Living with sea level change and coastal flooding – Collective responses of households and communities in Indonesia

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Living with sea level change and coastal flooding – Collective responses of households and communities in Indonesia

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Summary

Responding to flooding and sea level change is a daily challenge for coastal populations worldwide. Filling knowledge gaps on how households and communities respond to these hazards is crucial to recognize the adaptation needs and capacities of exposed communities. This thesis presents the results of original, mixed-methods research (focus group discussions and a standardized household survey) collected in Jakarta and the Semarang Bay area on Java, Indonesia. This study analyses the main question: *How do households and communities respond to coastal hazards and what are their resources to self-organize and to act collectively?* The adaptive capacity of communities, especially in the Global South, is critically related to social capital, as manifested through social networks, self-organization, and collective action. This thesis applies social capital first from a spatial perspective, focusing on local socio-spatial structures, and second, from a translocal perspective, analyzing boundary-crossing social networks.

The results show that coastal hazards have become a normal element of live in the risk perception of local people. Rather than retreating or gaining permanent protection, people found ways to accommodate to and hence live with floods. This result adds an important dimension to the contemporary theorization of responding to coastal hazards. *Accommodating strategies*, such as informal non-bank saving systems, are crucial for people to maintain their livelihoods on a more substantial basis than recognized in much of the literature. Furthermore, the findings demonstrate that social capital is significantly shaped by the specific spatial forms of neighborhoods, particularly in the presence and form of places to meet. The urban form of North Jakarta facilitates bonding social capital, which enables the formation of *responsive neighborhoods* capable of responding on mid-term scales. Bonding ties, together with attachment to place and social belonging, appear to be key local assets for flood responses. However, there is insufficient evidence to suggest that the current urban form of North Jakarta supports the formation of *adaptive neighborhoods* in the long-term, which would require social ties to the outside world. In this regard, the results on *translocal social capital* show

that households with a higher number of translocal contacts are more likely to act proactively against coastal hazards. Furthermore, the propensity for translocal social capital is economically stratified. Poorer households have fewer translocal ties, which impairs their adaptive capacities.

The results add to advancing the conceptualization of collective adaptation processes and derive important policy implications. The thesis offers new insights into how community-based approaches can be better aligned with top-down strategies, one of the biggest challenges for contemporary and future disaster risk reduction. Furthermore, the findings provide new understanding into how the urban form of neighborhoods influences the resulting social capital and adaptive capacities. Thus, a spatial perspective on collective hazard responses is important for urban planning to empower local communities. Planning *together with* instead of just *for* hazard-affected communities is the key to long-term and effective coastal adaptation.

Zusammenfassung

Meeresspiegelveränderungen und Überschwemmungen stellen eine tägliche Herausforderung für Küstenbevölkerungen weltweit dar. Wie Haushalte und Gemeinschaften mit diesen Gefahren umgehen, ist von entscheidender Bedeutung, um neue Forschungserkenntnisse über Anpassungsbedürfnisse und -kapazitäten der gefährdeten Gemeinschaften zu gewinnen. Für die vorliegende Dissertation wurden Primärdaten in Jakarta und der Semarangbucht auf Java, Indonesien, erhoben. Dabei kam ein Methodenmix zum Einsatz, bestehend aus Fokusgruppen-Diskussionen und einer standardisierten Haushaltsbefragung. Diese Studie untersucht die Frage: Wie passen sich Haushalte und Gemeinschaften an Küstengefahren an und welche Ressourcen stehen ihnen zur Selbstorganisation und zum gemeinschaftlichen Handeln zur Verfügung? Die Anpassungsfähigkeit von Gemeinschaften, insbesondere im Globalen Süden, ist abhängig vom vorhandenen Sozialkapital, welches sich in sozialen Netzwerken, Selbstorganisation und kollektivem Handeln manifestiert. In dieser Dissertation wird Sozialkapital zunächst aus einer lokal-räumlichen und anschließend aus einer translokalen Perspektive untersucht. Dabei werden lokale sozial-räumliche Strukturen und grenzüberschreitende soziale Netzwerke analysiert.

Die Ergebnisse zeigen, dass Küstengefahren in der Risikowahrnehmung der lokalen Bevölkerung zu etwas Alltäglichem geworden sind. Anstatt umzusiedeln oder permanenten Küstenschutz zu bekommen, finden die Menschen Wege mit den Überschwemmungen zu leben. Anpassungsstrategien (*accommodating*), wie informelle Finanzinstrumente, tragen in weit substanziellerem Umfang zur Erhaltung der Lebensgrundlage der lokalen Bevölkerung bei als bislang von der wissenschaftlichen Literatur anerkannt wird. Darüber hinaus wird gezeigt, dass die spezifischen räumlichen Formen von Stadtvierteln signifikant zur Entstehung des jeweiligen Sozialkapitals beitragen. Insbesondere das Vorhandensein und die Ausgestaltung von sozialen Treffpunkten ist hier maßgeblich. Die urbane Raumausstattung von Nordjakarta unterstützt die Entstehung von „bonding“ Sozialkapital. Dieses fördert die Bildung von „*responsive neighborhoods*“,

die eine mittelfristige Anpassung ermöglichen. „Bonding“ Sozialkapital – im Zusammenspiel mit Ortsgebundenheit und sozialer Zugehörigkeit – ist die wichtigste lokale Ressource für den Umgang mit Küstengefahren. Es gibt jedoch keine ausreichenden Belege dafür, dass die gegenwärtige urbane Form von Nordjakarta die Entstehung von „*adaptive neighborhoods*“ unterstützt. Diese würden soziale Netzwerke zur Außenwelt erfordern, um eine langfriste Anpassung zu ermöglichen. Hierzu zeigen die Ergebnisse zum *translokalen Sozialkapital*, dass Haushalte mit einer höheren Anzahl an translokalen Kontakten mit einer größeren Wahrscheinlichkeit proaktiv gegen Küstengefahren vorgehen. Darüber hinaus ist die Entstehung von translokalem Sozialkapital ökonomisch stratifiziert. Ärmere Haushalte haben weniger translokale Verbindungen, was ihre Anpassungsfähigkeit beeinträchtigt.

Die Ergebnisse tragen zu einer verbesserten Konzeptualisierung von kollektiven Anpassungsprozessen bei und dienen als Grundlage für politische Handlungsempfehlungen. Die Arbeit bietet neuen Erkenntnisgewinn, wie Bottom-up-Ansätze besser mit Top-down-Strategien abgestimmt werden können, eine der größten Herausforderungen für die gegenwärtige und zukünftige Katastrophenvorsorge. Darüber hinaus liefern die Ergebnisse neue Erkenntnisse darüber, wie die urbane Raumausstattung von Stadtteilen das entstehende Sozialkapital und die Anpassungsfähigkeit beeinflusst. Eine räumliche Perspektive auf kollektive Anpassungsstrategien ist wichtig für Stadtplaner, um lokale Gemeinschaften zu stärken. Gemeinsam mit den gefährdeten Gemeinschaften zu planen – anstatt nur für sie – ist der Schlüssel zu einer langfristigen und effektiven Küstenanpassung.

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BAPPEDA	Badan Perencanaan Pembangunan Daerah (District or Provincial Development Planning Agency)
BNPB	Badan Nasional Penanggulangan Bencana (National Disaster Management Agency)
BPBD	Badan Nasional Bencana Daerah (Regional Disaster Management Agency)
DFG	Deutsche Forschungsgemeinschaft (German Research Foundation)
FGD	Focus group discussions
GFZ	German Research Centre for Geosciences
GNSS	Global Navigation Satellite System
GSGS	Graduate School of Geosciences
ICT	Information and communication technologies
IPCC	Intergovernmental Panel on Climate Change
NGO	Non-governmental organization
RQ	Research question
RT	Rukun Tetangga (smaller neighborhood associations)
RW	Rukun Warga (larger neighborhood associations)
SPP	Special Priority Program
UGM	Gadjah Mada University
UI	University of Indonesia
UNDIP	Diponegoro University
VIF	Variance inflation factors

1 Introduction

1 Introduction

"Change is the only constant…" (Heraklitus)

Communities around the world are facing increasingly fast and complex changes in their surrounding socio-ecological systems (cf. Gallopín 2006; Wong et al. 2014). Environmental changes, such as sea level rise, occur at different scales (local, regional, and global) and within different timeframes, each of them bearing specific challenges for exposed local populations (cf. Bennet et al. 2016). Especially in many areas of the Global South, interrelated socio-economic and environmental changes, such as rapid urbanization, land-use changes, and sea level rise are occurring at unprecedented rates (cf. Conway et al. 2019).

Preparing for and responding to sea level change and coastal flooding is one of the major contemporary and future challenges for low-lying coastal areas around the world, including the coastlines of the Indonesian archipelago. Recent estimates from radar altimetry data predict an accelerated sea level rise over the 21st century which would result in average sea level increases in the period to 2100 being twice as fast as current rates (Nerem et al. 2018). Thus, advanced understanding about human responses and planning under uncertainty is urgently required to develop coastal risk reduction strategies in time as even best-case climate scenarios forecast drastic changes (IPCC 2014).

From a social science perspective, the impacts of such slow on-set events (sea level changes in the range of mm per year) on human behaviors are not directly measurable but require a long time series analysis (cf. Kunreuther et al. 2014). To enhance understanding about human responses towards possible future sea level changes, this thesis therefore focusses on areas that are already highly affected by land subsidence and resulting coastal flooding. The specific risk constellation of high subsidence rates (changes in the range of cm per year) makes it possible to study human responses to changing sea levels as if in a time-lapse and to gain empirical evidence on how people respond to these socio-ecological challenges already today.

Within scientific debates about sea level changes, urban coastal areas are of central concern. It is here where impacts such as coastal flooding, erosion, and the resulting destruction of buildings and infrastructure are experienced, which makes human responses to these local impacts inevitably place-specific (cf. Adger et al. 2011, Karlsson & Hovelsrud 2015). Urban areas, especially in coastal regions, are thereby both drivers of and subject to environmental change and resulting coastal hazards (WBGU 2016). As land subsidence is often amplified by anthropogenic impacts, such as large scale land-use changes, excessive ground water extraction, and high urban surface loads, areas with the highest subsidence rates coincide with densely populated settlements (Bott et al. 2018, Marfai et al. 2015, Minderhoud et al. 2018). These processes result in an especially hazardous potential emerging from the interplay of climate-change induced sea level rise (partially in the future) and already existing land subsidence.

This interplay of human-induced and natural hazards in coastal zones is receiving increasing awareness and calls for new approaches in disaster risk reduction to systematically manage and prevent the impacts of contemporary and future coastal hazards (e.g. Wong et al. 2014, Gill & Malamud 2017). These approaches include concepts, policies, and strategies to reduce exposure and vulnerabilities, to plan under uncertainty, to develop sustainable spatial planning and environmental management, and to enhance disaster preparedness (UNDRR 2017).

While disaster risk reduction policies are developed at international and national levels, the laboratories for disaster risk management and the implementation of strategies lie at municipal and communal levels in the exposed cities and villages (cf. WBGU 2016). Here, the marginalized and poor population living on flood plains and along riverbanks are affected the most (cf. Leitner & Sheppard 2018). Especially in the Global South, these local households and communities often have to take on roles that would otherwise be the responsibilities of governmental disaster risk management agencies (Adger et al. 2003). Thus, local communities and households need to develop, organize and implement own bottom-up strategies to reduce risk and to live with floods and subsidence.

This thesis addresses these community-based hazard responses and adaptive capacities. The overarching research question is: *How do households and communities respond to*

coastal hazards and what are their resources to self-organize and to act collectively? Gaining better knowledge about households' and communities' socio-economic vulnerabilities and adaptation pathways is crucial to understand drivers and barriers that enable or hamper coastal adaptation at the local level. The generated empirical evidence is used to advance the theoretical conceptualization of collective adaptation processes and to derive policy implications.

Research in coastal hazard-prone environments provides crucial knowledge about adaptive capacities and bottom-up response strategies that are not only relevant in the Indonesian context, but can contribute to advancing disaster risk reduction in local and regional contexts worldwide. Generating bottom-up insights is important to guide disaster risk reduction that meets the place-specific adaptation needs of local populations. Applying this household and community-based perspective allows to focus on the active agency of local people, instead of depicting them as passive victims in the face of socio-ecological changes (cf. Waters & Adger 2017). Community responses have the potential to add a meaningful bottom-up perspective to the often top-down dominated approaches on disaster risk reduction and to substantially contribute to the success of governmental initiatives (Conway et al. 2019, Murphy 2007, Nakagawa & Shaw 2004). New (soft) adaptation pathways might be identified in addition to engineering and technical construction initiatives which municipal authorities often prioritize (cf. Koerth et al. 2013).

To this aim, this study presents the results of original, mixed-methods social science research, collected in four different coastal hazards exposed urban and rural study areas in North Java, Indonesia (fig 1). The megacity, Jakarta, and the Semarang Bay area are prominent case study areas as these large urban agglomerations show some of the highest subsidence rates worldwide, with maximum subsidence values of 26 cm per annum in Jakarta and 18 cm/a in Semarang (Marfai et al. 2015, Yastika et al. 2019). In consequence, both regions are among the most affected ones by regional sea level change and are highly exposed to frequent coastal flooding (fig 1). This already high flood risk is likely to increase in the future (Hanson et al. 2011).

