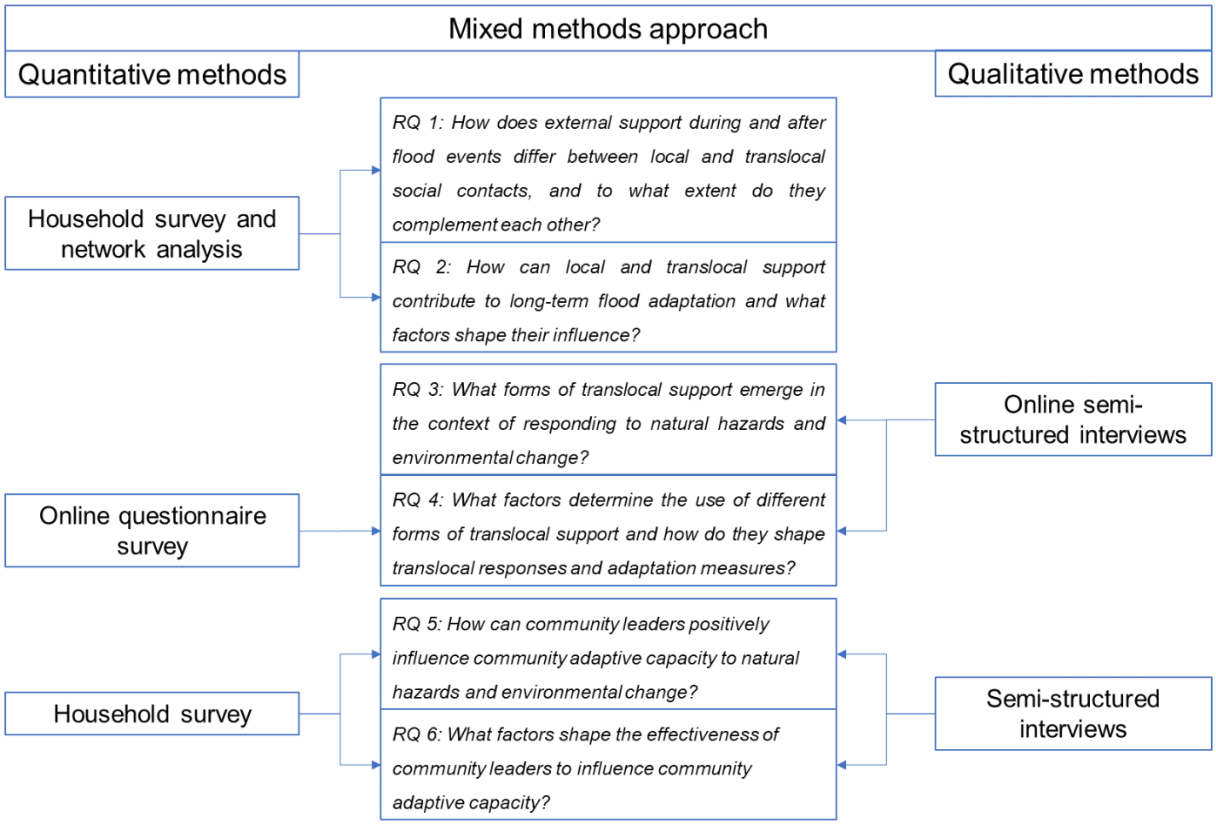


Figure 5-1. Overview of different methods applied to the main research questions of the thesis

The rationale to employ a mixed-methods approach stems from the need to capture the multifaceted dimensions of social support networks and their role in fostering adaptive capacity to natural hazards. Quantitative methods, including structured surveys and statistical analysis, provide a broad overview of patterns, correlations, and potential causal relationships within large data sets (Sheard 2018). This enables the identification of generalizable trends and the assessment of the prevalence and effectiveness of different forms of support across diverse populations. Conversely, qualitative methods (i.e., in-depth interviews and content analysis) offer nuanced insights into the lived experiences of individuals and communities (Brinkmann & Kvale 2018; Flick 2018). They facilitate a deep understanding of the motivations, perceptions, and context-specific dynamics that underpin social support networks

and adaptive capacity. By integrating these methodological perspectives, the thesis aims to achieve a comprehensive and multi-dimensional examination of the research questions. On top of that, the thesis showcases the versatility of mixed-methods research through the three studies across different contexts, underlining mixed-methods research's adaptability and efficacy in diverse research settings (see also Creswell 2022).

Quantitative household survey and social network analysis in Denpasar and Padang: The first study included in this thesis (see Chapter 7) investigates the role of local and translocal support during and after flood events, assessing how these different forms of support complement each other and contribute to long-term adaptation efforts. Methodologically, the study has a strong quantitative focus. The methodology integrates a pre-survey for site selection, a quantitative household survey (N=620) including ego-centric network data (N=1169), and advanced statistical analyses, each component playing a critical role in uncovering the structural and dynamic aspects of local and translocal support networks (RQ 1 & 2).

The quantitative household survey focuses on the composition and functionality of personal support networks. The inclusion of ego-centric network data is central for mapping out the structure of these networks, detailing the relationships centered around an individual and categorizing contacts based on relationship type, geographic location, and tie strength (see Crossley et al. 2015). This methodology is useful to identify who constitutes an individual's support network and how these contacts are positioned in relation to the individual.

Moreover, by examining the types of support received from these contacts before, during, and after flood events, the survey captures the dynamics of social networks, providing insights into how and under what circumstances support networks are activated and mobilized. Comparing local and translocal support reveals how embeddedness in networks and the nature of relationships influence the effectiveness of support in enhancing adaptive capacity.

Mixed methods online research with migrant communities in Europe: The second study (see Chapter 9) follows an exploratory research design, integrating qualitative online interviews (N=39) and a quantitative standardized online survey (N=265). This mixed methods approach is particularly effective in capturing the complex interplay between social networks and migration in the context of responding to natural hazards.

The qualitative interviews provide deep insights into the formation, maintenance, and mobilization of translocal networks among Indonesian migrants. This exploratory approach allows for a detailed inventory of the various forms of support that exist in translocal support networks, such as emotional, financial, and informational (RQ 3). Further, this approach shows the intricacies of the motivations and factors that influence whether and how migrants provide support to family members in Indonesia when they are affected by natural hazards (RQ 4).

The quantitative standardized online survey is based on the findings of the qualitative data analysis and allows for the empirical validation and generalization of the qualitative insights. The study systematically analyzes how socio-spatial factors, such as the characteristics of networks in host and home-country and individual migrant characteristics, influence the activation and effectiveness of translocal support.

This quantitative analysis not only corroborates the qualitative findings but also extends the investigation by providing a broader view of the patterns and determinants of translocal network utilization across a larger sample of Indonesian migrants throughout Europe.

By synthesizing the insights gained from both qualitative and quantitative phases, this study offers validated empirical insights into the socio-spatial dynamics of translocal social networks from a migrant and support-providing perspective. The mixed methods design ensures a detailed exploration of personal experiences and systemic patterns. This methodological framework, therefore, addresses the research questions with depth and breadth and is suitable for producing empirical contributions to the discourse on migration, social networks, and environmental adaptation.

Qualitative interviews with community leaders in Semarang supported by quantitative analysis: The third study (see Chapter 11) investigates the role of community leaders in Semarang in enhancing adaptive capacity to natural hazards and environmental changes. It specifically aims to understand the factors that determine the effectiveness of such leadership. To achieve this, a mixed-methods approach was utilized, integrating a quantitative household survey (N=330) with qualitative interviews (N=19). The methodological choices enable a comprehensive exploration of the formal and informal institutional context of community leaders and are directly aligned with the research questions (RQ 5 & 6). This approach not only helps to identify the extent of leaders' influence but also illustrates the institutional mechanisms through which this influence is mediated, offering deep insights into the factors that enhance or limit leaders' effectiveness in fostering adaptive capacity.

The data selection of the study in Semarang ensures that the investigation is grounded in the realities of those most directly involved in and affected by coastal hazards, adaptive capacity, and community leadership. The household data has been collected as part of the research project TRANSOCAP I (PI: Boris Braun; PM: Lisa-Michéle Niesters). Details on the methodology behind the development of the household survey, including the sampling of households and collection of the data, can be found in Bott (2020). The interview data was collected as part of my Master's thesis (Gisevius 2019). The existing household survey data from TRANSOCAP I and interview data were combined and used for independent secondary analysis in this thesis, developing a distinct and independent research focus.

In sum, each study contributes to the overall application of mixed-methods research in this thesis, demonstrating the versatility and adaptability of this approach in addressing diverse research contexts and objectives. The first study utilizes quantitative analysis and network analysis on support networks in Denpasar and Padang, focusing on the ability to identify patterns across large datasets. The second study examines Indonesian migrants in Europe, combining qualitative interviews and quantitative surveys to validate and expand insights, illustrating the synergy between qualitative and quantitative methods. The third investigates community leaders in Semarang, employing qualitative interviews enriched by quantitative data, highlighting how mixed methods can provide comprehensive insights into diverse research contexts. This flexible use of methodologies across the different studies not only deepens the understanding of the research questions but also highlights the potential of mixed-methods research in addressing complex social phenomena.

The integration of methodologies across these studies underscores the mixed-methods approach's primary strengths: the ability to triangulate findings, ensuring the validity of research results; the flexibility to explore and adapt to emergent themes; and the capacity to balance the generalizability of quantitative analysis with the rich detail and contextualization of qualitative insights (Creswell 2022; Domínguez & Hollstein 2014). Methodologically, the studies are designed to be sequential, allowing for an iterative dialogue between quantitative and qualitative data. This ensures that broader patterns identified through quantitative analysis inform the qualitative exploration of individual narratives, while qualitative insights, in turn, contextualize and enrich the quantitative data (see Creswell 2022; Domínguez & Hollstein 2014). In sum, the overarching methodological framework of this thesis reflects a deliberate and thorough integration of quantitative and qualitative methods, designed to leverage the strengths of each to address the research questions fully.

5.3. Ethical considerations and data management

Ethical principles of informed consent, anonymity, voluntary participation, and data integrity guide all research components presented in this thesis. All participants of the presented studies provided informed consent for participation and / or recording. Anonymity was preserved across all studies through an ID numbering system, ensuring that individuals cannot be identified in any resulting publications or reports. Participants were informed about the study's purpose, the voluntary nature of their participation, and their right to omit any questions or withdraw at any time without consequence. Participants were assured of no adverse effects from their participation or non-participation. Online interviews were audio-recorded with explicit consent, then transcribed, anonymized, or pseudonymized, with identifiable information altered to protect privacy. After the transcription of the interviews, audio recordings were deleted. A data policy was communicated at the start of online surveys, detailing data management practices to safeguard participant information. All data utilized in this research has been anonymized, and no third party has access to individual responses or information. The data is securely stored on an encrypted external hard drive as well as on the server of the working group “Economic Geography and Environmental Change” (Prof. Dr. Boris Braun) at the Institute of Geography, University of Cologne. Third parties do not have access to this data.

6. Introduction to the first study: Socio-economic vulnerabilities and responses of coastal households and communities towards coastal hazards in Padang and Denpasar

This chapter introduces the first study on Padang and Denpasar, as detailed in Chapter 7. It presents the demographic composition, socio-economic conditions, flood exposure and impacts, and individual and community flood response patterns of surveyed households in the two cities. The aim is to identify the common challenges of these households to get a better understanding of the local context. Also, examining the descriptive results from the household survey in Padang and Denpasar helps to discern the formation and importance of local and translocal support networks within these communities.

Table 6-1. Overview socio-economic characteristics household survey sample Padang and Denpasar (N=620)

	Padang	**Denpasar**
Variables	**Sample (N=405)**	**Sample (N=215)**
Household Size	Mean = 4.9 Min = 1 Max = 24	Mean = 4.6 Min = 1 Max = 10
Income (IDR per month)	Mean = 2,732,000 Min = 250,000 Max = 15,000,000	Mean = 3,937,150 Min = 900,000 Max = 30,000,000
Birth Place	50.0 % This Keluharan 20.3 % This city 20.8 % Other city/village in this province 8.9 % Other province	14.0 % This Keluharan 22.3 % This city 22.4 % Other city/village in this province 42.3 % Other province
Highest level of formal education	9.6 % Primary school 69.6 % Secondary school 20.0 % Tertiary education	1.0 % Never attended school 13.5 % Primary school 58.9 % Secondary school 26.6 % Tertiary education
Ethnicity	87.7 % Minangkabau 3.5 % Javanese 2.9 % Malay 5.9 % Other	51.2 % Balinese 43.7 % Javanese 5.1 % Other

Table 6-1 gives an overview of the basic socio-economic characteristics of the household survey in Padang and Denpasar. This data is presented here because it forms the basis for Chapter 7. In Padang, the ethnic makeup is predominantly Minangkabau, and half of the respondents are native to their *Kelurahan*, indicating a largely homogenous and localized population with a potential for local social ties. Conversely, the Denpasar reveals an ethnically diverse population, with a majority of Balinese and

a significant Javanese minority. A considerable portion of the population originates from other provinces, suggesting a more translocal and heterogenous community composition than in Padang.

Both cities experience high flood exposure and impacts, particularly during the monsoon season (Figure 6-1). Denpasar reports a slightly higher daily exposure rate to rain floods, while Padang experiences significant exposure to both rain and river floods. Tidal floods affect Padang moderately and Denpasar with varied frequencies, with 25.5 % of households having nearly daily exposure during the monsoon season. The floods, typically ankle to knee height, present considerable challenges to daily life and mobility in both cities. Typical impacts of floods include job disruptions, financial losses, and detrimental physical and mental health effects. In both cities, more than 70 % of households are regularly affected by one or more of these impacts.

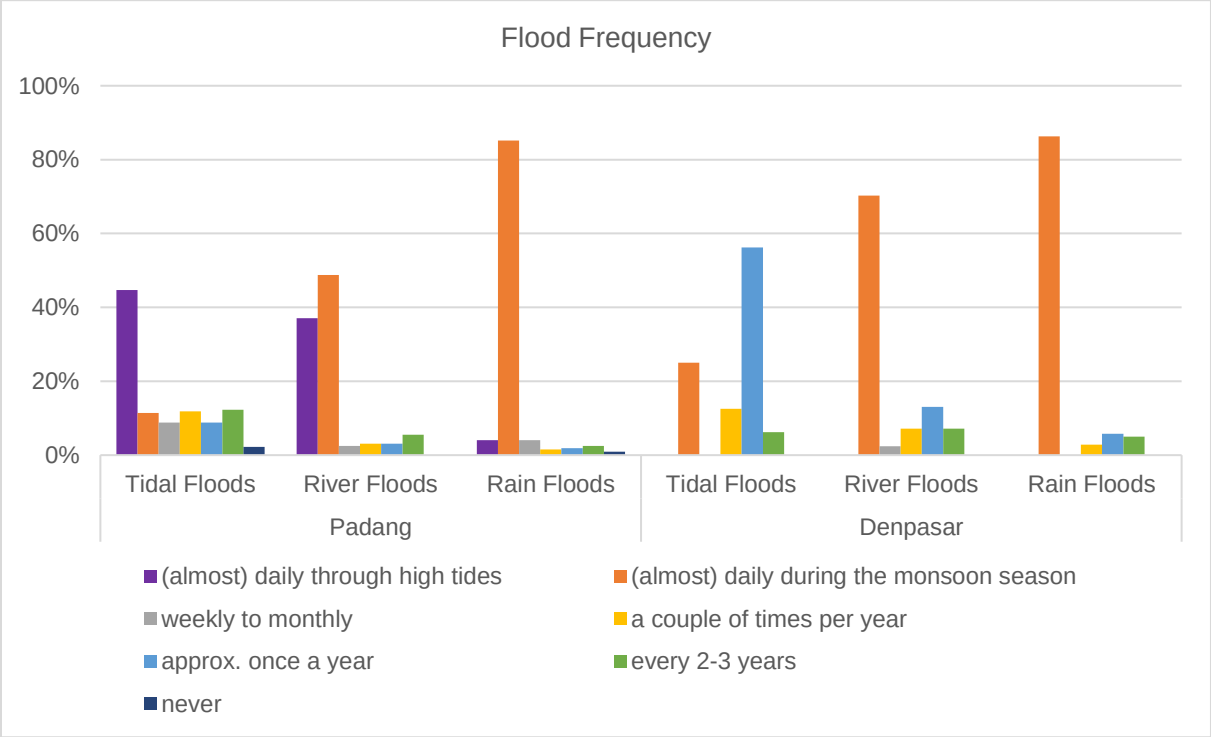


Figure 6-1. Frequency of flood exposure of surveyed households in Padang and Denpasar (N=620).

The individual and collective responses to flooding in both cities indicate low levels of preparedness and adaptation (Figures 6-2, 6-3, & 6-4). Households in Padang exhibit a low level of flood preparation activities, with more than two-thirds reporting no specific actions. Structural adaptations post-flood are moderately implemented, such as elevating furniture, house elevation, and creating higher house thresholds. Community measures in Padang are also limited, with almost two-thirds undertaking no specific actions to reduce flood impacts. In Denpasar, surveyed households share a similar pattern of low preparedness, with 78.6 % of individuals doing nothing in particular for flood preparation. Structural adaptations are less common in Denpasar compared to Padang, with only a small percentage of households implementing measures such as building higher house thresholds and elevating houses. Community measures against flooding are exceedingly rare in Denpasar, with 93.5 % of the community undertaking no particular action.

In both cities, almost all households see a high individual responsibility to deal with flooding (92.3 % in Padang and 99.5 % in Denpasar). Further, the perception of having influence to make their neighborhood safer from flooding is low in both cities, with 78.8 % in Padang and 90.6 % in Denpasar feeling they have little to no influence. Both findings point to a significant challenge in mobilizing community action.

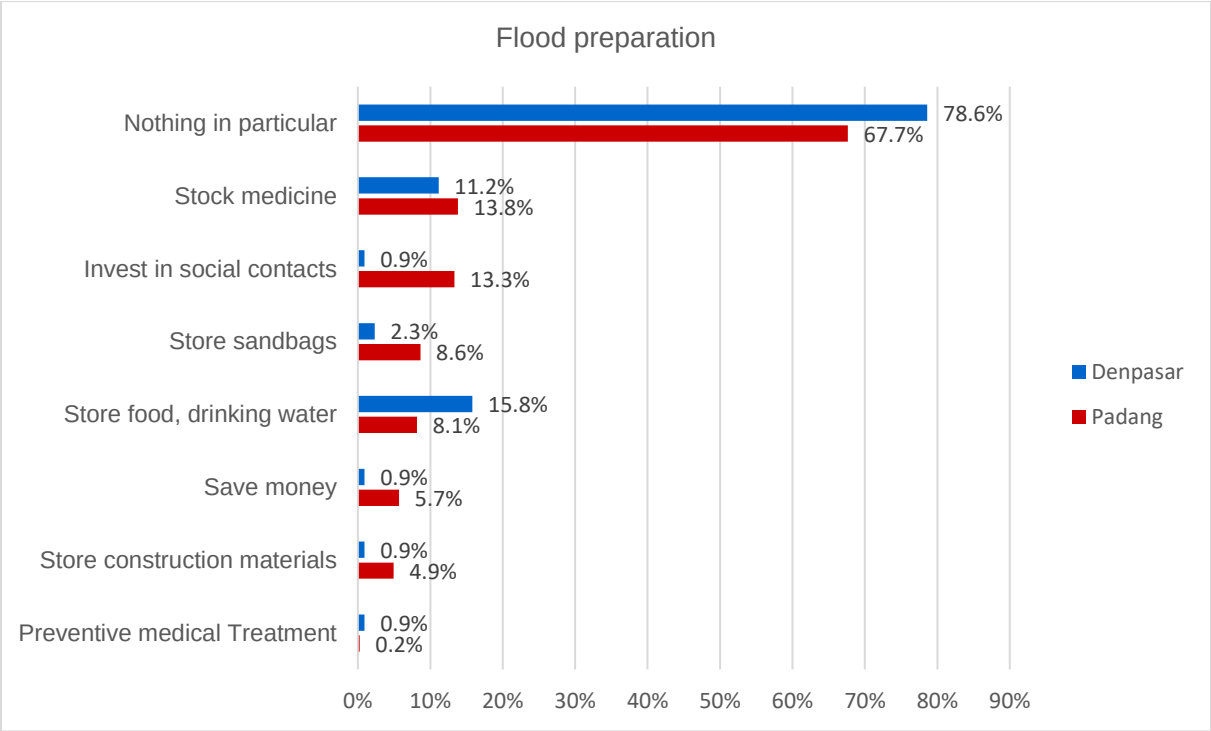


Figure 6-2. Descriptive answers of surveyed households in Padang and Denpasar on the question: How do you prepare for floods? (N=620)

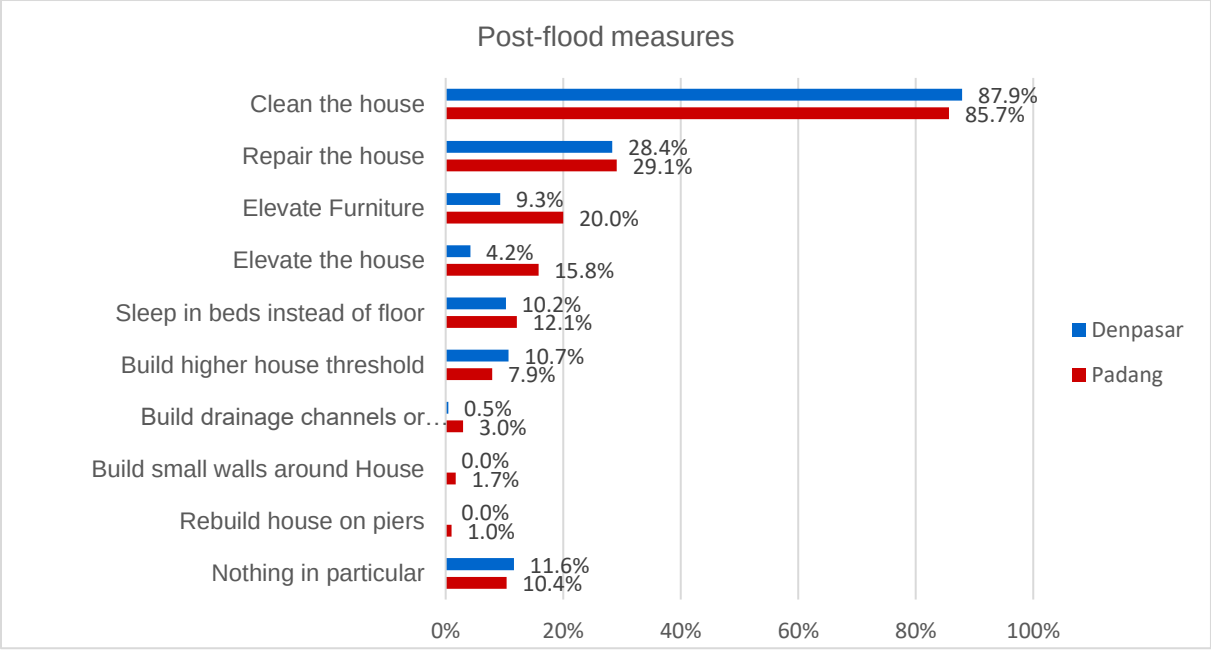


Figure 6-3. Descriptive answers of surveyed households in Padang and Denpasar on the question: What do you do after a strong flood? (N=620)

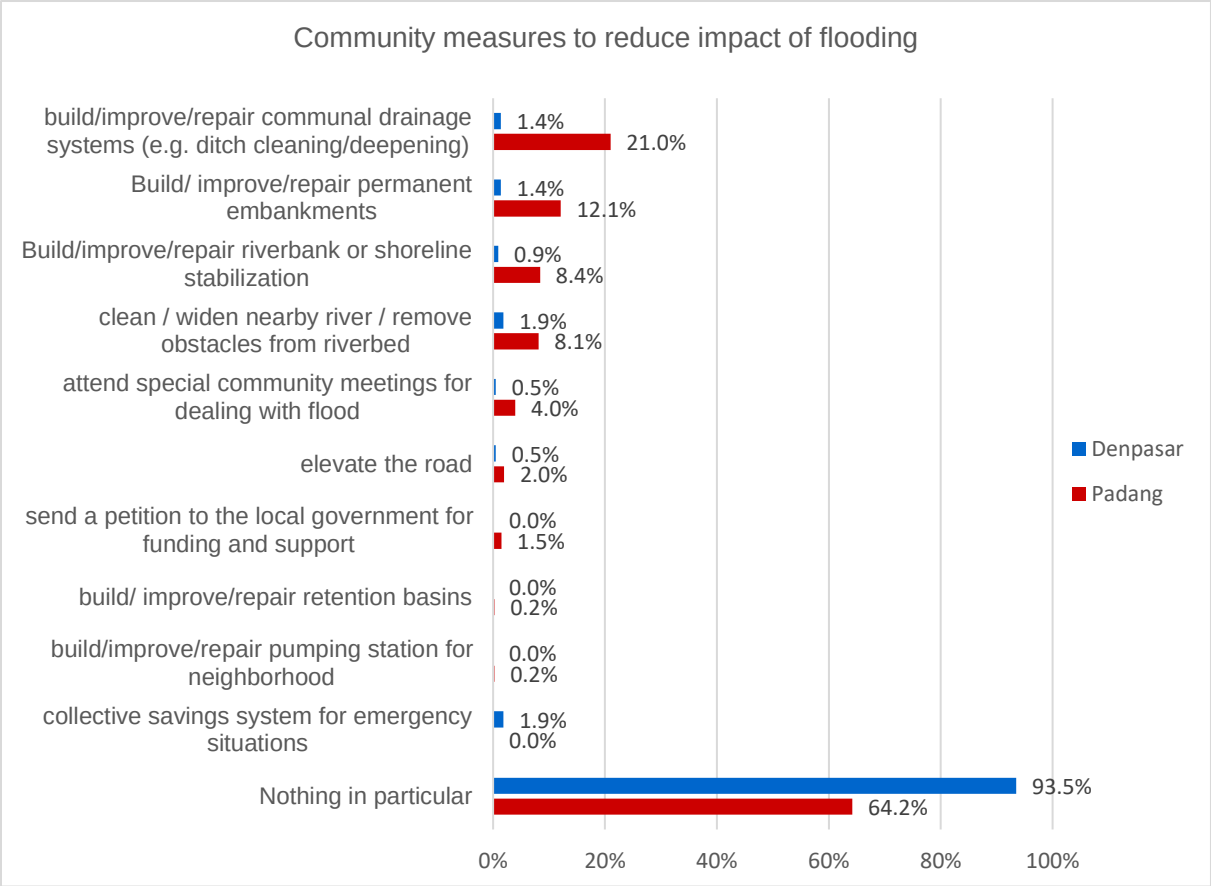


Figure 6-4. Community measures to reduce the impact of flooding in Padang and Denpasar (N=620)

The initial findings on the demographic composition, socio-economic conditions, and community engagement in Denpasar and Padang lay the groundwork for understanding how local and translocal support networks operate within these cities in response to frequent flooding. In Padang, the predominance of local residents and the ethnic Minangkabau majority suggest strong local ties that contribute to local support networks. Conversely, Denpasar's diverse population and a significant number of migrants indicate a higher propensity for translocal support networks.

Households in both cities, despite their socio-economic and cultural differences, show limited individual and communal responses to flooding, high levels of flood impacts, a high sense of individual responsibility, and low self-perceived influence on improving flood safety in their communities. These findings suggest that informal support networks play a substantial role in the adaptive capacity of coastal communities in Padang and Denpasar. Against this backdrop, the next chapter will explore the characteristics and determinants of local and translocal support networks in detail.

7. The complementary nature of local and translocal social capital in flood adaptation: Evidence from urban coastal communities in Indonesia

Gisevius, K., Niesters, L.-M., Larasati, A., & Braun, B. The complementary nature of local and translocal social capital in flood adaptation: Evidence from urban coastal communities in Indonesia.

This is the authors' original manuscript of the submitted article.

Own contribution is detailed in appendix B.

Abstract

Environmental change and sea level rise pose significant challenges to urban coastal communities worldwide, particularly in the Global South. Research on household and community-level adaptation highlights the central role of social capital in adaptation processes. Despite this fact, the importance of translocal social capital, which encompasses social support and resources that extend beyond local boundaries and connect people at different places, often remains overlooked by existing hazard research. To reduce this research gap, we investigate the impact of local and translocal social capital on coastal adaptation of flood-prone households in Padang and Denpasar, Indonesia. Using household survey data (N=620) including social network data on flood-related support (N=1169), we analyze the aid provided by local and translocal personal contacts. Our results show that translocal contacts are more likely to provide emotional and moral support as well as financial and material support, while local contacts are more likely to share flood-related knowledge, skills, advice, and practical support (e.g., physical labor or caregiving). Further, our findings reveal that the effectiveness of local and translocal support in improving long-term responses of flood-prone households depends on several factors. Local support is strengthened by community ties and diverse forms of support, whereas translocal support's substantial role for mental health issues relies on intimacy and reliability found in strong personal relationships. Additionally, well-connected support contacts are instrumental in giving households' access to wider social networks. Finally, proactive households can more effectively use their networks to mobilize social capital for their and their community's advantage. These findings reveal the complementary functions of local and translocal social capital and the determinants for their effectiveness in long-term adaptation, demonstrating that households will benefit from maintaining diverse support networks.

Keywords: Coastal hazards; Social capital; Translocality; Adaptation; Urban communities

7.1. Introduction

Environmental change and rising sea levels pose significant challenges for urban coastal communities, with particularly severe impacts felt in the Global South due to often heightened exposure to natural hazards and lower governmental capacities (Carmen et al. 2022). Many coastal cities in the Global South face a myriad of problems including flooding, erosion, land subsidence, and saltwater intrusion, leading to profound socioeconomic implications such as displacement and loss of livelihoods (Birkmann et al. 2022; Wong et al. 2014). The cumulative effects of these challenges underscore the urgent need for effective and inclusive disaster risk management. However, in situations where governmental capacities are constrained, community and individual household adaptation has to step in (Adger et al. 2003). In addressing these strategies, the role of social capital emerges as critical for effective hazard adaptation (Aldrich & Meyer 2014).

Social capital is a key asset to hazard adaptation strategies for vulnerable communities. It can reduce vulnerability, enhance adaptive capacity, and foster risk reduction, response mechanisms, and recovery strategies (Aldrich et al. 2016; Bixler et al. 2021; Wilkin et al. 2019). Empirical evidence shows that social capital can provide access to critical and innovative information, enables the mobilization of resources during crises (Wood et al. 2013), and offers emotional support (Pacoma & Delda 2019).

The shift towards integrating both local and translocal social capital in hazard research reflects an evolving understanding of social networks, emphasizing the need for more empirical studies to explore the dynamics and interrelationships between these two spatial dimensions. Research has traditionally concentrated on local social capital, emphasizing the networks, relationships, and connections within specific communities and locations (Lee & Lee 2019). This focus has provided valuable insights into the resources and support systems available within a community, but it has also inadvertently overlooked the contributions of translocal social networks, spanning multiple places, regions or even countries (Andersson et al. 2018; Boas 2017; Rockenbauch & Sakdapolrak 2017). Translocal social capital encompasses the relationships and networks that connect individuals or groups across different geographical areas, offering access to diverse resources, knowledge, and opportunities beyond the boundaries of a single community (Bott et al. 2020; Chaudhury et al. 2017). In recent years, there has been a growing recognition of the significance of translocal social capital, complementing local perspectives by acknowledging how cross-regional connections can enhance adaptation strategies and resource mobilization (inter alia Bott et al. 2020; Pacoma & Delda 2019; Rockenbauch et al. 2019). Such studies are crucial for a comprehensive understanding of the role of social capital in addressing environmental challenges and facilitating community resilience.

Given the complexity of social capital, our study aims to gain a better understanding of the dynamics of both local and translocal social capital as resources for hazard adaptation. Using the example of Padang and Denpasar – two Indonesian second-tier coastal cities – this study investigates the common features, differences, and potential interactions of local and translocal social capital on household and community adaptation to coastal hazards. Our main research questions are:

1. *How does support during and after flood events differ between local and translocal social contacts, and to what extent do they complement each other?*

2. *How can local and translocal support contribute to long-term flood adaptation and what factors shape their influence?*

Understanding the spatial dimensions of social capital can provide deeper insights into how communities respond to hazards and how they can best be supported by governmental agencies or NGOs. For policymakers, community leaders, and organizations incorporating both local and translocal social capital in disaster management plans can be essential for promoting resilience and adaptation strategies of local communities, putting a greater emphasis on wider social networks, boundary-spanning community participation, and the role of social organizations in recovery and planning processes (Kumari & Frazier 2021).

7.2. Conceptual background

Social capital plays a crucial role in adaptation strategies, especially for communities in the Global South (Adger 2003; Aldrich & Meyer 2014; Cinner et al. 2018). Social capital is defined as resources within social networks that enable collaboration and collective action among individuals and communities (Lin 2010). In other words, social capital manifests itself in the access to both tangible and intangible resources, including financial and non-financial assets (such as money, food supply, information, or emotional support), available through connections within a network. Social capital is supposed to compensate for limited financial or human resources and institutional support gaps (Braun & Aßheuer 2011; Bott & Braun 2019; Glaeser et al. 2002; Rockenbauch et al. 2019).

Bonding, bridging, and linking social capital are essential concepts in categorizing and understanding community responses to natural hazards and their ability to adapt (Adger 2003; Aldrich & Meyer 2014). Bonding social capital refers to the strong ties and trust within close-knit groups like families and local communities. Bonding social capital provides access to support among socio-economically similar individuals, which are crucial for immediate support and enable communities to respond to mid-term scales of natural hazards through self-organization and collective action, for example through creating informal insurance systems such as communal loans (Bott et al. 2019; Hawkins & Maurer 2010). Bridging social capital, on the other hand, involves weaker ties that open up new opportunities and connections across socio-economically and/or culturally different groups, such as ethnic minorities or professionals from various sectors (Cofré-Bravo et al. 2019; Nguyen-Trung et al. 2020). This form of social capital is beneficial for accessing a broader range of resources and information (Adger 2003; Aldrich & Meyer 2014). Lastly, linking social capital refers to connections towards individuals or groups at higher levels of influence or authority, such as government entities or large companies (Aldrich et al. 2016). In sum, bonding, bridging, and linking social capital each play a distinct role in enabling communities to adapt effectively to natural hazards. Bonding social capital provides immediate internal support, bridging opens pathways to broader resources, and linking facilitates access to external aid and decision-making power.

While bonding, bridging, and linking social capital highlight the role of internal and external network ties, the spatial dimensions of social capital, particularly the role of translocal social capital, is only starting to be increasingly recognized in hazard research (Bott et al. 2020; Pacoma & Delda 2019; Rockenbauch

et al. 2019). Translocal social capital involves connections between communities across different locations (Cope et al. 2018; Elliott et al. 2010; MacGillivray 2018). Scholarship on translocal social capital underscores the importance of geographical spread and distance in leveraging support networks beyond immediate and local ties, thereby expanding the scope of resources accessible in times of need. These translocal connections can work as a co-insurance between network members at different places providing access to resources such as funds, supplies, or information, that might not be available locally (Bott et al. 2020; Chaudhury et al. 2017). However, establishing and keeping up these networks requires considerable financial and human capital, for example, to afford communication or travel. Thus, poorer households or communities might not have the means to build and maintain such far-reaching networks, making them potentially more vulnerable in hazardous situations (Bott et al. 2020; Elliott et al. 2010).

Despite the relevance of translocal social capital for community adaptative capacities, empirical studies focusing on the specific content and dynamics of social support facilitated by both local and translocal social capital are largely lacking (for exemptions see Bott et al. 2020; Rockenbauch et al. 2019). In other words, many existing studies focus more on the presence or absence of social capital as a predictor for adaption outcomes instead of looking deeper into the dynamics of how social capital actually works: How is social capital activated and how is it utilized? What kind of resources and support are accessible through social networks and for whom? How do different network configurations influence the availability of support? Passing over these questions overlooks the unique contributions of different forms of social capital to community resilience.

Consequently, the current understanding of the relation between local and translocal social capital remains partly superficial. There are research gaps on the differences, commonalities, and potential interactions of local and translocal social capital. This knowledge is vital to inform and understand more nuanced adaptation strategies.

Additionally, the research focus has traditionally been on the receiving end of social capital, with limited attention to the dynamics of the support-lending side within these networks and relationships (see Dalgas 2018; Su & Le Dé 2021). We argue that investigating the roles of both support recipients and providers within the context of adaptation is critical. By examining how individuals and communities engage in supportive behaviors within their social networks, we aim to uncover new insights into the mechanisms by which social capital enhances adaptive capacity.

7.3. Study area description and methodology

In this study, we explore the differing impacts of local and translocal social capital on coastal adaptation for flood-prone households in Padang and Denpasar, Indonesia. These two cities have been chosen because of their comparable size, proneness to coastal hazards, and differences in the socioeconomic dynamics and cultural aspects of their coastal populations, giving rise to diverse sets of social networks.

Padang is located on the coast of West Sumatra and faces the open Indian Ocean, thus being vulnerable to tsunamis. In 2022, Padang had a population of 919,145 (BPS Kota Padang 2023). Almost half of the city area lies on low-lying coastal plains, making these urban areas prone to coastal, fluvial, and rain flooding (Khomarudin et al. 2010; Sari et al. 2022). The city's overall disaster preparedness is notably

low (Sari et al. 2022). This is reflected in the local community's limited economic resources and low levels of savings. Additionally, there is a need for a broader understanding of disaster risk and mitigation strategies for local authorities (Kusumastuti et al. 2014; Sari et al. 2022). Socioculturally, Padang is distinguished by its Minangkabau culture, a matrilineal society known for its tradition of outmigration. We expect that this societal structure has implications for the development of local and translocal social capital, as family ties are maintained even over long distances, influencing the dynamics of support networks (Iman & Mani 2013; Rahman 2016).

Like Padang, Denpasar is regularly affected by coastal hazards such as tidal, fluvial, and rain flooding, coastal abrasion, and seawater intrusion due to its flat terrain and high rainfall intensity (Kusmiyarti et al. 2018; To 2018). In 2022, Denpasar had a population of 726,808 (BPS Kota Denpasar 2023). The city's sociocultural landscape is shaped by its predominantly Balinese Hindu culture, which influences its social order within a patriarchal society. Religious affiliations and ties to both an individual's birth village and family play significant roles in shaping social structures (Putra & Creese 2016; Wade et al. 2018). Additionally, driven by Bali's developed local tourism industry, Denpasar experiences high immigration rates from across Indonesia but especially East Java, with predominately Muslim and patriarchal sociocultural structures, thus, adding to the complexity of its sociocultural dynamics and impacting the development of social capital (Prajnawrdhi et al. 2015).

In June 2022, we conducted a pre-survey to collect socioeconomic and flood-related data for study site selection in Padang and Denpasar. In total, 12 coastal *Kelurahan* (eng.: urban villages) have been selected as study sites, nine in Padang and three in Denpasar, respectively (see Figure 7-1). In Indonesia, *Kelurahan* represent urban administrative units at the subdistrict level (Nasution 2017). All selected study sites are coastal residential areas directly connected to the sea and have been affected by flooding in the last five to ten years.