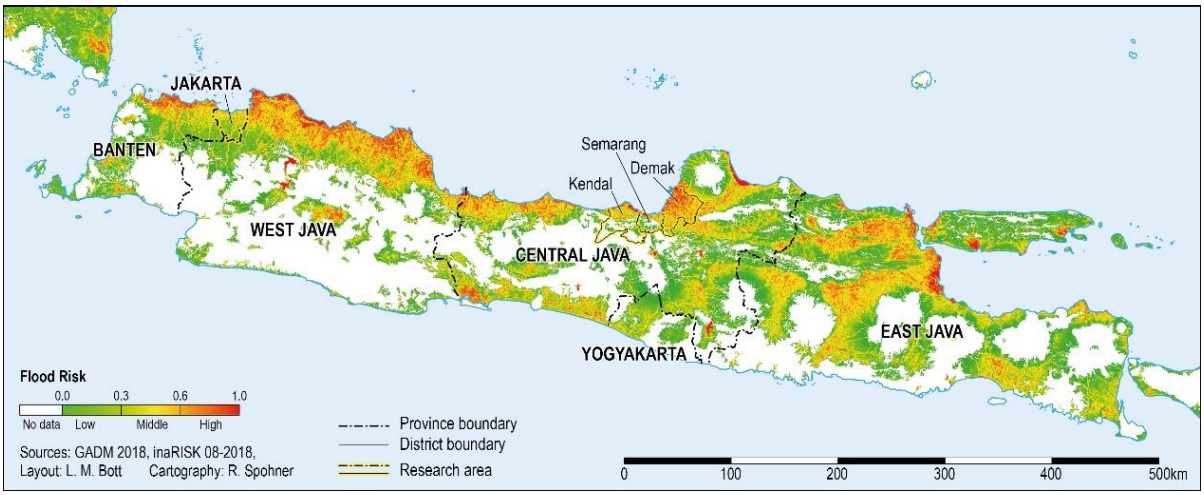

Figure 1: Risk towards tidal and rain/river floods on Java

This research was guided by two main conceptual approaches, i.e. (Chapter 1.1) adaptation to coastal hazards and (Chapter 1.2) social capital and translocality. These concepts will be briefly introduced in the following and allow to derive the nuanced research questions formulated in 1.3.

1.1 Adaptation to coastal hazards

To advance the understanding of human responses to coastal hazards, the IPCC (2014) has developed the tripartite framework of: (1) strategies of *retreat*, i.e. migration, relocation of buildings and infrastructure, managed plot and river realignment, and setback zones, (2) strategies of *protect*, e.g. dikes, seawalls, floodgates, dune restauration, and mangrove reforestation, and (3) strategies of *accommodating* change, namely changes in human activities, daily routines, and infrastructure (Wong et al. 2014). In this context, so far, much attention has been placed on 'big picture issues' such as the debate about climate-induced migration (inter alia: Baldwin & Fornalé 2017, Bettini 2014, Ionesco et al. 2017, Piguet et al. 2011, Rothe 2017, Tacoli 2009, Trombetta 2014) or large governmental prestige projects such as big seawalls (inter alia: Colven 2017, Sumantyo et al. 2016, van der Wulp et al. 2016).

However, these two strategies of retreating and structural protection do not reflect the realities and daily practices of most coastal populations. Despite their flood exposure, most coastal urban areas in the Global South are still gaining populations, a trend which is expected to further continue (Birkmann et al. 2010, McGranahan et al. 2007, Merkens et al. 2016, Neumann et al. 2015). Hence, local communities and households must have developed strategies to live with their hazardous environment and these community-based accommodating strategies can be assumed to be carried out to a much larger extent than commonly assumed in academic studies.

Yet, accommodating practices – in particular on the household and community level – remain largely under-emphasized in the scientific literature. This study addresses this research gap and examines *how households and communities accommodate risks*, and offers an empirical evidence-based conceptualization of accommodating practices (Chapter 4). Developing a modified framework allows to more firmly articulate *accommodating practices* and to include them in conceptual frameworks which guide further research. In this study, 'human responses to coastal hazards' are understood as an umbrella term for both short-term and recuperative coping as well as for long-term and proactive adaptation (cf. Gallopín 2006). Nevertheless, within the detailed analysis of accommodating processes, differentiations in timescale, quality, and agencies are applied to examine the viability of different hazard response options (Chapter 4).

Furthermore, empirical evidence of this study shows that the capacities of households and communities to carry out accommodating practices are dependent on their ability to self-organize and to act collectively. This is especially true for poorer communities faced with complex and slowly emerging risk constellation such as relative sea level rise along the north coast of Java. These communities often lack the financial and human capital required for strategies of retreat and protection (cf. Koerth et al. 2014). Thus, instead they change their daily practices and organize themselves, e.g. by installing collective informal non-bank saving systems or organizing collective waste cleaning of dikes and ditches. This thesis, then, provides a practical and grounded lens on the realities of living with sea level change and land subsidence by investigating these capacities to act collectively with a focus on social capital and social networks on different geographical scales.

1.2 Collective responses: Social capital and translocal networks

Many empirical studies have shown the importance of social capital in the collective adaptation processes of local communities and households (inter alia: Aldrich 2011, Chatterjee 2010, Murphy 2007, Portes 1998). In fact, social capital is assumed to be the most important capital endowment of local communities in the Global South (cf. Braun & Aßheuer 2011). Through trust and reciprocal support, members of social networks are able to secure benefits and to organize the access to tangible and intangible resources such as loans, remittances, mutual help, advice, information, and knowledge (cf. Kerr 2018, Portes 1998).

The overarching hypothesis of this study is that these assets have the potential to become valuable resources for disaster recovery, community adaptation, and long-term responses to natural hazards (cf. Aßheuer et al. 2013). Therefore, this study analyzes the role that social capital plays for collective hazard responses; thereby looking at the effects of local bonding social capital between largely homogeneous groups as well as of bridging and linking ties that connect people over different socio-economic and cultural backgrounds or even over different hierarchical social stratums (cf. Agurto Adrianzén 2014, Lin 2008, Portes 1998). Former assumptions are investigated that bonding ties are more likely to support short-term coping practices and recovery, whereas the bridging and linking ties are essential for the innovation of ideas and long-term adaptation (cf. Aßheuer 2014, Hawkins & Maurer 2010). To this aim, social networks are analyzed in different geographical scales, both with a local perspective on socio-spatial practices as well as with a perspective of border-crossing translocal ties.

1.2.1 Social capital and spatial structures

Firstly, this thesis applies *social capital from a spatial perspective*. Socio-spatial practices and structures still remain underestimated in hazard research, despite the significance of social capital for community-based adaptation (cf. Acedo et al. 2017, Adger et al. 2011, Marshall et al. 2012). This is surprising, as discussing such geographical aspects of social capital is not new to social sciences, especially economic geography

(inter alia: Adger et al. 2003, Bathelt & Glückler 2018, Bærenholdt & Arsæther 2002, Boschma & Frenken 2006, Jacobs 1961, Lin & Lockwood 2014).

This study addresses this research gap with the aim to introduce the debate of socio-spatial practices into hazard research (Chapter 5). Based on former research by Adger et al. (2011), Houghton (2005), Spencer (2015), Wood & Giles-Corti (2008), the hypothesis is derived that a) the specific urban form of a neighborhood, especially in the presence and form of places to meet, is decisive for the probability of social encounters and dwell-time and, therefore, shaping social networks and b) that the emerging social capital is in turn decisive for collective adaptive capacities.

Drawing on concepts of economic geography on 'knowledge neighborhoods' and 'urban creative fields' (Scott 2010, Spencer 2015), this thesis develops the concept of an *'adaptive neighborhood'*. Such a neighborhood resembles the ideal of a socio-spatial fabric with well-established social networks of all types (bonding, bridging, and linking) that allow for local self-organization and immediate mutual help, as well as for the exchange of new knowledge and innovative ideas. This concept contributes to a new understanding on how social networks are formed and why certain groups or individuals are excluded or included. Furthermore, the results offer new guidelines for more sustainable urban planning.

1.2.2 Translocal social capital

Secondly, this study analyzes *social capital from a translocal perspective*. Spatially-anchored local bonding social capital plays a key role in the disaster recovery and hazard accommodating processes of vulnerable households and communities. However, in an ever more integrated world by globalization and technological innovations, social networks increasingly transcend the local and connect people from different places, regions, and countries (cf. Andersson et al. 2018, Boas 2017, Rockenbauch & Sakdapolrak 2017). Despite this fact, most of the existing studies on the use of social capital in adaptation processes have framed these processes in place-based ways, thereby running the risk of underestimating the emergence of boundary-crossing, trans-

local social networks (inter alia: Adger 2003, Aldrich 2011, Aßheuer et al. 2013, Chatterjee 2010). Likewise, most studies on translocality in anthropology, geography, cultural sciences, and population and development studies have not applied their approaches in environmental and hazard research (inter alia: Brickell & Datta 2011, Etzold 2016, Greiner 2010, Steinbrink 2009, Verne 2012, Zoomers et al. 2016). A first exception is a recent publication by Rockenbauch and Sakdapolrak (2017), who combine insights from translocality and resilience studies.

This thesis aims at broadening this relatively narrow view of social capital in hazard and environmental change research; and develops the hypothesis that the response capacity of local households and communities can be further enhanced by engaging in translocal social networks, which allow to overcome local resource constraints and to develop innovative ideas for proactive response measures (cf. Norris et al. 2008, Chapter 6). To this aim, this study conceptualizes social capital not only as a local but also as a translocal phenomenon and evaluates the significance of translocality for the use of social capital in hazard responses. Translocality here is understood as social networks that extend over multi-scalar geographies and that support network members to circulate, to share common practices, and to exchange ideas and resources (Greiner & Sakdapolrak 2013).

Adding this perspective of *translocal social capital* to hazard research allows to develop a more holistic conceptual framework to analyze resources, structures, and dynamics of social networks of different scales. The concept offers numerous advantages for disaster risk reduction studies. It has an actor-oriented focus, emphasizes the importance of networks, shifts the focus away from the national state towards local processes, and enables researchers to analyze the formation of social capital beyond processes of human migration (e.g. by including communication technologies). Moreover, by explicitly focusing on local conditions, an emphasis is put on the physical environment (cf. Greiner & Sakdapolrak 2013).

The combination of formerly separated branches of research offers critical new insights. So far, social capital has been assumed to work as a substitute for lacking financial and human resources in poor communities (inter alia: Li et al. 2017, Nasution et al. 2015, Rustiadi & Nasution 2017). However, insights from translocally studies have

indicated an important role of financial and human capital in establishing translocal social networks which is strongly shaped by practices such as migration, producing within global value chains, tourism, and the use of information and communication technologies (Etzold 2016, Freitag & Oppen 2010, Zoomers & van Westen 2011). Therefore, the hypothesis is derived that a certain amount of financial assets and education are in fact required to engage in translocal networks and to build translocal social capital.

To capture the different local and translocal forms of social capital, this study applies a multi-place-based approach with a rural-urban perspective. In doing so, it is possible to adequately cover the specific roles of bonding, bridging, and linking ties. Traditionally, translocality research stemming from transnationalism approaches has focused on international relations, especially migration (e.g. Ley 2004, Levitt & Glick Schiller 2004, Smith 2001, Guarnizo & Smith 1998, Basch et al. 1995). However, more recent studies also focus on regional translocal spaces. Thereby, rural-urban interactions often represent particularly dynamic social linkages (Greiner & Sakdapolrak 2013).

In general, this study analyzes how both local and translocal social capital enables (or hampers) the endowed households and communities to live with coastal flooding and sea level change. The results lead to improved knowledge about bottom-up adaptation processes and local response capacities in times of rapid socio-environmental change. Furthermore, this approach allows to analyze why vulnerabilities are unevenly distributed even at the local level and why some households respond proactively while others do not (cf. Conway et al. 2019).

The results of this thesis add to moving forward the contemporary theorization of concepts that are important to advance in social science hazard research, namely *accommodating*, *adaptive neighborhoods*, and *translocal social capital*. Embedded within the theorization of these three concepts lies the aim to better align community-based hazard responses with top-down governmental disaster risk reduction (cf. Koerth et al. 2014). This is highly relevant as community-based responses tend to escape the purview of policy makers who often plan for disaster risk reduction with limited understanding or consideration of household response strategies, which in turn can lead to adverse ef-

fects such as maladaptation and social conflicts. Therefore, key parameters and pathways for top-down interventions and the linking of top-down and bottom-up strategies are discussed with each concept. In that way, the findings of this thesis also aim to contribute to more sustainable coastal risk reduction which includes and empowers local communities.

1.3 Research questions and structure of the thesis

To analyze the outlined research gaps, this thesis draws on a multi-place-based case study of rural and urban areas along the north coast of Java, Indonesia, to answer the following main analytical research questions (RQs):

RQ 1: How do households and communities accommodate the uncertainties of coastal flooding and sea level change? Behind this question stands the hypothesis that local households and communities, instead of retreating or gaining permanent protection, carry out accommodating strategies and slowly change their day-to-day practices.

RQ 2: What strategies do communities apply to self-organize and to absorb the risk of coastal hazards? With this question, the hypothesis is investigated that high participatory capacities and traditions of self-organization enable local communities to accommodate their multi-risk environment.

RQ 3: What role does social capital play in collective responses of households and communities compared to other capital endowments? This question addresses two hypotheses: a) that social capital has a positive impact on collective bottom-up hazard responses, and b) that for collective responses of communities and households in the Global South, social capital tends to be more relevant than other forms of capital.

RQ 4: How is social capital interlinked with the urban form of neighborhoods and what is the impact on the community's response capacity towards coastal hazards? Here, it is hypothesized that the formation of social capital as a resource for hazard responses is partly determined by the specific urban form of the neighborhood.

RQ 5: What role do translocal social networks play for the responses of local households to coastal hazards, and how are these networks established? The two hypotheses entailed in this question are: a) that households with more translocal contacts are more likely to undertake proactive measures against coastal hazards and b) that, in contrast to local social capital, translocal social capital requires a significant amount of financial and human capital to be established.

The remaining six chapters of this thesis are structured in the following way: In the subsequent Chapter 2, the research design is described. Chapter 3 presents the multi-risk environment of the case study areas in more detail. This chapter elaborates on natural and anthropogenic processes contributing to sea level change and coastal flooding as well as on socio-economic and political factors, which add to vulnerabilities.

Chapters 4 to 6 each present individual research papers which analyze the central research questions named above. Consequently, each chapter entails a separate introduction, theoretical framework, methods, discussion, and conclusion. Chapter 4, on *accommodating* strategies in the Semarang Bay area, analyzes community-based responses to coastal hazards and establishes a new framework for the contemporary theorization of accommodating. The two following chapters analyze social capital and networks with a primarily local (Chapter 5) and a broader translocal perspective (Chapter 6). Chapter 5 applies a local place-based focus on urban coastal neighborhoods in North Jakarta and examines the relationship between the urban form, social capital, and the resulting response capacities of these neighborhoods. In this chapter, the concept of an ideal *adaptive neighborhood* is developed. Chapter 6 then expands this local focus to all rural and urban study areas and beyond by taking on a *translocal perspective on social capital* as a resource for hazard responses.

Finally, Chapter 7 answers the research questions and offers a broader discussion of the empirical results and new conceptual frameworks with regard to theoretical contributions and political implications. Furthermore, it discusses the limitations of this study and provides recommendations for further research.

Research design

2.1 Sampling of case study areas on Java

2.2 Mixed-methods approach

2.3 Ethical considerations

2 Research design

This study applies a case study approach (cf. Yin 2014). Case studies are beneficial in analyzing household and community-based hazard responses, as they provide the contextualization for risk perceptions, problem articulations, and decision-making (cf. Potschin & Haines-Young 2012). This chapter describes the research design of this study and explains the sampling of the study areas and the applied mixed-methods approach.

2.1 Sampling of case study areas on Java

Given the translocal focus of this study, a multiple place-based approach is adopted, focusing on four different rural and urban locations. A multi-place-based analysis is useful in questions on translocal networks (RQ 5, Chapter 6) as it allows to analyze both 'mobility' and 'places' (cf. Zoomers & van Westen 2011). To gain a comprehensive picture of vulnerabilities and response capacities of households and communities towards current and future coastal flooding and sea level change (RQs 1 & 2), it is necessary to integrate both rural and urban settlements. This selection allows to analyze household and community-based hazard response strategies in regard to rural-urban livelihoods and different capital endowments (RQs 3 & 5).

Thus, to inquire into adaptation processes, social networks, and migration patterns, I chose to analyze coastal settlements of different scales on Java, namely urban neighborhoods in the capital and megacity Jakarta and in the regional urban center Semarang, as well as neighborhoods in surrounding peri-urban villages in the district Kendal and rural villages in the district Demak. Together Kendal, Semarang, and Demak represent the Semarang Bay area (fig 2).

Megacities such as Jakarta, with more than 10 mill inhabitants, are in the center of social science hazard research since these places combine high exposure with high anthropogenic contributions to environmental changes (WBGU 2016, UN DESA 2019). The reason to focus on a second-tier city, such as Semarang, is that many of these cities

are growing particularly fast. These cities can be seen as ‘emerging megacities’, with all the administrative thresholds that a mostly unplanned development entails, making them highly vulnerable towards natural hazards and sea level changes (Birkmann et al. 2016). A vulnerability which remains under-researched in comparison to the one of megacities. Only recently, second-tier cities have become a subject of renewed interest by scholars and development organizations (Roberts 2014).

Furthermore, this thesis includes peri-urban areas in the Kendal district, as these are faced by sub-industrialization and urban sprawl from the city of Semarang. These processes contribute to rapid land-use and environmental changes. In turn, rural areas, such as Demak, still remain less prioritized in coastal hazard research (Kapucu & Rivera 2013). However, in many countries of the Global South the share of population living in rural areas is still high and often growing. In Indonesia, a country with comparatively high urbanization levels, about half of the population still lives in rural areas (BPS 2014). These areas are often characterized by structural weaknesses and tend to be marginalized in governmental disaster risk reduction (Kapucu & Rivera 2013).

The specific neighborhoods and villages within all four study areas were chosen based on on-site inspections and in close collaboration with local research partners from the Faculty of Geography of Gadjah Mada University (UGM) in Yogyakarta, the Geology Department of Diponegoro University (UNDIP) in Semarang, and the Department of Geography of University of Indonesia (UI) in Jakarta.

Indonesian cities are structured in the following administrative units: Kota (city), followed by Kecamatan (district), Kelurahan/Desa (urban quarter/rural village), RWs (larger neighborhood associations, usually 5-10 per Kelurahan), and finally RTs (lower level neighborhood associations of about 40 to 60 households; Marfai et al. 2015). For the study at hand, I chose Kelurahan and Desa as the administrative units of analysis.

The criteria for the sampling of the specific Kelurahan and Desa were based on spatial structures, land-use, and housing patterns, and on coastal hazards impacts. Selected Kelurahan/Desa had to be located along the coastline and being influenced by coastal hazards, at least by tidal floods and future sea level rise. All selected Kelurahan/Desa are furthermore located on alluvial plains and, thus, are potentially prone to land subsidence and rain/river flooding (fig 2). In terms of land-use, the areas had to be housing

areas with single unit houses, including neighborhoods with formal and unplanned residential statuses.

These criteria allow for a comparison between the Kelurahan/Desa based on similar natural hazards exposure and housing patterns. However, they cover different social, ethnical, and religious backgrounds, including lower and lower-middle income households as well as long-term established and newer settlements. It was not possible to interview higher middle- or high-income residents, because people of a higher social stratum often tend to live in gated communities which cannot be accessed by the interviewers. Moreover, housing areas of higher-income residents are largely flood protected and, hence, not in the focus of this study.

In total, seven Kelurahan were sampled along the coastline of Semarang during the first field research phase in 2016. They cover the major share of the coastal residential areas of the city (fig 2). In the second field research phase in 2017, I further selected the Kelurahan and Desa in Jakarta, Demak, and Kendal. The seven Kelurahan in Jakarta were selected based on the same criteria as in Semarang. In the rural areas, additional sampling criteria were applied. Rural villages in Demak had to be located at least 1.5 driving hours away from Semarang, to avoid daily commuter relationships and to ensure rural livelihood patterns. Peri-urban villages in Kendal are, in turn, located in an area well connected to the City of Semarang by major roads and the railway (fig 2). Industrial suburbanization towards this district is ongoing (cf. The Jakarta Post 2016).

Sources: GADM 2018; OpenStreetMap; Sentinel 2 Natural Color (4/3/2) [modified Copernicus Sentinel, processed by ESA]: Jakarta 2018-06-19, Semarang 2018-08-20
Layout: L. M. Bott Cartography: R. Spohner

Figure 2: Study areas and land-use patterns

2.2 Mixed-methods approach

This study follows a mixed-methods social science approach (cf. Kelle 2014), consisting of focus group discussions (FGD) and a questionnaire household survey as the main instruments, supplemented by a final experts' workshop, cultural mapping, and additional key informant and expert interviews (fig 3 & 4). Qualitative and quantitative methods were conducted separately in different research phases; but the methods' development builds on one another and the results were systematically triangulated.

A mixed-methods approach was chosen, as social capital and social networks of all scales are only measurable by indirect and disaggregated indicators. A combination of qualitative methods with a larger scale household survey provides a substantial advantage for advancing in studies of adaptation processes (cf. Pelling & High 2005).

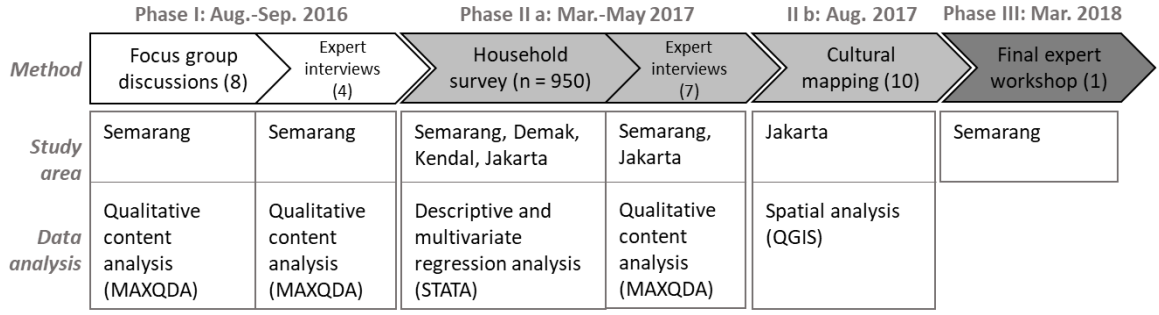

Figure 3: Schematic overview of research phases, applied methods, and data analysis

2.2.1 Focus group discussions

The first field research phase from August to September 2016 consisted of an explorative qualitative investigation in the Semarang area (fig 3). This phase entailed eight FGDs conducted at the community level. In this thesis, 'community' is understood synonymously with a spatial neighborhood unit. Members of one community are living in the same neighborhood, knowing one another, and sharing some degree of common perceptions and narratives about their surrounding socio-ecological environment (cf. Murphy 2007). FGDs served as an entry point into the field research to gain first knowledge about the communities under study, to further frame the research design,

and to develop the household survey questionnaire (cf. Flick 2014). This qualitative method is particularly valuable when discussing more 'fuzzy' aspects such as social norms and cognitive barriers which can be glossed over by standardized surveys. FGDs allow not only to gain relevant qualitative information but to analyze the interactions and communication patterns between participants (cf. Longhurst 2010). They are a fitting method in analyzing social norms, collective knowledge, and shared cultural embeddedness all of which determine risk perceptions and institutions regulating collective actions (cf. Flick 2014). Regarding the main research focus, this method is mainly suitable for analyzing social ties within networks where people personally know each other (local linkages but also family ties between different localities; RQs 1-3 & 5). A particular focus was laid on obtaining information about how people interact and collaborate in local social networks, including resources that they share and relevant ways of communication.

The guideline questionnaire of the FGDs was developed based on an intensive literature review and was structured in five sections which include questions on (1) community/household characteristics and livelihoods, (2) hazard exposure and risk perceptions, (3) personal and collective hazard response strategies, (4) social capital, and (5) translocal and local social networks (see Appendix A).

I conducted the FGDs with the assistance of three students from UGM to reduce language and cultural barriers. I conducted one female only and one male only FGD. However, as the results turned out very similar, the other FGDs were conducted with mixed-gender participants. Each FGD had seven to eleven participants, with a total of 29 female and 46 male discussants from seven urban quarters in Semarang.

Qualitative results were translated and transcribed with the help of the local field assistants. The data analysis was oriented on a qualitative content analysis (cf. Mayring 2004). For the detailed analysis, an open coding system was applied using MAXQDA. In doing so, patterns and connections between statements were identified and linked into categories (cf. Bryman 2008).

2.2.2 Quantitative household survey

Based on a former literature review and on the qualitative results, I subsequently developed the questionnaire for the household survey, structured in the same five sections as the FGD guideline questionnaire. Developing a questionnaire based on literature review, such as the World Bank Social Capital Assessment Tool (Krishna & Uphoff 1999), allows to include well-established indicators which enable future comparative studies. In addition, the qualitative results from the FGDs enabled the development of answer categories specific to the Javanese context. This procedure ensures both the comparability of the study as well as the explanatory power of the results for the specific case study.

The household survey was carried out between March and May 2017. The quantitative survey targeted households within neighborhoods in all four study areas: Demak, Kendal, Semarang, and Jakarta. This method was chosen in order to gain detailed knowledge about vulnerabilities, hazard response strategies, and social networks not only regarding bonding, but also bridging and linking ties (RQ 1, 3 & 5). The survey includes questions about social networks and social capital such as collective ways of decision-making, close friends, family ties, links to other social groups, migration of household members, sources of financial support, participation in collective activities, and mutual help in times of crisis. Questions address issues such as trust in neighbors, relatives, NGOs, and local leaders as well as social norms, benefits, punishments, and social responsibilities. Further questions deal with coastal hazard response strategies, perceptions of hazard exposure, and knowledge about underlying physical and anthropogenic processes (see Appendix A).

Two teams of 15 and 16 student assistants from UGM, UI, and UNDIP conducted the survey in Indonesian under my supervision in the Semarang Bay area (Semarang, Demak, and Kendal) and in Jakarta. Both interviewer teams were trained during three days' kick-off workshops in each region. A pretest was conducted and evaluated at the beginning of March 2017 in Semarang.

In total 950 households were surveyed (not counting the pre-test), distributed between the four study areas: Demak: n = 160, Kendal: n = 160, Semarang: n = 330, and Jakarta:

n = 300, representing 2 248 female and 2 122 male household members. The interviewed households were selected during random walks, choosing every fifth house on a street. The resulting answers were coded as numbers and entered by the research assistants into an English/Indonesian excel file. The respondents' ratio female to male was close to 50/50. The survey targeted households as collective units of decision-making. In the questionnaire, household members were defined as all people who sleep and eat under the same roof a minimum of 180 days per year.

After finishing the subsequent data cleaning, I analyzed the quantitative data statistically using STATA. Descriptive and bivariate analyses were used to obtain general weightings and first data overviews in all three research papers (Chapters 4-6) as well as to identify significant correlations between two variables, e.g. a correlation between participating in neighborhood meetings and participating in collective activities (RQ 2, Chapter 4); or correlations between different proactive hazard response measures and a high number of translocal contacts (RQ 5, Chapter 6). A more detailed understanding was obtained from multivariate analyses. A binary logistic regression analysis was applied to identify the impact of social capital on collective adaptation measures (RQ 3, Chapter 5). A Poisson regression analysis was carried out to examine the origin of translocal social capital by using a dependent count variable of the number of translocal contacts a household has as the dependent variable (RQ 5, Chapter 6).

In the final data analysis, complementary results from the FGDs and the household survey were used to gain a more comprehensive picture, e.g. the qualitative results allow to analyze narratives about living in a multi-risk environment as well as agreements and disagreements among the discussing community members, whereas quantitative results enable to analyze the actual versus perceived hazard exposure. In addition, comparable results from both methods were triangulated to cross-check convergent or divergent results and to achieve a higher validity of the research findings. Qualitative results helped to interpret significant statistical findings, and the quantitative results supported qualitative findings with statistical numbers (see fig 4). The following additional methods further complemented this mixed-methods approach (see fig 4).