Subsequently, in October 2022, a quantitative household survey (N = 620) was carried out, covering, among others, demographic and socio-economic characteristics, flood exposure, impacts, responses, and community activities. Data collection was supported by research assistants from Padang State University and Udayana University in Denpasar. The households were sampled systematically by selecting every fifth house on a row of residences, starting from the closest to the shoreline. Also, the respondent of each sampled household should have lived in the area for at least five years and be affected by flooding. In Padang, surveys were conducted across 405 households, representing approximately 3.1% of all households living in the nine surveyed *Kelurahan*. Meanwhile, in Denpasar, 215 households were surveyed, accounting for about 1.4% of the total number of households in the three surveyed *Kelurahan*.

As part of the household survey, the respondents were asked about their personal support networks – i.e., personal contacts who provide support related to flood events. In this study, a social or personal contact refers to an individual who provides material or immaterial support to respond to flooding, such as family members, neighbors, work colleagues, or friends. Alongside demographic information about these social contacts, we asked respondents about the type of relationship (e.g. family member, neighbor/ community member, work colleague, or friend) and relationship strength (very close, close, or not close) with these contacts and the types of support they receive from them before, during and after

flood events. The resulting ego-centric network data collected comprises information of 1169 support contacts. Ego-centric network data refers to the collection and analysis of social connections and relationships surrounding a specific individual (the "ego") within a network, focusing on how that individual is directly connected to others without necessarily considering the wider network structure (see Borgatti et al. 2018). These contacts were further categorized into local and translocal contacts and formed the core sample for our analysis. Social contacts are considered translocal when the place of residence lies outside of Denpasar or Padang respectively.

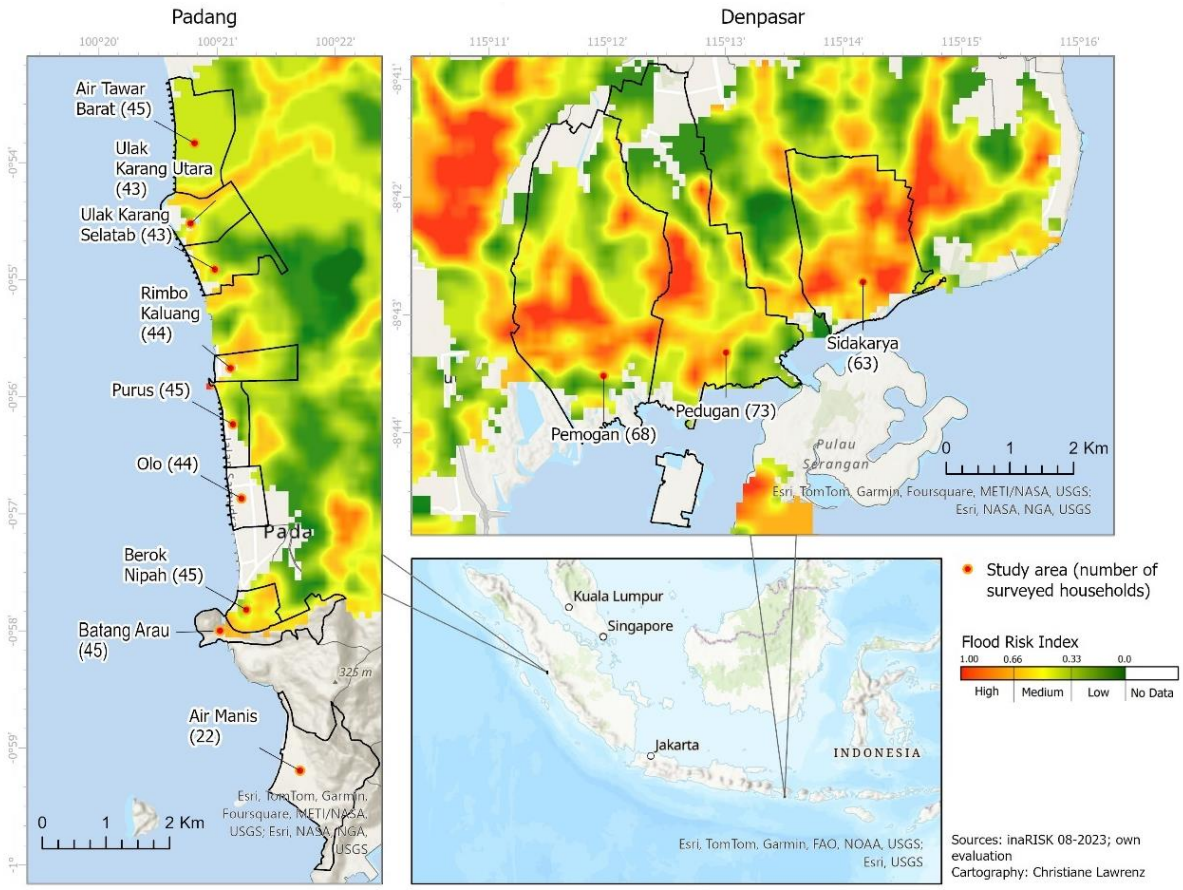


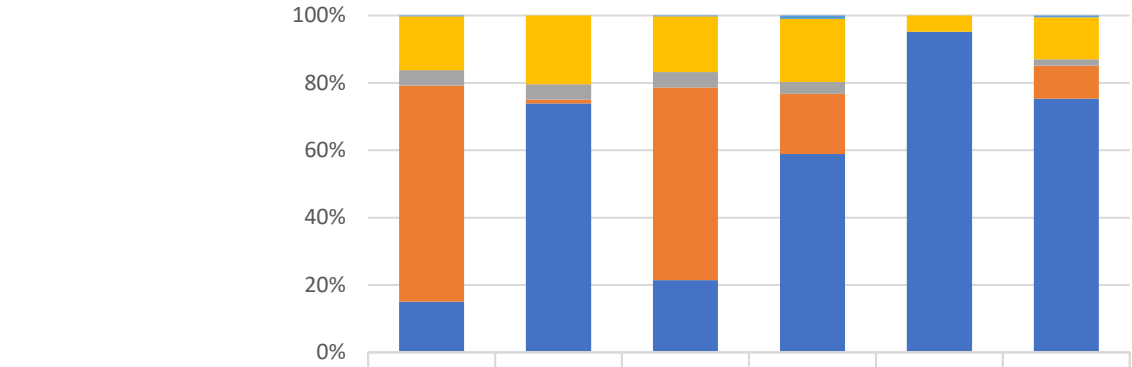
Figure 7-1. Map of study areas in Padang and Denpasar showing flood risk

First, the resulting data was analyzed using descriptive and bivariate statistical analysis to identify differences in the types of social support provided by local and translocal contacts. Further, we used multivariate logistic regression analyses to investigate the contribution of local and translocal support to improving long-term flood adaptation. Long-term flood adaptation is here defined as either (1) a lasting impact reduction of future flood events; or (2) a faster or more effective recovery from the detrimental impacts of future flood events (see Peck et al. 2022).

7.4. Results

7.4.1. Characteristics and prevalence of local and translocal social ties in Padang and Denpasar

In order to investigate the role of local and translocal personal social contacts in providing support to households affected by floods, we start by comparing the characteristics of these support networks in Padang and Denpasar respectively. The findings show that flood-specific personal support networks of individual households are rather small according to the respondents, with an average of 1.97 (min = 0; max = 10) support contacts in Padang and 1.71 (min = 0; max = 6) in Denpasar, respectively. Overall, in both cities, households rely on a mix of local (78 %) and translocal (22 %) contacts for flood-related support. However, our analysis reveals significant differences in the support networks between households in both cities (see Figure 7-2).



	Padang			Denpasar		
	Local contacts	Translocal contacts	Total	Local contacts	Translocal contacts	Total
other	0.3%	0.0%	0.3%	1.0%	0.0%	0.5%
Friends	16.0%	20.5%	16.5%	18.8%	4.8%	12.5%
Work colleagues	4.6%	4.6%	4.6%	3.5%	0.0%	1.9%
Neighbors / Community members	64.1%	1.1%	57.1%	17.8%	0.0%	9.8%
Family	15.1%	73.9%	21.3%	58.9%	95.2%	75.3%

Data source: Own questionnaire survey 2022/23

Figure 7-2. Distribution of relationship types among local and translocal contacts in Padang and Denpasar

In Padang, our results indicate a strong reliance on local community structures for flood support. Here, the majority of support (89 %) comes from local sources, compared to a small share of translocal contacts (11 %). Local contacts in Padang are predominantly neighbors and community members (64%), followed by friends (16 %) and family members (15 %). The relationships are primarily described as “close” (54 %) or even “very close” (45 %).

Conversely, surveyed households in Denpasar show a greater dependence on translocal ties, which make up 45 % of their support contacts. Here, family members dominate the support structure, accounting for 75 % of all contacts, followed by friends (13 %) and community members or neighbors (10 %). Further, relationships are categorized as largely “very close” (79 %). The prevalence of translocal support in Denpasar is likely linked to the high rate of internal migration to the city, with 64%

of respondent households originating from other regions in Indonesia, especially East Java and other parts of Bali.

Contrasting the findings from both cities indicates that the prevalence of local and translocal support ties is linked to the migration status of a household. Interestingly, the expectation that the tradition of outmigration in Padang would result in a higher occurrence of translocal flood support does not become apparent, at least when comparing the two study areas. Instead, the results suggest that migrants – regardless of their socio-cultural background – are more likely to possess translocal ties compared to non-migrants. To test this assumption, we used an additional Chi²-test using two dichotomous variables: (1) the household has migrated to its current place of residence and (2) the household has translocal ties (see Table 7-1). The results of this test confirm our assumption, showing that 46 % of migrant households have translocal contacts, compared to only 12 % in non-migrant households. This finding is in line with the prevalent notion that migration is considered the most influential practice in establishing translocal ties (see Brickell & Datta 2016; Etzold 2016; Freitag & von Oppen 2010).

Table 7-1. Bivariate analysis of the migrant status of households and presence of translocal ties

Migrant household (1=yes)	**Household has translocal contacts (1=yes)**		**Total**
	Yes	**No**	
Yes	115 46.0 %	135 54.0 %	250 100.0 %
No	40 12.1 %	291 87.9 %	331 100.0 %
Total	155 26.7 %	426 73.3 %	581 100.0 %

Data source: Own questionnaire survey 2022/23 *Pearson chi2(1) = 83.7523 P = 0.000*

While there are significant differences between the characteristics of personal contacts in Padang and Denpasar, our findings suggest that support networks in both cities – regardless of their (trans)local orientation – can largely be described as bonding social capital. In both cases, we predominantly find strong ties within similar socio-economic groups, which are typical categories of bonding social capital (Adger 2003; Aldrich & Meyer 2014; Hess 2017). Although the relationship types vary significantly between Padang and Denpasar, this finding shows a lack of bridging and linking social capital and a substantial reliance on close personal relationships in providing support during floods in our study areas.

7.4.2. Types of support provided by local and translocal contacts

In order to answer our first research question on the differences and commonalities between local and translocal social capital, we employ a bivariate analysis of support provided by the different social contacts (Table 7-2). Notably, none of the surveyed support forms are exclusive to local or translocal contacts. However, we find significant differences in the likelihood of providing different types of support. Local contacts are more likely to share flood-related knowledge, skills, and advice as well as practical support (e.g., physical labor or caregiving) during and after flood events. Translocal contacts, on the

other hand, are significantly more likely to provide emotional and moral support as well as financial and material support. These results are largely robust across both cities and different relationship types.

Table 7-2. Bivariate analysis of the relationship between local and translocal contacts and support types (N=1169)

Support type: Contact…	Significance	Test	Categories N	Share of translocal contacts
provides emotional and moral support	***	$Chi^2 = 30.34$	Yes = 832 No = 337	219 (26.3%) 39 (11.6%)
provides financial and material support	***	$Chi^2 = 12.83$	Yes= 250 No = 919	76 (30.4%) 182 (19.8%)
provides flood-related knowledge support	***	$Chi^2 = 19.29$	Yes = 230 No = 939	26 (11.3%) 232 (24.7%)
provides practical support on-site (e.g., manual labor, caregiving)	***	$Chi^2 = 35.47$	Yes = 347 No = 822	38 (10.9%) 220 (26.8%)
discusses flood adaptation strategies with household	***	$Chi^2 = 25.98$	Yes = 385 No = 784	51 (13.3%) 207 (26.4%)
has connections to influential people useful for flood responses	n.s.	$Chi^2 = 0.00$	Yes =150 No = 1019	33 (22.0%) 225 (22.1%)
has improved household's long-term response to floods	*	$Chi^2 = 3.18$	Yes = 523 No =646	128 (24.5%) 130 (20.1%)

Data source: Own questionnaire survey 2022/23 *** p<0.01, **p<0.05, *p<0.1, (n.s.) not significant | Scale = Dichotomous

The finding that translocal contacts are more likely to provide emotional support than local contacts can be explained by several factors. Maintaining relationships across different places often demands more effort, which usually results in stronger connections with close friends or family (Elliot et al. 2010; Su 2022). Experiences shared among these groups, such as migrating or belonging to the same culture, can make these bonds even stronger (Esnard & Sapat 2016). The absence of physical presence may lead to emotional compensation and reduced social friction (Cronin 2015). The broader and often less intimate nature of local relationships, such as those with neighbors or casual acquaintances, might lead to less emotional support compared to translocal contacts. Finally, people from the immediate neighborhood are usually also affected by the flooding and related hazards, so they may be less able to provide moral support themselves.

Answering our first research question, our analysis of support during and after flood events highlights distinct but complementary roles of local and translocal social contacts. We can show that local and translocal contacts play equally important but different roles in supporting flood-affected households during and after floods. Local contacts are more likely to address the immediate practical challenges posed by the floods, while translocal contacts provide essential emotional backing and resources crucial for longer-term recovery. These complementary functions underscore the importance of a diverse social network for households and communities for building adaptive capacity.

7.4.3. Contribution of local and translocal contacts to long-term flood responses

Our next aim is to identify factors that influence the extent to which local and translocal support contributes to long-term flood adaptation. We constructed two binary logistic regression models for local and translocal contacts respectively (Table 7-3). The dependent variable is a self-reported dichotomous variable asking whether the support of a social contact has helped to improve the long-term flood response of a given household. The independent variables, selected based on literature review and preliminary bivariate analyses, were grouped in (1) demographic and socioeconomic characteristics, (2) hazard exposure, (3) community characteristics, (4) relationship attributes, and (5) support types. Since the contact data is nested in our household data, we control for intragroup correlation by using variables on the contact scale and household scale through the use of clustered standard errors. Also, multicollinearity can be ruled out as the Variance Inflation Factor (VIF) of the independent variables is below 2.0 (Kim 2019). Emotional support was not included in the final models due to its high prevalence among local and especially translocal contacts, masking the other results.

In the local model, we find evidence that the embeddedness of a household in the local community networks improves the long-term contributions of their personal local network. For instance, we find a positive correlation with residence duration, suggesting that longer residency equates to higher embeddedness in local community networks (odds ratio (OR) = 1.02). Similarly, attendance at community meetings, indicative of higher community integration, also demonstrates a positive correlation (OR = 2.3). Interestingly, access to community funds shows a negative correlation (OR = 0.4), implying that collective communal support mechanisms might reduce the contribution of support at an individual level. However, community funds are pooled from individual contributions within the community, which might include people from a household's personal local network. Therefore, the contribution of community funds is not seen as coming directly from personal contacts, explaining the observed negative correlation.

Translocal contacts with ties to influential people that are useful for flood responses (e.g. community leaders, entrepreneurs, politicians), are almost six times as likely to have contributed to improvements in a household’s long-term flood response (OR = 5.8). This finding demonstrates that while in our sample most translocal contacts are characterized as bonding ties, these connections harbor great potential for flood adaptation by providing access to broader and more distant networks (see Su 2022). In other words, well-connected translocal contacts can give indirect access to bridging and linking social capital which is beneficial for a household’s flood adaptation (Bott et al. 2020).

While financial support is common among translocal contacts in general, it shows no significant effect in the model. This finding can be attributed to the dynamics of financial interactions following emergency events, where financial support appears to often address immediate needs rather than contributing to long-term goals (see Le De et al. 2013; Su 2022). On top of that, our sample contains a large share of migrants, who themselves are often providers of regular remittances to their relatives, reducing the likelihood of receiving financial support themselves. Additional Chi^2 tests confirm that we do find a significant positive correlation between households who receive regular remittances and their likelihood of receiving financial support in response to flooding events.

Table 7-3. Logistic regression models: Determinants of local and translocal support effectiveness for long-term flood responses

Dependent variable: Support from contact has improved long-term response to flooding of HH (Yes/no)	**Local**	**Translocal**
N	**904**	**255**
Pseudo R2	**0.3624**	**0.3019**
Household characteristics		
Demographic & socioeconomic characteristics		
Residence duration (in years)	1.017*** (0.00635)	
Avg. monthly Income (in 1000 IDR)		0.999 (0.000121)
HH has regular access to ICT (yes=1)		1.339 (0.924)
Main earner is self-employed (yes=1)	0.920 (0.240)	
HH receives government subsidies (yes=1)	1.688* (0.461)	
Flood impact		
Flooding affected income/job situation (yes=1)	0.822 (0.262)	
Flooding caused negative impacts on mental health (yes=1)	1.349 (0.443)	4.709*** (2.520)
Flooding caused negative impacts on physical health (yes=1)	1.085 (0.371)	1.434 (0.776)
Local social network / community characteristics		
HH attends community meetings (yes=1)	2.281*** (0.609)	1.805 (0.782)
HH contributes to community funds (yes=1)	0.867 (0.299)	
HH has access to community funds (yes=1)	0.423** (0.175)	
Perceived level of trust in community (high=1)	0.894 (0.246)	
Perceived participation level in community (high=1)	0.667 (0.200)	
Agency		
Self-assessment of personal influence to make community safer from flooding (some/substantial=1)	3.623*** (1.231)	6.629** (5.156)
Contact characteristics		
Relationship type and tightness		
Contact is family member (yes=1)	3.413** (2.028)	
Contact is a neighbor or community member (yes=1)	1.915 (1.078)	
Contact is a friend (yes=1)	2.018	
Relationship strength (very close=1)	1.139 (0.288)	7.977*** (5.708)
Support types		
Contact provides financial support (yes=1)	5.827*** (1.942)	1.241 (0.589)
Contact has shared knowledge on how to deal with floods (yes=1)	1.301 (0.413)	1.278 (1.028)
Contact will visit HH for practical support (yes=1)	3.359*** (0.922)	4.772 (5.429)
Contact discusses flood adaptation strategies with HH (yes=1)	4.325*** (1.092)	3.427* (2.291)
Contact has connections to influential people beneficial for flood responses (yes=1)	2.456*** (0.794)	5.795** (4.691)
Constant	0.0278*** (0.0194)	0.0152*** (0.0177)

*** p<0.01, **p<0.05, *p<0.1, (n.s.) not significant; standard error in parentheses | Data source: Own questionnaire survey

In cases where respondents suffer mental health impacts from flooding, translocal contacts are almost five times as likely to contribute to a household's long-term flood response (OR = 4.7). This finding is likely related to the high share of close family members among translocal contacts providing emotional support in dealing with this type of impact. Along the same line, relationship strength also showed a strong positive correlation (OR = 8.0), underlining that intimacy and reliability are important factors in activating translocal ties (see Pacoma & Delda 2019).

In both models, the household agency shows up as a significant determinant of whether social support contributes to long-term adaptation or not. Agency reflects the household's self-assessment of their personal influence to make their community safer from flooding. In other words, households that perceive themselves as having a higher level of agency are more likely to engage in proactive measures to safeguard their community against flooding (see Cinner et al. 2018; Mortreux & Barnett 2017). Our results show that agency positively influences the efficacy of both local and translocal support networks in enhancing long-term flood responses, giving us an indication that the ability of households to actively and effectively mobilize and use their social capital is an important prerequisite of developing adaptive capacity. This finding highlights the importance not just of the presence of social capital, but of the household's skill in leveraging network support for long-term flood response and adaptation (see Cinner et al. 2018; Mortreux & Barnett 2017).

Further, we see in both models that knowledge sharing is not a significant determinant in improving long-term responses to flooding. This finding can be attributed to the nature of the predominantly bonding ties among both local and translocal contacts. Bonding ties usually involve close-knit, relatively homogenous groups that often lack the diversity and external connections necessary to introduce new or innovative knowledge, a feature more characteristic of bridging and linking ties that connect across different social groups or with influential actors (Cofré-Bravo et al. 2019; Tu 2020). On top of that, even though translocal bonding contacts often represent connections to external networks from the perspective of flood-affected households, they still may struggle to provide locally relevant knowledge. This may be due to contextual differences as their knowledge might not align with the specific geographical, social, and situational needs of the local context (see Rockenbauch et al. 2019).

In summary, answering our second research question, our findings display a complex interplay of factors influencing the contributions of local and translocal support in improving long-term flood responses of flood-prone households. While local support benefits from multiplier effects through community integration and a higher diversity of support forms, translocal support is much more contingent on psychosocial aspects and personal relationship strength between households and their social contacts. Additionally, well-connected support providers – especially translocal – give indirect access to bridging and linking social capital, working as an extension of the households' network. Finally, support-receiving households with high agency are able to leverage their networks actively and have a considerable influence on the way social capital is activated and utilized for themselves and their community. Thus, we find that the characteristics and actions of both the providers and recipients of support shape and contribute to long-term flood responses of households in Padang and Denpasar.

7.5. Concluding discussion

We contribute to hazard research by examining how local and translocal social capital contribute to flood adaptation, examining the cases of Padang and Denpasar. Our results demonstrate that households affected by coastal hazards will benefit from a combination of local and translocal social capital for increased adaptive capacity. Local support, deeply rooted in the socio-spatial context of flood-affected households, is characterized by practical aid, deliberation, and knowledge sharing, making it valuable

for both immediate responses and longer-term strategic planning efforts. This finding aligns with previous studies emphasizing the critical role of local networks in emergency scenarios and adaptation processes in general (inter alia Bott & Braun 2019; Pacoma & Delda 2019). Translocal support, in contrast, represents a greater source of emotional and financial assistance, crucial for managing the psychological and economic challenges before, during, and after flood events. The substantial role of psychosocial factors and emotional support, particularly from translocal contacts, stands out from our results. This form of support, often overlooked in favor of more tangible forms of support, can play a vital role in sustaining individuals and communities through the recovery process (McGuire et al. 2018). Emotional resilience, especially in the aftermath of disasters, is crucial for psychological well-being and long-term recovery (Mayer 2019; Kaniasty 2020). On top of that, translocal ties often provide access to a broader network and support remains operational when local support networks are overwhelmed (see Elliot et al. 2010). Thus, diverse social networks comprising both local and translocal ties have the potential to provide more wide-ranging and complementing support.

Our findings underscore the indispensable role of bridging and linking social capital in effective hazard adaptation, highlighting limitations within local and translocal support networks that are strongly dominated by bonding ties. Specifically, our results reveal two important indications that bridging and linking social capital is needed for effective hazard responses and that a lack of it, regardless of local or translocal support networks, is an obstacle to long-term adaptation. First, while knowledge sharing is present as a form of support in our sample, we find no significant effect on long-term adaptation in our models. We attribute this finding to the fact that in our sample, we find almost exclusively bonding ties in local and translocal support networks, underlining the prevalent notion that bridging and linking social capital play a much more important role as sources of new and innovative knowledge for adaptive action (see Bott et al. 2020). Also, we found no significant evidence that translocal contacts provide greater access to novel information or adaptation-related knowledge compared to local contacts. This suggests that spatial distance does not automatically equate to access to sources of diverse or innovative knowledge, indicating some limitations to the argument that translocal bonding ties offer similar benefits as bridging and linking social ties (Su 2022). Second, our findings show that one major aspect of how personal contacts contribute to long-term flood responses is their ability to connect households to influential people or organizations beneficial for flood responses, or in other words, providing access to bridging and linking ties. Thus, our findings are in line with the prevalent view that a balanced combination of bonding, bridging, and linking social capital is vital for adaptive capacity (see Azad & Pritchard 2023; Cinner et al. 2018).

Next to the diversity and quality of support networks, we demonstrate that self-perceived agency represents an important factor in leveraging social capital for effective adaptation. Accordingly, it is crucial to distinguish between the presence of social capital and the direct actions taken by households. Social capital serves as a potential source of support and resources but does not inherently lead to concrete adaptation actions (Barnes et al. 2020; MacGillivray 2018; Rockenbauch et al. 2019; Saptutyningsih et al. 2020). Help from support networks often serves more as enablers or catalysts of adaptive responses rather than direct agents of change. Therefore, the actual contribution of social

capital to household adaptation can vary, depending on the agency of households, the nature of social ties, available resources, and specific contextual needs.

The findings of this study have important implications for disaster management policies and planning. We underscore the need to shift from a predominantly local focus to a more inclusive approach that integrates translocal perspectives and different spatial scales of social networks. Such a broader perspective is essential for designing resilience strategies that are both effective and socially sensitive, ensuring that they are tailored to the specific needs and resources of diverse communities. Central to this approach is the development and maintenance of local and translocal networks. In this context, the role of policymakers and planners becomes one of cautious facilitation rather than direct control. Efforts should be directed towards laying down a framework that naturally encourages individuals and communities to create, maintain, and leverage their personal networks. For example, this can involve facilitating access to platforms for the exchange of resources and information, which inherently supports the development of local and translocal networks. Moreover, strategic alliances with community leaders, local and regional NGOs, and diaspora communities can serve as a catalyst for such network formation. Importantly, the empowerment of communities and the nurturing of a sense of agency among individuals are crucial. Thus, while interventions should aim to bolster social networks, they must concurrently empower individuals and households to actively participate in and exploit these networks for their adaptive strategies.

We recommend focusing on the following key areas to advance future research. First, future investigations should focus on the processes by which social capital is translated into adaptive actions, looking at the conditions that allow for the effective use of social capital, both within local and translocal contexts. This entails conducting comparative studies across diverse socio-economic and cultural environments to identify factors that universally and specifically enable or hinder the mobilization of resources for adapting to hazards. Second, subsequent studies should attempt to further quantify the effectiveness and quality of social support networks in improving adaptive capacities, for example by focusing deeper on the degree of improvement. Third, since social networks and the embedded social capital develop through everyday interaction of people and communities and are activated in times of emergency (Romankiewicz et al. 2016), future research should adopt a whole-network research design (see Borgatti et al. 2018) to move beyond the duality of support provider and receiver interactions presented in this study. Such a broader approach would give deeper insights into other types of support structures and mechanisms present in networks that are not observable from an ego-network perspective. Also, looking at whole networks enables a more detailed and complex representation of the underlying dynamics of household and community resilience in displaying and mapping flows of emotional, informational, and material support.

In conclusion, the study underscores the complexity of local adaptation, which is not solely about physical preparedness or economic resources but also about leveraging diverse social networks at different scales. Our results highlight the important role of the dynamics of community integration, the strategic utility of connections beyond immediate social networks, and household agency in mobilizing social capital and leveraging support networks. It emphasizes the necessity to recognize and integrate translocal social capital into resilience strategies, shifting from a predominantly local focus to a more

inclusive, relational perspective which also includes network connections over longer distances. Ultimately, building hazard adaptation strategies in coastal communities requires acknowledging the role of social ties that transcend geographical and administrative boundaries.

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Author Contributions

K Gisevius: Conceptualization, Methodology, Investigation, Formal Analysis, Data Curation, Writing – Original Draft, Review & Editing, Visualization

L-M Niesters: Conceptualization, Methodology, Writing – Review & Editing

A Larasati: Field Investigation, Data Curation, Writing – Review & Editing, Visualization

B Braun: Conceptualization, Writing – Review & Editing, Supervision, Project Administration, Funding Acquisition

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8. Introduction to the second study: Translocal social networks and migration

The first study (Chapter 7) has shown that translocal social capital tends to fulfill different functions compared to local social capital when it is activated as a response to natural hazards. The results of this study make clear that it is valuable to further explore the dynamics, facets, and potential of translocal social support networks in more detail.

One important finding from the first study is that migration appears to be a primary driver in the development of translocal networks. Socio-cultural factors such as the *Merantau* tradition of the Minangkabau may contribute to the occurrence of migration and, therefore, increase the likelihood of the development of translocal support networks. The observed effects of migration on the development of local and translocal support networks demonstrate that the socio-spatial context matters for the structure and dynamics of social networks, resulting in variations in the types of support provided to flood-affected households.

Furthermore, the first study reveals that access to broader networks through social contacts significantly contributes to the long-term adaptation of households affected by floods. This points to the potential of translocal networks to provide critical support in times of need. Focusing on the individuals who provide this support yields deeper insights into how these networks are activated and mobilized under specific circumstances. Understanding the characteristics and drivers of social support from the providing side offers new perspectives on the dynamics of social networks and their activation mechanisms.

Building on these insights, the following chapter looks deeper into the intricacies of translocal social capital through a case study of Indonesian migrants abroad. This examination focuses on the provider perspective and – due to its transnational context – offers insights into the structure and dynamics of translocal networks, as well as the costs and benefits associated with migration within the context of translocal hazard responses.

9. Translocal responses to natural hazards and environmental change: Insights from Indonesian support-lending migrant communities in the European Union with a focus on Germany

Gisevius, K., & Braun, B. Translocal responses to natural hazards and environmental change: Insights from Indonesian support-lending migrant communities in the European Union with a focus on Germany.

This is the authors' original manuscript of the submitted article.

Own contribution is detailed in appendix B.

Abstract

Translocal social networks connect people across different places and enable the flow of financial resources, knowledge, skills, and practices. This translocal social capital is expected by scholars to be beneficial for the adaptive capacity of communities affected by natural hazards and environmental change. While existing hazard studies show the positive influence of translocal social capital for affected communities, it remains unclear what forms of support are available through translocal social capital, and how translocal social capital is activated, utilized, and translated over spatial and socio-cultural distances to improve adaptive responses of households and communities. To address this question, we examine the characteristics and determinants of translocal support provided by Indonesian migrant communities in Germany and other EU countries to family members affected by natural hazards in Indonesia. We apply a mixed-methods approach, combining the results of qualitative interviews and a quantitative online survey. Our results show that translocal social capital can materialize in much more diverse ways than previously assumed, including emotional/mental support, financial/material support, mobilizing social networks for practical support, sharing knowledge and skills, discussing adaptation/response strategies, as well as local support through being on-site. Further, we find that the identified forms of support are shaped by a variety of individual and situational factors of the sending migrants including socio-economic situation, migration history, experiences with and knowledge about environmental hazards, embeddedness in a (trans)local network, and perceived agency. Our study highlights the multifaceted nature of translocal support, emphasizing the importance of understanding both provider and recipient perspectives in harnessing these networks.

Keywords: Translocality; Social capital; Natural hazards; Migration

9.1. Introduction

For many local communities in the Global South, their ability to cope with and adapt to environmental change and natural hazards is closely related to their social capital, which is accessed through their social networks (Adger 2003; Dapilah et al. 2019). Social capital can fulfill a variety of functions in times of crisis such as providing moral and material support, resources, or information, ultimately shaping the adaptive capacity of local communities (Wilkin et al. 2019). As climate change and sea level rise are expected to exacerbate the risk and impact of natural hazards globally, social capital will likely grow in importance, particularly for communities that have limited financial and human capital or are constrained by limited government resources and interventions (Bott et al. 2020; Carmen et al. 2022).

In a globalized world, social capital is increasingly becoming more translocal, meaning that it is organized across local, regional, and national boundaries (Andersson et al. 2018; Boas 2017; Rockenbauch & Sakdapolrak 2017). In this regard, migration is considered the most influential practice in establishing translocal ties as family ties between migrants and their non-migrant families in their place of origin represent the most cohesive and reliable translocal ties (Brickell & Datta 2016; Elliot et al. 2010; Etzold, 2016; Freitag & von Oppen 2010; Rockenbauch et al. 2019a; Su 2022). The resulting translocal social capital enables households and local communities to access resources, knowledge, and opportunities that are not available locally (Bott et al. 2020; Chaudhury et al. 2017).

The flow of people, financial remittances, knowledge, skills, and practices between places in translocally connected social networks can have a significant effect on resilience and climate change adaptation of households and communities (Rockenbauch et al. 2019a). This vital role of translocal social capital for community resilience is especially highlighted in the event of major disasters when local ties reach the limits of their support capacity (Cope et al. 2018; Elliot et al. 2010; MacGillivray 2018).

The prevalent conceptual understanding of translocal and migrant support is usually limited to the transfer of financial resources, knowledge, skills, and practices (e.g. Bal & Palmer 2020; Minto-Coy et al. 2019; Tuccio & Wahba 2020) and often does not consider other potential forms of translocal support such as psychosocial and moral support (Pacoma & Delda 2019), or labor (Rockenbauch 2019a). Much of the literature on translocal social capital in hazard and climate change adaptation research has looked at whether the presence of translocal social capital improves adaptive responses or the overall adaptive capacity and resilience of affected households and communities (Bott et al. 2020; Cope et al., 2018; Su 2022). In other words, while translocal social capital is regarded as a valuable resource for households and communities affected by natural hazards and environmental change, knowledge about the formation and implementation of translocal support remains limited.

Furthermore, most research in this context is focused on the receiving end – households and communities that are affected by natural hazards (e.g. Ley 2019; Pacoma & Delda 2019). While acknowledging that translocal support will be influenced by the needs of the receiving end, we argue that major determinants of translocal support lie in individual characteristics on the support-lending side of translocal social networks (see Dalgas 2018; Su & Le Dé 2021). Ultimately, there is little knowledge about those who actually lend translocal support and what factors may contribute to or inhibit them to

provide it. To address these research gaps, the following two research questions are at the center of our analysis:

1. *What forms of translocal support emerge in the context of responding to natural hazards and environmental change?*
2. *What factors determine the use of different forms of translocal support and how do they shape translocal responses and adaptation measures?*

To address our research questions, we examine the characteristics and determinants of translocal support migrants provide to their non-migrant family members affected by natural hazards and environmental change.

We focus on Indonesian migrant communities in Germany and other EU countries as an empirical case. Indonesian migrants in the EU are mostly high-skilled workers (Welcker 2016). Given their available financial and human capital, we expect a greater potential for a vaster range of translocal support from these individuals (see Isaakyan & Triandafyllidou 2017). Following this approach, we aim to identify the various forms of translocal support that can emerge when responding to natural hazards and environmental change and examine the factors that determine and shape the activation of different forms of translocal support. In doing so, we broaden our understanding of how individual characteristics on the support-lending side influence translocal social capital, ultimately shedding light on the crucial role it plays in community adaptation.

9.2. Conceptual background

Social capital refers to the resources embedded within social networks, which facilitate cooperation and collective action among individuals and communities (Lin 2010). Social capital is seen as an important resource in countries of the Global South because it can compensate for deficiencies in financial or human capital (Rockenbauch et al. 2019a). As a result, social capital enables vulnerable communities to manage natural hazards effectively, though it may not always be sufficient for long-term development and resilience (Aßheuer et al. 2013). Social capital comprises three interrelated forms: bonding, bridging, and linking (Adger 2003; Aldrich & Meyer 2014; Harrison et al. 2016; Hess 2017; MacGillivray 2018). Bonding social capital refers to close-knit relationships and strong ties within homogeneous groups, such as families, close friends, or members of the same cultural or religious communities. This form of social capital fosters trust, reciprocity, and emotional support among its members. In contrast, bridging social capital involves the formation of connections and networks between more diverse and heterogeneous groups, promoting the exchange of ideas, resources, and opportunities across social boundaries. Finally, linking social capital connects individuals and groups to institutions, enabling access to resources and decision-making processes to shape their social, economic, and political environments.

In contrast to social capital grounded in one specific location or neighborhood, translocal social capital transcends geographic boundaries, connecting individuals and communities across different locations, regions, or countries (Bott et al. 2020). Translocality originally emerged as a conceptual framework to describe grounded or rooted transnationalism and forms of local-local connections and relations (Brickell

& Datta 2016; Esnard & Sapat 2016). Because the concept is interested in practices that are shaped by their immediate environments, it also concerns the actual practices of people from below (Mikami 2022). Studying translocal social capital has become increasingly relevant due to globalization, advancements in communication technologies, and growing migration flows. While local social capital primarily focuses on the immediate environment and shared values, translocal social capital allows for intercultural exchange, international perspectives, and broader resource access (Andersson et al. 2018; Boas 2017; Rockenbauch & Sakdapolrak 2017).

Translocal social capital and migration are intricately linked, as the mobility of individuals and communities across borders drives the development of these expansive networks and relationships (Etzold 2016; Su 2022). In fact, migration is considered the most influential practice in establishing translocal ties (Brickell & Datta 2016; Etzold 2016; Freitag & von Oppen 2010). When people migrate, they often maintain connections with their country of origin while simultaneously forging new relationships in their host communities (Platte 2019). Family ties usually represent the most cohesive and reliable translocal ties, highlighting the importance of translocal bonding social capital for fostering social resilience (Elliot et al. 2010; Peth & Sakdapolrak 2020; Rockenbauch et al. 2019a). These connections also benefit their home communities, as the flow of knowledge, remittances, and cultural exchange can foster economic development and social progress (Bal & Palmer 2020). Additionally, migrants often experience different political, economic, and social contexts compared to the affected households at home, which enables them to offer similar benefits as bridging and linking social ties might (Su 2022). In this regard, it is crucial to recognize that translocal social networks and social capital usually develop independently of exposure to natural hazards. Instead, existing networks are often created due to processes like migration, maintained through close relationships, and then activated in emergencies (Romankiewicz et al. 2016). In other words, translocal social networks are typically established as general livelihood support strategies, independent of hazard exposures.

Translocal support – the flow of financial resources, knowledge, skills, and practices facilitated by translocal social capital – has significant implications for communities' adaptive capacity (see Figure 9-1). Translocally connected households and communities can access resources and opportunities not available locally, which is especially relevant when local resources are depleted or overburdened (Elliot et al. 2010). Translocal social capital is positively associated with responding to natural hazards and environmental change and with long-term adaptation strategies and innovation (Bott et al. 2020; Cope et al., 2018; Rockenbauch et al. 2019b). Thus, disaster-affected households can significantly benefit from the support of migrants through various means, as translocal connections establish channels for assistance that supplement local and governmental relief efforts.

We argue that individual translocal support from migrants plays a significant yet often overlooked role in disaster relief, complementing collective efforts and providing unique benefits to affected households. The existing literature predominantly focuses on the role of diaspora and collective efforts in disaster relief (e.g. Cahyanto et al. 2023; Esnard & Sapat 2016, Sewordor et al. 2019; Shivakoti 2019), often overlooking individual relief channels (Dalgas 2018). Migrants usually maintain strong connections with their non-migrant family members, providing aid while remaining geographically distant and physically unaffected by the same disaster (Elliot et al. 2010). Moreover, disasters tend to amplify migrants'

engagement with their country of origin (Esnard & Sapat 2016), drawing increased attention from their host countries to the disasters happening in their homeland (Platte 2019). Platte (2019) states that this is especially relevant for events happening far away from potential donors or disasters that are so small scale that they may go unnoticed in the global news stream.

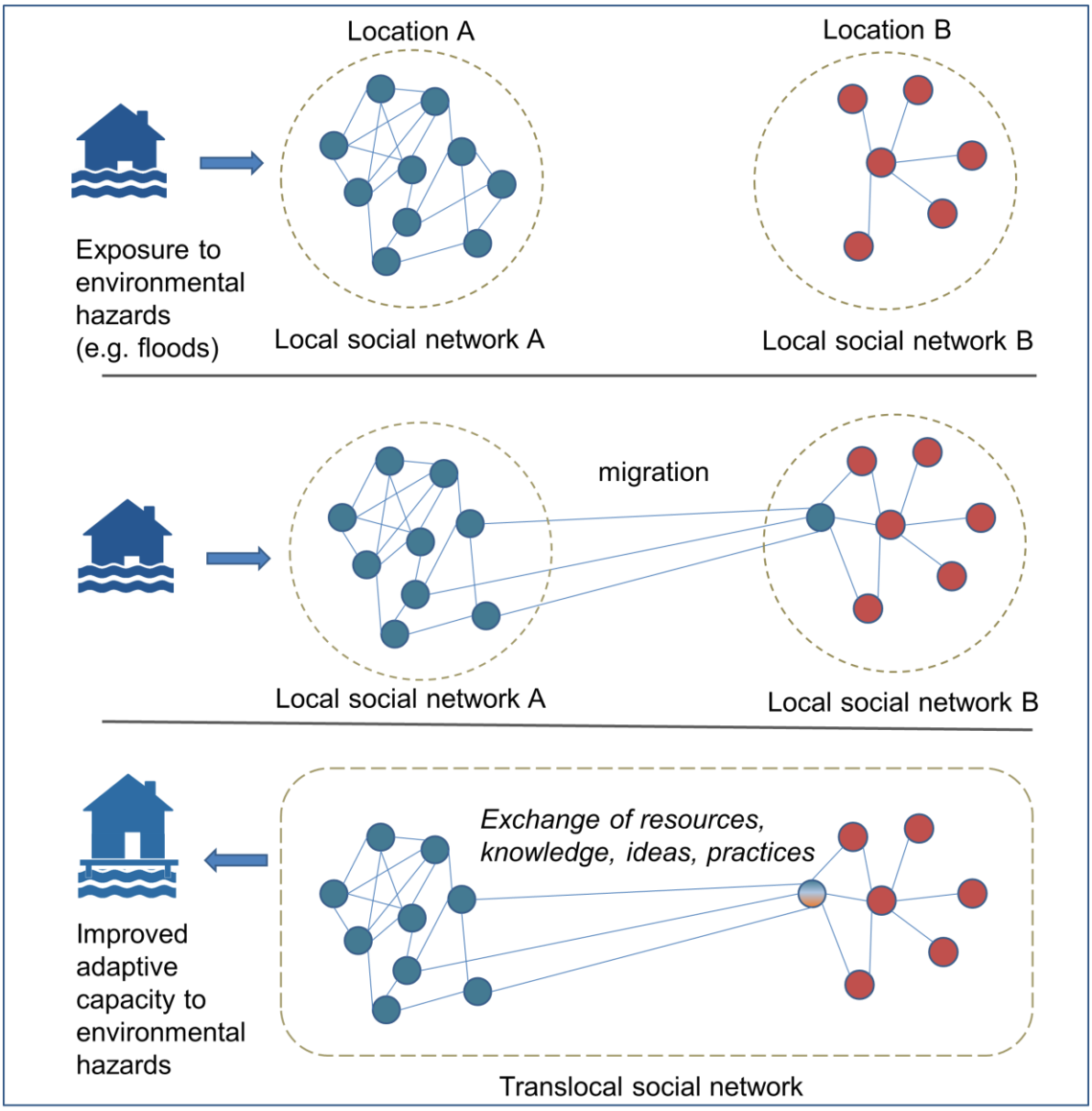


Figure 9-1. Translocalization of social networks through migration and its impact on adaptive capacity to environmental hazards (Own illustration)

Drawing from migration and development studies, translocal support from migrants is typically conceptualized as financial and social (or non-financial) remittances. Financial remittances involve migrants sending money to their families and communities in their countries of origin, which can offer relief for immediate needs like food, shelter, and medical care, as well as contribute to long-term recovery efforts such as rebuilding homes and restoring livelihoods (Bal & Palmer 2020; Minto-Coy et al. 2019). In contrast, social remittances refer to the sharing of knowledge, skills, and practices between migrants and their home communities (Levitt & Lamba-Nieves 2011; Tuccio & Wahba 2020). This type

of remittance can enhance adaptive capacity and climate resilience, especially among at-risk households, by fostering the transfer of innovative ideas, risk reduction strategies, and environmental management techniques (Entzinger & Scholten 2022). Financial remittances have received widespread attention in the literature due to their accessibility and measurability, while the potentially more important effects of social remittances have only recently received more attention (see Minto-Coy et al. 2019).

While financial and social remittances from migrants serve as valuable conceptual foundations for understanding how translocal social capital can manifest, research gaps remain concerning the diverse ways individual migrants engage in such support and the factors influencing their involvement in disaster response and adaptation efforts. Specifically, remittances carry the notion of continuous processes and dynamics within translocal networks. However, as illustrated by other scholars (e.g., Erdal 2022; Pacoma & Delda 2019; Sewordor et al. 2019), we argue that translocal social capital can manifest in diverse forms of support, especially when activated as a response to external threats and shocks such as natural hazards and environmental change. For example, Pacoma and Delda (2019) highlight the significant role of psychosocial support for household resilience in the aftermath of Typhoon Haiyan in the Philippines.

Finally, to advance research on translocal social capital and responses to natural hazards and environmental change it is crucial to identify and analyze the characteristics and determinants of translocal support. The factors shaping migrants' translocal engagement and the activation of translocal support within social networks are still poorly understood. Both financial and social remittances are influenced by a range of factors, including personal, social, economic, spatial, political, and cultural aspects (see Su & Le Dé 2021). For instance, Dalgas (2018) argues that the extent of individual relief provided by migrants likely depends on their wealth and the nature of their translocal social networks. Social remittances, in particular, are seen as highly contextual (Minto-Coy et al. 2019).

9.3. Indonesian migrant communities in Germany and other EU countries

Indonesia is one of the most disaster-prone countries in the world, displaying a wide range of natural hazards across large areas of the country such as earthquakes, tsunamis, volcanic eruptions, flooding, or land subsidence. The impact of climate change and sea level rise are expected to exacerbate the risk and impact of some of these natural hazards in Indonesia in the future (Djalante 2018; Kusumasari 2014).

We focus on the context of translocal connectedness between support-providing migrants and individuals who are directly affected by natural hazards in Indonesia which makes this case relevant for examining the characteristics and determinants of translocal responses to natural hazards. Germany harbors one of the largest Indonesian migrant communities in the European Union (Welcker 2016). Other important countries of Indonesian immigration in Europe are the Netherlands, Belgium, and France. There are currently around 22,000 Indonesians living or working in Germany. Indonesian-German migration is characterized by labor and educational migration. These mostly high-skilled and educated migrants come from diverse regional and social backgrounds and maintain strong connections with other Indonesian migrants in Europe and their families and communities in Indonesia (ibid.).

9.4. Methodology

To comprehensively answer our research questions, we employed a two-part mixed methods research design. This approach involved semi-structured qualitative online interviews and a quantitative standardized online survey. We used qualitative interview data to inform the design of a subsequent standardized quantitative survey. By doing so, we ensured that our research process enabled both in-depth information gathering and rigorous data analysis. Consequently, we increase the overall validity and generalizability of our results, which ultimately helps to apply our findings to other similar contexts. We chose to conduct this research online due to the mobility and accessibility constraints caused by the Covid-19 pandemic during the data collection period, which took place from November 2020 to February 2022.

9.4.1. Qualitative interviews: data collection and analysis

As a first step, we conducted qualitative semi-standardized interviews with Indonesian migrants living in Germany and the Netherlands. For practical reasons, we used a respondent-driven sampling technique, where interview partners would refer to other potential respondents. To reduce the bias caused by this approach, we purposefully selected respondents by aiming at a high rate of heterogeneity among the interviewees concerning their demographic and socio-economic characteristics including age, gender, occupation, place of residence and origin, as well as their time spent outside of Indonesia.

The interviews followed a semi-structured approach with the use of interview guidelines. The guidelines covered questions on (1) demographic and socio-economic status; (2) migration history / background and motivation; (3) social networks of migrants in place of origin and destination; and (4) experiences with natural hazards and environmental change.

In total, 39 interviews have been conducted with Indonesians living in Germany and the Netherlands. The interviews were conducted from November 2020 to March 2021. The interviews have been conducted in English or German according to the preference of the interviewees. The interviews have been audio recorded and transcribed afterward. The average interview duration was 60 minutes. The interview data was analyzed using qualitative content analysis in MaxQDA (see Mayring 2015).

The findings of the qualitative data analysis serve as the basis for the development of the subsequent quantitative standardized online survey. We identified six forms of translocal support that are common in our sample: (1) emotional/mental support, (2) financial/material support, (3) mobilizing social networks for practical support, (4) sharing knowledge and skills, (5) discussing adaptation/response strategies, as well as (6) local support through being on-site.

9.4.2. Quantitative online survey: data collection and analysis

We conducted a quantitative standardized online survey to validate the findings from the interviews by developing more representative data about Indonesian migrants living in Germany and other EU countries. Our interview findings indicate that Indonesian migrant communities throughout the EU are

well-connected via ICT and mobility. Therefore, we expect that spatial differences within the EU are not very pronounced. To test this assumption, we expanded our data collection to include Indonesian migrants from other EU countries and added the place of residence as a control variable in the subsequent data analysis to see whether our results are robust across regions.

To ensure the reliability of the survey items, we translated the questionnaire into Bahasa Indonesia and conducted a pre-test. Data collection ran from July 2021 until February 2022 using LimeSurvey. The data was imported and analyzed using Stata 16.1.

In total, 265 respondents have completed the online survey. All first- or second-generation migrants from Indonesia with their place of residence inside the European Union were eligible to participate in the survey. After implementing the survey online, we disseminated the questionnaire through online channels such as mailing lists or social media of Indonesian migrant communities or organizations such as student associations, Indonesian embassies, social, cultural, and religious communities as well as other organizations related to Indonesian migrants. In total, more than 250 groups, communities, and organizations have been contacted and asked to share the survey among their members. About 79 % of respondents have their residence in Germany, about 10 % in the Netherlands and the remaining 11 % in other EU countries (France, Belgium, Italy, Hungary, and Romania).

We find that our quantitative sample is biased, mainly due to the large share of Indonesian students (55 %; see Table 9-1). The effect of this can be seen in the comparatively short length of stay and the high level of education of the participants in the sample. This is a systematic selection bias which is a result of the sampling method that relied on the distribution of the online survey through social media. These include a large share of Indonesian Student Associations. On top of that, we can expect that (younger) students are more active on social media which increases the likelihood of reaching this part of the total population. While our results appear to be robust when controlling for this existing bias, we acknowledge that the generalizability of our results to other migrant populations or contexts might be limited.

To find out more about the prevalence of translocal support forms identified in the interview data, we asked respondents which natural and man-made hazards have negatively affected their families in Indonesia over the past 10 years. About half (49 %; N=136) of the survey respondents selected at least one hazard that affected their family negatively in the past 10 years (see Figure 9-2). As a next step, we asked respondents, using Likert scale items for each form of support, how likely they were to provide each form of support to their family if they were affected by the previously selected hazards.

Table 9-1. Comparison of sample data with general data on Indonesian migrants living in Germany

	Sample	**Indonesians in Germany** (2020)[1]
Total Number	265	21 650
Place of residence:		
Germany	78.7%	N/A
The Netherlands	10.3%	N/A
Other EU countries[2]	11.0%	N/A
Gender Ratio	62.0% female / 38.0% male	57.6% female / 42.4% male
Avg. age in years	30.8 (Median = 28)	34.5
Avg. length of stay (in years)	4.5 (Median = 2.3)	10.9
% married	54.9%	36.3%
Born in Germany	1.9%	3.4%
Tertiary education	81.2 %	~45%
(self-)employed	33.5%	37.8%
Share of students	54.9%	~26%
Religion	56.77% Islam / 34.21 % Christian	~40% Islam / less than 60% Christian[3]

[1] Data obtained from Bundesagentur für Arbeit (2023); Statistisches Bundesamt (2021), Rabl (2021); Welcker 2016 | [2] France, Belgium, Italy, Austria, Hungary, Romania, Lithuania | [3] estimate - no accurate data available (see Welcker 2016)

Given our limited sample size and the large variation between different natural hazards, we decided to aggregate and dichotomize the translocal support variables. Dichotomization was necessary to ensure adequate statistical power. To address the limitations of dichotomization, we performed a sensitivity analysis examining the relationship between the continuous versions of these measures and our dependent variables and found that our results were robust across different operationalizations of translocal support.

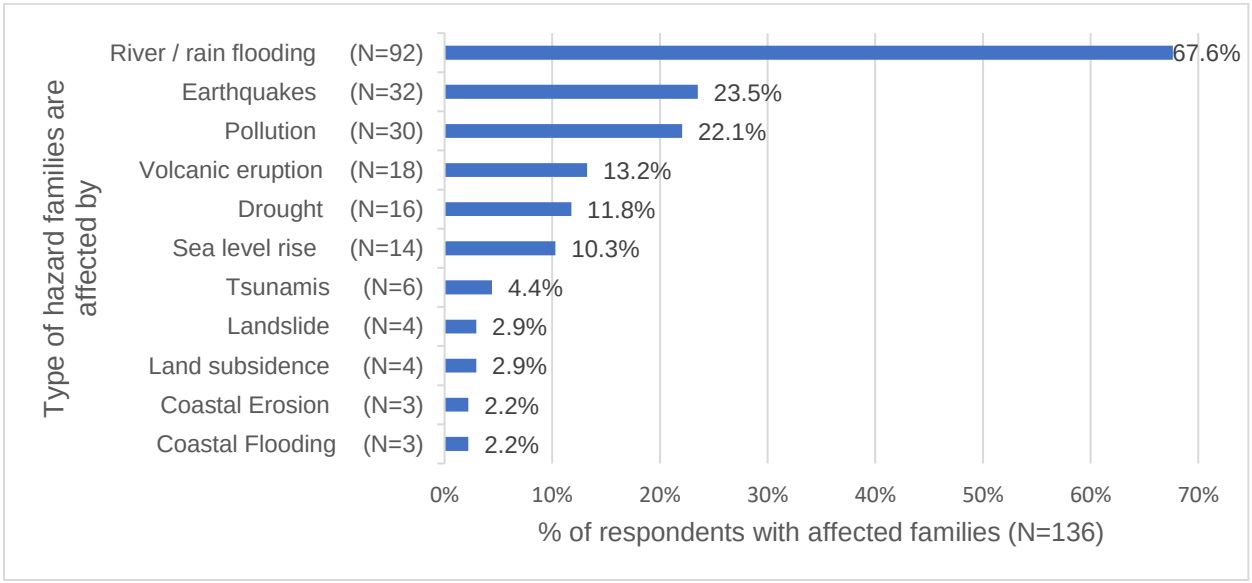


Figure 9-2. Distribution of different natural and man-made hazards affecting family members of respondents in Indonesia (N=136)

As a final step, we developed logistic regression models for each translocal support form to test for determining factors of different support forms. Emotional support is omitted in this step due to its high prevalence (91 %) among respondents and small sample size, making further multivariate analysis not viable. Our independent variables are grouped into indicators for (1) the demographic and socio-economic situation, (2) migration history, (3) experiences with and knowledge about environmental hazards, (4) embeddedness in (trans)local social networks, and (5) self-perceived agency. The indicators were selected based on statistical significance, theoretical relevance, and effect size. Measures for each indicator were constructed from the survey items and are presented in Table 9-2.

Table 9-2. Summary statistics of survey sample grouped by indicators

Indicator/variable	N	Mean	SD	Min	Max
Demographic and socio-economic					
Female (1=yes)	265	0.62		0.00	1.00
Age (in years)	265	30.78	10.56	18.00	79.00
Married (1=yes)	265	0.55		0.00	1.00
Religion: Muslim (1=yes)	265	0.57		0.00	1.00
Ethnicity: Javanese (1=yes)	265	0.46		0.00	1.00
Student (1=yes)	265	0.55		0.00	1.00
Employed or self-employed (1=yes)	265	0.33		0.00	1.00
Migration					
Residence in Germany (1=yes)	265	0.81		0.00	1.00
Residence in the Netherlands (1=yes)	265	0.12		0.00	1.00
Residence in another EU country (1=yes)	265	0.08		0.00	1.00
Time living abroad (in years)	265	4.51	6.80	0.00	46.80
Planning to move back to Indonesia (1=yes)	265	0.45		0.00	1.00
Hazards					
Personal experiences with natural hazards and environmental change (1=yes)	265	0.49		0.00	1.00
Family affected by coastal hazards (Coastal flooding, erosion, tsunamis, sea-level rise)	265	0.07		0.00	1.00
Family affected by tectonic hazards (Earthquake, volcanic eruption)	265	0.17		0.00	1.00
Family affected by river/rain floods	265	0.35		0.00	1.00
Family affected by man-made environmental hazards (Land subsidence, pollution)	265	0.12		0.00	1.00
Gained knowledge abroad on how to respond to natural hazards and environmental change (1=yes)	247	0.33		0.00	1.00
Environmental issues and hazards are often discussed with family (1=yes)	265	0.55		0.00	1.00
Social network					
# of regular* contacts in Indonesia	264	9.09	14.04	0.00	150.00
# of regular* Indonesian contacts in place of residence	264	7.82	18.54	0.00	200.00
Active in humanitarian organization (1=yes)	265	0.16		0.00	1.00
Active in Indonesian migrant community in place of residence (1=yes)	265	0.61		0.00	1.00
Family will ask for help when affected by hazard (1=yes)	265	0.48		0.00	1.00
Family members in Indonesia in leadership position (1=yes)	265	0.27		0.00	1.00
Agency					
Perceived influence to help family in Indonesia (0=low; 1=high)	265	0.72		0.00	1.00

* Regular contact = at least once every month Data source: quantitative online survey

Table 9-3. Bivariate analysis of translocal support forms and selected indicators

Independent variable	Scale	Test	Financial support N=136 no=56 yes= 80	Social network support N=136 no=61 yes=67	Visit to support practically N=128 no=83 yes=45	Knowledge support N=129 no=91 yes=38	Discuss adaptation strategies N=136 no=49 yes=87
Demographic and socio-economic variables							
Female (1=yes)	D	Chi² / Fisher's exact	*	**	**	(n.s.)	(n.s.)
Age (in years)	M	Wilcoxon rank-sum test	***	(n.s.)	(n.s.)	(n.s.)	(n.s.)
Married (1=yes)	D	Chi² / Fisher's exact	**	*	(n.s.)	(n.s.)	(n.s.)
Religion: Muslim (1=yes)	D	Chi² / Fisher's exact	***	*	***	(n.s.)	***
Ethnicity: Javanese (1=yes)	D	Chi² / Fisher's exact	(n.s.)	(n.s.)	*	(n.s.)	(n.s.)
Student (1=yes)	D	Chi² / Fisher's exact	***	(n.s.)	(n.s.)	(n.s.)	(n.s.)
Employed or self-employed (1=yes)	D	Chi² / Fisher's exact	***	(n.s.)	(n.s.)	(n.s.)	(n.s.)
Migration							
Residence in Germany (1=yes)	D	Chi² / Fisher's exact	(n.s.)	(n.s.)	(n.s.)	(n.s.)	(n.s.)
Residence in the Netherlands (1=yes)	D	Chi² / Fisher's exact	(n.s.)	(n.s.)	(n.s.)	(n.s.)	(n.s.)
Residence in another EU country (1=yes)	D	Chi² / Fisher's exact	(n.s.)	(n.s.)	(n.s.)	(n.s.)	(n.s.)
Time living abroad (in years)	M	Wilcoxon rank-sum test	*	(n.s.)	(n.s.)	(n.s.)	(n.s.)
Planning to move back to Indonesia (1=yes)	D	Chi² / Fisher's exact	(n.s.)	(n.s.)	(n.s.)	(n.s.)	(n.s.)
Environmental hazards							
Personal experiences with natural hazards and environmental change (1=yes)	D	Chi² / Fisher's exact	(n.s.)	(n.s.)	**	(n.s.)	(n.s.)
Family affected by coastal hazards (Coastal flooding, erosion, tsunamis, sea-level rise)	D	Chi² / Fisher's exact	(n.s.)	(n.s.)	(n.s.)	*	***
Family affected by tectonic hazards (Earthquake, volcanic eruption)	D	Chi² / Fisher's exact	(n.s.)	*	(n.s.)	**	(n.s.)
Family affected by river/rain floods	D	Chi² / Fisher's exact	(n.s.)	(n.s.)	(n.s.)	(n.s.)	*
Family affected by man-made environmental hazards (Land subsidence, pollution)	D	Chi² / Fisher's exact	(n.s.)	(n.s.)	(n.s.)	(n.s.)	***
Environmental issues and hazards are often discussed with family (1=yes)	O	Wilcoxon rank-sum test	***	(n.s.)	(n.s.)	***	*
Gained knowledge abroad on how to respond to natural hazards and environmental change (1=yes)	O	Wilcoxon rank-sum test	**	***	*	***	***
Social Network							
# of regular contacts in Indonesia	M	Wilcoxon rank-sum test	(n.s.)	(n.s.)	(n.s.)	(n.s.)	*

# of regular Indonesian contacts in place of residence	M	Wilcoxon rank-sum test	**	(n.s.)	*	*	(n.s.)
Active in humanitarian organization (1=yes)	D	Chi² / Fisher's exact	***	***	(n.s.)	(n.s.)	*
Active in Indonesian migrant community in place of residence (1=yes)	D	Chi² / Fisher's exact	(n.s.)	***	**	**	(n.s.)
Family will ask for help when affected by hazard (1=yes)	D	Chi² / Fisher's exact	***	*	**	(n.s.)	(n.s.)
Family members in Indonesia in leadership position (1=yes)	D	Chi² / Fisher's exact	(n.s.)	***	*	**	(n.s.)
Agency							
Perceived influence to help family in Indonesia	O	Wilcoxon rank-sum test	***	***	*	**	***

*** p<0.01, ** p<0.05, * p<0.1 Data source: Quantitative online survey

Our approach aimed to balance model complexity with the risk of overfitting, while considering the relevance of the independent variables to our research question. Therefore, we run our models with a maximum of five independent variables. For instance, as no significant group differences could be found for place of residence, these variables have not been added to the models (see Table 9-3). Further, sensitivity analyses and robustness checks were performed to test the stability of our results. Finally, we validate the regression results with our qualitative results from the interviews.

9.5. Qualitative and descriptive results: Identifying translocal support forms

To answer our first research question on what forms of translocal support can emerge in the context of responding to natural hazards and environmental change, we use a qualitative content analysis of our interview data. Our findings reveal six distinct types of translocal support employed by Indonesian migrants whose families in Indonesia are affected by natural hazards and environmental change (see Table 9-4). Subsequently, we supplement these qualitative findings with a descriptive overview of the quantitative results concerning the different support types in our survey sample (see Figure 9-3).

The first form of support identified from our interview sample was *emotional or mental support*. This type of support ranges from simple expressions of goodwill following a negative event, extending to comprehensive mental and psychological support provided to loved ones over extended periods. Despite the common perception of natural hazards as a standard aspect of life in Indonesia, many interviewees emphasized the importance of mutual support, presence, and affection. They highlighted these factors as crucial elements in helping from afar. A large majority (91 %) of our survey respondents indicated that they offered such support. This finding underscores the widespread and accessible nature of emotional support which is facilitated by affordable and user-friendly communication technology, such as the internet and social media. These tools enable instantaneous communication, making them particularly valuable for providing emotional support. However, this support form faces some limitations such as time differences between Europe and Indonesia, connection problems, and limited technological proficiency, especially for elderly family members residing in Indonesia.

The second support form we found was *financial support.* Financial support is largely undertaken in the form of regular or event-specific remittances or donations. This support form was the most commonly mentioned among the interviewees and also more than half (59 %) of survey respondents will provide financial support to family members in cases of emergency. Again, internet technology and cheap transaction costs make this support form relatively easy to implement. Many interviewees would send regular financial remittances which are not related to specific events. A large part of the interviewees mentioned that it was part of their cultural norm to support their family, especially their parents financially. However, several younger interview partners, who were university students, mentioned that they were rather recipients of financial support from their families in Indonesia. As they stated, their families would not accept any financial support while they were still in training, especially when the impact of a hazard is relatively minor. This finding is confirmed by our statistical results, where students are significantly less likely to provide financial support (45 %) compared to non-students (73 %). Apart from traditional remittances and direct money transfers from individual to individual, some interviewees mentioned that they would activate their social networks in their place of residence and of origin to collect larger sums of money and funnel it to their family when more severe events were taking place.

The third support form entails using one's social network to *organize practical support* in Indonesia. Interviewees mentioned that they would inform friends and family in Indonesia when relatives were affected by adverse events. These contacts would then be asked to bring food, materials, or help repairing and cleaning any damage. Some interviewees mentioned that they met other Indonesians abroad who could either provide local contacts in Indonesia to help family members in need or serve as a connection to relief groups or communities. Just over half (52 %) of survey respondents would utilize their social network to this end. The mobilization of the migrants' social capital to provide practical support to their family members via proxy demonstrates the diverse ways in which translocal support can materialize.

The fourth support form we found was *visiting to support on-site*. Oftentimes, interviewees would give this type of support only when they were planning to visit affected family members anyways, as travel from Europe to Indonesia was not always possible due to work or family-related responsibilities in their place of residence. Accordingly, just over a third (35 %) of survey respondents indicated providing this type of support.

The fifth support form involves *sharing hazard-related knowledge or skills* that were gained abroad. This knowledge was in most cases gained through education, professional training, or practical skills. Relevant fields of education mentioned included medicine, civil engineering, geology, environmental sciences, business, and law. Several interviewees received professional training in disaster mitigation, climate change and environmental protection, or water management. Practical skills included first aid skills, waste management, communication and research of information, disaster monitoring and early warning systems, as well as general disaster preparedness skills. Especially interviewees who worked or studied at a university mentioned that Indonesian student groups regularly organized workshops on disaster mitigation and preparedness. However, it also was mentioned often that while migrants learned

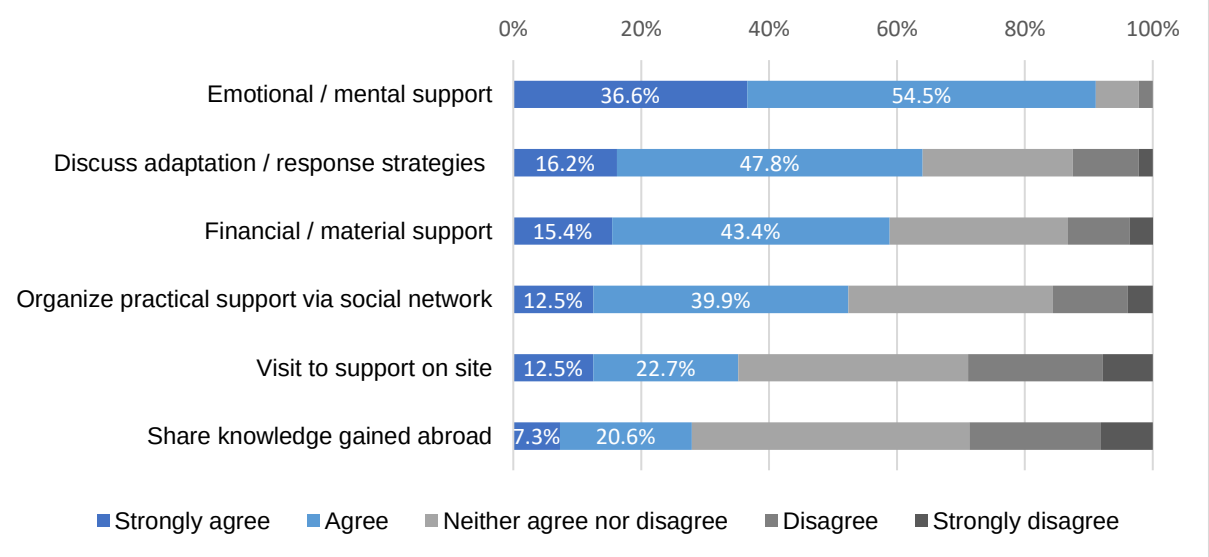
Table 9-4. Summary of interview responses and exemplary quotations concerning translocal support forms

Type of translocal support	# of participants who mentioned (N = 39)	Exemplary quotations
Emotional support	9	"Emotionally, [me and my family in Indonesia] always support each other and share almost everything." (032)
		"I feel the need to support my family there. Yeah, mental support by being there, even though virtually." (039)
Financial support	22	"We tried to give some financial help to our family members affected by flood, for instance." (033)
		"As a part of society, we collect money and help people with food, with clothes and with medications." (034)
Use own social contacts in Indonesia to organize practical help for affected family	5	"For example, there was a student. The parent of a student cannot contact his son or his daughter. So, we communicated in our group to find out what happened with the son or this daughter. And you know, we also help when there is an accident or something else." (007)
		"The most important that we organized is how to coordinate with other family members who are not affected by the flood to give some safe place and supporting, you know, supporting materials they need during that situation until they get normal again, they get their normal life again." (033)
Travel to family to support directly on site	6	"The last time I went to Indonesia and we kind of cleaned up." (024)
		"And then I went to [Indonesia] and I brought many things, multiple medical stuff." (037)
Share knowledge and skills	12	"For example, we have organized events or workshops about tsunamis or disasters. We then do a seminar and invite experts and they then give information about this disaster. We have also had disaster management as a topic, for example how to prepare. If something happens, what should we do?" (015)
		"And then something that we can adopt or we can do the same thing in our country or practice in agriculture. Because you know every time I got a lecture, it's like, whoa, this is interesting. Like, I suddenly want to jump to my farm field and then just discuss it with my father, you know?" (027)
Discuss adaptation / response options	11	"They think of making some anticipation steps with their neighbors. Like make a cleaning from the sanitary, something like that. And they organize trash better, but they did not know what the causes of the big flood this year is. So, they tried the very best they could to anticipate the flooding maybe in this rainy season." (033)
		"I always tell them to think about safety route, for example, if something happens. Think about emergency packages, think about having enough batteries or supplier batteries at home, so, then I am able to contact them" (039)

Source: In-depth interviews. November 2020 to March 2021

more about natural hazards or how to respond to them, a crucial problem was how to translate this knowledge into the Indonesian context or simply convince family members to adopt new response strategies. This is also reflected in the results of the survey, where only about a quarter (28 %) of respondents indicated transferring hazard-related knowledge to support affected family members (see Figure 9-3).

Finally, the sixth support form involves *discussing and developing adaptation and response options* with affected family members. This support form is closely related to knowledge sharing but is still employed even though migrants might not have gained any relevant knowledge or skills abroad. Moreover, this support form is characterized by a more organizational character, focused on the implementation of solutions and improvements indicating that the migrants are not just providing immediate support but are also concerned with longer-term adaptation of their family members. Compared to knowledge support, discussing improvements is much more common in the survey sample with almost two-thirds (64 %) using it. However, the interviewees stressed the notion that discussing new strategies was mostly done when an improvement could be anticipated. As such, the use of this support form appeared to be highly dependent on the interviewees' perceived ability to improve the adaptive strategies of affected family members.



Data Source: Online questionnaire | Only includes respondents who have family members that are affected by natural hazards.

Figure 9-3. Distribution of answers on whether translocal support forms are used (N = 136)

In sum, returning to our first research question on what forms of translocal support can emerge in the context of responding to natural hazards and environmental change, we identified six distinct forms of support. Each of these support forms represents a different way in which migrants can contribute to their family's well-being and response to natural hazards. By analyzing the diverse ways in which translocal support can be provided, we illustrate the factors that influence the type and extent of support offered. For example, one recurring theme is the role of technology in facilitating these support forms. Another important theme is the influence of cultural norms and roles on the type and extent of support provided. Moreover, several barriers to providing support emerged from the interviews, including spatial distance,

work or family-related responsibilities in the migrants' place of residence, the challenge of translating knowledge gained abroad to the Indonesian context and convincing family members to adopt new response strategies.

9.6. Multivariate analysis results on the determinants of translocal support forms

To answer our second research question on what factors determine the use of different forms of translocal support and how they shape translocal responses, we developed logistic regression models for each translocal support form to test for determining factors of different support forms (Figure 9-4). From our interview data, we derived relevant individual and situational characteristics of the sending migrants which can be grouped into (1) demographic and socio-economic situation, (2) migration history, (3) experiences with and knowledge about environmental hazards, (4) embeddedness in a (trans)local network, and (5) self-perceived agency. In the following, we briefly discuss the results of the logistic regression analysis for each support form.

Financial support

Our analysis of financial support provided by Indonesian migrants to their families in Indonesia revealed a set of interacting factors that significantly influence the likelihood to provide this type of support. These are: financial independence, socio-cultural expectations, awareness of issues, and perceived agency and control.

Financial independence emerged as a theme in our interviews and is also reflected in the statistical model. We discovered a negative correlation between student status and the act of providing financial support, with students being 65 % less likely to offer support compared to their non-student counterparts. Our interviews echoed this finding as students often either lack the resources to support their families or are culturally not expected to do so. In many cases, students are the recipients of regular financial support from their families in Indonesia.

The theme of socio-cultural expectations came to light through the positive correlation between active requests for help from family members and financial support. Migrants are four times more likely to provide financial support when asked for it, indicating a societal norm around reciprocity and familial duty. This finding is substantiated by interviewees mentioning that families often will not accept financial aid from students, reflecting socio-cultural expectations about parental responsibilities.

Awareness of issues is another significant factor. Migrants who frequently discuss environmental and hazard issues were found to be three times more likely to provide financial support. It is unclear whether these discussions lead to more financial support or vice versa. However, the interviews suggest that the active requests for help by family members could be triggering these discussions.

The final theme is revolving around the perceived agency of migrants. Migrants who believe in their ability to improve their family's living situation in Indonesia are 2.5 times more likely to provide financial support. A possible explanation is that a greater sense of agency and control could lead to a stronger

feeling of responsibility towards the family members' well-being and thus an increased motivation to assist during challenging times.

Practical support via social network

Our logistic regression results underscore the substantial role of social networks and the mobilization of social capital in enabling Indonesian migrants to arrange practical support for their families in response to natural hazards and environmental changes. Three key factors significantly influence this mobilization, emphasizing the connection of knowledge, social connections, and influence in facilitating network-centered responses to environmental challenges.

Firstly, respondents who gained knowledge abroad about responding to environmental change are approximately 2.7 times more likely to utilize their social networks for arranging practical aid. This finding highlights the potential benefits of cross-cultural experiences and international education, suggesting that relevant learning opportunities can help individuals to make informed decisions when activating their social networks in Indonesia.

Secondly, respondents actively involved in humanitarian organizations are 3.8 times more likely to mobilize their social networks for practical support. This points to the power of organized, collective action and how humanitarian organizations serve as effective platforms for this. Not only do these organizations provide useful knowledge and resources for practical support, they also strengthen social ties and amplify the influence of individual actions. This multiplier effect was confirmed by many of our interviewees.

Lastly, even though the statistical significance is relatively low ($p<0.1$), the presence of family members in leadership positions in Indonesia more than doubles the odds of respondents organizing practical support, with an odds ratio (OR) of 2.25. This demonstrates the potential impact of influential network ties and the importance of leadership within a network.

Visit to support on site

The logistic regression model demonstrates that gender and sociocultural expectations play a significant role. Our findings show that female respondents are approximately 60 % less likely to visit affected family members to provide support on-site. Our interview findings indicate that socio-cultural expectations of gender roles in Indonesian society are a relevant factor here. Women typically shoulder a larger share of family responsibilities, especially childcare, in their place of residence, making it more difficult for them to organize short-notice visits to Indonesia. Additionally, on-site support largely consists of manual labor — a domain often seen as a male duty.

Another finding centered on the role of age and personal experience. Age exhibited a low but positive correlation ($p<0.1$) with the likelihood to provide on-site support, indicating older respondents were slightly more likely to visit for on-site assistance (OR=1.06). However, the influence of personal experiences with natural hazards was more pronounced, making individuals 2.8 times more likely to visit. This suggests that life experiences, be it age-related or tied to specific events, can significantly shape an individual's ability to provide adequate support on-site.

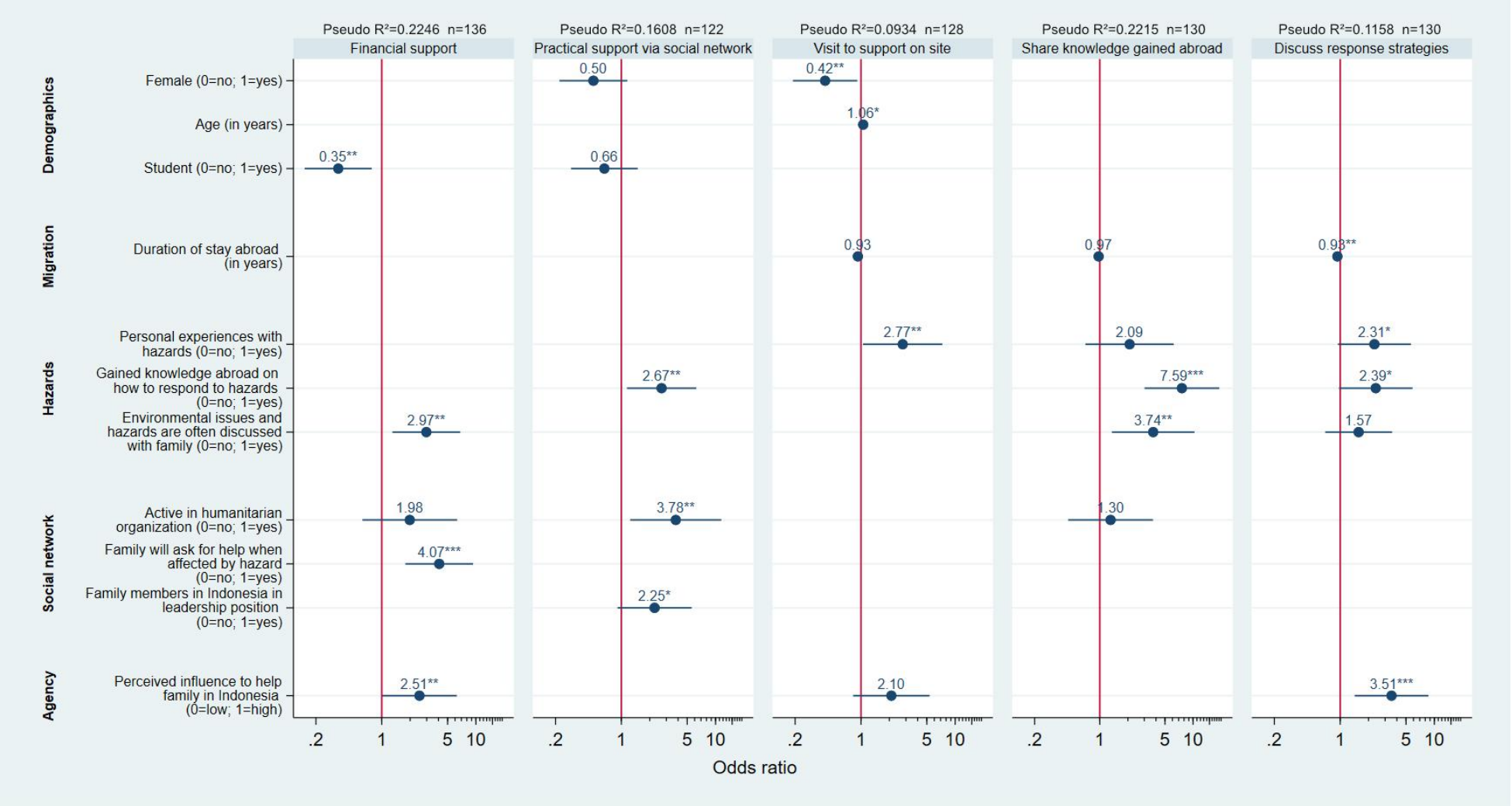


Figure 9-4. Plot of logistic regression model coefficients: support forms as independent variables (N=136). *** p<0.01, ** p<0.05, * p<0.1 | Data source: quantitative online survey

However, the current model's overall predictive strength regarding this support form was relatively low, which is reflected by a pseudo R^2 of 0.09. This indicates the presence of other potential factors influencing the decision to visit and provide on-site support. Based on the insights from the interviews, situational and individual factors can include personal motivations and family relations, accessibility of the affected area, the severity of the event, or the type of impact, which cannot be sufficiently reconstructed from the available quantitative data.