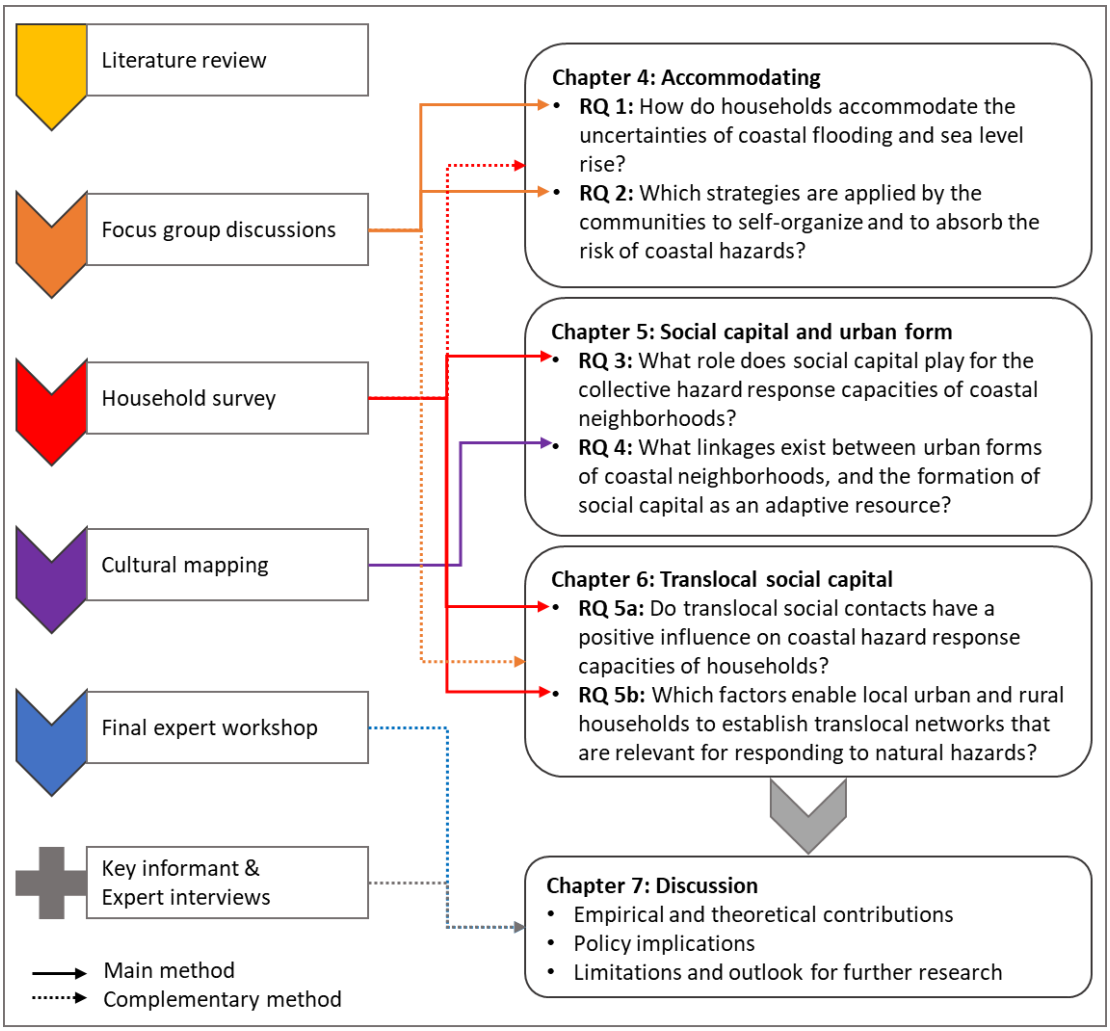

Figure 4: Application of methods related to the respective research questions

2.2.3 Cultural mapping

To analyze the urban form of neighborhoods in the study areas in Jakarta, furthermore, the results of cultural mapping are used with the aim to identify the spatial basis for the emerging social capital (RQ 4, Chapter 5). This method is applied to explicitly visualize socio-spatial relationships and practices (Sacco & Vella 2017). This particular method was carried out by Leda Ankel during field research for her master's thesis in close collaboration with the TRANSOCAP research project (cf. Ankel 2018). Central research questions and the classification of mapped places were developed based on the

household survey. The data analysis combines the results of both methods to answer questions about the urban form of public open spaces in coastal neighborhoods of Jakarta (RQ 4).

2.2.4 Final experts' and practitioners' workshop

The validation of empirical results was further enhanced by presenting the findings at all three Indonesian partner universities and by conducting a final experts' and practitioners' workshop of the TRANSOCAP project in March 2018 in Semarang. Twenty local experts from academia, provincial and municipal government, and NGOs discussed and commented on the empirical findings and debated potential implementation options. The aim was to gain feedback on the empirical results as well as to identify which aspects of this research are of particular concern from the perspective of local practitioners.

By conducting this participatory method, key findings were translated to practitioners. That way, an interactive dialog was achieved with the goal to enable mutual benefits for both participants and researchers (cf. Preller et al. 2017). The results of these discussions enabled the identification of cognitive barriers in top-down hazard planning and give insights into policy practices which support the final discussion of the research findings (Chapter 7).

2.2.5 Qualitative interviews

In addition to the principal research methods, I conducted eleven open qualitative interviews with local community leaders, municipal officials, university scholars, and hazard management agencies (see Annex A). The aim was to gain additional background information on governance and top-down perspectives, which add to the community- and household-based research design of this study. These interviews were either conducted directly in English or translated with the help of local student assistants. The interviews were either recorded and transcribed in English, to allow for a content analysis, or notes were taken during the interviews.

2.3 Ethical considerations

Prior to the interviews, all FGD participants were asked about their permission for recording. They all gave their consent. The anonymity of all participants is guaranteed by applying a numbering system in both quantitative and qualitative data analyses and in the written version of the research results. Before starting the FGDs and the survey, all participants were informed that they did not have to feel obligated to answer questions they did not feel comfortable with. After the publication of this thesis, the results will be made available to participants who expressed their interest

Sea level change, coastal flooding, and subsidence along the north coast of Java

3.1 Relative sea level rise: Physical and anthropogenic causes

3.2 Socio-economic vulnerabilities and governmental disaster risk management

3 Sea level change, coastal flooding, and subsidence along the north coast of Java

Urban coastal areas are at the center of political and scientific debates about global sea level rise and local hazard risk reduction. In these places, the negative effects become particularly visible, e.g. in the form of coastal flooding, erosion, and storm surges. Jakarta has one of the highest urban flood risks worldwide, and the Semarang Bay area shows similar exposure (Abidin et al. 2013, Hanson et al. 2011). Over the last decades, both Jakarta and Semarang have undergone a rapid population increase, reaching 10 mill and 1.5 mill inhabitants respectively in the core municipal areas alone (Garschagen et al. 2018, Marfai & King 2008). Consequently, housing and economic activities are sprawling into sensitive low-lying coastal zones and coastal flooding is becoming ever more frequent (Garschagen et al. 2018, Neise 2019). Thus, current and future sea level changes are becoming an immense challenge for municipal planning agencies as well as for the inhabitants of coastal neighborhoods.

To analyze the main research questions regarding human hazard responses, first, these underlying natural and anthropogenic processes need to be understood. To this aim, this chapter addresses relevant socio-environmental processes within the study areas in North Java. The following questions are discussed: Which coastal hazards affect the north coast of Java? How do natural and anthropogenic processes contribute to sea level rise? What socio-economic and political factors add to human exposure?

3.1 Relative sea level rise: Physical and anthropogenic processes

Globally, the average sea level is currently rising by 3.1 to 3.5 mm/a (Esselborn & Schöne 2012, Kusche et al. 2016). However, there are strong regional variances. Throughout the Indonesian archipelago, local sea level changes show rates between -5 mm/a and +10 mm/a (Bott et al. 2018, fig 5).

For the north coast of Java, data from both Global Navigation Satellite System (GNSS)-controlled tide gauge stations and radar altimetry show no significant trend in the absolute sea level change (Bott et al. 2018). These combined measurements are necessary, as radar altimetry data can only be obtained at 10 to 30 km distance from the coastlines because radar signals illuminate about 10 km diameters of sea surface. Hence, in coastal areas, these raster contain reflections of land masses which interfere with the sea surface signal (Kusche et al. 2016).[1] Thus, tide gauges are required to obtain water-level data directly at the coastline. Within these stations, first, the water level sensors measure the water levels in relation to the tide gauge station. Second, at GNSS-controlled stations, the GNSS antenna on the roof of the station measures the vertical position of the building, which allows to calculate the influence of land movements. The combined GNSS-tide gauge measurements then allow for the analytical distinction between sea level change and subsidence or heaving of the land mass.

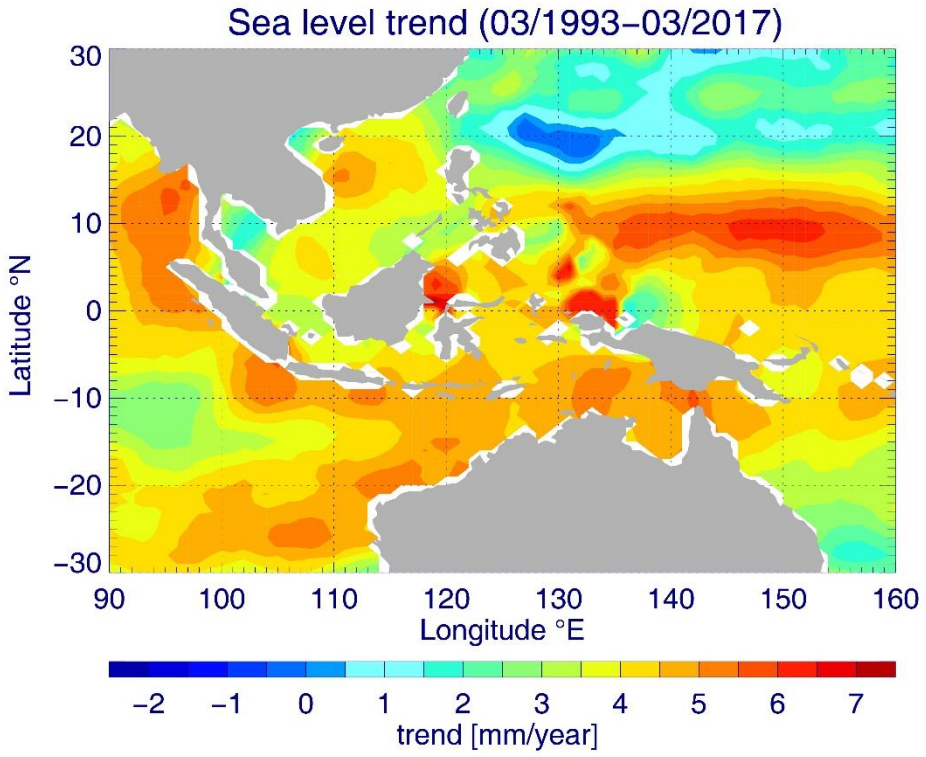

Figure 5: Local sea level trend in Indonesia (1993-2015)
Source: edited after GFZ Potsdam in Bott et al. 2018: 5.

[1] Within the next years, newly developed measuring systems integrating Synthetic Aperture Radar with radar altimetry will allow measurements much closer to the coastline (Kusche et al. 2016).

In Semarang, isolated tide gauge measurements show an average sea level increase of about 10 cm/a for the years 2012 to 2017 (fig 6: blue curve). At the same time, GNSS measurements reveal an opposite vertical movement of the tide gauge station, which means that the whole structure is subsiding with the same rate of 10 cm/a. Accordingly, a combined sea level measurement curve cleared of subsidence shows no significant change in the absolute sea level (fig 6: orange curve). Red dots indicate radar altimetry measurements, which also show almost stable water levels (fig 6).

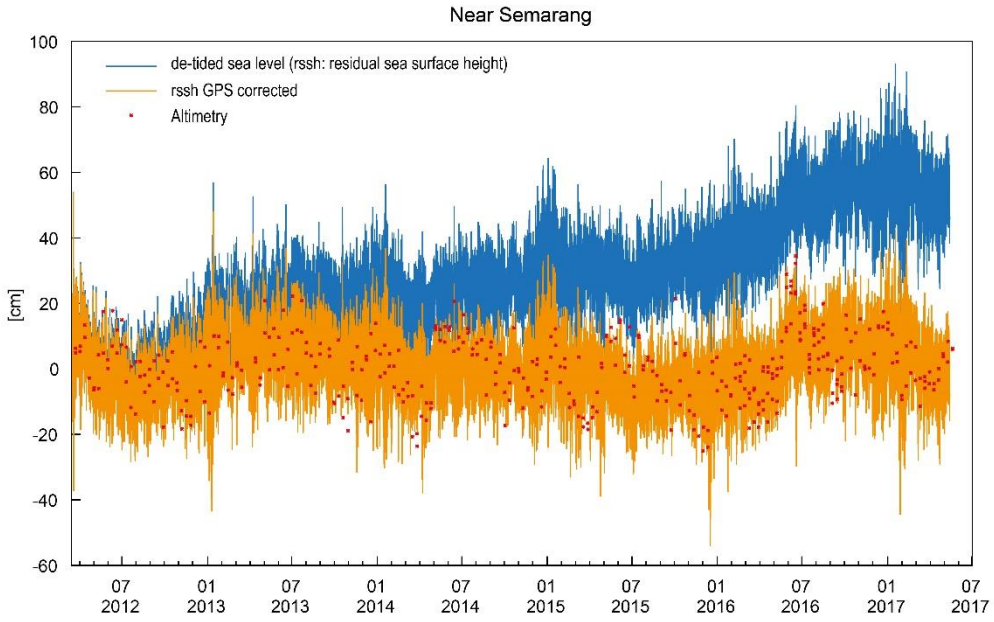

Figure 6: GNSS-tide gauge measurements in Semarang
Source: edited after GFZ Potsdam in Bott et al. 2018: 6.

Longer-term radar altimetry data from 1993 to 2017 obtained near the coast of Semarang confirm this result of no significant trend with regard to absolute sea levels (fig 7). Time series are constructed by consistently combining data from subsequent satellite missions (different colors in the plot). Oscillations in the curves (fig 6 & 7) are mainly caused by El-Niño and La-Niña events. Thus, all available data confirm that the locally visible sea level rise along the northern Java coastline is currently almost exclusively a relative one, which means that it is only occurring in relation to this specific

coastline caused by land subsidence and not by an actual rising sea level due to global warming[2].

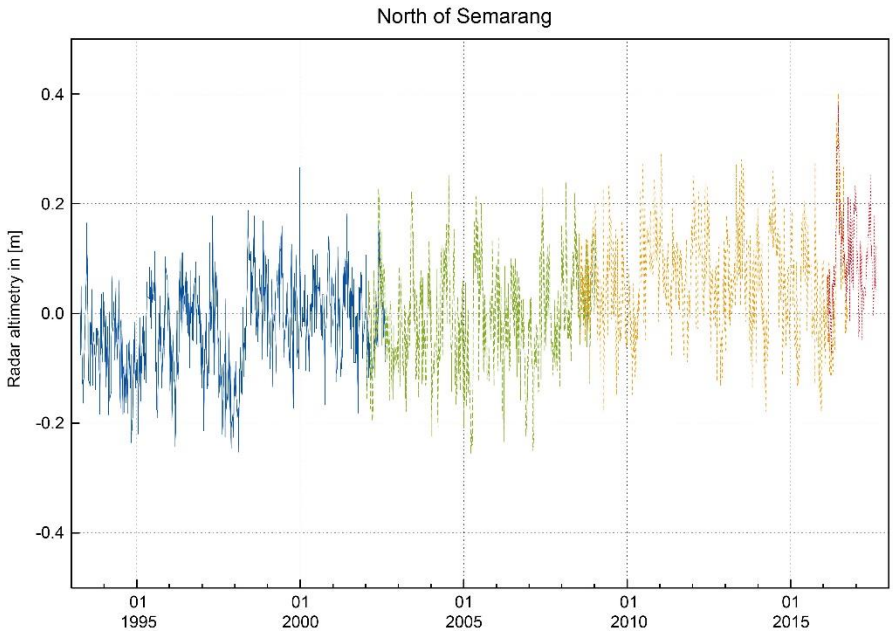

Figure 7: Radar altimetry measurements near Semarang (1993-2017)
Source: edited after GFZ Potsdam in Bott et al. 2018: 6.

Land subsidence occurs almost along the whole north coast of Java as the geologically young clay-silt soils of the alluvial plains are still naturally consolidating (Bott et al. 2018). In urban agglomerations and especially in Jakarta and Semarang, this natural subsidence is strongly accelerated by anthropogenic processes. In Semarang, over the last three decades, 12 km² of former alluvial plains, rice paddies, and fishponds, which functioned as buffer zones between the sea and the city, have been urbanized (Harwit-asari & van Ast 2011). Within the administrative boundaries of Jakarta, the built-up area has increased by 276% since the late 1970s (Garschagen et al. 2018).

In addition, large parts of newly urbanized areas are built on reclaimed land with even less compacted soils (Abidin et al. 2013). Land reclamation has been ongoing since the colonial Dutch period, over more than 300 years, but has been accelerating with the

[2] Measurements of relative sea level rise refer to the respective coastlines and rely on local tide gauge stations. In contrast, absolute sea level rise is usually measured by radar altimetry, which is independent of the landmass but refers to an ellipsoid (Kusche et al. 2016).

rapid urban sprawl of the last decades. About 40 years ago the coastline of Semarang was one to two kilometers distant from the settlements. Originally, this land had been used for agri- and aquaculture purposes. *"The fact is that land reclamation significantly influences this area. The condition of recharge areas, the fishponds, and also coasts – those spaces should be allocated for water, well, the business sectors infilled these areas and turned them into buildings"* (FGD Trimulyo, M6)[3].

In built-up areas, the high urban surface load increases the natural soil consolidation. Most importantly, groundwater extraction is increasing due to continuously rising fresh water demands of the growing industry and population. The exact contribution of the three main causes of subsidence (natural soil compaction, surface load, and groundwater extraction) has not been quantified yet. However, there is a strong agreement about groundwater extraction being the main driver (cf. Marfai et al. 2015, Yastika et al. 2019). The depletion of aquifers creates cavities in the subsoil which are compacted by the high surface load before the aquifers can be naturally refilled (Bott et al. 2018, Minderhoud et al. 2018). In consequence, the porous sediment soil subsides in many areas. Average subsidence rates are higher in Semarang than in Jakarta with 6 to 7 cm/a compared to 4 cm/a, however, maximum peaks of 26 cm/a are reached in Jakarta compared to of 18 cm/a in Semarang (Abidin et al. 2013, Marfai et al. 2015, Yastika et al. 2019). These rates are still increasing (Yastika et al. 2019). The damage on buildings and infrastructure is high, making frequent elevations necessary. Of the surveyed households, 55% reported being affected by subsidence. However, all households were selected in subsidence areas, thus, the actual number is much higher. The main reason behind this mismatch is that some coastal dwellers blame street elevations by the municipal authorities for the lower levels of their buildings due to a lack of knowledge about the processes and causes of land subsidence (FGD Mangunharjo, M3; Tugurejo, M1).

Because of subsidence, low-lying coastal zones are increasingly prone to tidal, pluvial, and fluvial floods. Risk towards coastal flooding is particularly high in the three largest coastal urban agglomerations on Java, namely Jakarta, Surabaya, and Semarang (fig

[3] All quotes from FGDs are structured in: (FGD Place, M=male/F=female and no. of participant).

1). However, there are regional differences. The Semarang Bay area is especially prone to tidal floods, which affect 22% of the municipal area and around 150 000 inhabitants, reaching inundations up to 40 to 60 cm (see fig 1, Harwitasari & van Ast 2011, Marfai & King 2008, Nugraha et al. 2015). High tides frequently flood the streets of 41% of all surveyed households. Peri-urban and rural areas are affected the strongest (50-54% of households) compared to urban areas (34-37%) due to better municipal flood protection infrastructures in Semarang City and Jakarta.

The risk towards coastal flooding is further aggravated by rain and river floods in all study areas, showing the highest intensities in Jakarta (see Chapter 6, fig 3). The megacity is drained by several small and nine major rivers, which create a small delta (Marfai et al. 2015). The annual mean precipitation of 2 065 to 2 460 mm/a at the north coast of Java strongly concentrates on the monsoon season from December to February (Marfai & King 2008). The resulting run-off from the southern volcanic slopes exposes coastal settlements to river and rain floods from the hinterland (Marfai et al. 2008). During monsoon, 20% of the surveyed households are frequently exposed to river and 35% to rain floods. The latter especially affect Jakarta with 51% reporting frequent flooding. In February 2007, a strong flood in Jakarta was caused by heavy rainfall and following high river run-off at the time of a spring tide, which blocked the rivers discharge into the sea. This flood inundated 60% of the built-up area of Jakarta up to 4 m, causing the death of 56 people and the evacuation of 340 000 (IFRC 2007). Yet, this flood was not an isolated incident. Strong flooding also occurred in 2013, 2014, and 2015, and a future intensification of flood risks is likely due to the combined effects of subsidence, changes in river discharge regimes, soil sealing, and expected increasing heavy rainfalls (cf. Garschagen et al. 2018). In 2011, the number of flood-exposed inhabitants in Jakarta was estimated at 513 000 people. Under a business-as-usual scenario in both natural processes and human behavior, this number could increase up to 2 248 000 exposed people in 2070, mainly due to an extension of flood prone areas (Hanson et al. 2011).

A lack of waste management further exacerbates the risk towards flooding. Indonesia ranks second in a global comparison of total mass of mismanaged plastic waste carried from rivers into the ocean (Jambeck et al. 2015). In Semarang, only about 60% of the

city is serviced by communal waste collection (expert interview, BAPPEDA Semarang 2017). FGDs reported that domestic and industrial waste piles up in the rivers and along the shoreline, causing the blockage of drainage channels and sluice gates which strongly increases the risk for embankments and dikes to break (FGDs Mangunharjo, Tugurejo).

Not only residential areas, but also important job-relevant industries are located in hazard-prone zones, along with critical infrastructures, such as international airports, sea ports, and the central train station of Semarang (fig 2, Neise et al. 2018). Flooded roads have inhibited 29% of all survey respondents to reach their work places in the past, in Jakarta even 44%.

While floods occur with high frequency, the intensity of floods is usually low in terms of flood height and duration. The survey findings for the Semarang Bay area show that most floods are not higher than ankle deep and have a median duration of three hours, which is why 95% of respondents never actually had to evacuate and rather remain in their houses during flood events. In Jakarta, higher water inundations are caused by river floods usually reaching up to knee height. Yet, despite slightly higher flood levels, still 79% of the surveyed households never had to be evacuated in the past and 18% only once. Despite the usually low intensity of flood events, the high frequency affects the livelihood and wellbeing of local coastal dwellers. Valuable assets of physical capital can be lost in floods such as electronic devices (experienced by 17%), clothes (21%), and furniture (44%). Flooding is also a health issue with the potential to reduce human capital. Skin infections occur in 49% of households and gastrointestinal diseases in 29%.

The combined effects of natural and human-induced hazards along the coasts of Jakarta and the Semarang Bay area bear a complex hazard risk potential and, thus, create a multi-risk environment.

3.2 Socio-economic vulnerabilities and governmental disaster risk management

The individual knowledge about future coastal risks is limited in all study areas. In Jakarta only 46% and in Semarang 52% of respondents have heard the term ‘sea level rise’. In peri-urban and rural areas this share is even less (37% and 38%). Out of the respondents who have heard the term, 28% still think that sea level rise will not affect them in the future. This perception is potentially problematic as risk awareness is the first precondition to plan for changing threat horizons and to take proactive measures (cf. Adger 2003, Tschakert 2007). In fact, recent estimates from radar altimetry indicate a significant acceleration of the average global sea level rise over the next century (Nerem et al. 2018). Thus, a future increase in the absolute sea level along the coast of North Java is not unlikely and would add to the already occurring relative one.

This future risk potential underlines the importance of a timely and proactive coastal risk management. Especially the local anthropogenic contributions such as lacking waste management, uncontrolled urban sprawl, and excessive groundwater extractions need to be tackled. These larger infrastructural issues require state and municipal engagement, which should not only consider adaptation but also mitigation strategies. Subsidence is the biggest threat to any effective and sustainable adaptation to coastal flooding. Even under a business-as-usual scenario, a tipping-point could be reached, after which living in hazard-affected areas could become no longer feasible. However, the example of Tokyo shows that subsidence can actually be stopped in a relatively short time frame by changing fresh water supplies from groundwater to surface waters and by declaring no-development zones in spatial planning (cf. Bucx et al. 2015, Erkens et al. 2015).

Nevertheless, governmental disaster risk management in Indonesia strongly focusses on flood symptoms without addressing the root causes: the combined natural and anthropogenic drivers of land subsidence (cf. Garschagen et al. 2018). Thus, risk reduction strategies favor hard structural and engineering solutions, such as the proposed ‘Grant Garuda’ sea wall in Jakarta and a toll-road embankment in Semarang (cf. Colven 2017, expert interview with BAPPEDA Kota Semarang). The effectiveness and

durability of these measures are at least debatable. Expert interviews in Semarang revealed that, so far, subsidence is not even considered in municipal spatial planning. This leads to adverse effects, some of which could even be classified as maladaptation (cf. Juhola et al. 2016, Klein et al. 2001). In addition, recent plans to relocate the capital from Jakarta to East Kalimantan (Walden 2019) are unlikely to mitigate ongoing drastic socio-environmental changes in Jakarta. The economic center is highly likely to remain in Jakarta as local industry (manufacturing firms and business offices) are expected to stay at their current location (cf. Neise & Revilla Diez 2019) and therefore their employees as well (cf. Chapter 4). Thus, the capital relocation might even have adverse effects, as the estimated costs of relocating the capital could otherwise be used to improve adaptation and resilience in Jakarta. Instead of mitigation pressing infrastructural issues, as traffic problems, lacking waste management, and required fresh water supply from surface water, the relocation of the government might exacerbate Jakarta's urban under-funding.

Morover, contemporary municipal flood risk reduction strategies such as river normalizations are highly contested by the civil society. Poor urban dwellers are often forced to live in marginalized areas such as along river banks and drainage channels or on flood plains (Leitner & Sheppard 2018). Municipal flood risk management often includes the resettlement of these households. The normalization of Jakarta's major river, the Ciliwung, alone resulted in the resettlement of 15 000 people (Garschagen et al. 2018). Interviews with BAPPEDA Kota Semarang report that the city is planning large resettlements in the course of the revitalization of the city's eastern flood channel as well. Local neighborhoods are largely excluded from the planning of such projects and often even communication towards local people is missing (van Voorst 2016). Accordingly, there is widespread resistance among urban populations towards resettlement projects, which highlights the mismatch between top-down policy implementation and the interests of local communities (cf. Leitner & Sheppard 2018).