Share knowledge on how to deal with natural hazards gained abroad

The results of the model on knowledge sharing suggest that accumulating knowledge about managing natural hazards is a critical factor for knowledge transfer. Specifically, individuals who have obtained knowledge on managing natural hazards during their time abroad were found to be approximately 7.6 times more likely to provide hazard-related knowledge support. Our interview data supports this finding, revealing that in Indonesia, family members often perceive knowledge and skills gained abroad as more reliable. This perception establishes migrants with specialist knowledge as knowledge brokers, consequently increasing the likelihood of implementing new practices. This pattern underscores the importance of providing relevant learning opportunities for migrants, which forms a key element of successful knowledge transfer. It also indicates that migrants are generally receptive and willing to share the knowledge they possess.

Additionally, the regression results demonstrate a significant positive correlation between discussing environmental or hazard-related issues and the likelihood of providing knowledge support. When engaged in such conversations, migrants are 3.7 times more likely to share their knowledge. This outcome highlights the social aspect of knowledge sharing. Regular conversations about natural hazards and appropriate responses create a conducive environment for migrants to share and apply their knowledge and skills gained abroad. This also facilitates the adaptation of this knowledge from one local context to another.

Discuss adaptation and response options

Concerning the final logistic regression model on discussing and planning adaptation and response strategies, our findings offer insights into the importance of personal involvement, knowledge, and perceived agency in this translocal support form.

We find a negative correlation between the duration of stay abroad with the likelihood of discussing adaptation responses (OR=0.98). Also, our interview data indicates that a longer duration of stay abroad often results in reduced contact with (extended) family members, reduced personal concern, and the feeling that migrants who lived abroad for a longer period have limited contributions for these discussions to offer.

Conversely, personal experiences with hazards were found to increase the likelihood of discussing adaptation options by a factor of 2.31. Additionally, knowledge gained abroad was positively associated with the likelihood of discussing adaptation responses, as denoted by an odds ratio of 2.39. Despite the statistical significance of both variables being relatively low ($p<0.1$), this finding reflects insights from several interviewees who suggested that personal experiences with hazards can foster a greater

understanding of their implications and risks, which in turn increases personal concern, presence of relevant knowledge, and perceived agency to be able to help.

Finally, the most impactful variable for discussing response and adaptation strategies is a migrant's self-perceived influence. A strong positive correlation was found between this factor and the likelihood of discussing and recommending adaptation responses, indicated by an odds ratio of 3.51 and high statistical significance.

The fact that the overall model has a relatively weak pseudo R^2 value of 0.11 implies that there are other factors that were not included in the model that could also be influencing this support form. Therefore, the results should be interpreted with caution. Nonetheless, the individual findings underscore the importance of personal involvement, knowledge, and perceived influence in stimulating discussions about adaptation responses. It suggests that knowledge is an important facilitator, but the sense of personal agency is a more potent driver in this engagement. The findings also indicate that physical or emotional distance might reduce engagement.

In sum, by addressing our second research question regarding the determinants of various forms of translocal support and their influence on shaping translocal responses, our findings demonstrate that translocal support is not a linear flow of resources and knowledge but a complex process influenced by the demographic and socio-economic situation, migration history, experiences with and knowledge about environmental hazards, embeddedness in a (trans)local network, and perceived agency of support-lending migrants. Specifically, three overarching themes emerge from our analysis: (1) socio-economic status and socio-cultural norms, (2) hazard-related knowledge exchange, and (3) social influence and personal involvement. The socio-economic situation of migrants, combined with socio-cultural norms and expectations, shapes the ability and willingness to provide and accept financial support, emphasizing the complex dynamics of activating social capital within translocal networks. Knowledge emerges as a significant factor, with personal hazard experiences and specialized education empowering migrants to become key knowledge brokers. Their knowledge and understanding influence the direct provision of information and stimulate critical discussions about environmental hazards and response strategies. Finally, the role of social influence and personal involvement is notable. Our results show that bridging and linking ties of migrants (e.g. to humanitarian organizations or community leaders) and a strong sense of personal agency, combined with personal involvement and emotional attachment facilitate and amplify the potential of translocal support.

9.7. Discussion

In this study, we examined the characteristics and determinants of support manifesting in translocal social networks in the context of responding to natural hazards and environmental challenges. Our findings demonstrate that support generated from translocal social capital is a multifaceted phenomenon that can manifest in a variety of ways and is shaped by individual characteristics of support-lending migrants, as well as socio-cultural and relational dynamics within social networks.

The case of Indonesian migrants in Germany and other EU countries presents a valuable case for understanding the dynamics of translocal responses to natural hazards and environmental change. Indonesia is characterized by a multitude of natural hazards and is highly prone to be adversely affected by the effects of climate change and sea level rise. The studied Indonesian migrant communities in our case consist largely of high-skilled workers and students, appear well-organized and display a high degree of emotional attachment and the desire to contribute to the positive development of their place of origin (see Muhidin & Utomo 2016; Oktafiani 2019).

While earlier research has described the pronounced role of financial and knowledge support in advancing responses to natural hazards (see Rockenbauch 2019a), this conceptualization falls short in describing and explaining other support forms that do not fit well into these two broad categories. Drawing from migration and development studies (e.g. Erdal 2022; Galstyan & Ambrosini 2022; Isaakyan & Triandafyllidou 2017; Minto-Coy et al. 2019; Tuccio & Wahba 2020), we find fruitful links to the concepts of financial and social remittances as more diverse manifestations of translocal social capital. These concepts, however, also do not fully grasp the processes and dynamics taking place when migrants provide support to hazard-affected non-migrant family members.

Our results show that translocal social capital and the resulting translocal support is a much more diverse phenomenon than previously acknowledged, substantiating Su's (2022) argument that translocal bonding ties to migrants can offer similar benefits as bridging and linking social ties. First, our data reveals that migrants are able to leverage their social networks in their place of residence and place of origin to organize practical support for their families. Second, discussing adaptation options emerges from our study as an independent sub-form of knowledge transfer that is more focused on organization and implementation independent of accessible knowledge for innovation. Interestingly, discussing hazard responses and adaptation strategies is more common than one-sided hazard-related knowledge transfer. Nonetheless, knowledge support from migrants is highly valued by non-migrant family members. Third, visits to provide practical support demonstrate that translocal social capital can also be a source of more localized forms of support, indicating that local and translocal support are not mutually exclusive categories. Finally, our results demonstrate the widespread use of emotional or mental support, underlining the importance of psychosocial factors when dealing with natural hazards and other challenging events (see Pacoma & Delda 2019).

Translocal support is often taking place on a semi-collective level, blurring the lines between the prevalent dualistic understanding of individual or collective support from migrants (i.e. direct support between migrants and non-migrant family members and contribution to community/diaspora activities such as donations, respectively). In the context of financial remittances, Galstyan and Ambrosini (2022) describe this phenomenon as "collective remittances from below" and "semi-collective remittances". Our findings confirm this and extend this conceptualization to other forms of translocal support. For instance, when looking at the support from the broader social networks of migrants, it is evident that the networks in their new residences enhance mutual support within migrant communities, demonstrating how support is embedded in broader social and geographical contexts.

Our analysis revealed that the implementation of different support forms is heterogeneous and largely determined by individual characteristics of the support-lending side. While the specific determinants

might be very context-specific, we identified five major groups of determinants which can be applied in a variety of specific contexts: (1) demographic and socio-economic situation, (2) migration history, (3) experiences with and knowledge about environmental hazards, (4) embeddedness in (trans)local network, and (5) perceived agency. Specific relevant variables may be different from case to case, but indicator groups of determinants for translocal support are likely applicable to variable contexts, either socio-cultural or related to other (external) shocks affecting members of a (trans)local social network. The interplay of these factors revealed a pronounced role of personal involvement, self-perceived agency, as well as socio-cultural expectations shaping the use of different translocal support forms. Our findings are in line with a study from Su and Le Dé (2021), who identified the migrant's occupation, intra-family dynamics, and cultural norms, among others, as relevant factors affecting the ability of households to turn their ties with migrants into financial remittances after disasters. Thus, overall, our results show that the rationales, motivations, drivers, and inhibitors of migrants in providing translocal support will influence the available social capital of affected households and communities.

Additionally, while our interview results give some indication that different natural hazards demand different types of support, especially when looking at the severity and intensity of certain events, our quantitative analysis shows that the choice of whether a particular support is implemented or not does not depend on the type of hazard itself, but rather the fact that there is an emergency. In other words, potential translocal support is shaped by the social networks themselves and the attributes of the individuals within them and is largely independent of the type of hazard event that may activate them. However, hazard events act as activators and catalysts of translocal social capital that will mobilize the flow of support in these networks (see Romankiewicz et al. 2016).

Our study is in line with other literature showing that migration can serve as a diverse driver to build and maintain adaptive capacity to natural hazards and environmental change. However, migration as a livelihood strategy is not typically pursued by the poorest members of society, as it necessitates a certain degree of education and financial assets (Bernzen et al. 2019; Codjoe et al. 2017; de Haas 2005; Foresight 2011). This leads to challenges such as the exclusion of certain groups and the limited capacity for vulnerable groups to participate in translocal activities (Ley 2019). In fact, the capacity of the urban poor to organize translocally is a matter of debate, as developing and maintaining translocal networks may place an additional burden on already vulnerable groups (see Ley 2019). Accordingly, the implementation of relationship-building beyond the local context is only beneficial to communities if it is relevant to their local needs. In other words, both human and financial capital play a crucial role in determining individuals' access to translocal social capital and their ability to engage in transnational activities.

While our study makes significant strides in understanding the nature and dynamics of translocal support in response to environmental hazards, we acknowledge some limitations. The focus on Indonesian migrant communities in Germany and other EU countries, though valuable, limits the scope and generalizability of our findings. Cultural, social, and economic factors that influence translocal support can vary greatly across different migrant communities and host countries. Similarly, our study is biased toward high-skilled workers and students, which may not represent all segments of the migrant population. Finally, the limited sample size of our online survey may impact the wider applicability of our

findings. However, this limitation does not undermine the depth and richness of the qualitative data generated.

In light of these insights, it would be beneficial for future research to extend this study to a broader range of migrant communities from different socio-economic backgrounds and in different geographical contexts. Exploring how these dynamics manifest in low-income or less-organized migrant groups could provide vital insights. Additionally, the potential disparity in access to translocal social capital revealed by our study underscores the need for further research into strategies for overcoming socio-economic barriers in developing and maintaining translocal networks. The exploration of how different types of hazards may trigger different support dynamics, even if our study found the type of hazard is not a determinant of support form, may be another potential avenue for future research to fully understand the versatility and applicability of translocal social capital. Finally, we underline with our research the notion that social capital can only be fully understood by looking at the entire social network involved, at the smallest level being those who provide support and those who receive it. Our research contributed to close research gaps on the support-lending side of translocal networks in hazard and development research. Future research on translocal social capital should strive to study both the support-lending and support-receiving side of social networks with a focus on bi-directional flows and potential interdependencies.

This study presents possible policy implications for harnessing translocal social capital effectively in response to natural hazards. Policymakers and practitioners should focus on fostering robust, adaptive (trans)local support networks in affected communities. Policy interventions should aim to reduce socio-economic barriers that may limit access to translocal social capital, acknowledging the role of human and financial capital in enabling migration and maintaining translocal support networks. This could include tailored programs for poverty reduction and education in affected communities, for example through scholarship programs. Further, our findings highlight the need to broaden the understanding of migrant support beyond financial contributions, recognizing the substantial potential of migrant communities as well as the beneficial impact of psychosocial support. Policymakers and practitioners should strive to facilitate these support forms, for instance by facilitating access to ICT infrastructure and devices.

9.8. Conclusions

In conclusion, our analysis sheds light on the intricate and interconnected nature of translocal support in the context of responding to environmental hazards. This exploration lays the groundwork for a nuanced understanding of translocal support dynamics that intersect natural, personal, social, and cultural domains.

The nuances of translocal support uncovered in our study demonstrate diverse migrant engagement in hazard responses, moving beyond the more established categories of financial support and knowledge transfer. Our findings shift attention towards the potential of harnessing social networks for practical assistance and support amplification, adaptation planning, and psychosocial assistance, thus broadening our understanding of the roles migrants play in their home communities resilience.

Our findings also challenge the prevalent dichotomy of individual versus collective support, with evidence suggesting that translocal support occurs semi-collectively, thus capturing a more complex and socially embedded reality. Recognizing this, we must re-evaluate our understanding of translocal social networks, acknowledging them as interconnected units of support rather than simply avenues for individual contributions.

Further, we demonstrate in our case that the nature of the hazard event itself does not substantially determine which forms of support are provided. Instead, emergencies serve as catalysts, activating the inherent capacities of social networks. This compels us to reimagine our approaches to disaster response, focusing on the cultivation and activation of robust and versatile social relations.

While our findings highlight the potential of migration as a strategic tool in disaster response, it also uncovers existing challenges. Socio-economic disparities can restrict certain groups from participating in these translocal networks. It is a reminder that not all solutions are universally applicable and that context-specific barriers must be addressed to ensure equitable access to resources.

Lastly, we want to stress the importance of a comprehensive understanding of translocal networks, acknowledging both the provider's and receiver's perspectives. Such a holistic approach is critical to understand and to harness the resources embedded in (trans)local social networks. Ultimately, as we navigate towards a future increasingly marked by environmental and climate-related challenges, the effective leveraging of translocal social networks will be key to building and maintaining resilient communities.

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10. Introduction to the third study: Community leadership and social network development

The findings of chapters 7 and 9 indicate that access to social capital that transcends local administrative and community boundaries – in both cases exemplified by translocal social capital – offers added benefits compared to only local social capital. Specifically, translocal ties facilitate the linkage of different networks, enhancing the diversity of accessible resources and knowledge. In this regard, translocal bonding social capital shares qualities of bridging and, in some cases, linking social capital.

However, the case study in Padang and Denpasar (Chapter 7) shows that households generally have limited access to bridging and linking social capital, a finding that is very common in the Global South, especially among poor populations (see Bott et al. 2020; MacGillivray 2018; Rockenbauch et al. 2019). Further, the case study of Indonesian migrants in Europe (Chapter 9) shows that support providers tend to direct their support towards bonding ties as well.

This leads to the third case study, detailed in the upcoming chapter, which focuses on community leaders in Semarang. Unlike the first two studies that concentrated on the individual household level and dyadic network interactions between support providers and receivers, this case study shifts the focus more to a community perspective and how powerful individuals in favorable network positions can influence community adaptive capacity. Since community leaders on Java fulfill formal functions such as the distribution of state resources among the neighborhood, but at the same time are elected community members (see Berenschot 2019), they provide a suitable example to investigate the formal and informal institutional context of their social networks. Investigating this highly formalized environment of neighborhood organizations on Java provides further insights into how the structure and processes of social networks are shaped. Also, this case closes the loop of the conceptual model and shifts the focus again to community adaptive capacity, thus demonstrating more direct outcomes for flood-affected households and communities.

11. The role of community leadership in building community adaptive capacity to coastal hazards – Insights from neighborhood networks in Semarang, Indonesia

Gisevius, K., Niesters, L.-M., & Braun, B. The role of community leadership in building community adaptive capacity to coastal hazards – Insights from neighborhood networks in Semarang, Indonesia.

This is the authors' original manuscript of the submitted article.

Own contribution is detailed in appendix B.

Abstract

Coastal communities in the Global South face significant challenges due to urbanization, population growth, and climate change-induced sea level rise. This paper contributes to the study of community adaptation in the context of natural hazards by emphasizing the critical role of community leaders in developing, maintaining, and activating community adaptive capacity. By drawing on quantitative data from a household survey and qualitative interviews with community leaders in Semarang, Indonesia, this study identifies and empirically analyzes previously overlooked linkages between community leadership and adaptive capacity. Our key findings demonstrate that effective community leadership significantly impacts community adaptive capacity by enabling the creation of networks and building social capital, organizing collective action, accessing knowledge and skills, managing communal funds, and representing community interests to external actors. The paper highlights that community leaders' influence on adaptive capacity primarily stems from their network position as brokers and their ability to mobilize resources and knowledge from external sources. Furthermore, we develop a new empirically based framework of determining factors for community leadership effectiveness, emphasizing the importance of social networks in shaping community adaptive capacity. Factors such as social capital, formal authority, personal influence, and legitimacy determine the scope of actions and resources available to community leaders and are closely connected to the structure and dynamics of social networks. Overall, our research advances the literature on community adaptive capacity by underlining the critical role of community leaders and social networks in enhancing community adaptation to natural hazards and environmental change.

Keywords: Coastal hazards; Social capital; Community adaptive capacity; Community leadership; Indonesia

11.1. Introduction

Many urban coastal areas worldwide face natural hazards such as flooding, land subsidence, erosion, or eustatic and steric sea-level rise (Wong et al. 2014). Although many coastal communities in the Global South have a remarkable record of sustaining their livelihoods while coping with coastal hazards and environmental changes (e.g. Bernzen et al. 2019; Bott et al. 2019; Goulding et al. 2018; Nguyen-Trung et al. 2020), they often face constraints in the resources necessary to adapt successfully in the long term (Cinner et al. 2018; Nichols et al. 2019).

To respond to natural hazards, communities need to be able to generate, maintain, and mobilize adaptive capacity. In general, adaptive capacity refers to the enabling conditions, assets, and processes necessary to prepare for and respond to environmental changes, reduce the impacts of these changes, recover from sudden shocks, and exploit new opportunities. Adaptive capacity enables communities to achieve common goals and ultimately implement successful adaptation strategies (Cinner et al. 2018; Siders 2019).

Effective community leadership is likely to have a significant impact on community adaptive capacity and is generally regarded as beneficial for community development (Lamm et al. 2017; Miller 2008). Scholarly work shows that community leaders in the Global South often serve as intermediaries or brokers between their communities and various outside institutions (Bénit-Gbaffou & Katsaura 2014; Berenschot 2019). Well-connected and active leaders are in a position to boost the capacity of community members to self-organize and to acquire and mobilize resources needed for adapting to natural hazards and environmental change (Atanga 2020; Lamm et al. 2017; Surtiari et al. 2017).

However, up to date, there has only been limited research analyzing the relationship between community leadership and community adaptive capacity (for an exception, see Ridzuan et al. 2020), creating knowledge gaps on how and why community leaders might positively influence community adaptive capacity and what factors drive or inhibit effective community leadership in the context for hazard adaptation**.** To address this research gap, we aim to answer the following research questions:

1. *How can community leaders positively influence community adaptive capacity to natural hazards and environmental change?*
2. *What factors shape the effectiveness of community leaders in influencing community adaptive capacity*?

This paper aims to examine and empirically support hitherto overlooked linkages between community leadership and community adaptive capacity to natural hazards and environmental change. Advancing the knowledge on the role of community leadership in shaping adaptive capacities would (1) improve the understanding of the mechanisms and determinants of effective community leadership in the context of bottom-up community adaption to natural hazards and (2) allow for better policy implementation for lawmakers and practitioners interested in building and developing community adaptive capacity. Using empirical data from a quantitative household survey (N=330) conducted in neighborhood-level communities and qualitative interviews (N=19) with local community leaders in coastal areas of Semarang, Indonesia, we aim to draw conclusions about the potential influence of community leadership on adaptive capacity and identify factors that determine its effectiveness in general.

11.2. Linkages between effective community leadership and adaptive capacity

Communities are central entities in studying bottom-up adaptation to natural hazards (e.g. Goulding et al. 2018; Wilkin et al. 2019). In this paper, "community" refers to a group of people living in the same neighborhood who typically have personal relationships with one another and share common views and narratives about their environment. Communities create identity and link their members through shared values and norms. Community membership provides an opportunity for people to organize activities and resources collectively, enhancing their ability to protect themselves from external threats (Murphy 2007; Norris et al. 2008).

To conceptualize community adaptive capacity, we apply Cinner and colleagues' (2018) framework of five domains of adaptive capacity to climate change, which offers a comprehensive perspective on the interrelated elements that enable communities to effectively respond to environmental challenges (Figure 11-1). The first domain entails *assets* – financial and technological resources or services that people have access to, such as income, land and house ownership, material possessions, or insurance (Barnes et al. 2017; Siders 2019). Second, *flexibility* describes the ability to develop, choose, and innovate adequate adaptation options in the context of (evolving) natural and socio-economic circumstances (Cinner et al. 2018; Norris et al. 2008). Third, *social organization* highlights a community's ability to cooperate, mobilize collective action, and practice knowledge sharing (Barnes et al. 2017; Dapilah et al. 2019). Successful social organization is fueled by social capital – i.e. all the resources that can be accessed by being a member of a social network. Social capital derives from trust and social cohesion within communities (bonding social capital) as well as connections across communities (bridging social capital) and to people in positions of power or organizations operating at larger scales (linking social capital; Adger 2003; Aldrich & Meyer 2014; Harrison et al. 2016; Hess 2017; MacGillivray 2018). The fourth domain is *learning*, describing the ability to develop, obtain, and process new information about environmental change, available adaptation options, and possible ways to manage risks (Cinner et al. 2018; Ensor & Harvey 2015; Phuong et al. 2017). The fifth domain is *agency*, or the power to translate latent capacities into action. Agency demonstrates the importance of psycho-social factors such as risk attitudes, personal experience, trust, expectations of authorities, place attachment, and perceptions of marginalization or empowerment (Cinner et al. 2018; Mortreux & Barnett 2017; Waters & Adger 2017).

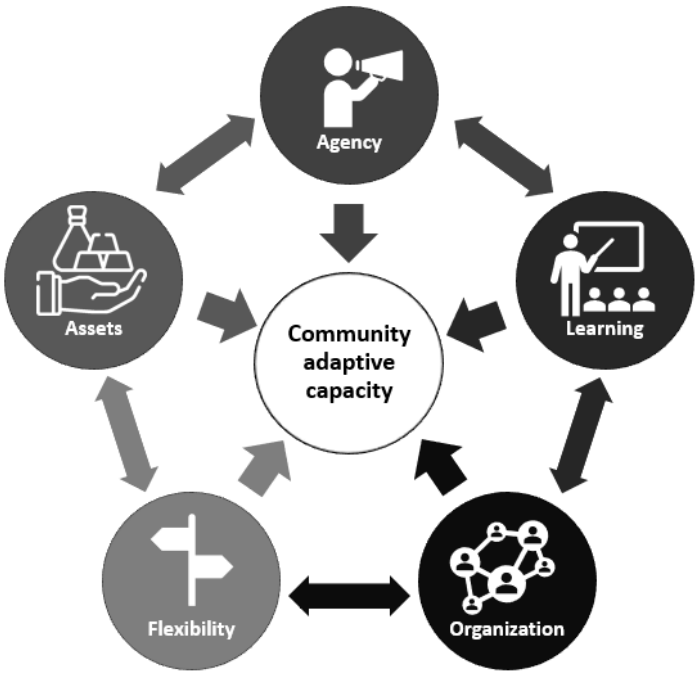

Figure 11-1. Five domains of community adaptive capacity. Own illustration based on Cinner et al. (2018)

Community leaders can potentially facilitate their communities' access to and usage of the five domains of adaptive capacity. Effective leadership at the community level is essential for organizing community action, promoting social well-being, and improving community viability (Lamm et al. 2017). Leadership effectiveness can thus be understood as the degree to which leadership enables leaders, followers, teams, and organizations to reach desired outcomes (see Carter et al. 2015). Indeed, prior research demonstrated that community leaders play a significant role in supporting and enabling community development in general (Kirk & Shutte 2004; Lamm et al. 2017). As intermediaries between their community and external actors, community leaders are involved in transferring resources and providing services (Schaer & Hanonou 2017), which may contribute to the availability of financial and material assets necessary to realize adaptive strategies (Cinner et al. 2018; Siders 2019). Additionally, leaders can promote knowledge transfer by accessing diverse sources of information, and by contributing to the development of innovative new ideas (Haas 2015; Long et al. 2013). Moreover, community leadership has been found to be particularly important to enable collective action to mobilize the resources necessary to achieve a common goal (Lamm et al. 2017; Wilkin et al. 2019). Accordingly, community leaders are highly instrumental in shaping the behavior of social groups and promoting self-organization processes by building consensus within communities (Bodin et al. 2017; Crona & Bodin 2010). Finally, leaders have been shown to empower others through delegation and sharing leadership (see Lamm et al. 2017), creating motivation and agency among group members (Schaer & Hanonou 2017).

Focusing on the link between community leadership and adaptive capacity, it is clear that a community leader's social capital and networks greatly impact their ability to effectively support their communities (Carter et al. 2015). From a network perspective, community leaders occupy an intermediary or broker

position between civil society and the state or other institutions in a vertical relationship (Bénit-Gbaffou & Katsaura 2014). Unlike leaders in formal organizations, community leaders depend less on formal authority and more on personal influence and legitimacy. This is achieved through networking with external individuals and engaging frequently with community members, fostering strong internal relationships within the community (Pigg 1999; Rami et al. 2021). Typically, community leaders are grounded in a relatively small geographical space that they understand well in terms of its spatial, social, and political dimensions, allowing them to develop a personal relationship with their community and to find flexible solutions to local issues (Bénit-Gbaffou & Katsaura 2014). Consequently, leaders who effectively leverage their networks and social capital can enhance their own resources for their own benefit and that of their organizations and communities (Carter et al. 2015).

Recognizing the importance of community leaders' social capital and networks, one must also consider the potential challenges and consequences associated with their role as brokers of adaptive capacity within communities. As brokers, they can build bridges but also create bottlenecks, potentially controlling access to resources and creating disparities in adaptive capacity (see Balkundi et al. 2009; Bodin et al. 2017). Information distortion, withholding, and broker inefficacy can potentially hinder community development (see Balkundi et al. 2009; Long et al. 2013). Limited choice of leadership in smaller governance units may exacerbate these issues (Lowndes & Sullivan 2008). Moreover, social exclusion can generate resentment, negatively impacting community mobilization and social cohesion (Dapilah et al., 2019). This situation can create vicious circles, further disadvantaging vulnerable households (Cassidy & Barnes 2012). Lastly, brokers face a constant trade-off between connectivity and efficacy, which can result in stratified communities with varying adaptive capacities (Balkundi et al. 2009; Barnes et al. 2017; Chaudhury et al. 2017).

While effective leadership has been recognized as a relevant factor for adaptive capacity at the community level (see D'agata et al. 2020; Gupta et al. 2010), explicit studies on the direct effects of community leadership on community adaptive capacity are scarce. A noteworthy exemption is a recent study by Ridzuan and colleagues (2020), who demonstrated that community leadership mediates the relationship between factors of community resilience (community engagement, education, and awareness) and community preparedness for natural hazards. Their analyses show that communities are better prepared for disasters when they are engaged, educated, aware, and led by a competent leader with the necessary leadership skills (Ridzuan et al. 2020).

Likewise, the determinants of effective community leadership remain under-researched (see Lamm et al. 2017). On the community level, Onyx and Leonard (2011) identified seven recurring themes of successful community leadership for community development: (1) leaders' embeddedness in the formal and informal networks of the community; (2) shared decision-making with the community; (3) an open system, allowing leaders to engage with external actors; (4) a clear vision about the future of the community; (5) leadership and practical management skills; (6) planning for potential successors; and (7) commitment, persistence and personal energy. Other studies have tried to identify sub-sets of these elements (e.g. Lin et al. 2017; Martiskainen 2017; Rami et al. 2021; Ridzuan et al., 2020). However, it

remains unclear what the relative importance of these factors is, how they relate to each other, or how context-specific they are.

Having identified these research gaps, attention now turns towards the empirical contributions of this study to shed new light on the role and influence of community leaders as central brokers of adaptive capacity for their respective communities, using the example of Semarang, Indonesia.

11.3. Study Area: Coastal hazards, community responses, and the role of community leaders in Semarang, Indonesia

The Semarang Bay area, located on the northern coast of Java Island, is a well-known example of a region that is highly susceptible to coastal hazards and environmental risks. Coastal residents in this area face a wide range of hazards, including tidal inundation and river floods (Harwitasari & van Ast 2011), land subsidence (Bott et al. 2021), saltwater intrusion, shoreline change, erosion (Andreas et al. 2017; Hadi 2017), and land use change (Suroso & Firman 2018). Additionally, the city is prone to flash floods due to its topography, featuring a low and narrow coastal plain, and steep mountain slopes in the hinterland (see Figure 11-2; Andreas et al. 2017). Although these hazards are generally not life-threatening, they are disruptive to the daily lives of the affected population and cause long-term negative effects on livelihoods, e. g. by requiring repetitive home repairs or by compromising the health of residents (Bott & Braun 2019; Harwitasari & van Ast 2011).

Due to limited governmental efforts to mitigate these coastal hazards (Nurhidayah et al. 2022; Saputra et al. 2017), coastal communities in Semarang have developed various self-help strategies as a response to the adverse effects of coastal hazards (Bott & Braun 2019; Bott et al. 2020; Harwitasari & van Ast 2011). The most common responses include house and road elevation, dike construction, sandbag walls or small drainage channels, mangrove afforestation, private pump installation, but also other forms of mutual support, such as community loans, donations, knowledge exchange or labor services (see Andreas et al. 2017; Bott & Braun 2019; Bott et al. 2021; Marfai et al. 2015; Handayani & Kumalasari 2015; Harwitasari & van Ast 2011). These strategies showcase a well-developed culture of social organization and collective action, enabling communities to maintain living standards and compensate for missing resources (Bott & Braun 2019). While these strategies are beneficial in accommodating the short-term effects of flood events, long-term adaptation to environmental changes often remains limited (Aldrich et al. 2016; Bott et al. 2020).

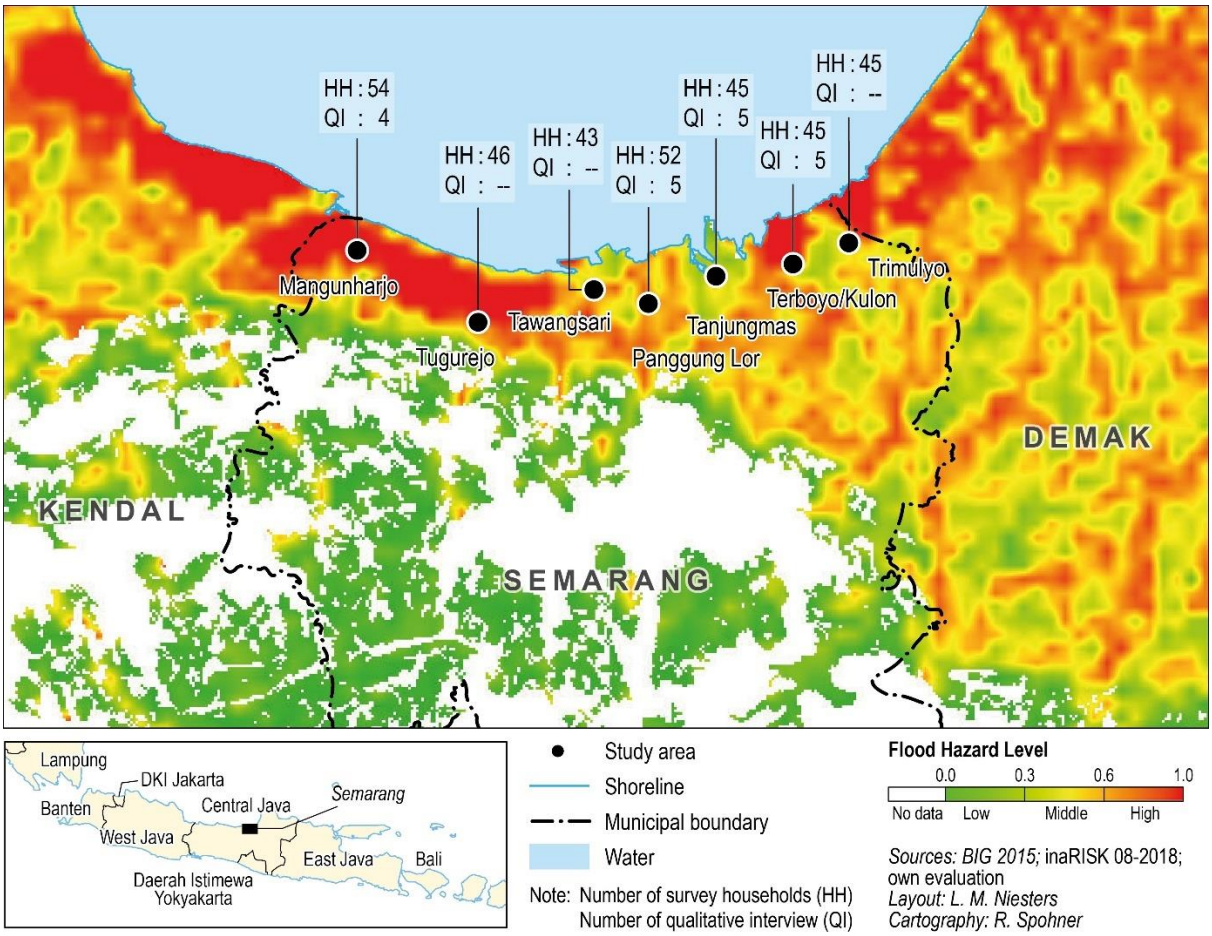

Figure 11-2. Study areas and flood hazard levels in Semarang Bay

Community leaders play a vital role in Javanese society. Communities on Java are highly institutionalized and are often defined by administrative neighborhood boundaries (Bott et al. 2019). Access to state resources such as subsidized healthcare, welfare, or infrastructure programs are mostly distributed through state representatives such as the heads of different tiers of neighborhood associations (Berenschot 2019). Figure 11-3 shows the typical hierarchical structure of neighborhood organizations on Java. The lowest administrative level is called *Rukun Tetangga* (RT; neighborhood association) and usually consists of 30 to 50 households. The next higher tier is called *Rukun Warga* (RW; citizen association) which encompasses two to five RTs (Marfai et al. 2015). The heads of RT and RW organizations are elected neighborhood members and serve as interfaces between Indonesian citizens and the state. They fulfill a variety of administrative functions, such as the management of garbage collection, or the organization of welfare and healthcare programs (Berenschot 2019). These associations are central to communal life and shape social interaction (Bott & Braun 2019). The next administrative level is called *Kelurahan* (urban village). The head of a Kelurahan is a government official appointed by the city mayor. Thus, there is a distinct community / government interface between the RW and the Kelurahan level. It is at this interface where the *Lembaga Pemberdayaan Masyarakat Kelurahan* (LPMK; Village Community Empowerment Institution) is situated. The heads of LPMK are also elected community members. The LPMK focuses on development planning and implementation, and coordinating activities between different community organizations (Kosali 2020). Furthermore, the

Pemberdayaan Kesejahteraan Keluarga (PKK; Family Welfare Empowerment) is an organization for wives and mothers, which exists parallel to all administrative levels, addressing social and health-related issues (Bott & Braun 2019; Marfai et al. 2015). Typically, the wives of the heads of the different neighborhood associations automatically become the head of the respective PKK in that administrative unit. On Java, community leadership positions (with exceptions) other than the PKK are typically occupied by men. Additionally, most communities feature a variety of less formal community organizations (e.g. disaster preparedness, mangrove reforestation, trade associations, etc.). Overall, these neighborhood governance networks and the heads of neighborhood associations are part of a "strongly institutionalized broker network, running through the bureaucracy" (Berenschot 2019, p.13), forming a cornerstone of communal life on Java.

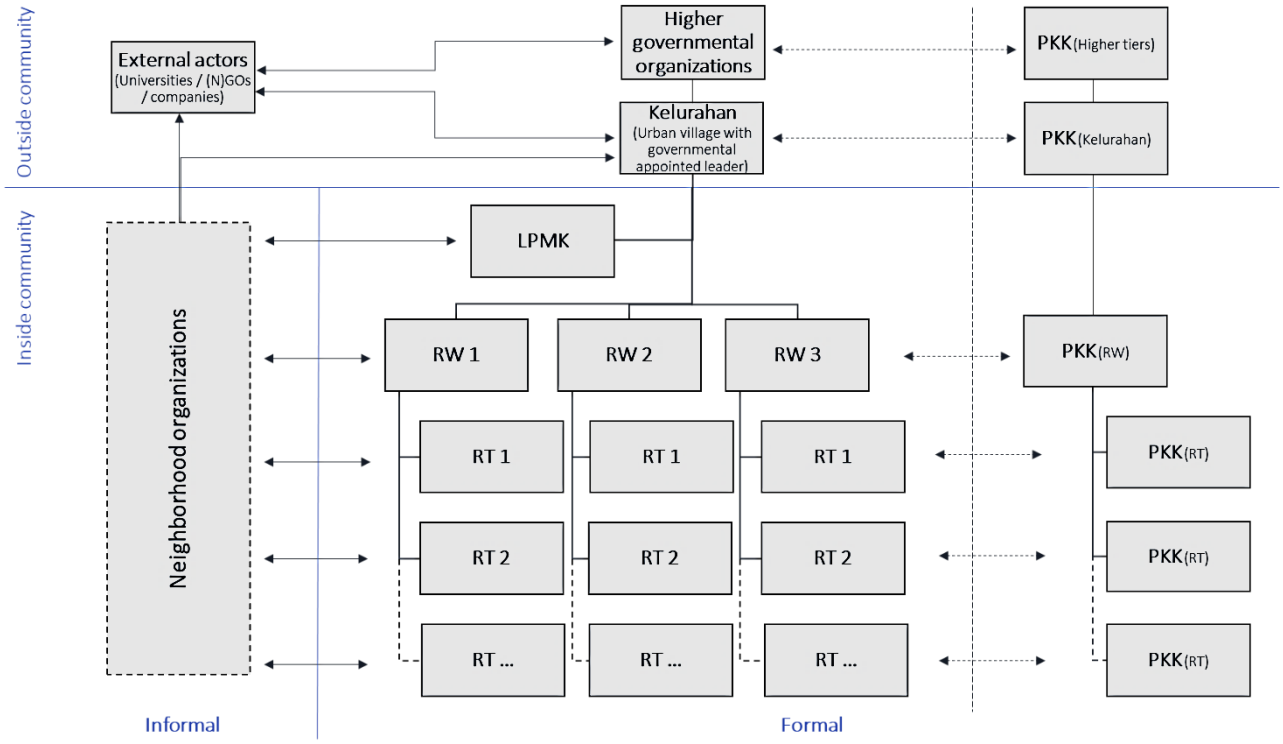

Figure 11-3. General hierarchical structure of (in)formal neighborhood organizations on Java (own illustration)

11.4. Methods

The paper applies a mixed-methods approach, combining standardized household survey data and subsequent qualitative interviews. From March to April 2017, 330 households were surveyed in seven flood-prone coastal urban villages (*Kelurahan*) of Semarang, representing a total of 753 female and 704 male individuals. The survey covered, among others, questions about social networks (family ties, social groups, organizations, and community leaders). Furthermore, questions address indicators of adaptive capacity, such as sources of financial support, participation in collective activities, mutual help during emergencies, coastal hazard response strategies, and perceptions of hazard exposure. Within that sample of 330 households, 41 households (12.4 %) had at least one member in a leadership position.