One reason for the lack of communication and coordination of top-down disaster risk management emerges from manifold and overlapping jurisdictions. Indonesia is one of the most decentralized countries of the world, which at the national level has contrib-

uted substantially to improved democratic structures such as multiple parties, democratic election, and free press (van Voorst 2016). However, with regard to planning and implementing disaster risk reduction strategies, there are different national, regional, and local levels of responsibilities. The principal agency for coordinating the implementation of the disaster management policy is the National Disaster Management Agency (BNPB; Mardiah et al. 2017). Yet, the BNPB is one among other national agencies and ministries with whom disaster risk reduction policies and implementation strategies have to be coordinated. At the sub-national level, the responsibility for the implementation of these policies lies at the Regional Disaster Management Agencies (BPBDs) and the Local Planning and Development Agencies (BAPPEDAs), which are established from provincial over regency down to city or district levels (Mardiah et al. 2017). While local governments have been empowered by decentralization, they often lack resources and capacities. By 2012, only 15% of the city and district BPBDs had developed local disaster management plans (BAPPENAS 2015). Thus, the coordination of responsibilities and the coordination and implementation of strategies need to be improved especially at sub-national levels, but also with NGOs, the civil society, the private sector, and research institutions (Mardiah et al. 2017, Neise 2019). Another problem is the minimal budget allocation. Even in Jakarta, with an approved disaster management plan, the BPBD budget only accounted for 1% of the annual total within the provincial budget plan in 2012 (Intarti et al. 2013).

Faced with unreliable top-down hazard management and a lack of coordination and communication towards local communities, households, and communities often have to develop alternative bottom-up disaster risk reduction strategies in their neighborhoods. Hence, they take over where state authorities fail their responsibilities.

Still, the economic flexibility of coastal dwellers to respond to flooding and subsidence is constrained. Most of these inhabitants belong to the low and lower-middle-income class. While for example 88% of the surveyed houses are built of permanent structure, less than 18% have more than one level, which would allow for a higher protection against floods. Most surveyed residents in all study areas own their houses (89%). Yet, the ongoing land subsidence is a strong financial stressor. In the most affected areas, such as Genuk in Northeastern Semarang, people have to elevate their houses every 5

to 10 years. According to the FGD (Mangunharjo, M3), the costs for elevating a single store family home starts at 800 US$. Only 16% of urban, 6% or peri-urban, and 5% of rural households in the survey had sufficient savings to do this. Consequently, a much higher percentage of affected urban houses, with higher financial capital, has been elevated in the past (82% compared to 52% in peri-urban and 27% in rural areas). The money required for elevation purposes is lacking for other acquisitions and the economic advancement of many households is hence restrained. *"Every year we have to think about how we can elevate our house. Automatically, we focus our concentration on this matter instead of the others"* (FGD Trimulyo, M6). In fact, 53% of respondents stated that saving money for elevation and flood protection has become more difficult in the last five years.

The education levels of the surveyed households are at a medium scope. About half of all households have a high school degree as the highest education level. As expected, education levels are highest in the urban areas (Jakarta and Semarang) with 28% of households having at least one member with tertiary education. Furthermore, education levels are increasing with younger generations, signaling a positive development. Occupation patterns show a classical urban, suburban, and rural distribution. In Semarang and Jakarta, 63% of the main earners work in the tertiary sector, whereas in rural Demak the primary sector is still dominating with 65%.

Symbolic capital, such as prestige and power, is limited. Most respondents (72%) perceive themselves as having 'not very much' or 'no' influence on making their village a better place. This answer is important as the perception of the own adaptive capacity and not the actual capacity is crucial for taking action. A perceived low adaptive capacity and power can lead to passiveness even when there is a realistic chance at making a change (Adger et al. 2007). Thus, adaptation can be inhibited. Results from a bivariate descriptive analysis show that perceptions of the personal influence as 'some' or 'a lot' highly significantly correlate with being from households that hold leading positions in the neighborhood.

Despite their high exposure and the unreliable governmental hazard management, coastal dwellers are not willing to leave. Of the respondents, 93% are planning to stay in the area for the foreseeable future. Surprisingly, some of the most exposed urban

areas in Northeastern Semarang are still experiencing a net population gain, mostly due to labor migration within the larger urban agglomerations (Hillmann & Ziegelmayer 2016).

This raises the question: How are households and communities able to respond to multi-risk coastal hazards and which resources allow them to do so? This overarching question is now addressed in the following Chapters 4-6.

How do households respond to coastal hazards? A framework for accommodating strategies using the example of Semarang Bay, Indonesia

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4 How do households respond to coastal hazards? A framework for accommodating strategies using the example of Semarang Bay, Indonesia

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Abstract

Responding to coastal hazards is a daily challenge for populations in low-lying coastal areas all over the globe. How local communities develop accommodating strategies for these hazards remains largely under-emphasized. Filling this knowledge gap is vital to connect the big picture science of sea-level rise with the adaptation needs and capabilities of affected communities. This paper contributes new understanding by presenting the results of original, mixed-methods research (a household survey and focus group discussions) that documents the accommodating strategies of communities and households in the Semarang Bay area on northern Java. We find that participatory capacity and self-organization are key factors in enabling communities to live in unstable environments. Coastal hazards have become a normal element of life and are not perceived as severe risks. Rather than retreating or gaining permanent protection, people found ways to accommodate to and hence live with floods. This result adds an important dimension to contemporary theorization of responding to coastal hazards. Although the IPCC (2014) acknowledges 'accommodating' as one form of adaptation alongside 'retreating' and 'protecting', it tends to be overlooked as temporary and insubstantial compared with the latter responses. This research finds that accommodating strategies, such as informal loans, are effective means for people to maintain their livelihoods in hazard-affected coastal areas on a more substantial basis than recognized in much of the literature. We therefore argue that accommodating should be distinguished from both long-term adaptation and short-term coping and deserves elevated consideration by researchers examining hazard response modes among coastal populations.

Keywords: Accommodate; adaptation; coastal hazards; bottom-up responses; social capital; Indonesia

4.1 Introduction

How humans respond to environmental change is one of the most challenging questions of the 21st century. Coastal areas are particularly concerned as more than 10% of the world's population (600 million) lives in low elevated areas < 10 m, most of them in Asia (McGranahan et al. 2007; Neumann et al. 2015). Low-lying areas are sensitive to a number of hazards such as storms, floods, tsunamis, and sea level rise. A better understanding of human responses to environmental risks helps to reduce vulnerabilities and to increase response capacities in these coupled social-ecological systems[1] (cf. Adger et al. 2005).

The understanding of human responses to coastal hazards has been advanced by the IPCC (2014) which developed a tripartite framework of retreat (moving away from the coast), protect (structural and soft measures) and accommodate (changes in human activities and infrastructure; Wong et al. 2014). Both the issues of protect and retreat are prominent topics in the media and in science. In fact, the debate about climate-induced migration is one of the most heated ones of our times (cf. Baldwin and Fornalé 2017; Bernzen et al. 2019; Bettini 2014; Ionesco et al. 2017; Piguet et al. 2011; Rothe 2017; Tacoli 2009; Trombetta 2014). Sure enough, talking about 'hundreds of millions of people' that might be affected by coastal flooding by 2100 and who will, without adaptation, potentially become climate migrants (Wong et al. 2014) sounds like a big picture indication of climate change; and large structural measures such as the proposed 'Giant Seawall' project in Jakarta call widespread attention (Colven 2017; Sumantyo et al. 2016; van der Wulp et al. 2016).

The problem, however, is that the retreat/protect dualism does not represent the reality of the lives of most coastal inhabitants (in the Global South). This is especially relevant with regards to contemporary sea level rise, which is a hazard with slow-onset characteristics. In these contexts, it becomes highly relevant to give close consideration to accommodating strategies, namely, the processes through which people change their

[1] Social-ecological systems describe coupled systems of natural and human aspects. Natural systems include the ecosystems and their physical features. Human systems contain the built environment, human activities and institutions. These systems can range from local communities to global scales (Gallopín 2006; Wong et al. 2014).

day to day practices. Compared to retreat/protect scenarios, accommodation is less visible and may seem less substantial. Yet, empirical evidence suggests that it is important; people tend to stay in hazard-affected areas even when environmental conditions progressively become unfavorable (Bernzen et al. 2019; Haas 2005; Tacoli 2009). In fact, most coastal urban areas in the Global South are rather gaining than losing population (Birkmann et al. 2010; McGranahan et al. 2007). Hence, accommodating strategies can be assumed to be carried out to a much larger extent than commonly imagined. This is especially so in regions with complex coastal morphologies and risk constellations, such as subsiding areas, and where individuals and communities lack the financial capital and resources required to retreat or to carry out large-scale structural protection measures (Koerth et al. 2014). A key question in studying human responses to coastal hazards therefore is: How important are accommodating strategies in areas that are strongly affected by coastal hazards and where resources to structurally protect populations are limited, and how viable are these approaches?

In seeking to answer this question, our paper draws attention to the importance of understanding accommodation to coastal hazards. We thereby focus on community-based responses which ensures that coastal dwellers are not depicted as passive victims in the face of natural hazards; instead we emphasis their active agency (cf. Brown and Westaway 2011; Grove 2014; Waters and Adger 2017). Bottom-up strategies become especially relevant where local and regional administrations lack the resources to adequately cope with natural disasters and environmental change (Adger 2003). However, they can often escape the purview of policy makers, who still tend to plan for coastal adaptation with minimal understanding or consideration of household response strategies, which can lead to adverse effects (cf. Koerth et al. 2013). Thus, there is a strong demand for concepts to assimilate these bottom-up approaches with top-down knowledge about processes of coastal environmental change (cf. Koerth et al. 2014). Recognizing this reality, we argue that researchers who use the IPCC's tripartite framework should find room to embrace the category of 'accommodating change' more explicitly, and through community-based methodological insights.

Consistent with this aim, this research uses mixed-method data collected in the Semarang Bay area on the north coast of Java to assess three questions: (1) How do households accommodate the uncertainties of coastal flooding and sea level rise? (2) Which strategies are applied by the communities to self-organize and to absorb the risk of coastal hazards? And (3) what conceptual lessons can be deducted from these empirical insights to advance the theorization of accommodating?

Many local communities worldwide have developed successful strategies to deal with coastal hazards collectively as all social systems possess inherent capacities to do so (cf. Adger et al. 2003). We found that accommodate practices are thereby distinguishable in timescale and quality from the response cycles of both short-term reactive coping and long-term innovative adaptation. Therefore, we argue that researchers need to give elevated attention to accommodating strategies within a new three-scale framework. Developing a new framework is highly relevant for policy makers as sustainable coastal risk planning needs to more firmly articulate the role of accommodating practices, and thus requires their inclusion in conceptual frameworks that guide further research (cf. Niven and Bardsley 2013).

In moving forward with this paper, we first describe the IPCC understanding of response options to coastal hazards followed by a short introduction of key analytical concepts for assessing the viability of those response options, before coming to the sections about methods and the study area. After setting this scene, we describe our empirical findings, and building on these results, we establish the new theoretical framework of accommodating coastal hazards in the discussion section before concluding the paper.

4.2 Response options to coastal hazards discussed in the literature

Research on how households and communities respond to past, present and future coastal hazards is crucial for understanding human-environmental systems. Literature names the following respective options for carrying out coastal adaptation under the IPCC framework (fig 1; cf. Alexander et al. 2012; Camare and Lane 2015; Gibbs 2016; Klein et al. 2001; Niven and Bardsley 2013; Wong et al. 2014): *Protection* typically

consists of ‘hard’ structural measures such as dikes, seawalls and floodgates, but also ‘soft’ structural options such as periodic beach nourishment and dune restauration, and more indigenous options such as afforestation, stone walls or coconut leaf walls. *Retreat* “involves moving away from the coast” (Wong et al. 2014: 387). Besides migration and population resettlement, it includes options such as relocating buildings and infrastructure to higher grounds or further inland, spatial planning for no-development zones, managed plot and river realignment, and setback zones. *Accommodate* involves changes and modification in existing structures and in human behavior, which allow to sustain the use of land (Koerth et al. 2014; Wong et al. 2014: 387). Thus, accommodating can be translated into ‘living with risks’. It refers to top-down measures such as modification of land-use and building styles, and early warning systems, as well as to community-based measures such as informal money pooling and collective workforce organization.

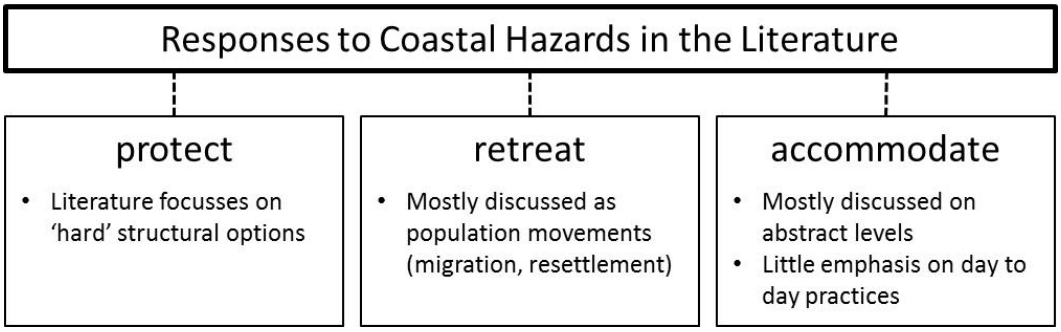

Figure 1: The IPCC framework of responses to coastal hazards and how it is mainly discussed in the literature

Of these three response options, protection and retreat tend to be more amenable entry-points for governmental action and top-down risk management. This is due to several reasons among them the higher visibility of the measures taken. In contrast, while accommodation can benefit from top-down interventions, in practice it tends to be more frequently undertaken as a set of initiatives by households and communities. Perhaps for this reason, accommodation has garnered less research attention than the other two types of strategic responses. Retreat strategies (including resettlement planning and climate-induced migration) have been discussed extensively in the social sciences (inter

alia: Abel et al. 2011; Alexander et al. 2012; Black et al. 2011; Farbotko and Lazrus 2012; Niven and Bardsley 2013; Stojanov et al. 2017). The literature on protection is also extensive, with additional strong input from natural and engineering sciences (inter alia: Betzold and Mohamed 2017; Borsje et al. 2011; Firth et al. 2014; Klein et al. 2001; Spalding et al. 2014).

Compared with these literatures, the consideration of accommodation has remained relatively undertheorized. This neglect is unwarranted. Accommodating options are more easily accessible for local communities in the Global South than are protect and retreat. As Gibbs (2016) argues, although protect and retreat options offer potential large-scale solutions for affected communities, they come with high costs. Accommodation strategies potentially offer less substantial long-term solutions, but are the most viable option for many communities due to their lower financial costs. Additionally, they embody an important principle revealed in much hazards-related research: that people often prefer to stay and continue their lives within their communities in the face of environmental risk (cf. Bernzen et al. 2019; Haas 2005; Tacoli 2009). In the following, this paper focusses on community-based accommodating strategies in a Global South context.

4.3 Concepts for analyzing the viability of response options to coastal hazards

In this paper, we use ‘response’ as an umbrella term for coping and adaptation (cf. Gallopín 2006). However, to analyze the viability of coastal hazard response options, such as accommodating, a closer look at the time-scale, quality, and agency is necessary.

While some authors use adaptation and coping synonymously (cf. Frazier et al. 2013; Lei et al. 2014; Wamsler and Brink 2014), others have illustrated fundamental differences between them (cf. Birkmann 2011; Lorenz 2013; Parsons et al. 2016). In line with the later, we argue that these concepts are distinguishable first of all by timescale (short- to long-term), point of time (before, during, after an event), quality (innovative, future-oriented or simple recovering) and agency (top-down or bottom-up).

While different protect and retreat option have already been examined under these different distinguishing parameters (technical measures such as permanent embankment systems and permanent resettlement offer long-term solutions; and sand sack walls and emergency evacuations can be regarded as short-term), options of accommodating have yet to be analyzed. In the following, we use these distinction parameters for assessing the viability of accommodating strategies.

Coping in this paper is understood as mostly short-term actions undertaken during and shortly after an event to recuperate. The focus of action lies on the present situation and learning from past events is limited – typically the same measures are repeated (cf. Birkmann 2011; Folke et al. 1998; Parsons et al. 2016).

Adaptation in turn is understood as socio-economic practices that moderate current or expected negative environmental impacts and hazard risks, and practices that take advantage of favorable environmental changes (cf. Klein et al. 2007). Adaptation thereby has a planned and proactive character, and social learning from previous events is essential (cf. Folke 2006).

A critical input that shapes both coping and adaptation, is the extent to which affected populations possess self-organization capacities and collaborative agency (Lorenz 2013; Vallance and Carlton 2015; Voss 2008). This notion of *participatory capacity* describes the ability of a social system to self-organize and to use its internal coping and adaptive capacities into action. Participatory capacity becomes manifested both within and between social systems.

Empirical studies in many parts of the world indicate that collaborations are easier to achieve in communities with higher *social capital* and denser *social networks* (e.g. Adger 2003; Aldrich and Meyer 2015; Braun and Aßheuer 2011; Chatterjee 2010; Murphy 2007; Portes 1998). Through networks of trust, people have access to loans, information, and mutual help that become valuable resources for their coping and adaptive capacities. Therefore, analyzing social networks is essential to better understand accommodating behavior.

Linked to these observations is the importance of bonding, bridging, and linking ties (cf. Lin 2008; Portes 1998). *Bonding ties* describe relations within a closely connected and largely homogeneous community (Agurto Adrianzén 2014). They are primarily

associated with immediate support. *Bridging ties* emerge between members of different ethnic, cultural, and occupational backgrounds, but with more or less similar socio-economic status. *Linking ties* describe connections over hierarchical stratums connecting members of different socio-economic classes. Bridging and linking ties are often described as less close (weaker) and less frequent than bonding ties. However, because they connect people from different backgrounds and living environments, and thus different knowledge and experiences, these ties can offer particularly promising pathways for innovations and new ideas (cf. Aßheuer 2014; Hawkins and Maurer 2010). These concepts underline how the direction that participatory capacity takes is carried by unequal distributions of power, prestige, and social connectedness within and between communities.

Thus, the process of accommodating coastal hazards needs to be understood as a set of strategies infused by political economies of power in socio-ecological contexts defined by information uncertainty and capital limitations. These general points having been established, attention turns now to the empirical contribution of this paper, which is the specific question of how coastal dwellers in Semarang Bay on the north coast of Central Java have been accommodating coastal hazards.

4.4 Methods

In a first explorative research phase (August and September 2016), we conducted eight focus group discussions (FGD) with community members[2] in seven hazard-prone coastal urban quarters of Semarang. The FGD guideline questionnaire was structured in five main sections containing questions on community/household characteristics, perceptions of coastal hazards, repose options, social capital, and social networks. This method allowed us not only to gain relevant qualitative information, but to analyze the interactions and communication patterns between participants (Longhurst 2010). In this paper, qualitative data are used for in-depth analysis of perception and behavior

[2] In this paper, we understand 'community' as a place-based neighbourhood unit. Within one community, members know each other, reside in the same neighbourhood, and share some degree of common narratives and beliefs (cf. Murphy 2007).

e.g. on collective accommodating strategies, community self-organization, and daily routines (Chapter 4.6.2). Each FGD had 7 to 11 participants, with a total of 29 female and 46 male discussants. The FGDs were conducted by the first author with the help of three Indonesian student assistants.

We subsequently developed a standardized household survey based on the results of the FGDs, structured in the same five question sections. For formulating the questions on social capital and networks, and to build on well-established indicators, we consulted the World Bank Social Capital Assessment Tool, which contains guideline questions for household and community investigations (Krishna and Uphoff 1999). The resulting quantitative data are analyzed mostly descriptively to show percentages and general trends and to support the qualitative findings.

In March and April 2017, 650 households were surveyed along the Semarang Bay area, including the City of Semarang (n = 330) as well as the adjoining districts Kendal and Demak (n = 160 each). The households where selected based on random walks, choosing every fifth house in a street. Sixteen student assistants conducted the survey in Bahasa Indonesia. These assistants were trained in a five days kick-off workshop, during which a pre-test was conducted. The reference units of the questionnaire were households defined as entities for collective decision-making. 49% of the respondents were female, 51% male, representing a total of 1462 female and 1381 male household members. Additional open and semi-structured key informant interviews with local leaders and municipal officials were conducted throughout both research phases to gain additional background information.

We selected 18 study areas along the entire Semarang Bay based on on-site inspections and with the help of local experts (fig 2). All selected areas are prone to flooding and subsidence. The study areas in Semarang City cover 50% of all urban quarters (Kelurahan) with direct coastal access and represent a large share of all coastal residential quarters. They include fishing communities, industrial worker areas, and settlements of the lower urban middle class. The studied district Kendal faces an ongoing industrial suburbanization. Major roads and the railway connect the coastal areas of Kendal to Semarang. The rural villages (Desa) in Demak remain largely aqua- and agriculture based.

We found that while there are some differences in protection strategies based on financial resources and building material available, the results show no significant rural urban divides when it comes to social capital and collective strategies to respond to coastal hazards. Therefore, a rural-urban comparison is not in the main focus of this paper, but differences in exposure and finances are highlighted when we found them to be significant.

Figure 2: Study areas and land-use in the Semarang Bay area
Layout: LM Bott; Cartography: R Spohner

4.5 Study area: The character of coastal hazards in the Semarang Bay area

The Semarang Bay area is a prominent example of a highly exposed low-lying coastal region. Both floods and slowly emerging relative sea level rise are threatening the local population, creating a multi-risk environment (Abidin et al. 2013; Buchori et al. 2018; Marfai and King 2008). Most of the coastal inhabitants belong to the low and lower

middle income class, thus, financial capital to respond to coastal hazards is limited (Hillmann and Ziegelmayer 2016).

Semarang City, the province capital of Central Java with 1.5 million inhabitants in the municipal area, is especially affected. Natural consolidation of geologically young alluvial soils is strongly accelerated by the urbanization of sensitive coastal areas, which becomes manifested in high surface loads and excessive and largely uncontrolled groundwater extraction (Abidin et al. 2013; Marfai and King 2008). The causes of local coastal hazards are thereby largely human-made. As a consequence, the coastal stretch of Semarang now faces massive land subsidence with an average rate of 6 to 7 cm/a, and maximum rates up to 19 cm/a in some industrial areas in the Northeastern district, Genuk (Abidin et al. 2013). 59% of our researched households claim to be affected by subsidence. The exposure is significantly higher in industrialized urban areas with 64% of subsiding households, but even in agriculture-based rural areas 46% experience subsidence.

While the absolute sea level rise in this region shows no significant trend, subsidence leads to a measured increase of the relative sea level of about 10 cm/a (Bott et al. 2018).[3] Consequently, the streets in low-lying coastal areas (22% of the city's area) are frequently flooded up to 40 to 60 cm by high tide (Nugraha et al. 2015; Marfai and King 2008). About 150 000 urban dwellers are regularly affected (Harwitasari and van Ast 2011). 43% of our surveyed households experience frequent tidal flooding of their streets. The exposure is higher in peri-urban and rural areas (50 and 54% respectively) compared to urban areas (34%) due to the better flood protection infrastructure in Semarang City.

In addition to the tidal floods, the annual mean precipitation of 2,065 to 2,460 mm/a strongly exposes coastal settlements to inland river and rain floods during the monsoon season from December to February (Marfai et al. 2008). During this time, 22% and 28% of the surveyed households said they were frequently exposed to river and rain floods respectively. Our FGDs revealed that the vulnerability of the urban population

[3] Absolute sea level rise would stand in relation to global warming and is measured by radar altimetry, which is independent of the landmass, but in relation to a reference ellipsoid. Relative sea level rise in contrast is only measureable in relation to the respective coast line using local tide gauge stations.

towards flooding is further aggravated by a lack of waste management. Domestic and industrial waste piles up in the rivers and along the shore. It blocks drainage channels and watergates, and in extreme cases can even lead to breaks in dikes and embankments. Indonesian rivers are highly contaminated with plastic waste in international comparison (cf. Jambeck et al. 2015). These problems affect not only residential areas, but also important job-relevant industries (Neise et al. 2018) and crucial transport infrastructure, such as the international airport, the sea port, and the central train station (fig 2). 22% of the respondents stated that reaching their work place can be inhibited by flooded roads. Tidal floods are a frequent phenomenon and subsidence is ongoing. Floods last a median of three hours and although usually do not inundate streets and houses more than ankle deep, they have wide-ranging effects. Because of their limited and regular nature, people generally stay in their houses during floods, and 95% of respondents have never had to evacuate. However, important assets can be lost in floods such as electronic devices (experienced by 14%), clothes (17%) and furniture (36%). Flooding is also a health issue. Skin infections are common in 51% of households and gastro intestinal diseases in 24%. Therefore, coastal hazards have considerable impacts on local people's lives, and hence, the issue of how people respond is crucially relevant to their wellbeing. These issues are now addressed. We first discuss retreat and protection measures, before analyzing accommodating behavior in more detail in the second part of the results section.

4.6 Results

4.6.1 Strategies of retreat and protect in the Semarang Bay area

While accommodating strategies are in center of our analysis, a short look at retreat and protection options is required to gain a full picture of response options to coastal hazards in Semarang Bay.

So far, retreat is not an option of choice in our study areas. Despite the high exposure to multiple and frequent coastal hazards, our results show that coastal dwellers are not leaving the flood affected areas along Semarang Bay, confirming findings of Hillmann

and Ziegelmayer (2016). This holds true even for the most exposed areas in Northeastern Genuk. 95% of all surveyed households stated that they are not planning to relocate within the next five years. Regardless of the high exposure, floods and subsidence do not push people to migrate. North-East Semarang still experiences a net population gain, mostly due to labor migration from Kendal and Demak (Hillmann and Ziegelmayer 2016). This propensity to stay accords with the argument of Abu et al. (2014), that physical events which are experienced over a long period of time become perceived as 'normal' and as a result do not motivate people to migrate away.

Close social ties and community belonging were mentioned as major reasons to stay for these hazard-prone populations (67% of survey respondents). Our FGDs revealed that the participants had hardly any contacts to people outside their villages, which reinforced the importance of localness. Thus, bridging and linking ties to other places, which could create migration corridors, are lacking (cf. Zoomers et al. 2011).

Economic factors are important contributors to the unwillingness to migrate. 39% of respondents stated that migrating would be too expensive, and proximity to job opportunities motivate people to remain in their living environment (49%). So far, the majority of local firms in Semarang is not planning to relocate either (Neise and Revilla Diez 2019).

Because retreating is currently socially and financially unattractive for most households, communities in the study areas have developed various strategies to protect themselves against flooding and land subsidence. With regards to flooding, the majority of strategies are 'soft' or indigenous protection measures such as afforestation of mangroves (applied by 13% of the households), sand sack walls (11%), and private pumps (2% only in Semarang City). People protect their homes by building small drainage channels around them (5%), by increasing thresholds in front of their doors (16%) or by covering their floors with ceramic tiles (31%). To prepare for water entering the house, coastal dwellers sleep in beds (51%), instead of on a traditional mattress on the floor, and they store their belongings on shelves (55%). Because tidal and rain floods are frequent, but normally low-level (high frequency, relatively low magnitude), these small-scale protection options are in fact sufficient during most flood incidents.

Permanent protection options, however, mainly exceed the financial resources and the know-how of most communities. For implementation they would need municipal engagement. We found that these linking ties between municipal and community stakeholders need to be enhanced in most study areas. That way, the required know-how and funding could be provided to 'up-scale' existing community protection strategies (cf. Marfai et al. 2015).

With regards to land subsidence, the protection response of affected private houses is undertaken through investments in elevation. The high rate of subsidence means that houses need to be elevated every five to ten years. This creates a huge financial burden for the households. Only 17% of urban, 6% of peri-urban and 5% of rural households have savings of 11 million IDR or more, the minimum amount required for elevating a house according to the FGDs. The money required for elevation purposes is lacking for other acquisitions, education, etc., and the economic advancement is hence restrained.