Based on the findings of the household survey, we subsequently conducted 19 semi-structured qualitative in-depth interviews with community leaders in four previously surveyed Kelurahan in March 2019 (see Figure 11-2). The interviewees included the heads of RT (3 interviews), RW (4), Kelurahan (KEL, 2), PKK (4), LPMK (2), Disaster Preparedness Group (KSB, 1), informal community organizations (mangrove community and flood protection organization; CO, 2), and fishermen association (FA, 1)[1]. All four female interviewees had a position in the PKK. The semi-structured interviews included, among others, questions on hazard experiences and responses, network position and social capital, institutional setting, community characteristics, and personal background. All interviews were audio recorded, transcribed, and translated into English with the support of local research assistants from UNDIP. The results from a subsequent qualitative content analysis (see Mayring 2010) are used to (1) identify how community leaders can influence community adaptive capacity to coastal hazards and (2) identify factors that shape the effectiveness of community leaders to influence community adaptive capacity. The interview results are supported by descriptive and bivariate analyses of the quantitative dataset.

11.5. Community leaders' influence on community adaptive capacity to coastal hazards

To answer our first research question on how community leaders can influence their communities' adaptive capacity, we first identify the duties, authorities, and activities of community leaders related to community flood responses and subsequently analyze their impact on community adaptive capacity. Subsequently, we relate these findings to the framework of five domains of adaptive capacity (Cinner et al. 2018) to generate a comprehensive picture of the role of community leaders in influencing community adaptive capacity.

Our interview data shows that the heads of formal neighborhood organizations in Semarang hold significant power and authority concerning flood responses within their communities. Most of their capabilities and actions are legitimized through elections and institutionalized in the Javanese administrative body. These include (1) the authority to give instructions to community members and staff and to give recommendations to lower and higher levels of neighborhood and government organizations; (2) the authority to organize various community activities and shape development in the community environment through directing collective action and community cooperation; (3) the authority to impose sanctions on all citizens who violate rules; (4) the duty to manage problems occurring in the community; (5) the duty to develop and implement plans and to communicate these aspirations to higher administrative levels.

Based on their institutionalized power and authority, community leaders in Semarang have a critical role to play in building and mobilizing social capital in their communities to promote collective action and flood adaptation. Leaders can use their authority to organize meetings, promote collaboration, and provide guidance and mediation in personal matters. In fact, 44 percent of survey respondents stated that flood protection is an important topic discussed at RT/RW and PKK meetings, demonstrating that

[1] In the results section, individual interview statements are labeled with unique codes. These codes combine the abbreviation of the organization and the study area number.

community leaders actively address this issue. Furthermore, 69 percent of survey respondents confirmed that the heads of RT/RW would deal with problems that affect the entire community, indicating that community leaders have a broad mandate to address issues of common concern. Next, traditional communal work (*kerja bakti* or *gotong royong*[2]) is often used by community leaders for flood preparation or responses, such as cleaning drainages and repairing flood protection infrastructure. Moreover, all of the interviewed neighborhood organizations stated that they prioritize open, inclusive discussions and maintain collaborative decision-making processes, emphasizing the importance of community engagement and participation. Finally, community leaders also act as advisors and mediators in personal matters, with 20 percent of respondents seeking guidance from the head of RW or RT and 36 percent stating that these leaders mediate conflicts between neighbors. These findings suggest that community leaders who foster harmony, cohesiveness, and participation in their communities build and increase bonding social capital, thus, providing the foundation for effective collective flood adaptation. Referring back to Cinner and colleagues' framework (2018), these results show that community leaders have high influence on the domain of social organization.

Disseminating knowledge about coastal hazards and their potential impacts, and best practices for addressing them, is another crucial role played by community leaders in Semarang. Community leaders provide education and training to community members on how to prepare for and respond to coastal hazards. Examples of such training include waste management (PKK3), flood prevention (KSB3), environmental protection (CO1), and health issues (PKK1). About 64 percent of survey respondents stated that RT, RW and PKK meetings help to increase environmental awareness in the neighborhood. Around 48 percent of the household survey respondents learned new skills or received valuable knowledge during meetings on RT, RW, or PKK, highlighting the role of these meetings as platforms for knowledge sharing. By organizing workshops, community meetings, and public events, community leaders contribute to raise awareness of the risks of coastal hazards and to build the skills and knowledge needed for successful coping and adaptation efforts. These results illustrate the significant role of community leaders in influencing the learning domain and to some extend flexibility domain of adaptive capacity.

The interview findings indicate that community leaders in Semarang have significant influence over a community's ability to finance flood response efforts. Leaders are responsible for collecting, managing, and allocating communal funds, which are used for various purposes, such as utilities, security, social welfare, and flood protection. 74 percent of survey respondents have access to such communal funds. Community leaders grant access to savings and credit to support the livelihoods of community members in need (PKK4). The role of these communal funds is especially important since access to formal loans is generally limited for many community members. Moreover, the heads of higher-level neighborhood organizations can raise government and private funds through petitions, securing much-needed external

[2] *Kerja bakti* and *gotong royong* refer to community work events in which people come together to perform various tasks for the common good such as cleaning public areas, fixing roads, or maintaining communal buildings. Both concepts are deeply rooted in Indonesian culture and emphasize the importance of social solidarity and collective action.

funding. Our findings indicate that without the involvement of neighborhood organization heads, communities would find it challenging to collect communal funds for individual relief, flood adaptation, or other development needs, indicating a substantial influence of community leaders on the adaptive capacity domain of asset building.

Community leaders in Semarang are essential in representing the needs and interests of their communities to external stakeholders and higher levels of government. Our results highlight that those leaders play a vital role as advocates of community interests, bridging gaps between community members and external actors and securing resources needed for adaptation efforts. Especially the heads of higher-level neighborhood organizations have extensive networks and relationships outside their communities (LPMK1; LPMK4), enabling them to develop partnerships and projects with public and private actors that aim to increase community adaptive capacity in the face of coastal hazards. This is especially relevant since many poorer coastal communities on Java tend to be inward-oriented with limited social networks to the outside world of the individual community members (see Bott et al. 2020). Consequently, by promoting self-determination and empowering local communities to proactively respond to coastal hazards, community leaders serve as catalysts in promoting the agency domain of adaptive capacity.

In sum, our findings show that community leaders play critical roles in building social capital, encouraging collective action, disseminating knowledge, managing communal funds, and advocating for their communities with external stakeholders and higher levels of government. By employing the adaptive capacity framework by Cinner et al. (2018), we demonstrate that community leaders have significant and encompassing influence over each of these domains. Their central role in community life is so vital that without their involvement, the overall adaptive capacity of the community would be severely compromised.

11.6. Determining factors of effective community leadership

To answer the second research question, which explores the factors that affect the ability of community leaders to enhance adaptive capacity within their communities, we have developed a new analytical framework grounded in our empirical data analysis (see Figure 11-4). We identified two main sets of determining factors of effective community leadership in the context of community adaptation to coastal hazards: (1) the characteristics of formal and informal social networks the community leaders are part of, and (2) the individual characteristics of the community leaders themselves. The first set of factors can be differentiated in (a) the organizational framework and (b) community characteristics. The second set of factors involves (a) the embeddedness in formal and informal networks and (b) individual personal characteristics. However, we see indications that individual characteristics are also shaped by the characteristics of the networks they are embedded in and vice versa. Our framework provides a novel and comprehensive approach to explain community leaders' scope of action and their accessible resources to influence community adaptive capacity. In the following, we analyze each determining set of factors in detail.

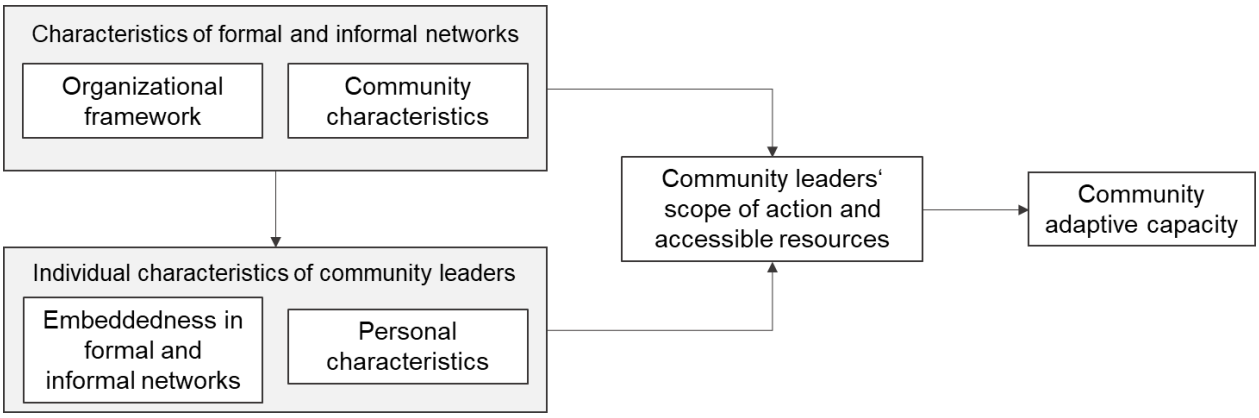

Figure 11-4. Determinants of effective community leadership and its influence on community adaptive capacity

11.6.1. Characteristics of formal and informal networks

Organizational framework

Our findings show that the highly institutionalized administrative environment on Java represents a bottleneck, limiting the scope of action for community leaders. Especially community leaders at the RT and RW level have little autonomy and are reliant on approval from higher authorities for external support initiatives. Moreover, going around official channels is viewed as unethical and risky (RW4; RT4). This hierarchical silo mentality inhibits direct communication among community leaders from different Kelurahan and with higher levels of government and represents a significant barrier to cooperation and bottom-up innovation (PKK1; PKK4; RW3; RT3; KSB3).

The strict organization of neighborhood associations combined with a dependence on external funding results in competition between communities, pressuring formal leaders to prioritize securing funding for their community rather than collaborating with neighboring communities (LPMK4; RW3; RT3). The local government is the main sponsor for formal community leaders. While operational funds have increased recently[3], some interviewees state that the budget is insufficient for self-initiated projects (RT4, PKK3). Consequently, leaders tend to focus on their own community's interests rather than fostering collaboration and shared resources with neighboring communities, which could potentially lead to more efficient and effective solutions for addressing common challenges such as coastal flooding.

Furthermore, the capacities of community leaders to develop and implement community-led projects are limited due to their high workload on top-down projects. This high workload is caused by a large number of government-led programs aimed at improving the living conditions in coastal communities (RW1; RW2; PKK2; KEL2; KEL4). These programs include infrastructure projects, social welfare programs and livelihood support, family benefits, slum and neighborhood development. While these programs are generally seen as beneficial, they cause confusion and tie up capacities needed for self-initiated projects (RW4; LPMK1). For instance, several interviewees stated that programs are often introduced without regard to the specific needs of the communities or proper follow-up strategies, leading to problems with

[3] According to one interviewee (RW4), operational funds have increased steadily for the heads of RW and RT from 75,000 IDR per month in 2016 to 600,000 IDR per month since January 2019.

their implementation and continuation (RT2; RW4; PKK4; RT4). As a result, many community leaders are unable to develop projects on their own.

Community characteristics

Coastal hazard exposure and risk perception of community members constitute a substantial influential factor affecting community leader activities. Our data shows that flooding is a common occurrence in the areas we surveyed, with almost 70 percent of households having experienced negative impacts from floods in the past five years. Furthermore, flooding causes problems for 43 percent of respondents at least once a year, and for 17 percent, it is a constant problem. Respondents also anticipate an increase in tidal floods (49 %) and subsidence (38 %) in the future. Most households affected by subsidence elevate their house on average every six years.

In flood-exposed communities, households need to invest in their private property and lack finances for community flood protection. Less than half (44 %) of households surveyed save money for private flood protection or house elevation. Only about half (51 %) have any savings at all and only about 18 percent have sufficient savings to fund individual house elevation. Moreover, almost half of the survey respondents (46 %) stated that it has become harder for them in the last five years to pay for flood protection and elevation. In this regard, one head of RT (RT2) stated that a collectively funded embankment could not be further maintained because community members prioritized elevating their houses over investing in the maintenance of communal embankments. Thus, a general lack of available financial capital among households also limits the ability of community leaders to collect communal funds (RT2; RT4; PKK4), fueling competition among communities to secure government funding (RT4).

Conversely, in already better-protected communities, the risk perception is decreasing, resulting in a reduced willingness to deal with flood issues. As a result, additional adaptation measures in one study area have stopped entirely, and community leaders find it challenging to persuade community members to attend disaster preparedness meetings. This development reduces the preparedness for extreme events that may still occur (LPMK4).

Community participation in neighborhood organizations and communal activities is another characteristic impacting the work of community leaders. Low participation rates are related to a lack of time or motivation to support communal activities or join social organizations (RT3, PKK3, KSB3). Our survey shows that only about 20 percent of respondents believed they have at least some influence to make their neighborhood a better place. Furthermore, some interviewees feel that their communities react apathetic towards new programs and issues, which they attribute to negative experiences with government-led programs (RW2, PKK2, LPMK4). Consequently, community leaders with uncooperative community members will need to put in extra effort to engage and mobilize them to participate in communal activities and increase awareness about environmental issues.

11.6.2. Individual characteristics of community leaders

Embeddedness in formal and informal networks

Community leaders with strong connections in both formal and informal social networks can leverage their social capital to significantly enhance their impact and scope of action when addressing coastal hazards. Generally, we find that community leaders have easier access to linking social capital due to their formal position. For example, only 6 percent of survey respondents without household members in leadership positions claimed to have personally interacted with influential individuals in the past five years. In contrast, nearly one-third (29 %) of those with household members in leadership positions reported making such connections. In fact, all interview respondents emphasized the importance of cultivating diverse networks to facilitate flood adaptation efforts and community development in general.

While higher-level community leaders possess increased influence and access to external actors, they may also face challenges in effectively representing their community's needs due to communication barriers and restricted information flow. For instance, it is common that connections with external actors such as businesses, universities, and NGOs are only made at the Kelurahan level or higher (KEL2). Consequently, community members and the heads of lower-level neighborhood associations have more difficulty in developing these connections. However, occupying a higher position often results in reduced direct communication with community members, potentially leading to misrepresentation of the community's needs and interests (RW1). Higher-level meetings are generally attended exclusively by other community leaders and their staff, resulting in a bottleneck of bottom-up information flow. As a consequence, higher-level community leaders have to rely on input from lower-level leaders and their personal connections when making crucial decisions associated with coastal adaptation.

Personal characteristics

The absence of strong leadership can lead to the stagnation of communal activities, disruption of access to public services, and hindered connections with other stakeholders. This greatly impairs collective flood responses and puts the livelihoods of vulnerable community members at risk (PKK4; RT4). Especially lower-level organizations face significant challenges when they lack a capable and motivated leader. Leadership positions within these organizations often have limited competition due to their unpaid, time-consuming nature and the high degree of responsibility and personal accountability associated with them. As a result, some individuals are elected into leadership positions involuntarily (RW1; RW4; RW3; RT3). Consequently, many lower-level leaders lack the necessary skills, experience, and motivation to effectively fulfill their responsibilities, which substantially hinders efforts to promote flood adaptation and overall community development.

Related to the challenges faced in securing competent leadership, we find that socio-economic factors influence the access to leadership positions and community leaders' ability to fulfill their roles effectively. Our findings suggest that individuals with higher socio-economic status (higher education, self-employment, savings, access to ICT) are more likely to gain access to (higher) leadership positions (see Table 11-1), highlighting the importance of socio-economic factors in determining community leadership opportunities. Community leaders have to balance the demands of their position with their professional

and personal responsibilities. For example, one head of RW (RW4) mentioned that he is not interested in pursuing a higher position, such as head of LPMK, as it conflicts with his family obligations. In contrast, several interview respondents stated that self-employment and financial security allow them to spend time in leadership positions without negative effects on their livelihoods (LPMK1; LPMK4; RW3; RT3; CO3; KSB3).

Table 11-1. Bivariate analyses of socio-economic indicators comparing households with and without members in leadership positions

Indicators/Factors, Total n	Scale	Test	Categories, n	Share of households with members in leadership positions
Secondary education or higher ** n=330	D	Chi2 = 7.47	Yes = 260	39 (15.0 %)
			No = 70	2 (2.9 %)
Non-farm self-employment * n=330	D	Chi2 = 5.12	Yes = 62	13 (20.1 %)
			No = 268	28 (10.4 %)
Having savings ** n=330	D	Chi2 = 9.53	Yes = 167	30 (18.0 %)
			No = 163	11 (6.7 %)
Access to internet/ communication devices ** n=330	D	Chi2 = 7.03	Yes = 116	22 (19.0 %)
			No = 214	19 (8.9 %)

** p<0.01, *p<0.05, (n.s.) not significant | D = Dichotomous

Based on our interviews, leadership experience is beneficial for community leaders' personal influence, legitimacy, skills, and social capital. Our sample includes individuals who have held formal leadership positions for varying lengths of time, ranging from six months (KEL4) to more than 34 years (RW2), with most having served for over three years. Although leadership terms typically last 3 to 5 years, some leaders continue in their roles well beyond this period. There is consensus among the interviewees that experience is an important asset to acquire skills and better networking ties with other stakeholders. As a result, community leaders who stay in their positions for extended periods can gradually consolidate their power and authority, and expand their social networks over time, thereby increasing their personal influence and scope of action.

In summary, our findings reveal that leadership effectiveness is substantially influenced by the structure and dynamics of social networks, as well as the individual and collective traits of network members. Utilizing our analytical framework for determining factors of effective community leadership, we identified three major barriers to effective leadership in our case: (1) The highly hierarchical Javanese administrative system, which restricts community leaders' scope of action and hinders their ability to engage with other actors freely; (2) a lack of motivation and skills, particularly among low-level

community leaders; and (3) insufficient socio-economic capabilities to support community efforts, coupled with community members' indifference towards community activities.

11.7. Discussion and conclusions

In this study, we examined the relationship between the work of community leaders and their influence on the adaptive capacity of their community to deal with coastal hazards. Our findings clearly show that community leaders are an integral part in the process of developing, maintaining, and activating community adaptive capacity.

Semarang has proven to be a fitting study area for our research, because the administrative system in Java places community leaders in a crucial position, making collective flood adaptation virtually impossible without their involvement. This is especially the case in communities with limited financial, human, and bridging/linking social capital. Community networks in Semarang are often isolated, as they predominantly align with administrative boundaries, resulting in a high dependence on community leaders' performance for adaptation. This carries substantial risks, particularly when incapable and unmotivated leaders are in charge. In many cases, only community leaders have relevant bridging and linking social capital, but their ability to expand and utilize their networks is largely determined by formal procedures and official guidelines. Thus, this research context allows to clearly study the advantages and disadvantages of community leadership.

By integrating valuable perspectives from hazard research, community adaptation, development studies, social network theory, and leadership theory, our study offers a comprehensive analysis and integration of prevalent connections between community leadership and adaptive capacity. The framework of five domains of adaptive capacity to climate change (Cinner et al. 2018) has demonstrated its efficacy as a conceptual tool for examining the connections between community leadership and adaptive capacity. As a result, we can show in detail how and why community leaders serve as crucial agents for enhancing adaptive capacity in response to coastal hazards, exerting a considerable impact on all five domains.

Our findings suggest that the adaptive capacity of a community is not only influenced by community leaders but that understanding the building of community adaptive capacities requires a research focus on these individuals. We demonstrate that community leaders are not just one of many factors influencing community adaptation, but can play a much more decisive role in determining the success of collective adaptation than is acknowledged in the existing literature (e.g. D'agata et al. 2020; Gupta et al. 2010).

Next to the question of what influence community leaders may exert over community adaptive capacity, our analysis provides new insights into the determinants that explain variation in the effectiveness of community leaders. Our results confirm the assumption that community leaders' influence on adaptive capacity primarily stems from their network position as brokers between the community and other (external) actors (Bénit-Gbaffou & Katsaura 2014; Berenschot 2019). This central role in community life enables them to make connections with other leaders, (N)GOs, companies, and universities. The

resulting bonding, bridging, and linking social capital empowers community leaders to mobilize funds, materials, and collaboration within the community while also accessing resources and knowledge from external sources. Our study reveals that the ability to utilize this social capital is closely linked to the formal authority, personal influence, and legitimacy of community leaders (see Pigg 1999; Rami et al. 2021). These factors ultimately determine the scope of actions and resources available to community leaders to enhance community adaptive capacity.

Concerning potential determinants of successful community leadership, our study reveals additional factors, thus advancing previous research by Lin et al. (2017), Martiskainen (2017), Onyx and Leonard (2011), Rami et al. (2021), and Ridzuan et al. (2020). From our analysis, the following points particularly emerge as relevant factors that are consistent with the literature: (1) the degree of network embeddedness and available social capital; (2) the openness of the political and societal system; (3) existing leadership skills, and (4) leaders' commitment and motivation to improve life in their communities (see Onyx & Leonard 2011). Additionally, our study context of adaptation to natural hazards revealed (I) exposure and risk perception as a novel factor. Furthermore, (II) community characteristics, especially socioeconomic status and involvement of community members, stand out as additional contextual factors for community leadership, which have not been discussed in the literature so far.

To understand successful community leadership, we developed an empirically-based framework of determining factors of community leadership effectiveness that emphasizes individual characteristics of community leaders and the characteristics of the (in)formal networks they are embedded in. Our framework highlights the significance of the structure and dynamics in social networks, highlighting how rules and norms dictate the potential influence and legitimacy of a community leader's actions.

A crucial aspect that emerged from our study is the impact of the structure and dynamics of formal and informal networks on three main issues: (1) the strategies that leaders can employ to leverage, activate, or expand their networks; (2) the accessibility of leadership positions and the composition of potential candidates; and (3) the incentives for collaboration or competition among multiple community leaders. Our research findings reveal that the structure and dynamics of social networks, along with the resultant social capital, play a vital role in shaping a community's adaptive capacity.

Investing in the development of community leaders and their networks is a strategic, long-term move for practitioners and policymakers to foster community adaptive capacity. Community leaders are integral to connecting bottom-up community actions and top-down governmental interventions as they connect communities with external actors and resources. Accordingly, decision-makers should strive to identify key actors and comprehend the social and organizational structures of community networks, especially when passive or inadequate leadership undermines community-building efforts. Consequently, making community leadership roles more appealing to young talent through the development and implementation of leadership incentives should be a priority. These could take shape as targeted support programs, leader-specific training, or workshops catering to the needs of marginalized communities as well as creating an environment that facilitates knowledge exchange and reduces the impact of restrictive organizational boundaries.

In looking forward to future research, we want to acknowledge some of the opportunities and potential avenues for further exploration. Our findings demonstrated the critical role of community leaders in building community adaptive capacity. However, it is important to note that simply building adaptive capacity does not guarantee favorable adaptation outcomes. Consequently, there are still questions regarding the impact of community leaders on actual adaptation outcomes. Therefore, we encourage further research to delve deeper into these areas. Furthermore, while this study focused on formal community leaders, future research in other settings and regions might have to consider other actors, such as religious leaders or informal community opinion leaders. Identifying the key individuals in community networks and creating a deeper understanding of their functions and roles remains a crucial research task and holds merit for policymakers and practitioners.

In conclusion, our study emphasizes the significance of community leaders and social networks in shaping the adaptive capacity of communities facing natural hazards and environmental change. Community leaders serve as an integral part of the process of developing, maintaining, and activating community adaptive capacity. They play a critical role in improving a community's response to environmental challenges, making them vital for overall community resilience. Moreover, the structure of social networks, such as the reliance on brokerage positions held by community leaders, greatly affects potential connections within and between communities, as well as with external actors. Additionally, the dynamics of social networks, including the rules, guidelines, and norms governing them, significantly impact a community's adaptive capacity. These factors determine the potential influence and legitimacy of a community leader's actions, ultimately shaping the scope of action and resources available to them to improve community adaptation. In short, a community's adaptive capacity is deeply linked to the actions and influence of community leaders, along with the structure and dynamics of the social networks they navigate. By acknowledging and capitalizing on the interrelationship between community leadership and social networks, policymakers and practitioners can support local community leaders to develop more effective and sustainable adaptation strategies, ultimately enabling communities to improve their responses to environmental challenges.

CRediT authorship contribution statement

Konstantin Gisevius: Conceptualization, Methodology, Investigation, Formal Analysis, Data Curation, Writing – Original Draft, Writing – Review & Editing, Visualization

Lisa-Michéle Niesters: Conceptualization, Methodology, Data Curation, Writing – Review & Editing, Supervision

Boris Braun: Conceptualization**,** Writing – Review & Editing, Supervision, Project administration, Funding acquisition

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12. Concluding discussion

This dissertation aimed to construct a comprehensive picture of how social networks serve as fundamental components in the adaptive processes of communities facing coastal hazards. The concluding discussion synthesizes findings from the three presented studies to demonstrate how social networks, influenced by socio-spatial and institutional contexts, enable communities and households to adapt to coastal hazards. Chapter 7 detailed how personal support networks assist coastal communities in managing natural hazards, focusing on urban areas in Padang and Denpasar. It highlighted the different yet complementary roles of local and translocal networks in preparing for and responding to floods. Chapter 9 explored how Indonesian migrants in the European Union support their home communities as a response to hazard exposure. This study underscores the complexity of translocal networks and their significant impact on coastal hazard adaptation, advocating for a nuanced understanding that encompasses both the providers' and receivers' perspectives. Lastly, Chapter 11 examined how social organization, collective efforts, and local governance interplay to enhance the adaptive capacity of coastal communities. It emphasizes the vital role of community leaders and offers insights into factors that influence their effectiveness, further illustrating how socio-spatial and institutional settings shape community resilience and adaptation strategies.

By focusing on the interplay between local and translocal networks, the dynamics of translocal support networks, and the role of leadership in brokering between communities and local government, this thesis developed an empirically-based expansion of the theoretical discourse on community adaptation to natural hazards and environmental changes (see Figure 12-1). Addressing the central research question, the thesis investigates how the structure and dynamics of social networks can create favorable conditions for household and community adaptation against coastal hazards. The results show that social networks are central to developing adaptive capacity and strategies that mitigate the risks associated with coastal hazards such as flooding, erosion, storm surges, and land subsidence.

12.1. Empirical and theoretical contributions

The major empirical contribution of this thesis is to provide evidence on how the structure and dynamics of social networks shape the adaptive capacity of coastal communities. An overview of the most important factors that emerged from the three studies can be found in Figure 12-1.

12.1.1. Structure and dynamics of social network and their influence on coastal adaptation

The thesis provides empirical evidence that the structure and dynamics of social networks – i.e., the way the network is organized and how it functions – affect the accessibility and utilization of different forms of support for individual and collective hazard responses. While the structure of networks is mostly relevant to the access to resources present in networks, the processes and dynamics taking place within

networks influence the effectiveness of activating and using these resources. Further, the results of the thesis demonstrate that the structure and dynamics of a network are not only distinct influences on adaptive capacity but also interrelated, affecting each other in complex ways. This suggests that changes in one aspect of a network can impact other aspects, influencing the overall adaptive capacity.

First, the results of this thesis are in line with a large body of research stressing the central role of social networks for hazard responses by providing access to social capital (inter alia Adger 2003; Bott & Braun 2019; Cinner et al. 2018; Dressel et al. 2020; Waters & Adger 2017). Chapter 7 examined how personal support networks help households and communities in coastal areas to deal with natural hazards. It focuses on the role of both local and translocal social networks in responding to floods in urban coastal communities in Padang and Denpasar. Access to diverse support forms has been shown to enhance the long-term hazard response of individuals and communities, exemplified by how local and translocal networks provide different forms of necessary support (RQ 2). Moreover, Chapter 11 provides empirical evidence on how community leaders can utilize their social capital to actively support their community members in responding to coastal hazards (RQ 5). Thus, the thesis further demonstrates the central role of social networks in enhancing the adaptive capacity of individuals and communities to cope with coastal hazards through a variety of support mechanisms.

Second, the examination of translocal networks, particularly through the lens of Indonesian migrant communities in Europe (Chapter 9), contributes to the growing body of literature on translocality in hazard studies (inter alia Bott et al. 2020; Mikami 2022; Rockenbauch et al. 2019), offering a deeper perspective on how these networks are activated, maintained, and utilized. Translocal networks function not merely as extensions of local networks but as distinct entities with their unique dynamics (RQ 3 & 4). The thesis provides a detailed analysis of how local and translocal ties in networks shape access to different forms of social support, i.e. financial and material resources, psychosocial support, practical aid, knowledge access, processes of deliberation and planning, and network access. Chapter 7 gives empirical evidence for the complementary nature of local and translocal social capital showing how the structure of a social network significantly shapes the availability of different support forms (RQ 1 & 2). Local social networks are immediate and rooted in the community's specific location. These networks tend to provide practical help, share knowledge, and facilitate discussions. It follows that local networks play a substantial role in quick hazard responses and in planning long-term strategies based on locally embedded and relevant knowledge. On the other hand, translocal support helps to address the psychological and economic impacts of floods, supporting long-term recovery and adaptation by connecting communities to broader, more diverse networks. On top of that, Chapter 9 expands upon established perspectives on translocal social capital, showing that translocal networks offer a wide range of support, not just financial and knowledge resources but also practical help, planning for future adaptations, and emotional support (RQ 3). By illustrating how these networks facilitate various forms of support across borders in response to environmental hazards, the research enriches the understanding of how social networks function in a broader spatial context. These findings suggest that effective adaptation strategies should incorporate both local and translocal perspectives, recognizing the importance of leveraging diverse social networks and the ability of households to use these networks for adaptation (Pacoma & Delda 2019).

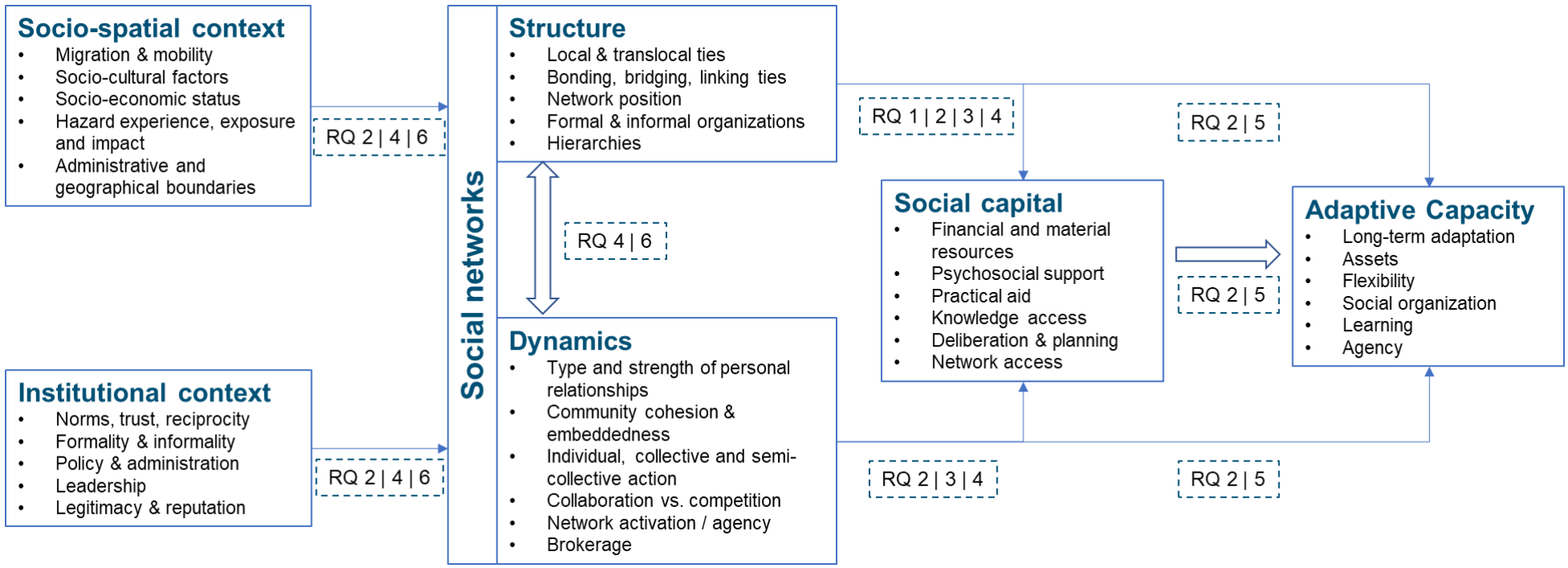

Figure 12-1. Conceptual model supplemented with the most important findings from chapters 7, 9, and 11

Third, investigating the structural elements of local and translocal social networks also highlighted the impact of bonding, bridging, and linking ties on the access to different kinds of social support relevant to flood adaptation. The results of Chapter 7 reveal bonding social capital as the primary source of support for coastal populations in Padang and Denpasar. One important finding of the study is that knowledge support is limited in both cities, which can be attributed to the lack of bridging and linking ties in the support networks of flood-affected households (RQ 1 & 2; see also Bott et al. 2020). Chapter 9 also shows that migrants will focus their support mostly on bonding ties. Accordingly, the results of the thesis demonstrate that network dynamics, such as the type and strength of personal relationships, can affect the flow and quality of information and support. For example, the effectiveness of translocal support in fostering successful long-term adaptation depends on the psychological and relational ties between households and their external contacts (RQ 2). Moreover, Chapter 11 illustrates that community leaders have much better access to bridging and linking ties, which allows them to have a broader scope of action compared to other community members (RQ 5). Thus, this research substantiates the notion that the presence of diverse social ties (i.e., bonding, bridging, linking) contributes to robust and flexible support mechanisms for long-term adaptation within different community settings (see Azad & Pritchard 2023; Cinner et al. 2018; Cofré-Bravo et al. 2019).

Fourth, another contribution of the studies is exploring how the network position of individuals and the presence of formal and informal organizational structures within social networks significantly influence access to information and resources, as well as the ability to affect community dynamics and decision-making processes. Chapter 11 explored the role of community leaders as intermediaries between the community and external stakeholders in detail. This role is vital for gathering resources, sharing knowledge, and fostering collaboration and, therefore, directly impacts community adaptive capacity (RQ 5). Accordingly, depending on the performance of community leaders, other community members' adaptive capacity to flooding will be impacted. The third study demonstrates that the success of community leaders in improving the adaptive capacity of their communities largely depends on their social capital and their formal position in neighborhood organizations (RQ 6). Also, Chapter 9 illustrates the broader access of migrants to network resources due to their special position between networks in their place of origin and place of residence, corroborating the argument that translocal bonding contacts fulfill functions of bridging and linking ties (see Elliot et al. 2010; Su 2022). This finding affirms the connection between the adaptive capacity of actors in networks and their position in their surrounding social network found by other scholars (e.g., Balkundi et al. 2009; Bodin et al. 2017; Chaudhury et al. 2017; Long et al. 2013). Thus, the thesis substantiates the role of network positions, brokerage, and the structural composition of social networks in shaping access to resources, influencing decision-making, and overall community adaptive capacity.

Fifth, the studies collectively illustrate that the dynamics of community cohesion, embeddedness, and the balance of interactions within networks have a substantial influence on shaping the effectiveness of resource mobilization and achieving adaptive outcomes. The results of the multivariate analysis of Chapter 7 show that the long-term contribution of local support is amplified by community cohesion and embeddedness (RQ 2). Cohesion and embeddedness increase the involvement of community members in joint activities and collaboration to achieve better adaptive outcomes (Chapter 11; RQ 6). Further, the

integration of community leaders into social networks influences their ability to mobilize network resources to respond to coastal flooding, as shown in detail in Chapter 11. One critical finding is that not only cohesion and participation within communities matters but also across communities. As such, competition for resources between communities has been identified as a major barrier to network mobilization in Semarang, affecting the overall effectiveness of collective action. These findings demonstrate that competition for resources between different communities present a barrier to adaptive strategies, an issue that is often only addressed implicitly by community adaptation studies (see Lubbers et al. 2020). Moreover, the results of Chapter 9 demonstrate less studied, semi-collective dynamics (see also Galstyan & Ambrosini 2022), where migrants may use their personal networks in their country of residence to amplify their support to family members in Indonesia, highlighting the importance of the embeddedness of migrants in networks both in their place of origin and place of residence. Hence, the thesis demonstrates the importance of embeddedness and cohesion within a community as an important factor in successfully mobilizing network resources to effectively respond to coastal hazards (see also Wei et al. 2019).

Sixth, the results presented in this thesis contribute empirical evidence to the theoretical discourse on the role of individual agency in adaptive capacity (see Cinner et al. 2018; Mortreux et al. 2020). The capacity of households to actively utilize their networks plays a crucial role in how effectively they can mobilize and use social capital for community and self-benefit, as highlighted by Chapter 7. Personal agency also plays an important role for migrants to decide whether or not certain support forms will be employed (Chapter 9). Finally, Chapter 11 highlights a reciprocal relationship between community leader agency and community agency: Engaged community leaders are vital to mobilizing communities for collective action, while at the same time, community agency influences participation in communal activities. By highlighting the importance of community leaders and household agency in leveraging social networks, the study builds on the notion that individual and collective agency or active engagement is a crucial mechanism for mobilizing social capital to respond to natural hazards and environmental change (Brown & Westaway 2011; Hudson et al. 2020; MacGillivray 2018).

Seventh, the thesis advances hazard research by analyzing support networks from the perspectives of both providers and receivers. Often, the dynamics between providers and receivers are overlooked in studies on social capital and hazards (see Dalgas 2018; Su & Le Dé 2021). This research shows the value of broadening the scope to include not only those directly impacted by natural disasters but also those in their extended networks who may not face the same risks (see Elliot et al. 2010). This approach enables a focused examination of social support mechanisms within these networks. The findings of the studies reveal the implicit norms governing behavior and highlight the insights of providers like family members and local leaders, contributing to the understanding of how social structures influence responses to natural hazards. Chapter 7 highlights a complex interaction between the attributes and actions of both support providers and recipients, emphasizing their combined effect on strengthening flood response mechanisms. The findings of Chapter 9 also give new insights into the provider perspective, demonstrating that socio-cultural expectations can influence the type and extent of social support for flooding. By capturing these perspectives, researchers can identify untapped resources such as local knowledge and skills, crucial for devising culturally appropriate adaptation strategies. This

integrated understanding significantly improves the effectiveness of solutions in coastal adaptation, ensuring more sustainable outcomes.

In sum, the thesis demonstrates that the structure and dynamics of social networks play a crucial role in enhancing communities' adaptive capacity to coastal hazards. It reveals that access to and effective utilization of social capital is fundamentally influenced by the organizational and functional aspects of both local and translocal networks. Key findings underline the importance of diverse social ties, network positions, and the central roles of community leaders and individual agency in mobilizing resources for adaptation. However, one has to keep in mind that social networks and the embedded social capital develop through everyday interaction of people and communities and are activated in times of emergency (Romankiewicz et al. 2016).

12.1.2. The influence of socio-spatial and institutional contexts on the formation and activation of social networks

A major contribution of the thesis is exploring the influence of the socio-spatial and institutional contexts of social networks and how these affect the formation and functioning of networks. The socio-spatial and institutional contexts are foundational to understanding how social networks function and evolve (see Carmen et al. 2022). The context of social networks not only determines their structural and dynamic aspects but also their capacity to enable adaptive responses among members. By shaping who participates in the network, how they interact, and the resources they can access, these contexts play a crucial role in the overall effectiveness of social networks in addressing the challenges of natural hazards and environmental change.

Factors of socio-spatial contexts that were identified by the studies include migration and mobility, socio-cultural factors, socio-economic status, hazard experiences, exposure and impact, and administrative and geographical boundaries. Chapter 7 has shown that migration is a principal driver of the formation of translocal networks, impacting social capital and network structure, confirming findings from translocality studies (Brickell & Datta 2016; Etzold 2016; Freitag & von Oppen 2010). Further, cultural norms and practices influence how networks form and operate, determining who interacts with whom and how. For example, the Minangkabau tradition of *Merantau* influences migration patterns in West Sumatra. Further, Chapter 9 points out several socio-spatial factors that influence the likelihood of migrants providing different types of translocal support (RQ 4), such as demographic and economic conditions, migration history, or knowledge about hazards. Chapter 11 also showed that the socio-economic status of communities will influence dynamics such as community participation in collective action or contributions to communal funding. These findings substantiate other studies that argued that socio-economic conditions shape networks, for example by determining access to translocal ties and the associated resources, influencing both the composition of networks and the nature of interactions within them (Bott et al. 2020; Rockenbauch et al. 2019; Su 2022). Next, exposure to hazards can lead to changes in network dynamics as communities adjust to individual and collective threats. For instance, the third study (Chapter 11) demonstrated that variation in exposure to coastal hazards impacts the risk

perception of the community, which in turn will affect their willingness to contribute to communal activities or further adaptive action. However, Chapter 9 finds that the type of natural disasters does not significantly change the kind of support given, suggesting that the intrinsic characteristics of social networks play a larger role in determining accessibility and utilization of social support. Finally, Chapter 11 clearly shows the effect of administrative boundaries as a barrier to network formation and function. Community networks in Semarang are largely determined by belonging to formal neighborhood structures, limiting opportunities for cross-community collaboration. Thus, the findings of the thesis underscore the profound influence of socio-spatial factors on the formation, function, and employment of social networks, demonstrating the added value of considering these contexts in hazard research.

The thesis highlights that studying the institutional context of social networks is crucial for hazard studies. Formal and informal institutions determine how rules, norms, and leadership within these networks influence the mobilization and distribution of resources necessary for effective community response and resilience building. Chapter 9 demonstrates how informal institutions such as norms, trust, reciprocity and shared expectations shape the utilization of social support by showing that network activation is often tied to socio-cultural expectations of the role migrants (RQ 4). Next, formal institutions such as policies and administrative frameworks can enable or restrict network activities, influencing how resources are distributed and how networks are mobilized (see Ceddia et al. 2017; Chaudhury et al. 2017; Cinner & Barnes 2019). As clearly shown in Chapter 11, highly formalized and restricted political and societal systems influence leadership effectiveness (RQ 6). The study also points out the importance of a cooperative relationship between community initiatives and government actions for successful adaptation planning (Baker et al. 2012; Measham et al. 2011). Chapter 11 explains the impact of both formal and informal organizations on a network's functionality and resource allocation. It details how hierarchical structures within a network affect decision-making and resource control. The thesis underscores the significant role of leadership within social networks in connecting individuals to broader institutional frameworks (see Atanga 2020; Bénit-Gbaffou & Katsaura 2014; Lamm et al. 2017). Leaders within networks can drive initiatives, mediate conflicts, and influence the strategic direction of the network. Also, the perceived legitimacy and reputation of network members can affect their influence and the trust others place in them, impacting network dynamics and potential for collective action. The empirical results of Chapter 11 show that community leaders in Semarang play a crucial role in helping their communities adapt to coastal hazards. Their importance is emphasized particularly in situations where financial and social resources are limited. These leaders are key to effective adaptation strategies due to their unique role within Java's administrative framework. The study also finds that the structure and dynamics of formal and informal social networks play a significant role in determining leaders' strategies, their accessibility to leadership roles, and whether they promote collaboration or competition. Thus, this analysis underscores the critical effect of formal and informal institutional frameworks in shaping network dynamics and the distribution of resources, highlighting their role in effective network mobilization and leadership within diverse organizational contexts.

In conclusion, the dissertation proposes an expanded and refined theoretical framework that accounts for the socio-spatial and institutional contexts in which social networks operate. This approach addresses a common critique of network research that is method-driven and often limited to descriptions

of network characteristics (Glückler & Panitz 2021). By doing so, it moves beyond a static and context-independent perspective that is still common in hazard studies, advocating for context-specific strategies that recognize the unique characteristics of social networks at different scales (see also Barnes et al. 2017; Carmen et al. 2022; Lubbers et al. 2020; Misra et al. 2017; Pachucki and Breiger, 2010). It enriches the empirical base of hazard studies but also expands the theoretical understanding of the relationship between adaptive capacity and social networks by including the interrelationship between network structure and dynamics as well as socio-spatial and institutional contexts. Integrating and applying social network theory in the context of disaster management and hazard research offers new insights and directions for future research in understanding the dynamics of social networks in enhancing adaptive capacity in diverse settings.

12.2. Policy implications

The research presented in the thesis has profound policy implications. These implications can be summarized through several key points:

First, the research findings advocate for the integration of social network analysis into the planning and implementation of disaster management and adaptation policies. Understanding the structure, dynamics, and potential of social networks can inform more inclusive, socially aware adaptation strategies that facilitate social capital within affected communities. Individual and collective agency is especially important in activating and utilizing social networks for adaptive purposes. Empowering people to help themselves necessitates policies that build capacities at the individual and community levels, enabling them to effectively mobilize and use their networks in times of need. This includes education, training, and the provision of resources to enhance people's ability to leverage their social capital.

Second, the distinct and complementary roles of local and translocal social networks in responding to coastal hazards underscore the necessity for policies that create the conditions for communities to develop and maintain these networks. The study on Indonesian migrants in Europe indicates the potential for diaspora communities to contribute significantly to their home communities' adaptation efforts. Policies should facilitate the formation and strengthening of local and translocal support networks for immediate disaster response and long-term adaptation strategies.

Third, the results show that the institutional context significantly shapes social networks' structure and effectiveness in natural hazard adaptation. Community leaders play a critical role in bridging top-down (institutional or governmental initiatives) and bottom-up (community-driven) approaches. They can facilitate the integration of external resources and policies with local needs and capacities. Policy implications include the need for targeted capacity-building programs for community leaders, enhancing their leadership skills, and integrating them more effectively into the planning and implementation of adaptation strategies. Providing community leaders with access to wider formal social networks and organizations can amplify their effectiveness in hazard response and adaptation planning.

Fourth, the results of the studies underscore the importance of socio-spatial and institutional contexts in shaping the effectiveness of social networks and community leaders in adaptive capacity. This suggests

that adaptation policies and strategies need to be context-specific, acknowledging the unique characteristics of each community's social, spatial, and institutional settings. Policies should be adaptive, allowing for local customization and innovation, rather than adopting a one-size-fits-all approach.

Fifth, highlighting the importance of cooperative relationships between community initiatives and government actions for successful adaptation planning indicates a need for policies that promote collaboration across different levels of governance. Such policies could facilitate the sharing of resources, knowledge exchange, and joint planning efforts, ensuring that community-led initiatives are supported and scaled up through governmental and institutional mechanisms.

Sixth, while social networks can be powerful tools for adaptation, they can also exacerbate social exclusions and inequalities. Some individuals or groups may be better connected than others, leading to uneven access to information, resources, and support. Policies should aim to address these disparities by fostering more equitable and inclusive networks, ensuring that vulnerable and marginalized groups are not left behind. This can be achieved through targeted outreach programs, inclusive community planning processes, and efforts to bridge gaps between different social groups.

Finally, dependence on social networks in times of crisis can lead to network overload, where the demand for support exceeds the network's capacity to provide it. This highlights the need for policies that balance reliance on social networks with the development and maintenance of formal support systems and institutional responses. Ensuring that communities have access to robust, formal disaster response and adaptation resources can help prevent network overload and ensure a sustainable approach to managing natural hazards.

12.3. Limitations and outlook for further research

The dissertation adds significant empirical and theoretical contributions to understanding how social networks influence the adaptive capacity of coastal communities facing natural hazards. However, like all research, this study has potential limitations that could be addressed in further research. Below, these limitations are outlined and directions for future research are proposed.

First, the dissertation examines specific urban areas in Indonesia – Padang, Denpasar, and Semarang – and Indonesian migrant communities in Europe, using a case study approach. While this method provides an in-depth analysis of the chosen areas, the determining factors of social network structure and dynamics may be context-specific and limit the generalizability of the specific findings. However, the findings may still hold relevance in similar contexts, particularly within the Global South, where socio-economic and institutional conditions are comparable to those of the selected study areas. On top of that, social network structures and dynamics are fundamental elements of human interactions and, therefore, offer insights that extend and can be applied beyond the specific geographic and cultural settings examined.

Second, the main focus of the presented research is on the relationship between social networks and community adaptive capacity. While this thesis aimed to include external and contextual factors of social

networks such as the socio-spatial and institutional contexts, there may be additional critical factors affecting adaptive capacity that were beyond the scope of this thesis. For instance, individual learning methods such as observation and experimentation also play a vital role in adaptation and often take place independent of social interactions (Glückler & Panitz 2021). Accordingly, adaptation processes are complex and cannot be fully explained solely through the analysis of relationship structures within social networks.

Third, the studies were conducted using a cross-sectional design and, therefore, are not able to capture the changes in social networks and adaptive strategies over time. The importance of considering the temporal dynamics of social networks is mentioned in the literature (Lubbers et al. 2020). Although the research investigates network dynamics, it might not fully capture the complexity of how these networks are established, maintained, or disrupted over time, particularly in response to recurring or evolving natural hazards. Longitudinal studies could provide more insight into how support networks evolve, especially in response to repeated or changing exposure to hazards.

Fourth, the three studies presented some methodological limitations. Specifically, in the first study, the reported flood-related support networks were notably small, which hindered the application of quantitative formal social network analysis techniques the calculate typical network measures such as density, centrality, and betweenness among members (see Borgatti et al. 2018). These metrics are used for the quantitative evaluation of the structure and efficacy of social networks. Additionally, social science research always harbors the risk of response bias. For instance, respondents might overstate the effectiveness of their networks to align with socially desirable responses, or conversely, underreport issues due to privacy concerns or cultural norms that discourage open sharing of negative experiences.

Fifth, the main focus of this thesis was on interpersonal and positive ties. Social network research often focuses on existing, positive, informal, and durable interpersonal ties. Accordingly, relationships that are absent, negative, formal, or transitory are often neglected (Lubbers et al. 2020). Despite the significant impact of negative ties on social dynamics, they remain a relatively understudied area within social network research. This neglect is related to various reasons, including the complexity of measuring and analyzing negative relationships as well as a historical focus on positive aspects of social connections (see Harrigan et al. 2020). Nonetheless, future research should strive to address this research gap.

Finally, the primary objective of this thesis was to investigate the contribution of social networks and social capital to enhancing community adaptive capacity. However, it is important to note, that high adaptive capacity does not inherently lead to successful adaptation outcomes (see Mortreux et al. 2020). This distinction highlights a significant research gap: the empirical link between the structures and dynamics of social networks and the actual adaptation outcomes within communities. Future research should focus on addressing this gap, providing detailed analyses that connect structural aspects and dynamics of social networks directly to tangible adaptation results in diverse community settings.

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Appendix A: Supplementary materials

Household survey questionnaire Padang and Denpasar

Introduction

(1) I am [name], I am a student at [name of university]. I would like to ask you some questions about your RW/Dusun/Banjar and natural hazards such as flooding. **(DPS: Dusun/Banjar; PDG: RW)**

(2) Do you live at least 5 years in this RW/Dusun/Banjar and have you been affected by floods (due to tides, rain, and/or river overflows) while living here? If yes, I would be more than happy about your important help with this survey. As a resident of this area, the questions will be easy for you to answer. It will take about 60 minutes.

(3) All comments and responses are anonymous and will be treated confidentially. The purpose is purely academic. If you don't feel fine answering some of the questions, feel free to leave them out. We hope that you participate in this survey and help us with your answers.

(4) May I proceed with the questionnaire?

A. Observation

NOT to be asked! Please fill out all the questions.

1.1.1. Interviewer ID *(Interviewer name or ID)*

DENPASAR (DPS)	PADANG (PDG)	
1. Alpredo C. Sitompul (ALP)	1. Aesya N. Avrila (AES)	10. Muhammad Taufik (MTA)
2. Helena Tampubolon (HEL)	2. Affan N. Muharram (AFF)	11. Natasyah Febriani (NAT)
3. Hernanda P. E. Sari (HER)	3. Bagus P. Dewantara (BAG)	12. Nisa Fitrianingsih (NIS)
4. Merrys A. R. Malau (MER)	4. Bambang Hermanto (BAM)	13. Rani Reviona (RAN)
5. Nanda Marpaung (NAN)	5. Bayu Akbar (BAY)	14. Rhagel Anugrah (RHA)
6. Paula N. T. Adi (PAU)	6. Dewi Sartika (DEW)	15. Siti Khofifah (SIT)
7. Pranata H. Panjaitan (PRA)	7. Diana Efendi (DIA)	16. Thuba I. Fauzi (THU)
8. Roses W. R. Br. Matondang (ROS)	8. Mayang A. Pertiwi (MAY)	17. Tira Mutiara (TIR)
	9. M. Raihan Al Faruq (MRA)	18. Zaki Mubarok (ZAK)

1.1.2. NR. of Interview *Example:* ***A01*** *=* ***A*** *(team code) +* ***01*** *(number of respondent) (without space)* DPS Team Code: A (HER, PAU) B (NAN, PRA) C (ALP, ROS) D (HEL, MER)	PDG Team Code: A (NIS, THU) B (MTA, RAN) C (AFF, BAM) D (AES, MAY) E (DEW, TIR)	 F (BAG, BAY) G (DIA, NAT) H (MRA, ZAK) I (RHA, SIT)
1.1.3. GPS long x, GPS long y		
1.1.4. Kelurahan		
1.1.5. RW/Dusun/Banjar		
1.1.6. RT		*not applicable for Denpasar*
1.1.7. Date of interview		
1.1.8. Time started		
1.1.9. Time finished		
1.1.10. Sex of respondent *(single choice)*		1 Male 2 Female

B. Basic household information

Thank you very much for participating in our survey. In the first part, we would like to ask you some general questions about your household.

2.1.1. In total, how many people, including yourself, are living in your household?	*only numbers* Household members = people that sleep and eat a minimum of 180 days per year in one house
2.1.2. Of those, how many members of your household are children? (under 18 years old)	*only numbers*
2.1.3. How old are you? (years)	*only numbers*
2.1.4. How long does your household live in this Kelurahan? (years)	*only numbers*
2.1.5 What is your place of birth?	1 This kelurahan *(born here, go to 2.17)* 2 This city *(born here, go to 2.17)* 3 Other city/village in this province, please specify 4 Other province outside this province, please specify (province, island) 5 Other city in other country, please specify (city, country)

2.1.6. If you were not born here, why did you move here?	1 Job offer/opportunities 2 Education/training/gain expertise in special field 3 Marriage/family reunion 4 Expand personal horizon 7 To be safe from natural disasters (e.g. flooding, earthquakes, etc.) 8 To improve support for family / household 7 To improve support for community 90 Other, please specify
2.1.7. Have some from today's household members come to live in your household from other places?	0 No *(go to 2.1.11)* 1 Yes
2.1.8. If yes: How many new members?	*only numbers*
2.1.9. If they were not born as members of your household, why did they join?	1 Job offer/opportunities 2 Education/training/gain expertise in special field 3 Marriage/family reunion 4 Expand personal horizon 5 To be safe from natural disasters (e.g. flooding, earthquakes, etc.) 6 To improve support for family / household 7 To improve support for community 90 Other, please specify
2.1.10. Where were they born?	1 This city 2 Other city/village in this province, please specify 3 Other province outside this province, please specify (province, island) 4 Other city in other country, please specify (city, country)
2.1.11. In the last 5 years, did any household members leave the household and migrate to another place?	0 No, If no, proceed with question 2.1.15 1 Yes
2.1.12. If yes: How many members left?	
2.1.13. Is their migration permanent or temporary?	1 Permanent 2 Temporary 3 Not clear yet 90 Other, please specify
2.1.14. What was/were the main reason(s) for them to migrate?	1 Job offer/opportunities 2 Education/training/gain expertise in special field 3 Marriage/family reunion 4 Expand personal horizon 5 To be safe from natural disasters (e.g. flooding, earthquakes, etc.) 6 To improve support of family / household

	7 To improve support of community 90 Other, please specify
2.1.15. What is the highest level of formal education in your household?	1 Never attended school 2 Preschool 3 Primary school 4 Secondary school 5 Tertiary education (college or university)
2.1.16. What is your religion?	1 Islam 2 Catholicism 3 Protestantism 4 Hinduism 5 Buddhism 6 Confucianism 7 Atheism 90 Other, please specify
2.1.17. What is your ethnic group?	1 Javanese 2 Sundanese 3 Malay 4 Batak 5 Madurese 6 Betawi 7 Minang 8 Buginese 9 Bantenese 10 Banjarese 11 Balinese 12 Acehnese 13 Dayak 14 Sasak 15 Chinese 16 Makassarese 17 Moluccans 18 Papuan 90 Other, please specify
2.1.18. Do household members belong to another ethnic group than yours? If yes, which?	0 None 1 Javanese 2 Sundanese 3 Malay 4 Batak 5 Madurese 6 Betawi 7 Minang 8 Buginese 9 Bantenese 10 Banjarese 11 Balinese 12 Acehnese 13 Dayak 14 Sasak 15 Chinese 16 Makassarese 17 Moluccans 18 Papuan 90 Other, please specify
2.1.19. Are you the main earner of of this household?	0 No 1 Yes

2.1.20. What is the (main) sector of occupation of the main earner?	1 Farmer 2 Fish farmer/ fisherman 3 (agricultural/fish) production/industry 4 trade of agricultural goods/fish 5 trade of other things/sales 6 construction 7 craftswoman/-man 8 own small business (kiosk/warung)) 9 factory worker 10 security services 11 other services 12 employed by/ working for (local/city) 13 government/ civil servant head of Kelurahan or higher/politician 14 hospitality & tourism 90 Other, please specify
2.1.21. What is the occupational form of the main earner?	5 Daily labourer 6 Employed 7 Self-employed 90 Other, please specify
2.1.22. How many household members, including you, contribute regularly to the household income?	

2.1.23. Did household members hold any of the following leadership positions in the last 5 years?	0 None, not applicable for Denpasar 1 Head of RT 2 Head of RW 3 Head of Kelurahan 4 Head of Dusun/Banjar *(only applicable for Denpasar)* 5 Head of LPMK 6 Head of PKK 7 Head of workers' associations 8 Head of Karangtaruna 9 (Community) project leader, e.g. mangrove or hazard management 90 Other, please specify, Add option "No" = 0
2.1.24. Does your household have a health insurance?	0 No 1 Yes
2.2.1. What is your household's average monthly income? (IDR per month)	*(only numbers; this includes all types of income that the household receives regularly such as income from work, rent, gov. funds, remittances, etc.)*
2.2.2. I apologize for the possible inconvenience this question might cause - does your household have more than 15 million IDR in savings?	0 No 1 Yes
2.2.3. Do you have a bank account?	0 No 1 Yes
2.2.4. The ownership status of your house is…	1 owned and completely paid for (incl. inheritance) 2 owned with a mortgage 3 rented 4 given in exchange for services 5 squatter 90 Other, please specify

2.2.5. Does your household receive any government funds or subsidies regularly? (examples: money for people who live under the poverty line, etc.)	0 No 1 Yes

C. Experience in dealing with floods and other natural disasters

Thank you for your answers. In the next part, we want to ask you some questions about your experiences with different types of floods and natural hazards in your neighbourhood. We are interested in the last 5 years.

3.1.1. Which of the following events affected your household* negatively** in the last 5 years?	1 Covid-19 2 Sickness (not Covid-19) 3 Death 4 Job loss

* Household members = people that sleep and eat a minimum of 180 days per year in one house ** financial / material losses, physical or mental harm	5 6 7 8 9 10 11 12 13 90	(forced) Relocation of household River flooding (caused by river overflow) Rain flooding (caused by (heavy) rainfall and storm surges) Tidal flooding (caused by the tides) Coastal erosion Land subsidence Earthquake Tsunami Storm surges Other, please specify
3.1.2. In the last 5 years, how often did tidal floods inundate the road in front of your house?	1 2 3 4 5 6 7	(almost) daily through high tides (almost) daily during the monsoon season weekly to monthly a couple of times per year approx. once a year every 2-3 years never
3.1.3. In the last 5 years, how often did river floods inundate the road in front of your house?	1 2 3 4 5 6 7	(almost) daily through high tides (almost) daily during the monsoon season weekly to monthly a couple of times per year approx. once a year every 2-3 years never
3.1.4. In the last 5 years, how often did rain floods inundate the road in front of your house?	1 2 3 4 5 6 7	(almost) daily through high tides (almost) daily during the monsoon season weekly to monthly a couple of times per year approx. once a year every 2-3 years never

3.1.5. When does your house get flooded?	1 2 3 4 5 6	every time the road in front gets flooded if the road in front is flooded ankle deep if the road in front is flooded knee-deep if the road in front is flooded hip-deep only in cases of extreme high flood never
3.1.6. How many hours do floods generally last? (hours)	*Not necessarily floods that affected house, road in front is also acceptable*	

3.1.7. In the last 5 years, how high did the water on average stand on the road in front of your house?	1 no water 2 ankle high 3 knee high 4 hip high 5 chest high 6 higher than chest high
3.1.8. In the last 5 years, how high did the water at most stand on the road in front of your house?	1 no water 2 ankle high 3 knee high 4 hip high 5 chest high 6 higher than chest high
3.1.9. In the last 5 years, how high did the water at most stand in your house?	1 no water 2 ankle high 3 knee high 4 hip high 5 chest high 6 higher than chest high
3.1.10. Have floods ever led to blackouts in your house?	1 never 2 once 3 every few years 4 once a year 5 every few months 6 once a month 7 (almost) daily 8 every time flood happens
3.1.11. How often have important facilities in the area been closed due to floods? (e.g., schools, medical centers, gas stations, government offices, markets, etc.)	1 never 2 once 3 every few years 4 yearly 5 every few months 6 monthly 7 constantly
3.1.12. How often did your household have to evacuate because of floods?	1 Never *(go to 3.1.14)* 2 once 3 every few years 4 yearly 5 every few months 6 monthly
3.1.13. If yes: when was the last time? (year)	
3.1.14. Did floods affect the income job situation of the household?	1 Strongly disagree 2 Disagree 3 Agree 4 Strongly agree
3.1.15. Did floods cause financial or material losses for the household?	1 Strongly disagree 2 Disagree 3 Agree 4 Strongly agree
3.1.16. Did floods cause panic, trauma, anxiety or other negative impacts to your mental health or the mental health of other household members?	1 Strongly disagree 2 Disagree 3 Agree 4 Strongly agree
3.1.17. Did floods impact the physical health of your household members?	1 Strongly disagree 2 Disagree 3 Agree 4 Strongly agree
3.1.18. How much money do you save per month to afford private flood protection of your house? (IDR per month)	*If they don't save, answer is 0*
3.1.19. Has it become more difficult for you to pay for flood protection during the last 5 years?	1 Strongly disagree 2 Disagree 3 Agree 4 Strongly agree

3.2.1. What do you think, how often will river floods happen in the future?	1 less often		2 more or less same frequency		3 more often
3.2.2. What do you think, how strong will river floods be in the future?	1 less flood water		2 more or less same amount of water		3 more flood water
3.2.3. What do you think, how much will it be raining in the future?	1 less rain		2 more or less same		3 more rain
3.2.4. What do you think, how high will tides be in the future?	1 lower tides		2 more or less same		3 higher tides
3.2.5. Have you heard of the term "sea level rise"?	0 No *(go to question 4.1.1.)* 1 Yes				
3.2.6. If yes, where did you hear it?	1 Media (Internet, TV, Radio..) 2 Friends or family members from the same Kelurahan 3 other people from the same Kelurahan 4 head of RW/RT 5 friends or family members from other residence place 6 NGOs 7 (university) researchers 8 politicians 9 government agencies 90 other, please specify				
3.2.7. Do you think sea level rise is a threat to your household?	1 Strongly disagree	2 Disagree	3 Neither agree nor disagree	4 Agree	5 Strongly agree

D. Responses to floods

In this part, we want to ask some questions about how your household responds to floods

4.1.1. What does your household buy or do to be prepared before strong floods happen?
(strong or heavy floods will have some kind of impact on household activities)

0 nothing in particular
1 Store food, drinking water
2 stock medicine
3 preventive medical treatment (vaccination)
4 store fuel for pumping system
5 Invest in social contacts (networks, associations, reciprocal gifts, etc.) so you give and receive help
6 store sandbags
7 store construction materials like bricks, stones, cement
8 save money
90 other, please specify

4.1.2. What do you do during strong floods that affect your house?

0 Nothing in particular
1 Stay in the house if possible and protect belongings (e.g. build sandbag walls, pump water, etc.)
2 Help other community members (e.g. cook food, protect other people's houses, etc.)
3 evacuate to friends/family/emergency shelter
90 other, please specify

4.1.3. What did you do to maintain and protect your house and belongings after you were affected by a strong flood?

0 Nothing in particular
1 Clean house
2 Repair house
3 Rebuild house on piers, pillars or columns
4 sleep on bed instead of floor
5 build elevated shelves etc. to store things
6 build higher house threshold
7 cover house floor with ceramic tiles
8 build drainage channels or foundation vents
9 build (small) concrete wall around the house
10 install a private pumping system
11 elevate house
90 other, please specify

4.1.4. For which communal measures for your RT/RW/Dusun did members of your household spend time or money in the last 5 years to reduce the impact of flooding?

0 No
1 Build/ improve/repair permanent embankments
2 Build/improve/repair riverbank or shoreline stabilization
3 build/improve/repair pumping station for neighborhood
4 clean / widen nearby river / remove obstacles from riverbed
5 build/improve/repair communal drainage systems (e.g. ditch cleaning/deepening)
6 build/ improve/repair retention basins
7 collective savings system for emergency situations
8 send a petition to the local government for funding and support
9 elevate the road
10 elevate important facilities like schools
11 plant mangroves or other vegetation (wetland restoration), (wetland restoration)
12 attend special community meetings for dealing with flood
90 other, please specify

4.1.5. in the last 5 years, did you do anything new against floods? (new protection methods, new materials, etc.)

0 No *(go to question 4.1.9)* 1 Yes

(Only asked if the answer to 4.1.5. is "Yes")	**Measure 1**	**Measure 2**	**Measure 3**	**Measure *n***
4.1.6. if yes, please specify				
4.1.7. If there are new measures, are the new measures more efficient/ do they last longer than older measures? *(answer for each measure mentioned)* 0 No 1 Yes				
4.1.8. If there are new measures, where did you get the idea from? *(answer for each measure mentioned)* 1 Own idea 2 relatives/friends from your kelurahan 3 other people from your kelurahan 4 Community meetings (RT/RW/Dusun/Banjar/PKK,etc.) 5 people who moved to the kelurahan 6 relatives/friends from other places 7 employer 8 landlord 9 government agencies 10 NGO/volunteers 11 (University) researchers 12 patronage/politician 13 companies/CSR 14 media 90 other, please specify				

4.1.9. How long in advance do you usually know that floods will come?	1 I don't know in advance *(go to question 4.1.11)* 2 only minutes before 3 approx. 1 hour before 4 between 1 to 5 hours before 5 more than 5 hours before
4.1.10. How do you usually know that floods will come?	1 using tide tables 2 weather forecasts in the media 3 rapid alert system/early warning system 4 through the head of RT/RW 5 through other community leaders 6 through people from my neighborhood 7 through whatsapp/ social media 8 own experience 90 other, please specify
4.1.11. Is your household planning to relocate because of floods in the next 5 years?	0 No *(go to question 4.1.13)* 1 Yes

---

4.1.12. If yes, where would you go? (City/ village and/or kelurahan)	1 Within same kelurahan 2 A different kelurahan within the city, please specify 3 Other city in this province, please specify 4 Other city in other province, please specify 5 Other country, please specify

4.1.13. If no, why not?	1 Cannot afford it 2 Don't want to lose social community 3 Need to be close to working place 4 Floods are not a major problem for our household 90 other, please specify

E. Supports and social networks

In this part, we want to know more about the people whose support can help you respond to floods better

5.1.0.a. From time to time, most people discuss their daily affairs with other people. Looking back over the last 6 months, how many people outside of your household have you discussed your daily affairs with regularly?	*Examples of daily affairs: finance, health, family, business, etc.*
5.1.0.b. Of the people you discuss important personal matters with regularly, how many of them live outside of this city?	
5.1.0.c. Of the people you discuss daily affairs with regularly, with whom have you discussed flood-related matters in the past? Please just tell me their first names or initials.	*(Respondents can name up to 10 people. Respondents should personally know the contacts they mention, if they do not know the name, they are not acquainted enough for this question. Also, If respondent named less than 10 contacts, please ask them again if they can think of anyone else.0*

LIST OF CONTACTS 1–10

The table below can be filled as a reference, how to address contacts, while asking questions 5.1.1 to 5.4.1

Contact-id	**5.1.1. First Name/Contact Initials** *(First line, gray = interview number)*				
Contact 1					
Contact 2					
Contact 3					
Contact 4					
Contact 5					
Contact 6					
Contact 7					
Contact 8					
Contact 9					
Contact 10					

Information on socioeconomic contacts and closeness to respondents	Contact 1	Contact 2	Contact 3	Contact *n*
5.2.1. How old is [Contact X]? (years)				
5.2.2. What sex is [Contact X]? 1 Male 2 Female				
5.2.3. Where is [Contact X]'s place of residence? 1 This kelurahan 2 This city 3 Other city/village in this province, please specify 4 Other province outside this province, please specify (province, island) 5 Other city in other country, please specify (city, country)				
5.2.4. What is [Contact x]'s level of education? 1 lower than our household 2 same as our household 3 higher than our household				
5.2.6. Did [Contact X] hold any (community) leadership positions in the last 5 years such as head of RT/RW/ Dusun/Banjar/PKK or similar? 0 No 1 Yes				
5.2.7. What is your relationship with [Contact X]? 1 family/relative 2 neighbor/community member 3 work colleague 4 friend 90 other, please specify				
5.2.8. How long have you known [Contact X]? 1 less than a year 2 1-5 years 3 5-10 years 4 10-20 years 5 more than 20 years				
5.2.9. How often are you in contact with [Contact X]? 1 Daily 2 weekly 3 monthly 4 every few months 5 once a year 6 less than once a year				
5.2.10. How would you describe your relationship with [Contact X]? 1 very close 2 close 3 not close				
*5.2.11. How many contacts did the respondent just mentioned?				

5.3.1. Of the people you just named, who would you ask for help if your household was affected by flooding?	0	None of the people I named	6	Contact 6
	1	Contact 1	7	Contact 7
	2	Contact 2	8	Contact 8
	3	Contact 3	9	Contact 9
	4	Contact 4	10	Contact 10
	5	Contact 5		
5.3.2. Of the people you just named, who would provide emotional/moral support for your household when you are dealing with flooding?	0	None of the people I named	6	Contact 6
	1	Contact 1	7	Contact 7
	2	Contact 2	8	Contact 8
	3	Contact 3	9	Contact 9
	4	Contact 4	10	Contact 10
	5	Contact 5		
5.3.3. Of the people you just named, who would provide financial or material support for your household when you are dealing with flooding? e.g. money, food, clothes, other goods	0	None of the people I named	6	Contact 6
	1	Contact 1	7	Contact 7
	2	Contact 2	8	Contact 8
	3	Contact 3	9	Contact 9
	4	Contact 4	10	Contact 10
	5	Contact 5		
5.3.4. Of the people you just named, who has shared knowledge, given you advice, or taught you new skills on how to deal with floods? (if no, go to question 5.3.6.)	0	None of the people I named	6	Contact 6
	1	Contact 1	7	Contact 7
	2	Contact 2	8	Contact 8
	3	Contact 3	9	Contact 9
	4	Contact 4	10	Contact 10
	5	Contact 5		
5.3.5. if yes, what skills/knowledge?				
5.3.6. Of the people you named, who would visit you to provide practical support when your household is dealing with flooding?	0	None of the people I named	6	Contact 6
	1	Contact 1	7	Contact 7
	2	Contact 2	8	Contact 8
	3	Contact 3	9	Contact 9
	4	Contact 4	10	Contact 10
	5	Contact 5		
5.3.7. Of the people you named, with whom has your household discussed strategies to reduce the impact of flooding?	0	None of the people I named	6	Contact 6
	1	Contact 1	7	Contact 7
	2	Contact 2	8	Contact 8
	3	Contact 3	9	Contact 9
	4	Contact 4	10	Contact 10
	5	Contact 5		

5.3.8. Of the people you named, who has connections to influential people or other social connections that are helpful to your household when dealing with flooding?	0	None of the people I named	6	Contact 6
	1	Contact 1	7	Contact 7
	2	Contact 2	8	Contact 8
	3	Contact 3	9	Contact 9
	4	Contact 4	10	Contact 10
	5	Contact 5		
5.3.9. Of the people you named, who's support helped to improve your households response towards flooding in the long-term?	0	None of the people I named	6	Contact 6
	1	Contact 1	7	Contact 7
	2	Contact 2	8	Contact 8
	3	Contact 3	9	Contact 9
	4	Contact 4	10	Contact 10
	5	Contact 5		

5.4.1. How would describe the relationship between the people you named? *Are XX and YY very close (1), close (2), not close (3), or do they not know each other at all (4)?*	1 *very close* 2 *close* 3 *not close* 4 *do they not know each other at all*

	Contact 1	*Contact 2*	*Contact 3*	*Contact 4*	*Contact 5*	*Contact 6*	*Contact 7*	*Contact 8*	*Contact 9*	*Contact 10*
Contact 1		1*								
Contact 2										
Contact 3										
Contact 4										
Contact 5										
Contact 6										
Contact 7										
Contact 8										
Contact 9										
Contact 10										

Note: gray cells are not filled in, white cells are filled 1, 2, 3, or 4

**Example: If Contact 1 knows very closely with Contact 2, then fill it with 1*

(5.5.1. - 5.6.6. The following questions are not limited to the people you named)	
5.5.1. Where does the largest number of your relatives live?	1 This kelurahan 2 This city 3 Other cities/villages in this province, please specify 4 Other province in Indonesia, please specify 5 (province, island) In other countries, please specify (cities, countries)
5.6.1. Do you own or have regular access to a…	0 No 1 Basic mobile phone / Landline telephone 2 Smartphone / tablet computer 3 Laptop/ personal computer(PC)

5.6.2. Do you have access or use … regularly?	0 No 1 Internet 2 Skype, Zoom etc. 3 Social Media (Facebook, Instagram, etc.) 4 Text Messaging (e.g. SMS/ Whatsapp)
5.6.3. Do you receive money from people from outside your city?	0 No 1 Only during emergencies (sickness, disasters) 2 Only for special occasions (birthdays, weddings, etc.) 3 Occasionally 4 Regularly
5.6.4. Do you send money to people from outside your city?	0 No 1 Only during emergencies (sickness, disasters) 2 Only for special occasions (birthdays, weddings, etc.) 3 Occasionally 4 Regularly
5.6.5. Other than the people you named earlier, who would you ask for advice on flood protection?	0 No 1 head of RW/RT/Dusun/Banjar 2 RT/RW/Dusun/Banjar or PKK meeting 3 other community leaders 4 employer/landlord 5 Universities/researchers/ student groups 6 NGOs 7 Government organizations
5.6.6. In the last 5 years, have you made a personal contact with someone in a position of power with important connections that go far beyond the borders of this kelurahan such as a politician, entrepreneur or religious leader? 0 No 1 Yes	

F. Participation in community activities

In this part, we want to learn more about life in your community / neighborhood

6.1.1. Do any household members attend the following meetings regularly?	0 No 1 RT (meeting) *(not applicable for Denpasar)* 2 RW (meeting) 3 PKK (meeting) 4 Dusun/Banjar (meeting) 5 LPMK (meeting) 6 Arisan meeting 7 work association (e.g. for fisher, farmer, factory workers, etc.) 8 youth organization (Karang taruna) 9 political group 10 sports group 11 religious group 90 other, please specify

6.1.3. Which meeting is the most important to your household concerning flood responses / protection? (not applicable for Denpasar)	0	None
	1	RT (meeting) *(not applicable for Denpasar)*
	2	RW (meeting)
	3	PKK (meeting)
	4	Dusun/Banjar (meeting)
	5	LPMK (meeting)
	6	Arisan meeting
	7	work association (e.g. for fisher, farmer, factory workers, etc.)
	8	youth organization (Karang taruna)
	9	political group
	10	sports group
	11	religious group
	90	other, please specify

6.1.4. Have you or your household members acquired new skills or learned something valuable on these meetings concerning flood responses /protection? 0 No, *(go to question 6.1.6)* 1 Yes		
6.1.5. If yes, what new skills did you learn? *(If yes, what new skills/something valuable did you learn?)*		
6.1.6. Are there meetings you would like to attend, but are not invited to?	0	No, if no, go to question 6.1.8
	1	Yes
6.1.7. If yes: which ones?	1	RT (meeting) *(not applicable for Denpasar)*
	2	RW (meeting)
	3	PKK (meeting)
	4	Dusun/Banjar (meeting)
	5	LPMK (meeting)
	6	Arisan meeting
	7	work association (e.g. for fisher, farmer, factory workers, etc.)
	8	youth organization (Karang taruna)
	9	political group
	10	sports group
	11	religious group
	90	other, please specify
6.1.8. In the last 5 years, have you actively participated in an information campaign concerning environmental issues or natural hazards like floods?	0	No
	1	Yes
6.1.15. Do you contribute to any of the following community funds regularly?	0	No
	1	RT/RW/ meeting savings
	2	Dusun/Banjar funds
	3	PKK funds
	4	Arisan
	5	Other, please specify

6.1.9. Does your household have access to the following communal funds?	0	No
	1	RT/RW/ meeting savings
	2	Dusun/Banjar funds
	3	PKK funds
	4	Arisan
	5	Other, please specify
6.1.10. If flooding affected the entire RW/Dusun/Banjar who would mainly deal with the situation?	1	Each household would deal with it individually
	2	neighbors among themselves
	3	local government/municipal political leaders
	4	Heads of RT/RW
	5	Heads of Dusun/Banjar
	6	Head of LPMK
	7	The entire Kelurahan collectively
	90	other, please specify
6.1.11. Do you think that the people living in your RW/Dusun/Banjar are similar concerning their profession, wealth, education level, religious beliefs, ethnic background and social status?	1	Strongly disagree
	2	Disagree
	3	Neither agree nor disagree
	4	Agree
	5	Strongly agree
6.1.12. How is the level of trust among community members in your RW/Dusun/Banjar?	1	very low
	2	low
	3	mediate
	4	high
	5	very high
6.1.13. Overall, how would you rate the degree of communal participation in this RW/Dusun/Banjar?	1	very low
	2	low
	3	high
	4	very high
6.1.14. How much influence does your household have to make this RW/Dusun/Banjar safer from flooding	1	no influence
	2	not much influence
	3	some influence
	4	substantial influence

G. COVID-19 impact

In the last part, we want to ask a few questions about Covid-19 and its impact on your life)

7.1.1. How has the communication with your contacts outside of your neighborhood changed since the COVID-19 pandemic started? previously mentioned contacts?				
1	2	3	4	5
Decrease greatly	Decrease slightly	Stay the same	Increase slightly	Increase greatly
7.1.2. How has your household's participation in community meetings (RT/RW/PKK, etc.) changed since the COVID-19 pandemic started?				
1	2	3	4	5
Decrease greatly	Decrease slightly	Stay the same	Increase slightly	Increase greatly

7.1.3. How has your household's activity in neighborhood/community organizations (RT/RW/Dusun/Banjar/PKK etc.) changed since the COVID-19 pandemic has started?				
1	2	3	4	5
Decrease greatly	Decrease slightly	Stay the same	Increase slightly	Increase greatly
7.2.1. How has your household's financial situation changed because of the COVID-19 pandemic?				
1	2	3	4	5
Decrease greatly	Decrease slightly	Stay the same	Improved slightly	Improved greatly
7.3.1. How have the remittances your household receives changed since the COVID-19 pandemic started?				
1	2	3	4	5
Decrease greatly	Decrease slightly	Stay the same	Increase slightly	Increase greatly
7.4.1. Do you think that your household has sufficient capacities to deal with the COVID-19 pandemic on your own?				
1	2	3	4	5
Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
7.4.2. Do you think that the COVID-19 pandemic has negatively affected the ability of your household to deal with the impact of flooding?				
1	2	3	4	5
Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

Interview guidelines Indonesian migrants in Europe

Introduction

Thank you for taking the time to participate in this study of the University of Cologne. Our research project deals with environmental hazards and changes in Indonesia. These include sea level rise and climate change, coastal erosion, flooding, land subsidence, earthquakes, tsunamis, volcanic eruptions, and environmental pollution. We research how Indonesian households and communities deal with these hazards and changes. In particular, we are interested in the role of social contacts of affected households and communities. Our project focuses on Indonesians living in the European Union. We are particularly interested in how Indonesians abroad can support their families, friends, and acquaintances in Indonesia in dealing with environmental hazards and changes.

The interview will take approximately 60 minutes.

Everything said during the interview will be handled anonymously. With your permission, we would like to record this interview to facilitate the subsequent analysis.

Block 1: Experiences with and responses towards natural disasters and hazards (sea level rise and climate change, coastal erosion, flooding, land subsidence, earthquakes, tsunamis, volcanic eruptions and environmental pollution)

Questions:

- Please tell me about your personal experiences with natural disasters or hazards in Indonesia
    - If yes: What kind? How often? Memorable event?
    - How did you deal with it?
- To what extent are your family members in Indonesia affected by natural disasters / hazards?
    - If yes: What kind? How often? Memorable event?
    - How do they deal with it?
    - What role do you play in their response to these hazards?
- Have you experienced or heard about natural hazards /disasters in your current place of residence?
    - Did you notice any differences in how the countries and their people deal with environmental hazards like floods, climate change, or environmental pollution?
- Do you think your perception of natural disasters and hazards changed since you moved abroad?
    - Have you learned anything new or different about environmental issues or adaptation in GER / NL since you migrated?

Block 2: Migration background

Questions:

- What was the main reason / motivation for you to migrate? (work, marriage, education...)
    - Was there a particular reason to come to GER or NL and not another place?
- How long do you plan to stay here?
    - *If stay is temporary*: What do you plan to do after your stay in Germany / the Netherlands?

Block 3: Network in Indonesia

Questions:

- What did your move abroad mean to your family members in Indonesia?
    - Expectations?
- How would you describe the relationship with your family members in Indonesia?
    - Did your relationship with family members change since you moved abroad?
- Do you help or support your family in Indonesia? Do you receive support?
    - What kind of support? Financial, knowledge, etc.

Block 4: Network in host country

Questions:

- How would you describe your social network in your place of residence?
    - Did you know people in your current place of residence before you came here?
- How would you describe the Indonesian community / diaspora in your place of residence?
    - What is special about living in your place of residence compared to
    - Are you a member of any social, political, or cultural organizations?
    - Are they involved in any development activities for Indonesia?
- To what extent are Indonesians living abroad able to support Indonesians who are affected by natural hazards in general?

Block 5: General information

- Age
- Gender
- Birthplace in Indonesia
    - Where does most of your family in Indonesia live? Region, City
- Since when do you live abroad?
- Where do you live at the moment?
    - Do you live alone?

    - Since when?
- What is your occupation?
- Highest level of formal education
- ethnic group and religion
- Regular visits to Indonesia? How often?
    - What places do you usually visit?

Conclusion of the Interview

Thank you very much for taking the time to participate in this interview. We appreciate your help in making this study possible. Before we conclude this interview, is there anything else you would like to add that we have not asked, or do you have questions for us?

- If any more questions come up, would it be okay for us to contact you again?
- Who else do you think I should talk to? Do you know more contacts?
- Did you fill out the online survey? Can you share it in your network?

Online survey questionnaire Indonesian migrants in Europe

Dear participant,

Thank you for your interest in contributing to our study.

Our research focuses on environmental hazards and changes in Indonesia such as climate change, flooding, earthquakes, tsunamis, volcanic eruptions, or pollution. We are interested in how Indonesian households and communities use their personal social contacts to deal with these hazards and changes. Specifically, we want to learn more about the role that Indonesians living in Europe like you play for affected Indonesians.

This questionnaire is designed for Indonesians living in the European Union. You are eligible to participate in this study if you or at least one of our parents is an Indonesian citizen. It is not necessary that you or your relatives have had personal experience with environmental hazards in Indonesia.

Your participation will help us to learn more about the adaptive capacities of people and communities in Indonesia who are affected by environmental hazards. The results of this study will form the basis for new scientific publications. In addition, we aim to share our findings with stakeholders in Indonesia to promote knowledge exchange and support future policy decisions.

Filling out the survey will take approximately 25 to 40 minutes. You have the option to pause the survey at any time and resume it later.

Participation in this survey is voluntary and its contents will be processed anonymously. Your answers cannot be traced back to you. We kindly ask you to fill out our questionnaire honestly and completely.

Additionally, ten book vouchers worth 25 euros will be raffled off among all participants. Participation in the raffle is also voluntary. You have the option to enter the raffle after finishing the survey.

In case you have any questions about this survey, please contact Konstantin Gisevius (k.gisevius@uni-koeln.de)

Section A: Environmental hazards

In the following part, we want to ask you some questions about your experiences with environmental hazards in Indonesi

A1. Have you ever personally suffered financial or material losses or been harmed physically or mentally caused by any of the following environmental hazards in Indonesia?

Financial loss refers to losing personal income or savings, e.g. due to repair costs or inability to work

Material loss refers to damage to personal property, e.g. house or motorcycle

Physical harm refers to injuries or illnesses that require medical treatment

Mental harm refers to any short- or long-term psychological impact, e.g. emotional strain, depression, or trauma

- ☐ Coastal flooding
- ☐ River/rain flooding
- ☐ Coastal erosion
- ☐ Land subsidence
- ☐ Earthquakes
- ☐ Tsunamis
- ☐ Landslides
- ☐ Volcanic eruptions
- ☐ Drought/heat waves
- ☐ Environmental pollution
- ☐ Climate change/sea level rise
- ☐ None of the above
- ☐ Other, please specify:

Other, please specify:

A2. How often did you personally suffer financial or material losses or were physically or mentally harmed by coastal flooding?

- ☐ Only once
- ☐ Less than once a year
- ☐ Once a year
- ☐ Every few months
- ☐ Monthly
- ☐ Weekly
- ☐ Continuously

I don't know ☐

Other, please specify: ☐

Other, please specify:

A3. How often did you personally suffer financial or material losses or were physically or mentally harmed by river/rain flooding?

Only once ☐

Less than once a year ☐

Once a year ☐

Every few months ☐

Monthly ☐

Weekly ☐

Continuously ☐

I don't know ☐

Other, please specify: ☐

Other, please specify:

A4. How often did you personally suffer financial or material losses or were physically or mentally harmed by coastal erosion?

Only once ☐

Less than once a year ☐

Once a year ☐

Every few months ☐

Monthly ☐

Weekly ☐

Continuously ☐

I don't know ☐

Other, please specify: ☐

Other, please specify:

A5. How often did you personally suffer financial or material losses or were physically or mentally harmed by land subsidence?

- Only once ☐
- Less than once a year ☐
- Once a year ☐
- Every few months ☐
- Monthly ☐
- Weekly ☐
- Continuously ☐
- I don't know ☐
- Other, please specify: ☐

Other, please specify:

A6. How often did you personally suffer financial or material losses or were physically or mentally harmed by earthquakes?

- Only once ☐
- Less than once a year ☐
- Once a year ☐
- Every few months ☐
- Monthly ☐
- Weekly ☐
- Continuously ☐
- I don't know ☐
- Other, please specify: ☐

Other, please specify:

A7. **How often did you personally suffer financial or material losses or were physically or mentally harmed by tsunamis?**

- ☐ Only once
- ☐ Less than once a year
- ☐ Once a year
- ☐ Every few months
- ☐ Monthly
- ☐ Weekly
- ☐ Continuously
- ☐ I don't know
- ☐ Other, please specify:

Other, please specify:

A8. **How often did you personally suffer financial or material losses or were physically or mentally harmed by landslides?**

- ☐ Only once
- ☐ Less than once a year
- ☐ Once a year
- ☐ Every few months
- ☐ Monthly
- ☐ Weekly
- ☐ Continuously
- ☐ I don't know
- ☐ Other, please specify:

Other, please specify:

A9. How often did you personally suffer financial or material losses or were physically or mentally harmed by volcanic eruptions?

- ☐ Only once
- ☐ Less than once a year
- ☐ Once a year
- ☐ Every few months
- ☐ Monthly
- ☐ Weekly
- ☐ Continuously
- ☐ I don't know
- ☐ Other, please specify:

Other, please specify:

A10. How often did you personally suffer financial or material losses or were physically or mentally harmed by drought/heat waves?

- ☐ Only once
- ☐ Less than once a year
- ☐ Once a year
- ☐ Every few months
- ☐ Monthly
- ☐ Weekly
- ☐ Continuously
- ☐ I don't know
- ☐ Other, please specify:

Other, please specify:

A11. How often did you personally suffer financial or material losses or were physically or mentally harmed by environmental pollution?

- ☐ Only once
- ☐ Less than once a year
- ☐ Once a year
- ☐ Every few months
- ☐ Monthly
- ☐ Weekly
- ☐ Continuously
- ☐ I don't know
- ☐ Other, please specify:

Other, please specify:

A12. How often did you personally suffer financial or material losses or were physically or mentally harmed by climate change/sea level rise?

- ☐ Only once
- ☐ Less than once a year
- ☐ Once a year
- ☐ Every few months
- ☐ Monthly
- ☐ Weekly
- ☐ Continuously
- ☐ I don't know
- ☐ Other, please specify:

Other, please specify:

A13. What were the impacts of coastal flooding?

- Emotional strain ☐
- Financial or material losses ☐
- Physical health ☐
- Other, please specify: ☐

Other, please specify:

A14. What were the impacts of river/rain flooding?

- Emotional strain ☐
- Financial or material losses ☐
- Physical health ☐
- Other, please specify: ☐

Other, please specify:

A15. What were the impacts of coastal erosion?

- Emotional strain ☐
- Financial or material losses ☐
- Physical health ☐
- Other, please specify: ☐

Other, please specify:

A16. What were the impacts of land subsidence?

- [ ] Emotional strain
- [ ] Financial or material losses
- [ ] Physical health
- [ ] Other, please specify:

Other, please specify:

A17. What were the impacts of earthquakes?

- [ ] Emotional strain
- [ ] Financial or material losses
- [ ] Physical health
- [ ] Other, please specify:

Other, please specify:

A18. What were the impacts of tsunamis?

- [ ] Emotional strain
- [ ] Financial or material losses
- [ ] Physical health

-

Other, please specify: ☐

Other, please specify:

A19. What were the impacts of landslides?

Emotional strain ☐

Financial or material losses ☐

Physical health ☐

Other, please specify: ☐

Other, please specify:

A20. What were the impacts of volcanic eruptions?

Emotional strain ☐

Financial or material losses ☐

Physical health ☐

Other, please specify: ☐

Other, please specify:

A21. What were the impacts of drought/heat waves?

Emotional strain ☐

Financial or material losses ☐

Physical health ☐

Other, please specify: ☐

Other, please specify:

A22. What were the impacts of environmental pollution?

- [ ] Emotional strain
- [ ] Financial or material losses
- [ ] Physical health
- [ ] Other, please specify:

Other, please specify:

A23. What were the impacts of climate change/sea level rise?

- [ ] Emotional strain
- [ ] Financial or material losses
- [ ] Physical health
- [ ] Other, please specify:

Other, please specify:

A24. In the last 10 years, have any members of your family in Indonesia suffered any financial or material losses or been physically or mentally harmed by any of the following environmental hazards?

Here, family includes both direct family members (e.g. (grand)parents, siblings) as well as extended family (uncle, aunt, cousins, in-laws)

Financial loss refers to losing income or savings, e.g. due to repair costs or inability to work

Material loss refers to damage to property, e.g. house or motorcycle

Physical harm refers to fatalities as well as injuries or illnesses that require medical treatment

Mental harm refers to any short- or long-term psychological impact, e.g. emotional strain, depression, or trauma

- [ ] Coastal flooding
- [ ] River/rain flooding
- [ ] Coastal erosion
- [ ] Land subsidence
- [ ] Earthquakes
- [ ] Tsunamis
- [ ] Landslides
- [ ] Volcanic eruptions
- [ ] Drought/heat waves

- [ ] Environmental pollution
- [ ] Climate change/sea level rise
- [ ] None of the above
- [ ] Other, please specify:

Other, please specify:

A25. On average, how often was/is your family affected by coastal flooding?

Here, family includes both direct family members (e.g. (grand)parents, siblings) as well as extended family (uncle, aunt, cousins, in-laws)

- ☐ Only once
- ☐ Less than once a year
- ☐ Once a year
- ☐ Every few months
- ☐ Monthly
- ☐ Weekly
- ☐ Continuously
- ☐ I don't know
- ☐ Other, please specify:

Other, please specify:

A26. On average, how often was/is your family affected by river/rain flooding?

Here, family includes both direct family members (e.g. (grand)parents, siblings) as well as extended family (uncle, aunt, cousins, in-laws)

- ☐ Only once
- ☐ Less than once a year
- ☐ Once a year
- ☐ Every few months
- ☐ Monthly
- ☐ Weekly
- ☐ Continuously
- ☐ I don't know
- ☐ Other, please specify:

Other, please specify:

A27. On average, how often was/is your family affected by coastal erosion?

Here, family includes both direct family members (e.g. (grand)parents, siblings) as well as extended family (uncle, aunt, cousins, in-laws)

- ☐ Only once
- ☐ Less than once a year
- ☐ Once a year
- ☐ Every few months
- ☐ Monthly
- ☐ Weekly
- ☐ Continuously
- ☐ I don't know
- ☐ Other, please specify:

Other, please specify:

A28. On average, how often was/is your family affected by land subsidence?

Here, family includes both direct family members (e.g. (grand)parents, siblings) as well as extended family (uncle, aunt, cousins, in-laws)

- ☐ Only once
- ☐ Less than once a year
- ☐ Once a year
- ☐ Every few months
- ☐ Monthly
- ☐ Weekly
- ☐ Continuously
- ☐ I don't know
- ☐ Other, please specify:

Other, please specify:

A29. On average, how often was/is your family affected by earthquakes?

Here, family includes both direct family members (e.g. (grand)parents, siblings) as well as extended family (uncle, aunt, cousins, in-laws)

- ☐ Only once
- ☐ Less than once a year
- ☐ Once a year
- ☐ Every few months
- ☐ Monthly
- ☐ Weekly
- ☐ Continuously
- ☐ I don't know
- ☐ Other, please specify:

Other, please specify:

A30. On average, how often was/is your family affected by tsunamis?

Here, family includes both direct family members (e.g. (grand)parents, siblings) as well as extended family (uncle, aunt, cousins, in-laws)

- ☐ Only once
- ☐ Less than once a year
- ☐ Once a year
- ☐ Every few months
- ☐ Monthly
- ☐ Weekly
- ☐ Continuously
- ☐ I don't know
- ☐ Other, please specify:

Other, please specify:

A31. On average, how often was/is your family affected by landslides?

Here, family includes both direct family members (e.g. (grand)parents, siblings) as well as extended family (uncle, aunt, cousins, in-laws)

- ☐ Only once
- ☐ Less than once a year
- ☐ Once a year
- ☐ Every few months
- ☐ Monthly
- ☐ Weekly
- ☐ Continuously
- ☐ I don't know
- ☐ Other, please specify:

Other, please specify:

A32. On average, how often was/is your family affected by volcanic eruptions?

Here, family includes both direct family members (e.g. (grand)parents, siblings) as well as extended family (uncle, aunt, cousins, in-laws)

- ☐ Only once
- ☐ Less than once a year
- ☐ Once a year
- ☐ Every few months
- ☐ Monthly
- ☐ Weekly
- ☐ Continuously
- ☐ I don't know
- ☐ Other, please specify:

Other, please specify:

A33. On average, how often was/is your family affected by drought/heat waves?

Here, family includes both direct family members (e.g. (grand)parents, siblings) as well as extended family (uncle, aunt, cousins, in-laws)

- ☐ Only once
- ☐ Less than once a year
- ☐ Once a year
- ☐ Every few months
- ☐ Monthly
- ☐ Weekly
- ☐ Continuously
- ☐ I don't know
- ☐ Other, please specify:

Other, please specify:

A34. On average, how often was/is your family affected by environmental pollution?

Here, family includes both direct family members (e.g. (grand)parents, siblings) as well as extended family (uncle, aunt, cousins, in-laws)

- ☐ Only once
- ☐ Less than once a year
- ☐ Once a year
- ☐ Every few months
- ☐ Monthly
- ☐ Weekly
- ☐ Continuously
- ☐ I don't know
- ☐ Other, please specify:

Other, please specify:

A35. On average, how often was/is your family affected by climate change/sea level rise?

Here, family includes both direct family members (e.g. (grand)parents, siblings) as well as extended family (uncle, aunt, cousins, in-laws)

- ☐ Only once
- ☐ Less than once a year
- ☐ Once a year
- ☐ Every few months
- ☐ Monthly
- ☐ Weekly
- ☐ Continuously
- ☐ I don't know
- ☐ Other, please specify:

Other, please specify:

A36. What impact(s) did coastal flooding have on your affected family members?

Here, family includes both direct family members (e.g. (grand)parents, siblings) as well as extended family (uncle, aunt, cousins, in-laws)

- ☐ Emotional strain

Financial or material losses ☐

Physical health ☐

I don't know ☐

Other, please specify: ☐

Other, please specify:

A37. What impact(s) did river/rain flooding have on your affected family members?

Here, family includes both direct family members (e.g. (grand)parents, siblings) as well as extended family (uncle, aunt, cousins, in-laws)

Emotional strain ☐

Financial or material losses ☐

Physical health ☐

I don't know ☐

Other, please specify: ☐

Other, please specify:

A38. What impact(s) did coastal erosion have on your affected family members?

Here, family includes both direct family members (e.g. (grand)parents, siblings) as well as extended family (uncle, aunt, cousins, in-laws)

Emotional strain ☐

Financial or material losses ☐

Physical health ☐

I don't know ☐

Other, please specify: ☐

Other, please specify:

A39. What impact(s) did land subsidence have on your affected family members?

Here, family includes both direct family members (e.g. (grand)parents, siblings) as well as extended family (uncle, aunt, cousins, in-laws)

- [ ] Emotional strain
- [ ] Financial or material losses
- [ ] Physical health
- [ ] I don't know
- [ ] Other, please specify:

Other, please specify:

A40. What impact(s) did earthquakes have on your affected family members?

Here, family includes both direct family members (e.g. (grand)parents, siblings) as well as extended family (uncle, aunt, cousins, in-laws)

- [ ] Emotional strain
- [ ] Financial or material losses
- [ ] Physical health
- [ ] I don't know
- [ ] Other, please specify:

Other, please specify:

A41. What impact(s) did tsunamis have on your affected family members?

Here, family includes both direct family members (e.g. (grand)parents, siblings) as well as extended family (uncle, aunt, cousins, in-laws)

- [ ] Emotional strain
- [ ] Financial or material losses
- [ ] Physical health
- [ ] I don't know
- [ ] Other, please specify:

Other, please specify:

A42. What impact(s) did landslides have on your affected family members?

Here, family includes both direct family members (e.g. (grand)parents, siblings) as well as extended family (uncle, aunt, cousins, in-laws)

- [ ] Emotional strain
- [ ] Financial or material losses
- [ ] Physical health
- [ ] I don't know
- [ ] Other, please specify:

Other, please specify:

A43. What impact(s) did volcanic eruptions have on your affected family members?

Here, family includes both direct family members (e.g. (grand)parents, siblings) as well as extended family (uncle, aunt, cousins, in-laws)

- [ ] Emotional strain
- [ ] Financial or material losses
- [ ] Physical health

I don't know ☐

Other, please specify: ☐

Other, please specify:

A44. **What impact(s) did drought/heat waves have on your affected family members?**

Here, family includes both direct family members (e.g. (grand)parents, siblings) as well as extended family (uncle, aunt, cousins, in-laws)

Emotional strain ☐

Financial or material losses ☐

Physical health ☐

I don't know ☐

Other, please specify: ☐

Other, please specify:

A45. **What impact(s) did environmental pollution have on your affected family members?**

Here, family includes both direct family members (e.g. (grand)parents, siblings) as well as extended family (uncle, aunt, cousins, in-laws)

Emotional strain ☐

Financial or material losses ☐

Physical health ☐

I don't know ☐

Other, please specify: ☐

Other, please specify:

A46. **What impact(s) did climate change/sea level rise have on your affected family members?**

Here, family includes both direct family members (e.g. (grand)parents, siblings) as well as extended family (uncle, aunt, cousins, in-laws)

Emotional strain ☐

Financial or material losses ☐

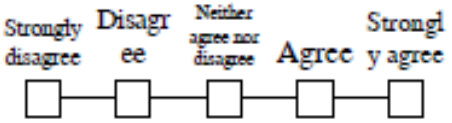
Physical health ☐

I don't know ☐

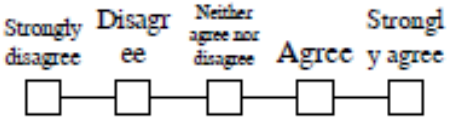
Other, please specify: ☐

Other, please specify:

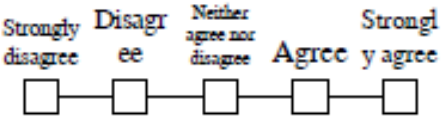
A47. All of my family members in Indonesia affected by coastal flooding have sufficient capacities to deal with the impacts of coastal flooding on their own



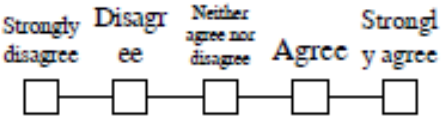
A48. All of my family members in Indonesia affected by river/rain flooding have sufficient capacities to deal with the impacts of river/rain flooding on their own



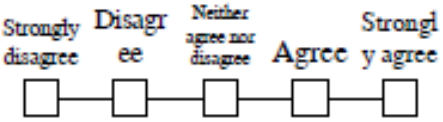
A49. All of my family members in Indonesia affected by coastal erosion have sufficient capacities to deal with the impacts of coastal erosion on their own



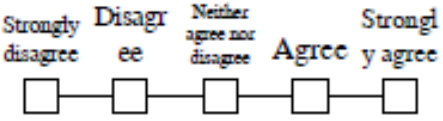
A50. All of my family members in Indonesia affected by land subsidence have sufficient capacities to deal with the impacts of land subsidence on their own



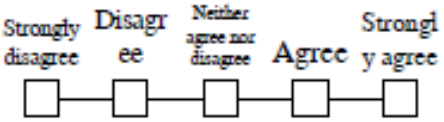
A51. All of my family members in Indonesia affected by earthquakes have sufficient capacities to deal with the impacts of earthquakes on their own



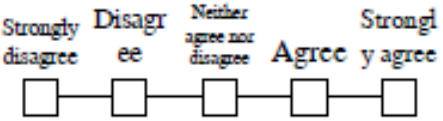
A52. All of my family members in Indonesia affected by tsunamis have sufficient capacities to deal with the impacts of tsunamis on their own



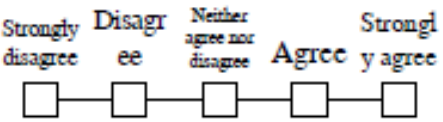
A53. All of my family members in Indonesia affected by landslides have sufficient capacities to deal with the impacts of landslides on their own



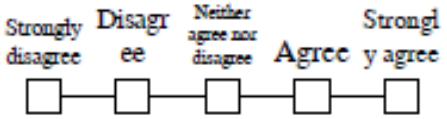
A54. All of my family members in Indonesia affected by volcanic eruptions have sufficient capacities to deal with the impacts of volcanic eruptions on their own



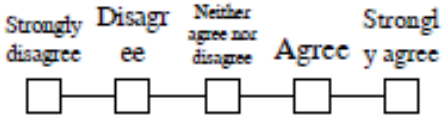
A55. All of my family members in Indonesia affected by drought/heat waves have sufficient capacities to deal with the impacts of drought/heat waves on their own



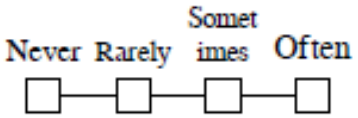
A56. **All of my family members in Indonesia affected by environmental pollution have sufficient capacities to deal with the impacts of environmental pollution on their own**



A57. **All of my family members in Indonesia affected by climate change/sea level rise have sufficient capacities to deal with the impacts of climate change/sea level rise on their own**



A58. **How often do you discuss environment-related topics such as climate change or natural hazards with your family in Indonesia?**



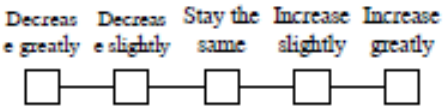
A59. **Which of these environmental hazards do you consider to be the most challenging for people in Indonesia in general?**

Choose up to three answer options

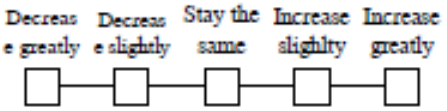
- ☐ Coastal flooding
- ☐ River/rain flooding
- ☐ Coastal erosion
- ☐ Land subsidence
- ☐ Earthquakes
- ☐ Tsunamis
- ☐ Landslides
- ☐ Volcanic eruptions
- ☐ Drought/heat waves
- ☐ Environmental pollution
- ☐ Climate change/sea level rise
- ☐ None of the above
- ☐ Other, please specify:

Other, please specify:

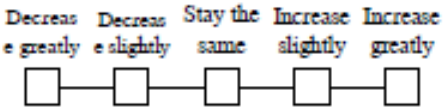
A60. **How will the impact of coastal flooding change for people in Indonesia in the next 5 years?**



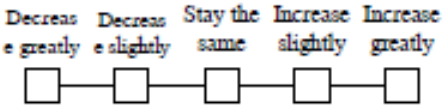
A61. **How will the impact of river/rain flooding change for people in Indonesia in the next 5 years?**



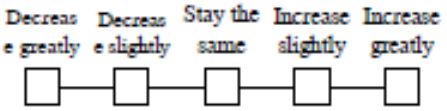
A62. **How will the impact of coastal erosion change for people in Indonesia in the next 5 years?**



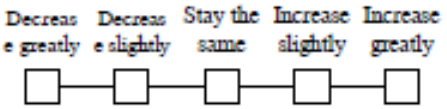
A63. **How will the impact of land subsidence change for people in Indonesia in the next 5 years?**



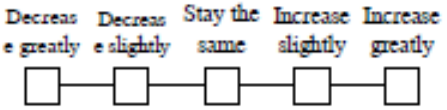
A64. **How will the impact of earthquakes change for people in Indonesia in the next 5 years?**



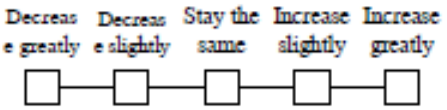
A65. **How will the impact of tsunamis change for people in Indonesia in the next 5 years?**



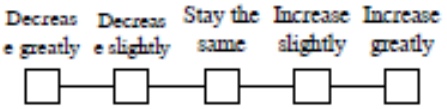
A66. **How will the impact of landslides change for people in Indonesia in the next 5 years?**



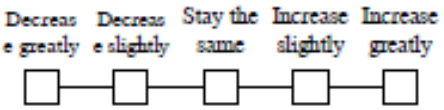
A67. **How will the impact of volcanic eruptions change for people in Indonesia in the next 5 years?**



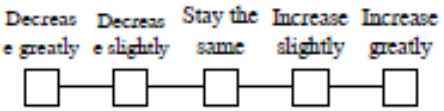
A68. **How will the impact of drought/heat waves change for people in Indonesia in the next 5 years?**



A69. **How will the impact of environmental pollution change for people in Indonesia in the next 5 years?**

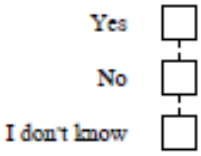


A70. **How will the impact of climate change/sea level rise change for people in Indonesia in the next 5 years?**

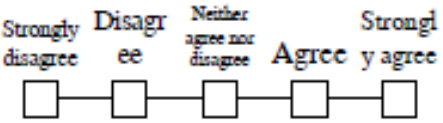


A71. **Would your family in Indonesia ask for your help if they suffered financial or material losses or were physically or mentally harmed by environmental hazards?**

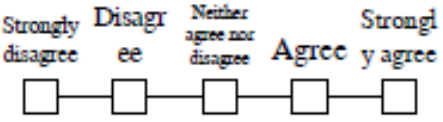
Here, family includes both direct family members (e.g. (grand)parents, siblings) as well as extended family (uncle, aunt, cousins, in-laws)

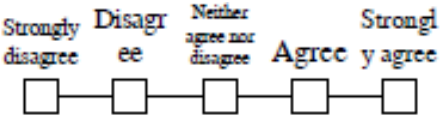


A72. **I support my family in Indonesia financially when they are affected by coastal flooding**

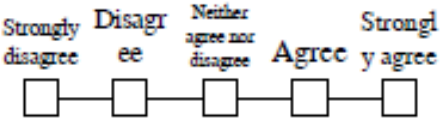


A73. **I support my family in Indonesia financially when they are affected by river/rain flooding**

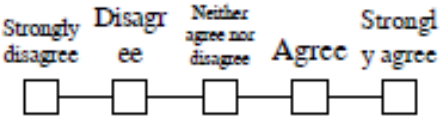




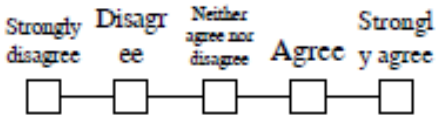
A75. **I support my family in Indonesia financially when they are affected by land subsidence**



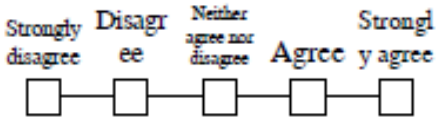
A76. **I support my family in Indonesia financially when they are affected by earthquakes**



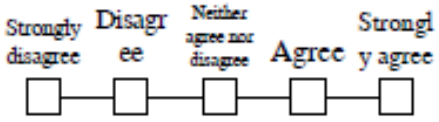
A77. **I support my family in Indonesia financially when they are affected by tsunamis**



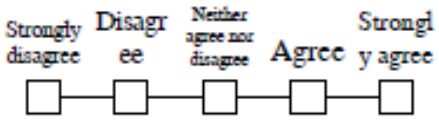
A78. **I support my family in Indonesia financially when they are affected by landslides**



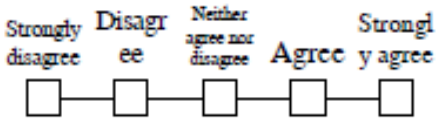
A79. **I support my family in Indonesia financially when they are affected by volcanic eruptions**



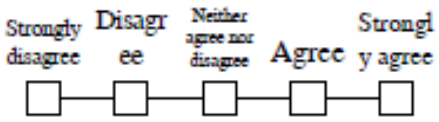
A80. **I support my family in Indonesia financially when they are affected by drought/heat waves**



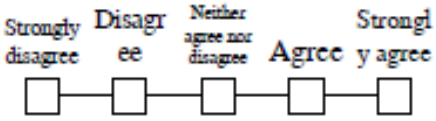
A81. **I support my family in Indonesia financially to help them deal with the impact of environmental pollution**



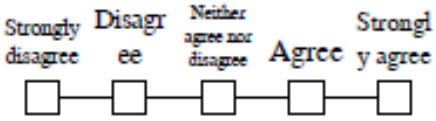
A82. **I support my family in Indonesia financially to help them deal with the impact of climate change/sea level rise**



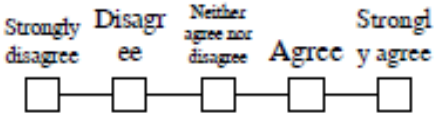
A83. I use my social contacts to organize practical help for my family when they are affected by coastal flooding



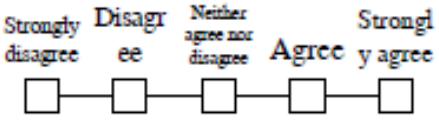
A84. I use my social contacts to organize practical help for my family when they are affected by river/rain flooding



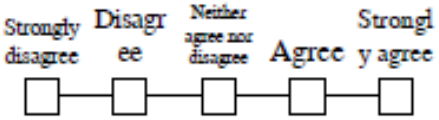
A85. I use my social contacts to organize practical help for my family when they are affected by coastal erosion



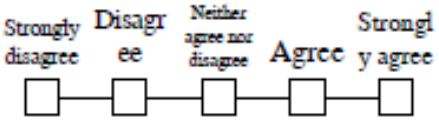
A86. I use my social contacts to organize practical help for my family when they are affected by land subsidence



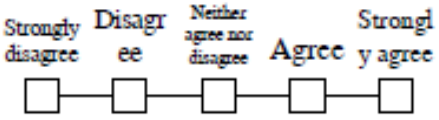
A87. I use my social contacts to organize practical help for my family when they are affected by earthquakes



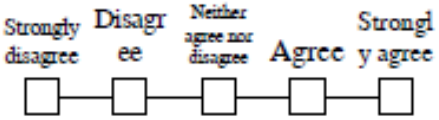
A88. I use my social contacts to organize practical help for my family when they are affected by tsunamis



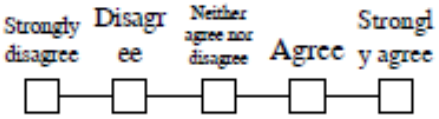
A89. I use my social contacts to organize practical help for my family when they are affected by landslides



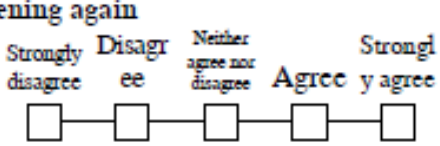
A90. I use my social contacts to organize practical help for my family when they are affected by volcanic eruptions



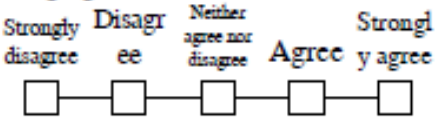
A91. I use my social contacts to organize practical help for my family when they are affected by drought/heat waves



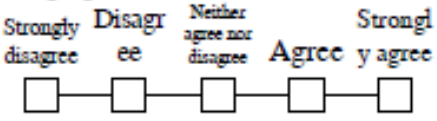
A92. When my family is affected by coastal flooding, I discuss with them how to prevent a similar situation from happening again



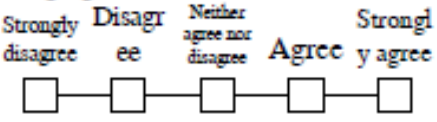
A93. When my family is affected by river/rain flooding, I discuss with them how to prevent a similar situation from happening again



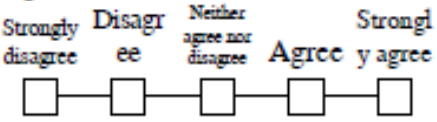
A94. When my family is affected by coastal erosion, I discuss with them how to prevent a similar situation from happening again



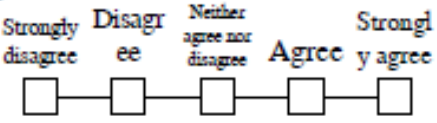
A95. When my family is affected by land subsidence, I discuss with them how to prevent a similar situation from happening again



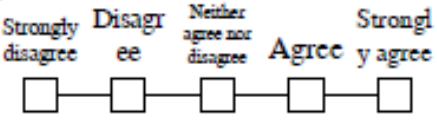
A96. When my family is affected by earthquakes, I discuss with them how to prevent a similar situation from happening again



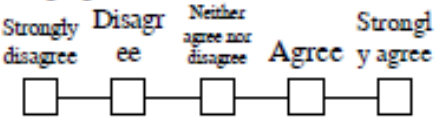
A97. When my family is affected by tsunamis, I discuss with them how to prevent a similar situation from happening again



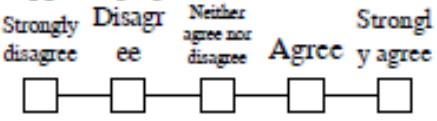
A98. When my family is affected by land slides, I discuss with them how to prevent a similar situation from happening again



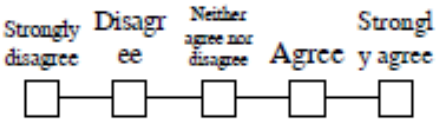
A99. When my family is affected by volcanic eruptions, I discuss with them how to prevent a similar situation from happening again



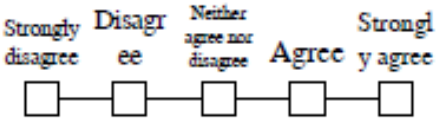
A100. When my family is affected by drought/heat waves, I discuss with them how to prevent a similar situation from happening again



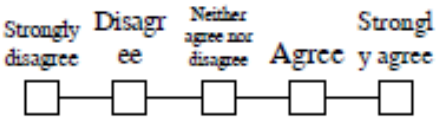
A101. **When my family is affected by environmental pollution, I discuss with them how to deal with such situations in the future**



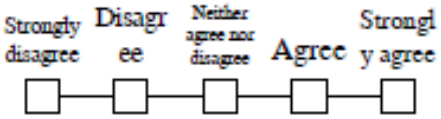
A102. **When my family is affected by climate change/sea level rise, I discuss with them how to deal with such situations in the future**



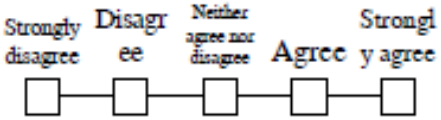
A103. **When my family is affected by coastal flooding, I visit them to practically help them deal with the impact**



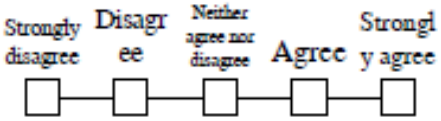
A104. When my family is affected by river/rain flooding, I visit them to practically help them deal with the impact



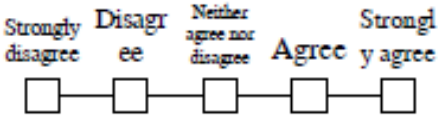
A105. When my family is affected by coastal erosion, I visit them to practically help them deal with the impact



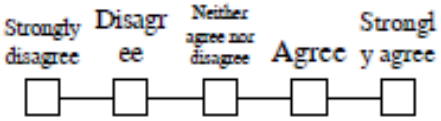
A106. When my family is affected by land subsidence, I visit them to practically help them deal with the impact



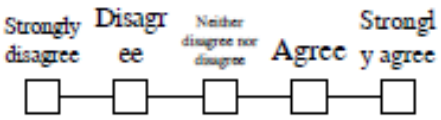
A107. When my family is affected by earthquakes, I visit them to practically help them deal with the impact



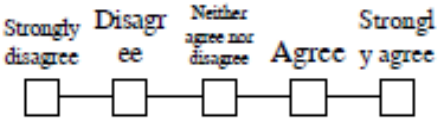
A108. When my family is affected by tsunamis, I visit them to practically help them deal with the impact



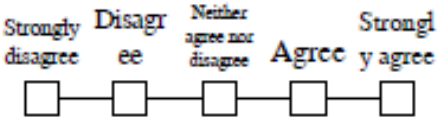
A109. When my family is affected by landslides, I visit them to practically help them deal with the impact



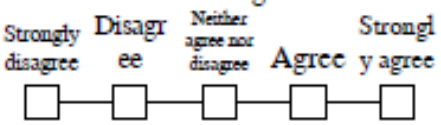
A110. When my family is affected by volcanic eruptions, I visit them to practically help them deal with the impact



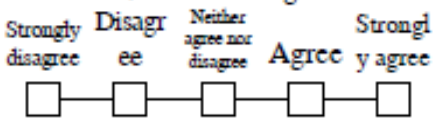
A111. When my family is affected by drought/heat waves, I visit them to practically help them deal with the impact



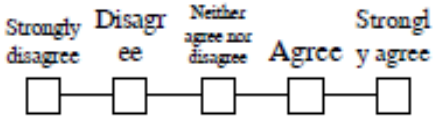
A112. I have acquired new knowledge/skill(s) abroad that I share with my family to help them better deal with or prepare for coastal flooding



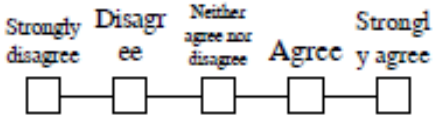
A113. **I have acquired new knowledge/skill(s) abroad that I share with my family to help them better deal with or prepare for river/rain flooding**



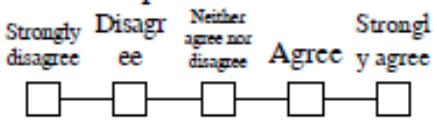
A114. **I have acquired new knowledge/skill(s) abroad that I share with my family to help them better deal with or prepare for coastal erosion**



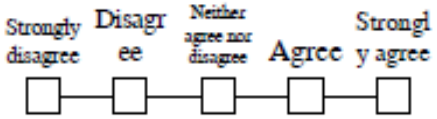
A115. **I have acquired new knowledge/skill(s) abroad that I share with my family to help them better deal with or prepare for land subsidence**



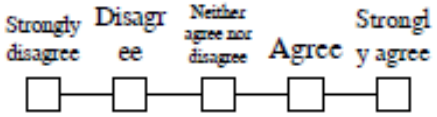
A116. **I have acquired new knowledge/skill(s) abroad that I share with my family to help them better deal with or prepare for earthquakes**



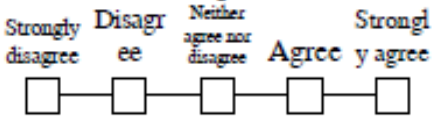
A117. **I have acquired new knowledge/skill(s) abroad that I share with my family to help them better deal with or prepare for tsunamis**



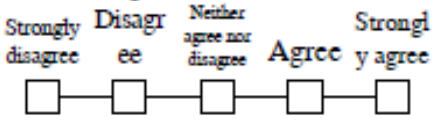
A118. **I have acquired new knowledge/skill(s) abroad that I share with my family to help them better deal with or prepare for landslides**



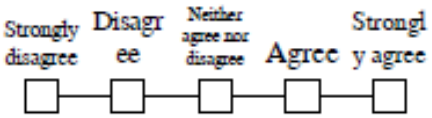
A119. **I have acquired new knowledge/skill(s) abroad that I share with my family to help them better deal with or prepare for volcanic eruptions**



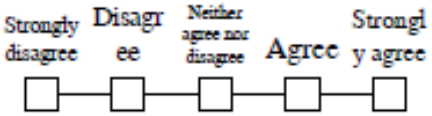
A120. **I have acquired new knowledge/skill(s) abroad that I share with my family to help them better deal with or prepare for drought/heat waves**



A121. I have acquired new knowledge/skill(s) abroad that I share with my family to help them better deal with or prepare for environmental pollution

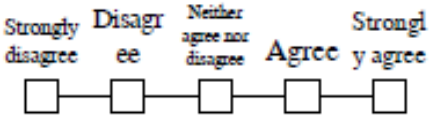


A122. I have acquired new knowledge/skill(s) abroad that I share with my family to help them better deal with or prepare for climate change/sea level rise

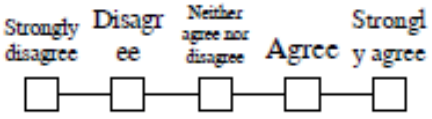


A123. Please specify the skill(s) and or knowledge that you have acquired

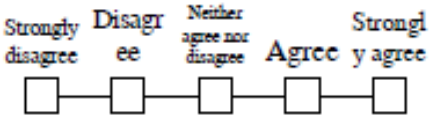
A124. I support my family in Indonesia emotionally/morally when they are affected by environmental hazards



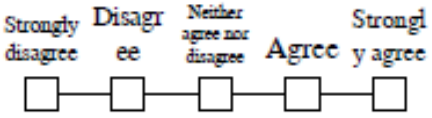
A125. My support has helped to improve the response towards coastal flooding of my affected family members in Indonesia



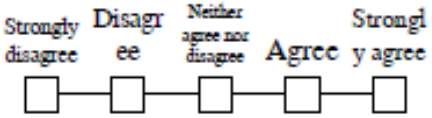
A126. My support has helped to improve the response towards river/rain flooding of my affected family members in Indonesia



A127. My support has helped to improve the response towards coastal erosion of my affected family members in Indonesia



A128. My support has helped to improve the response towards land subsidence of my affected family members in Indonesia



A129. My support has helped to improve the response towards earthquakes of my affected family members in Indonesia

Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree

A130. My support has helped to improve the response towards tsunamis of my affected family members in Indonesia

Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree

A131. My support has helped to improve the response towards landslides of my affected family members in Indonesia

Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree

A132. My support has helped to improve the response towards volcanic eruptions of my affected family members in Indonesia

Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree

A133. My support has helped to improve the response towards drought/heat waves of my affected family members in Indonesia

Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree

A134. My support has helped to improve the response towards environmental pollution of my affected family members in Indonesia

Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree

A135. My support has helped to improve the response towards climate change/sea level rise of my affected family members in Indonesia

Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree

A136. In the last 5 years, have you donated or collected money to help people in Indonesia who were affected by a natural disaster?

Yes ☐
No ☐

A137. In the last 5 years, have you done volunteer work to help people in Indonesia who were affected by a natural disaster?

Volunteer work can be carried out both remotely from abroad and physically present in Indonesia

Yes ☐
No ☐

A138. Are you active in any organization(s) that provide(s) help to Indonesians who are affected by natural disasters?

Yes ☐
No ☐

A139. Please specify the organization(s) you are active in

Organization 1 _____
Organization 2 _____
Organization 3 _____

A140. My awareness for environmental issues has grown since I moved abroad

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
☐	☐	☐	☐	☐

A141. How knowledgeable do you consider yourself on the topic of climate change and sea level rise?

Not knowledgeable	Somewhat knowledgeable	Knowledgeable	Very knowledgeable
☐	☐	☐	☐

A142. Since I moved abroad, I gained more knowledge about how to respond to natural hazards

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
☐	☐	☐	☐	☐

A143. Since I moved abroad, I gained more knowledge about what people like me can do to protect the environment

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
☐	☐	☐	☐	☐

A144. How much influence do Indonesians living abroad like you have to help Indonesians affected by natural disasters?

No influence	Not very much	Some	A lot
☐	☐	☐	☐

Section B: Socio-demographic data

We kindly ask you to answer some questions regarding your socio-demographic status.

B1. What gender do you identify with?

Male ☐
Female ☐
Other ☐

B2. What is your year of birth?

_____

B3. In which country were you born?

- ☐ Indonesia
- ☐ The Netherlands
- ☐ Germany
- ☐ France
- ☐ Belgium
- ☐ Italy
- ☐ Sweden
- ☐ Spain
- ☐ Austria
- ☐ Denmark
- ☐ Other, please specify:

Other, please specify:

B4. Please indicate the postcode of your place of birth.

If you don't know the postcode, you can enter the name of the city/town/village and province instead.

Postcode

B5. In which country do you currently live?

- ☐ The Netherlands
- ☐ Germany
- ☐ France
- ☐ Belgium
- ☐ Italy
- ☐ Sweden
- ☐ Spain

Austria ☐

Denmark ☐

Other ☐

Other

B6. **Please indicate the postcode of your current place of residence**

For Dutch postcodes: The four-digit postcode number is sufficient, letters can be left out

B7. **Since when are you living in your current place of residency?**

B8. **How many people, including you, are living in your household?**

Household members include all people that sleep and eat in the same house/apartment at least 180 days per year and share common living spaces and utilities such as kitchen, bathroom, etc.

B9. **How many members of your household are children? (under 18 years old)**

B10. **What is your relation to the other members of your household?**

family/partner/spouses ☐

friends or roommates ☐

Other ☐

Other

B11. **Are you married or in a relationship?**

Yes ☐

No ☐

B12. What is your highest level of formal education?

- ☐ Never attended school
- ☐ Preschool
- ☐ Primary school
- ☐ Secondary school
- ☐ Tertiary education (college or university)

B13. What is the highest level of formal education of your parents?

- ☐ Never attended school
- ☐ Preschool
- ☐ Primary school
- ☐ Secondary school
- ☐ Tertiary education (college or university)
- ☐ I don't know

B14. What is your religion?

- ☐ Islam
- ☐ Catholicism
- ☐ Protestantism
- ☐ Hinduism
- ☐ Buddhism
- ☐ Confucianism
- ☐ Atheist
- ☐ Other, please specify:

Other, please specify:

B15. What is your ethnic group?

You can choose more than one option

- ☐ European
- ☐ Javanese
- ☐ Sundanese
- ☐ Malay
- ☐ Batak
- ☐ Madurese

- [ ] Betawi
- [ ] Minangkabau
- [ ] Buginese
- [ ] Bantenese
- [ ] Banjarese
- [ ] Balinese

- [ ] Acehnese
- [ ] Dayak
- [ ] Sasak
- [ ] Chinese
- [ ] Makassarese
- [ ] Moluccans
- [ ] Papuan
- [ ] Other, please specify:

Other, please specify:

B16. What is your main occupational form?

- [ ] No work
- [ ] Homemaker/housewife
- [ ] Student
- [ ] Retired
- [ ] Employed
- [ ] Self-employed
- [ ] Other, please specify:

Other, please specify:

B17. What is/was your sector of occupation?

- [ ] Accountancy, finance, business, management
- [ ] Charity and voluntary work
- [ ] Creative arts and design
- [ ] Environment and agriculture
- [ ] Information technology
- [ ] Law, law enforcement and security
- [ ] Leisure, sport and tourism
- [ ] Marketing, advertising and PR
- [ ] Media and internet
- [ ] Property and construction
- [ ] Public services and administration
- [ ] Retail and sales
- [ ] Science and pharmaceuticals
- [ ] Social care
- [ ] Transport and logistics
- [ ] Other, please specify:

Other, please specify:

B18. Which regular income sources do you have access to?

- [ ] Income from my work
- [ ] Income from my spouse/partner
- [ ] Income from other household members
- [ ] Social security payments
- [ ] Pension payments
- [ ] Scholarship
- [ ] Financial support from family in Indonesia
- [ ] Financial support from family outside of Indonesia
- [ ] Rental income
- [ ] Other, please specify:

Other, please specify:

B19. **Are you the main earner of your household?**

Yes ☐

No ☐

B20. **How many household members including you contribute regularly to the household income?**

B21. What is your (households) average monthly net income from the above-mentioned income sources? (€ per month)

- under 500 € ☐
- 500 € to 1000 € ☐
- 1000 € to 1500 € ☐
- 1500 € to 2500 € ☐
- 2500 € to 4500 € ☐
- 4500 € and over ☐

B22. My financial situation has improved because of my move abroad

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
☐	☐	☐	☐	☐

Section C: Migration

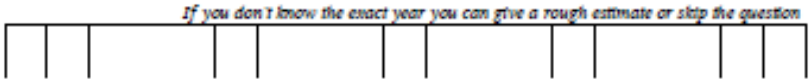
In the following part we want to ask you some questions about your (family's) migration background.

C1. Since when are you living outside of Indonesia?

C2. Since when is your family living outside of Indonesia?

Here, family refers to those relatives living in the household you were born into

If you don't know the exact year you can give a rough estimate or skip the question



C3. Before you moved abroad, who was living with you in your household?

Household members include all people that sleep and eat in the same house/apartment at least 180 days per year and share common living spaces and utilities such as kitchen, bathroom, etc.

- I lived alone ☐
- Spouse or partner ☐
- Child(ren) ☐
- Parents ☐
- Sibling(s) ☐
- Grandparents ☐
- Extended family (uncle, aunt, cousins, in-laws) ☐
- Friend(s)/roomates ☐
- Other, please specify: ☐

Other, please specify:

C4. Did you move abroad with your entire former household?

- ☐ Yes
- ☐ No

C5. It was/is difficult for my former household in Indonesia to replace my roles/responsibilities/help

Strongly disagree	Disagree	Neither disagree nor disagree	Agree	Strongly agree
☐	☐	☐	☐	☐

C6. What was/were the main reason(s) for you to move abroad?

Choose up to three answer options

- ☐ Job offer/opportunities
- ☐ Education/training/gain expertise in special field
- ☐ Marriage/family reunion
- ☐ Expand personal horizon
- ☐ Wanted to leave Indonesia
- ☐ Access to health care
- ☐ To be safe from natural disasters (e.g. flooding, earthquakes, etc.)
- ☐ To support my family at home
- ☐ To support my community at home
- ☐ Other, please specify:

Other, please specify:

C7. What was/were the main reason(s) for your family to move abroad?

Choose up to three answer options

Here, family refers to those relatives living in the household you were born into

- Job offer/opportunities ☐
- Education/training/gain expertise in special field ☐
- Marriage/family reunion ☐
- Expand personal horizon ☐
- Wanted to leave Indonesia ☐
- Access to health care ☐
- To be safe from environmental hazards (e.g. flooding, earthquakes, etc.) ☐
- To support other family members at home ☐
- To support their community at home ☐

- I don't know ☐
- Other, please specify: ☐

Other, please specify:

C8. How often do you travel to Indonesia on average (before the Covid-19 pandemic)?

- Never ☐
- Less than once per year ☐
- Once per year ☐
- More than once per year ☐
- Other, please specify: ☐

Other, please specify:

C9. What are the main reasons for you to travel to Indonesia?

Choose up to three answer options

- Visit family ☐
- Visit extended family/relatives ☐
- Visit friends ☐
- Special occasion (weddings, funerals, etc.) ☐

Vacation ☐

Business/work-related ☐

Religious activity ☐

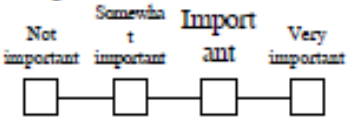
Volunteering/community work ☐

Political activity ☐

Other, please specify: ☐

Other, please specify:

C10. **How important is it for you to travel to Indonesia on a regular basis?**



C11. **On average, how often do you get visited by your family from Indonesia in your current place of residence (before the Covid-19 pandemic)?**

- ☐ Never
- ☐ Less than once a year
- ☐ About once a year
- ☐ More than once a year
- ☐ Other, please specify:

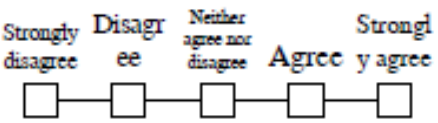
Other, please specify:

C12. **Did you receive support in your migration process from any of the following sources?**

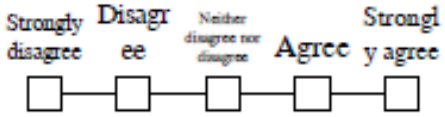
- ☐ Personal contacts living in Indonesia
- ☐ Personal contacts living outside of Indonesia
- ☐ (Online) platforms, organizations or communities for Indonesians living abroad
- ☐ Employer / educational institution
- ☐ Scholarship program
- ☐ Visa agency
- ☐ I organized everything myself
- ☐ Other, please specify:

Other, please specify:

C13. **My family was very supportive of my plans to move abroad**



C14. **I would not have migrated if my family disapproved of my migration plans**



C15. **Are you planning to move back to Indonesia permanently at some point?**

- ☐ Yes
- ☐ No
- ☐ I don't know

C16. **When are planning to move back to Indonesia?**

- ☐ Within the next year
- ☐ Within the next 5 years
- ☐ Within the next 10 years
- ☐ Later
- ☐ I don't know
- ☐ Other, please specify:

Other, please specify:

C17. **Which members of your (extended) family lived or are currently living outside of Indonesia (excluding family members living in your household)?**

Household members include all people that sleep and eat in the same house/apartment at least 180 days per year and share common living spaces and utilities such as kitchen, bathroom, etc.

- ☐ Children
- ☐ Parents
- ☐ Sibling(s)
- ☐ Grandparents
- ☐ Extended family (uncle, aunt, cousins, in-laws)
- ☐ None of the above
- ☐ Other, please specify:

Other, please specify:

Section D: Network in Indonesia

In the following section, we want to ask you some questions about your connection to Indonesia. The questions in this section refer exclusively to people who currently live in Indonesia.

D1. Are you currently in regular contact with any of the following people in Indonesia? (at least once every month)

Direct contact includes communication via phone, (video) chat, or personal text messages. It does not include indirect communication such as following updates on social media or receiving messages in group chats.

- ☐ Spouse or partner
- ☐ Child(ren)
- ☐ Parents
- ☐ Sibling(s)
- ☐ Grandparents
- ☐ Extended family (uncle, aunt, cousins, in-laws)
- ☐ Friend(s)
- ☐ Member(s) of my former neighborhood/community
- ☐ Business partners /Co-workers
- ☐ I do not have any contact with people living in Indonesia
- ☐ Other, please specify:

Other, please specify:

D2. On average, how many people in Indonesia do you have contact with at least once a month?

Direct contact includes communication via phone, (video) chat, or personal text messages. It does not include indirect communication such as following updates on social media or receiving messages in group chats.

D3. **Which important topics do you discuss when you talk to your regular contacts in Indonesia?**

- Health issues ☐
- Financial issues ☐
- Emotional issues ☐
- Family issues ☐
- Environmental issues/hazards ☐
- Legal issues ☐
- Business-related issues ☐
- Politics ☐
- None of the above ☐

Other topic, please specify: ☐

Other topic, please specify:

D4. **Where does your spouse or partner in Indonesia live? Please indicate the postcode.**

If you don't know the postcode, you can enter the name of the city/town/village and province instead.

Postcode | | | | | | | | | |

D5. **Where do(es) your child(ren) in Indonesia live? Please indicate the postcode.**

If your children live in different places, please separate locations with commas.

If you don't know the postcode, you can enter the name of the city/town/village and province instead.

Postcode | | | | | | | | | |

D6. **Where do your parents in Indonesia live? Please indicate the postcode.**

If you don't know the postcode, you can enter the name of the city/town/village and province instead.

Postcode | | | | | | | | | |

D7. **Where do(es) your sibling(s) in Indonesia live? Please indicate the postcode.**

If your siblings live in different places, please separate locations with commas.

If you don't know the postcode, you can enter the name of the city/town/village and province instead.

Postcode | | | | | | | | | |

D8. **Where do your grandparents in Indonesia live? Please indicate the postcode.**

If your grandparents live in different places, please separate locations with commas.

If you don't know the postcode, you can enter the name of the city/town/village and province instead.

Postcode | | | | | | | | | |

D9. **Where do the members of your extended family with whom you have regular contact live in Indonesia? Please indicate the postcode.**

Extended family refers to uncles, aunts, cousins, and in-laws.

If parts of your extended family live in different places, please separate locations with commas.

If you don't know the postcode, you can enter the name of the city/town/village and province instead.

Postcode | | | | | | | | | |

D10. **Did any of your regular contacts in Indonesia hold any of the following leadership positions in the last 5 years?**

Head of RT ☐

Head of RW ☐

Head of Kelurahan ☐

Head of LPMK ☐

- [ ] Head of workers' associations
- [ ] Head of Karangtaruna
- [ ] (Community) project leader
- [ ] No
- [ ] I don't know
- [ ] Other, please specify:

Other, please specify:

D11. What is the average total income of your parents per month?

- [ ] < IDR 500.000 per month
- [ ] IDR 500.000 - IDR 1.000.000 per month
- [ ] IDR 1.000.000 - IDR 3.000.000 per month
- [ ] IDR 3.000.000 - IDR 5.000.000 per month
- [ ] IDR 5.000.000 - IDR 7.000.000 per month
- [ ] > IDR 7.000.000 per month
- [ ] Both without work, retired or deceased
- [ ] I don't know

D12. What expectations does your family in Indonesia have regarding your stay abroad?

- ☐ No specific expectations
- ☐ Financial benefits/additional income
- ☐ Gain of expertise or special knowledge
- ☐ New business opportunities
- ☐ Gain of reputation / prestige
- ☐ Other, please specify:

Other, please specify:

D13. My family in Indonesia expects me to return to Indonesia at some point.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
☐	☐	☐	☐	☐

D14. Do you receive money from people in Indonesia?

- ☐ No
- ☐ Only during emergencies (sickness, disasters)
- ☐ Only for special occasions (birthdays, weddings, etc.)
- ☐ Occasionally
- ☐ Regularly
- ☐ Other, please specify:

Other, please specify:

D15. Do you send money to people in Indonesia?

- ☐ No
- ☐ Only during emergencies (sickness, disasters)
- ☐ Only for special occasions (birthdays, weddings, etc.)
- ☐ Occasionally
- ☐ Regularly
- ☐ Other, please specify:

Other, please specify:

D16. **On average, how much money do you send to people in Indonesia in € per year?**

- less than 100 € ☐
- 100 € to 500 € ☐
- 500 € to 1000 € ☐
- 1000 € to 1500 € ☐
- 1500 € to 2000 € ☐
- 2000 € to 3000 € ☐
- 3000 € and more ☐

D17. **My move abroad improved the economic situation of my family in Indonesia.**

Here, family includes both direct family members (e.g. (grand)parents, siblings) as well as extended family (uncle, aunt, cousins, in-laws)

Improvement of the economic situation can happen via e.g. sending remmitances, making financial investments, buying properties or investing in small businesses

Strongly disagree ☐ — Disagree ☐ — Neither agree nor disagree ☐ — Agree ☐ — Strongly agree ☐

D18. **I obtained useful knowledge and / or new skills abroad that I am sharing with my family in Indonesia**

Here, family includes both direct family members (e.g. (grand)parents, siblings) as well as extended family (uncle, aunt, cousins, in-laws)

Strongly disagree ☐ — Disagree ☐ — Neither agree nor disagree ☐ — Agree ☐ — Strongly agree ☐

D19. **How much influence do Indonesians living abroad like you have to improve the lives of their families in Indonesia?**

Here, family includes both direct family members (e.g. (grand)parents, siblings) as well as extended family (uncle, aunt, cousins, in-laws)

No influence ☐ — Not very much ☐ — Some ☐ — A lot ☐

Section E: Network abroad

In the following part, we want to ask you some questions about your life in your place of residence.

E1. **Outside of your own household, are you in regular contact with other Indonesians living in your current place of residence?**

- Yes ☐
- No ☐

E2. **On average, how many Indonesian migrants outside of your own household are you in regular contact with? (at least once a month)**

☐☐☐☐

E3. **What share of your personal social network is made up of Indonesians living in your current place of residence?**

- ☐ Almost everyone (75-100%)
- ☐ More than half (50-75%)
- ☐ About half (~50%)
- ☐ Less than half (25-50%)
- ☐ Only a few (0-25%)

E4. **It is important for me to be connected to other Indonesians living in my current place of residence.**

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
☐	☐	☐	☐	☐

E5. **Are you active in any association, community or group for Indonesian migrants in your current place of residence?**

- ☐ Yes
- ☐ No

E6. **What is the purpose of this/these association(s), community/communities or group(s)?**

- ☐ Culture (food, music, language, etc.)
- ☐ Academia & knowledge exchange (e.g. student associations)
- ☐ Humanitarian/development aid
- ☐ Health care
- ☐ Religion
- ☐ Diaspora/migration
- ☐ Community life
- ☐ Other, please specify:

Other, please specify:

E7. **In the last 5 years, did you hold any formal position within an Indonesian association such as chairman/woman, treasurer, etc.?**

- ☐ Yes
- ☐ No

E8. **Do you speak any of the following languages fluently?**

- ☐ English
- ☐ German

Dutch/Flemish ☐

French ☐

Italian ☐

Swedish ☐

Spanish ☐

None of the above ☐

E9. I feel integrated in and accepted by society in my current place of residence

Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree

☐ — ☐ — ☐ — ☐ — ☐

E10. I can turn to my local network in my place of residence when I need advice or information

Local network includes all people living in or close to your place of residence that you know (e.g. family, friends, colleagues, neighbors, etc.)

Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree

☐ — ☐ — ☐ — ☐ — ☐

E11. I can turn to my local network in my place of residence when I need practical support

Local network includes all people living in or close to your place of residence that you know (e.g. family, friends, colleagues, neighbors, etc.)

Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree

☐ — ☐ — ☐ — ☐ — ☐

E12. If I were to suffer an economic loss, my local network in my place of residence would assist me financially

Local network includes all people living in or close to your place of residence that you know (e.g. family, friends, colleagues, neighbors, etc.)

Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree

☐ — ☐ — ☐ — ☐ — ☐

E13. I can turn to my local network in my place of residence when I need emotional support

Local network includes all people living in or close to your place of residence that you know (e.g. family, friends, colleagues, neighbors, etc.)

Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree

☐ — ☐ — ☐ — ☐ — ☐

Section F: COVID-19

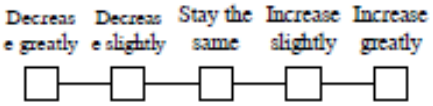
In this last part, we want to ask you some questions about the COVID-19 pandemic and how it affected your life and the life of your family in Indonesia

F1. How has the communication with your contacts in Indonesia changed since the COVID-19 pandemic started?

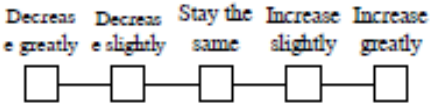
Decrease greatly | Decrease slightly | Stay the same | Increase slightly | Increase greatly

☐ — ☐ — ☐ — ☐ — ☐

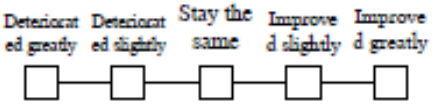
F2. **How has your contact to other Indonesians living in in your place of residence changed since the COVID-19 pandemic started?**



F3. **How has your activity in Indonesian migrant organizations/communities in your place of residence changed since the COVID-19 pandemic has started?**

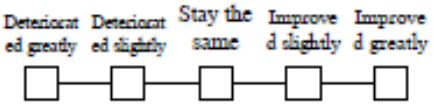


F4. **How has your (households) financial situation changed because of the COVID-19 pandemic?**

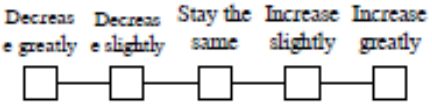


F5. **How has the financial situation of your family in Indonesia changed because of the COVID-19 pandemic?**

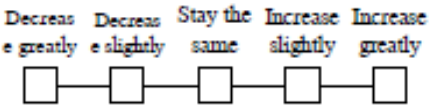
Here, family includes both direct family members (e.g. (grand)parents, siblings) as well as extended family (uncle, aunt, cousins, in-laws) as long as they are currently living in Indonesia



F6. **How have the remittances you send to people in Indonesia changed since the COVID-19 pandemic started?**

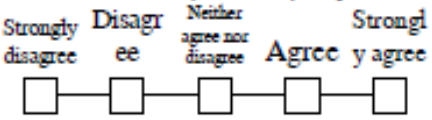


F7. **How have the donations you make changed since the COVID-19 pandemic started?**



F8. **All of my family members in Indonesia have sufficient capacities to deal with the COVID-19 pandemic on their own**

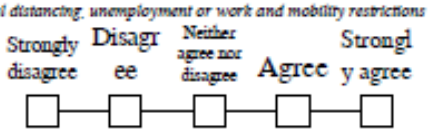
Here, family includes both direct family members (e.g. (grand)parents, siblings) as well as extended family (uncle, aunt, cousins, in-laws) as long as they are currently living in Indonesia



F9. **The COVID-19 pandemic has negatively affected the ability of my family members in Indonesia to deal with the impact of environmental hazards**

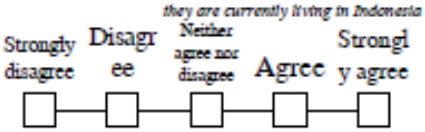
Here, family includes both direct family members (e.g. (grand)parents, siblings) as well as extended family (uncle, aunt, cousins, in-laws) as long as they are currently living in Indonesia

For example through illness, hygiene regulations and social distancing, unemployment or work and mobility restrictions



F10. **The COVID-19 pandemic has negatively affected my ability to support my family in Indonesia.**

Here, family includes both direct family members (e.g. (grand)parents, siblings) as well as extended family (uncle, aunt, cousins, in-laws) as long as they are currently living in Indonesia



Thank you very much for participating in the survey. Your answers have been submitted.

Ten book vouchers worth 25 euros will be raffled among all participants. If you want to participate in the raffle, please follow this link to enter your e-mail address. The winners will be contacted after the end of the survey.

In case you have any questions please contact Konstantin Gisevius (k.gisevius@uni-koeln.de)

You can close this window.

Interview guidelines community leaders Semarang

Introduction

Thank you for taking the time to participate in this study. It is a collaboration between Diponegoro University and the University of Cologne, Germany. Our goal is to better understand the role of local leaders like you in the context of community adaptation to flood risk and land subsidence. We are especially interested in the ways and possibilities local leaders have to engage with their communities. The interview will take approximately one hour to 90 minutes.

With your permission, we would like to audio record this interview to facilitate the subsequent analysis. Everything said during the interview will be handled anonymously.

Note to interviewers: Make sure all important information is covered in the interview and keep asking follow-up questions if important information is missing.

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Block 1: General Information about the Interviewee / Personal traits and ability (psychological traits, skills, personal backgrounds that contribute to a distinctive leadership style)

Important information: Age, time in village, place of birth (migration history?), time in office, educational, occupational, and political background, religion, ethnic group

Questions:

- Can you give us a short introduction of yourself and your background?
- What are your main tasks?
    - Do you delegate some of your tasks?
    - To what extent do you share your power with other members of the community?
- How long have you been in office?
- What was your motivation to assume your office?
- What did you do before you assumed your position?
    - Do you do other work?
- What would you say characterizes your leadership style?
- Does your background help you with your leadership position?
- **What is your vision for your community?**

Block 2: Institutional arrangement

Important information: formal and informal structures for acquiring formal power, identity, and authority; i.e., vision sharing, power division, commitment, trust, organizational structure, and communication process

Questions:

- What requirements does someone have to meet to get your position?
- Which factors / circumstances helped you to assume your office?
- Do you know many people who occupy the same or a higher/lower formal position as you?
    - How important is it for you to connect and collaborate with them?
- Are there challenges or obstacles you have experienced concerning authorities or other institutions?

Block 3: Community and local leader activity

Important information: personal and communal experience with floods and land subsidence, risk perception / environmental awareness, collaboration, social learning, networking, mediation, dialogue, relationship to other tiers of government, practices that facilitate knowledge sharing, joint learning, and co-creation of experiences between stakeholders around a shared purpose

Questions:

- What are the biggest problems / challenges in your community?
    - How do you tackle them?
    - Do you get help from other tiers of government or other organizations?
- What is your experience with floods and land subsidence in this area?
    - How bad do you think the problem is?
    - What activities do you follow to prevent flooding?
    - Where do you get new ideas / innovations from?
    - How do you fund projects?
    - Do you share your knowledge and expertise with your own and other communities?

Block 4: Internal factors (specific characteristics that are particular to the area)

Important information: culture, social customs, characteristics of the communities / neighborhoods

Questions:

- How often do you meet with people from your community?
    - What topics are usually discussed?
    - How do you make decisions?
- How would you characterize your community?

- How would you describe the relationship among the people in your community?
- What is the degree of participation, trust, and inclusiveness?
- What role do the people in your community play in adapting to flood and land subsidence?
    - Is the whole community involved? Do you think some households cannot be reached by your work?
- How do the local culture and the social customs influence your work in the community and in reaching adaptation goals?
    - What role do religious or political activities play in your community?

Block 5: External connections / networks (information on how the local leader connects his community to other communities and stakeholders)

<u>Important information:</u> connections to other stakeholders outside of the own community, collaboration, projects

- How do you establish connections with other actors / communities?
- How often do you meet with people from outside your community? Who are they?
- Are you in contact with people in the same position as you but from other RTs, RWs, Kelurahans, Kecamatans?
    - What are you meeting for?
    - How often?
    - Which topics are discussed?
- Do you have contacts with political officials/parties, Universities, NGOs other stakeholders?
    - What are you meeting for?
    - How often?
    - Which topics are discussed?
- Whom would you contact if you need advice / information on the following issues?
    - Flooding, subsidence
    - Elevation
    - Legal issues
    - Financing and funding
    - Etc.
- Did you initiate any projects or cooperations which involve stakeholders from outside your community? (i.e., Initiatives with external (co-)financing, or with the participation of NGOs, or with the help of university expertise)
    - If yes, please elaborate.

Block 6: External factors (broad context within which local leadership is exercised)

Important information: *economy, policy, political situation*

Questions:

- How would you characterize your relationship with the local government in Semarang?
- What responsibilities do higher tiers of government have with respect to risk adaptation?
- How responsive and supportive is the local government of community-level action?
    - Where do you see room for improvement?
- What are some economic challenges that you have to face in your position?
    - Do you get paid for your services to the community?
- Do you think the upcoming elections will have an impact on your work?

Conclusion of the Interview

Thank you very much for taking the time to participate in this interview. We appreciate your help in making this study possible. Before we conclude this interview, is there anything else you would like to add that we have not asked, or do you have questions for us?

Appendix B: Own contribution

Article 1 (Chapter 7) was co-authored by Lisa-Michéle Niesters (University of Cologne), Ajeng Larasati (University of Cologne), and Boris Braun (University of Cologne). Article 2 (Chapter 9) was co-authored by Boris Braun. Article 3 (Chapter 11) was co-authored by Lisa-Michéle Niesters and Boris Braun.

Article 1 is based on empirical data that has been collected as part of a field research trip in September and October 2022.

Article 2 is based on empirical data that has been collected through online interviews and an online survey from November 2020 to February 2022.

Article 3 is based on a secondary analysis of empirical data that has been collected as part of the research project “Building adaptive capacity through translocal social capital: Sea level rise and resilience of coastal communities and households in Indonesia” (TRANSOCAP I; PI: Boris Braun). The quantitative data has been collected by Lisa-Michéle Niesters. The qualitative data has been collected by myself as part of my Master’s thesis which has been funded by the German Academic Exchange Service (DAAD) through the PROMOS scholarship.

The research for this thesis has been funded by the German Research Foundation (Deutsche Forschungsgemeinschaft) under the Special Priority Program (SPP) 1889 ‘Regional sea level change and society’ (BR 1678/14-2).

My contributions to the three papers are the following:

- Review of relevant literature
- Development of the theoretical frameworks
- Development of research questions and hypotheses
- Organization of field research phase and coordination with local partner institutions (Universitas Negeri Padang; Universitas Udayana Denpasar)
- Selection and on-site inspection of the case study areas in collaboration with local research institutions
- Selection of research methods
- Further development of quantitative questionnaire based on household questionnaire from TRANSOCAP I (article 1)
- Development of qualitative and quantitative questionnaires (article 2)
- Conduction of all online interviews (article 2)
- Training and supervision of research assistants during kick-off workshops and during conducting the quantitative household survey (article 1)
- Cleaning and cross-checking of qualitative and quantitative research data (articles 1 & 2)
- Independent content analysis of qualitative results, using MAXQDA (articles 2 & 3)

- Independent statistical analysis of quantitative results, using STATA (all articles)
- Independent writing of all manuscripts
- Revision of all manuscripts under the supervision of Boris Braun (all articles) and Lisa-Michéle Niesters (articles 1 & 3)

Appendix C: Erklärung zur Dissertation

Erklärung zur Dissertation
gemäß der Promotionsordnung vom 12. März 2020

Hiermit versichere ich an Eides statt, dass ich die vorliegende Dissertation selbstständig und ohne die Benutzung anderer als der angegebenen Hilfsmittel und Literatur angefertigt habe. Alle Stellen, die wörtlich oder sinngemäß aus veröffentlichten und nicht veröffentlichten Werken dem Wortlaut oder dem Sinn nach entnommen wurden, sind als solche kenntlich gemacht. Ich versichere an Eides statt, dass diese Dissertation noch keiner anderen Fakultät oder Universität zur Prüfung vorgelegen hat; dass sie - abgesehen von unten angegebenen Teilpublikationen und eingebundenen Artikeln und Manuskripten - noch nicht veröffentlicht worden ist sowie, dass ich eine Veröffentlichung der Dissertation vor Abschluss der Promotion nicht ohne Genehmigung des Promotionsausschusses vornehmen werde. Die Bestimmungen dieser Ordnung sind mir bekannt. Darüber hinaus erkläre ich hiermit, dass ich die Ordnung zur Sicherung guter wissenschaftlicher Praxis und zum Umgang mit wissenschaftlichem Fehlverhalten der Universität zu Köln gelesen und sie bei der Durchführung der Dissertation zugrundeliegenden Arbeiten und der schriftlich verfassten Dissertation beachtet habe und verpflichte mich hiermit, die dort genannten Vorgaben bei allen wissenschaftlichen Tätigkeiten zu beachten und umzusetzen. Ich versichere, dass die eingereichte elektronische Fassung der eingereichten Druckfassung vollständig entspricht.

Teilpublikationen:

- Gisevius, K., Niesters, L.-M., Larasati, A., & Braun, B. (under review). The complementary nature of local and translocal social capital in flood adaptation: Evidence from urban coastal communities in Indonesia.
- Gisevius, K., & Braun, B. (under review). Translocal responses to natural hazards and environmental change: Insights from Indonesian support-lending migrant communities in the European Union with a focus on Germany.
- Gisevius, K., Niesters, L.-M., & Braun, B. (under review). The role of community leadership in building community adaptive capacity to coastal hazards – Insights from neighborhood networks in Semarang, Indonesia.

Datum: 06.05.2024 Konstantin Gisevius