Most identified soft protection strategies of households are temporary or semi-permanent, mainly allowing people to get by. This finding holds true especially for subsidence, a hazard which requires frequent house and infrastructure elevation. In fact, a permanent solution for subsidence is not possible to achieve by protection at the household level, it requires top-down mitigation approaches. The example of Tokyo proves that subsidence can actually be stopped relatively quickly by implementing mitigation options such as fresh water supply from surface water, spatial planning with no-development zones and coastal setback zones (cf. Bucx et al. 2015; Erkens et al. 2015). However, all these options require a high level of governmental and municipal engagement. Our findings regarding available retreat and protection options leave accommodating as the option of choice for communities and households in Semarang Bay.

4.6.2 How do people accommodate coastal hazards?

The predominance of accommodating practices (as opposed to retreat or protect strategies) reflects the risk perceptions of householders. In our survey, we asked households about the risks imposed by natural hazards. We asked this openly, so that respondents would self-nominate the particular hazards they regarded as most important. 39%

named tidal floods and 14% named land subsidence as hazards they faced. Notably however, these results underrepresented the proportion of survey respondents facing these hazards, indicating that they had been normalized in respondents' eyes, and alternatively perceived as something 'natural': *"We can´t resist land subsidence because it is the law of nature." (FGD Tawangsari, M2)*[4]*. "Here, tidal flood is not a disaster. We get used to it. It´s like a daily activity." (FGD Terboyo Kulon, F3). "At the beginning, [the tidal floods] disturbed us, but now they become part of our habit." (FGD Tanjungmas, M8).* Thus, living with floods and subsidence has become a habit and an integral part of the daily practices of local communities. *"We get used to it. When the tidal floods recede, we clean the house, the road." (FGD Terboyo Kulon, F1). "When small tidal floods occur, the children have to go to school. The children take off their shoes and carry their shoes with them to school." (FGD Trimulyo, F3).*

The ability to enact most accommodating strategies (such as collective money pooling and community workforce organization) is strongly tied to communities' social capital and requires a high participatory capacity. Our survey data affirms these characteristics in the case study sites. We identified a dominant inward-oriented bonding social capital in the Semarang Bay area. Accordingly, trust levels between people are high. *"Those who trust us are actually the people in the village. Because they already know about my behavior and attitude." (FGD Mangunharjo, M3). "People are close to each other. We are tight. […] You can come to this area in the afternoon, and I'll show you the keys of every house in this area." (FGD Terboyo Kulon, M8).* In line with the FGDs, 98% of all survey respondents perceive the trust levels within their village communities as mediate or high. 95% believe that people are willing to help them if they need support, and 97% feel accepted as a respected community member. On the other hand, such close social networks not only require high trust levels, but are also based on social control. People who do not engage in community matters risk to lose respect or to be ignored by the community. *"For example, if these people are sick, the others will not visit them because they never take care of other people. That's the social punishment." (FGD Tawangsari, M1).*

[4] All quotes from FDGs are structured in: (FGD Place, M=male/F=female and no. of participant).

The strength of this bonding social capital is reflected in how local communities have found ways to accommodate to, and hence, live with their environmental situation through mechanisms such as installing collective money pooling (non-bank savings) or by holding community meetings to deal with floods and subsidence. To implement these kinds of non-physical risk reduction strategies, a high level of community self-organization is necessary. In the Semarang Bay area, self-organization capacity and the internal participatory capacity are assisted by the highly institutionalized social orders in communities. Every Kelurahan or Desa has a governmental appointed village head. Furthermore, each village is formally structured in local neighborhood associations (RT, ~30-50 households) and higher ranking neighborhood associations (RW, ~2-5 RTs; Marfai et al. 2015). The heads of the RW and RT are elected by the adult community members and represent their members at the village level. With a few exceptions, RW and RT heads are male. Their wives, however, are usually the leaders of the corresponding PKK (wives and mothers association).

Collective action, and thereby accommodating activities, are organized in meetings at RT and RW levels. Men and women meet separately and their meetings have distinct functions. Male RT and RW meetings are more strongly related to legal issues, construction work, and security, while female PKK meetings focus more on communal festivities, health care, and vocational training. The frequency of meetings varies between different communities from weekly to at least monthly. Participation in both male and female meetings is high (90% of households participate regularly in RT and 74% in PKK meetings). While there is a clear division between the tasks of man and women, both take on agency and bring forward ideas for community and risk management (cf. Surtiari et al. 2017).

These experiences of self-organization and participatory local action in the Semarang Bay area are by no means unique in the Indonesian context. RT, RW, and PKK meetings are the social backbone of Javanese villages in rural and urban areas (cf. Okten and Osili 2004). Collective practices provide organizational structures for social care and community money pooling, which fulfills micro-insurance functions. Both male and female meetings organize communal money pooling by collecting contributions from members, which is accessible as loans by community members in need or are

provided freely in emergency cases such as the death of a family member for funeral arrangements. The purpose of collective action and regular meetings is thereby not solely on hazard risk reduction, but of community welfare and social protection in general. Thus, accommodating as a routinized practice is less clearly separable from daily actions for other purposes than are retreat and protect options. Yet, these collective activities result in higher coping and adaptive capacities and are, in turn, crucial for hazard risk reduction. In fact, two additional Chi-squared tests also show that people participating in RT meetings are significantly more engaged in community hazard response actions such as collective waste cleaning.

The village-level institutional fabric of RT, RW and PKK coexists in the Semarang Bay area with the traditional Javanese collective working system of *'gotong-royong'*, which translates loosely as 'mutual assistance'. It is one of the main non-structural community actions to reduce flood risks (cf. Marfai et al. 2015). This accommodating practice is deeply rooted in the tradition of working for the common good of the whole village and "inspires a strong volunteer culture" (Taylor and Peace 2015, 79) – a habit which is very important in a coastal hazard-prone environment. Mutual aid and working together help people not only in arranging community activities, such as funerals and festivities, but are key in preparing for coastal hazards, e.g. in keeping drainages and channels free of waste and operational. In the case of extraordinary strong floods (spring tides, small tsunamis, or broken river embankments after heavy rainfall), people organize first response activities such as evacuation and emergency kitchens (cf. Surtiari et al. 2017). A study by Taylor and Peace (2015) in Surakarta, Central Java, found that gotong-royong has a positive influence on children's resilience towards floods, as their inclusion in disaster response activities is promoted.

The following dialog from the FGD in Terboyo Kulon (East-Semarang) describes gotong-royong activities: *"Togetherness here means that we don't hurt each other, we respect each other." (M2). "We help each other." (M8). "It also means that, if we can, we contribute our money to do something good for the community."* (M2). *"We help by providing labor, we also help by praying."* (M1). *"Providing food."* (M 3).

Gotong-royong, as an accommodating practice and as a function of participatory capacity, allows community members to absorb shocks and to live with floods and subsidence. Lack of other forms of capital can be at least partly compensated. *"The quality of the human resource in this area is relatively low […]. But, Alhamdulillah [thanks God] the people here have quite a good sense of gotong-royong. [...] The economic condition of this area is low. […] Every time there is an activity in the area, the gotong-royong is reliable." (FGD Terboyo Kulon, M4).* 86% of all households were revealed by the survey as participating regularly in gotong-royong activities.

In contrast to retreat and protect, accommodating is usually carried out less intentionally with regards to coastal hazards and has more the character of an autonomous habit. For coastal dwellers in Semarang Bay responding to floods and subsidence is thus less a planned problem solving strategy, but more a daily social practice. This is made achievable by high participatory capacities, strong bonding social capital, and the resulting collective practices which allow people not only to stay in these areas but to accommodate their multi-risk environment.

Nevertheless, our survey found that local knowledge about possible future environmental changes is restricted. Only 45% of all surveyed households have ever heard about the term or the concept of 'sea level rise'. If the north coast of Central Java were to experience an increase in absolute and not just relative sea level in the future, additional flood stress would arise. Recent estimates derived from satellite altimetry indicate a significant acceleration of global sea level rise (Nerem et al. 2018).

4.7 Discussion: Establishing a new conceptualization of accommodating coastal hazards

The insights from Semarang Bay have wider resonance for the conceptualization of how communities respond to coastal hazards. As noted earlier, although accommodating has been conceptualized as one of three broad options of response to coastal hazards (along with retreat and protect), it has generally not held as much policy clout as those other two responses (cf. Camare and Lane 2015; Gibbs 2016; Klein et al. 2001; Wong

et al. 2014). Our fieldwork results suggest such dismissal of accommodating is misguided. Based on our findings in Semarang Bay, we argue that accommodating strategies are viably enacted by hazard-affected communities.

In addition to distinguishing accommodating from the other two response options, retreat and protect, we now analysis the viability of community-based accommodating by comparing it to the concepts of adaptation and coping. As being a constant habit, accommodating shows key distinctions in quality and timescale from long-term proactive adaptation and short-term reactive coping (tab 1).

Accommodating strategies are strongly based upon participatory capacities which empower communities to access and carry out their response capacities (cf. Lorenz 2013; Voss 2008). The timescale of community-based accommodating options can be both short- and long-term and accommodating has gained the character of a continuous habit – which leads to a different quality of responding to coastal hazards than the classical concepts of coping and adaptation, as described in Chapter 4.3.

Accommodating is not a single 'strategy' directly implied to reduce hazard risk, it is rather a daily practice deeply embedded in livelihood and habit in face of an ever-present hazard. This daily habit of living with costal hazards changes perceptions and narratives from 'risk' towards a 'given and tolerated environment'. In contrast to adaptation strategies such as permanent resettlement and hard structural protection, which potentially allow for a long-term or permanent risk reduction, the exposure under accommodating strategies remains largely unchanged. However, they are *accommodated*, as the term itself implies. Thus, typical accommodating measures are not only applied reactively after a shock but also in preparation for shocks and are therefore different from coping, such as repeated elevation (protect) and short-term evacuations (retreat). Accommodating is thus not an option specifically activated prior, during, or after an event, but rather a constantly applied and partly unintentional way of doing things. People slowly change their day to day practices – which leads to different points in time when action is taken. Thus, in contrast to most protect and retreat options, that can be classified as either adaptation or coping, accommodating can be placed between the latter concepts (tab 1).

Table 1: Key distinctions in time and quality between adaption, accommodating, and coping

Response to coastal hazards	**adapting**	**accommodating**	**coping**
Timescale	Long-term	Several but mostly mid-term timescales	Short-term
Level of preparedness	Pro-active	Daily practice/habit, continuously	Reactive
Level of planning	Planned	Autonomous	Spontaneous
Dynamics of development prospects	'Moving ahead'	'Making a living'	'Getting by'
Logic of action	Science-based, instrumental	Routinized practice	Mostly repetitive
Point in time of action	Preparing for shocks	Living with 'shocks' that become 'normal'	Recovering from shocks
Learning dynamics	Learning from shocks, scientific learning	Learning as part of living in the given environment	Learning by repetition
Actor's level	Top-down (and bottom-up aligned)	High participatory capacity	Individual/collective
Level of knowledge	Knowledge about past and present causes and future scenarios	Indigenous knowledge, mostly limited knowledge about future scenarios	Limited knowledge about underlying event causes and future scenarios
Examples	Permanent resettlement, permanent embankments	Collective money pooling, gotong-royong	Short-term evacuation, repeated house elevation

A further distinction is the collective nature of accommodating strategies. While coping strategies can be both collective and individual, 'living with risk' requires a high level of participatory capacity and self-organization, e.g. the mentioned money pooling and gotong-royong activities. Collective practices of accommodating are carried out continuously by communities with strong bonding ties, whereas long-term adaptation requires bridging and linking ties, and usually higher level planning and some form of top-down involvement.

As a consequence of lacking bridging and linking ties required for adaptation in our regional case study, knowledge transfer is constrained and the potential for preparing for future developments is limited. One could argue that accommodating strategies in Semarang Bay currently have to be regarded as mid-term solutions. So far, people in the Semarang Bay area respond to current, but not to possible future climate patters.

Finally, a key characteristic of accommodating is its flexibility. Our example of the Semarang Bay area considers responses within a relatively stable hazard context. Flood

cycles are regular (tidal and monsoonal) and subsidence is ongoing. We have argued that accommodating is a response strategy that is fitting to this scenario, because it corresponds to the size and scope of affected households' financial and social assets. However, it also provides a platform for dealing with changes to communities' threat horizons. This capability is displayed in figure 3. When communities are facing uncertainty, and in particular an intensification of coastal hazards, accommodating can be considered as a bridge between short-term and long-term cycles and thereby provide insights in how top-down and bottom-up approaches can be aligned.

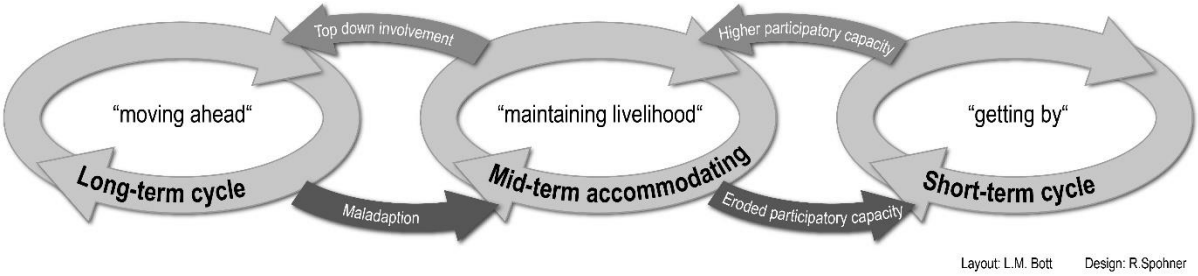

Figure 3: Response cycles of accommodating coastal hazards with up- and downscaling pathways

Reactive short-term responses can be upgraded to mid-term accommodating habits by a higher level of participatory capacity and self-organization. Thus, community cohesion and self-organization capacities are key and should be empowered by local governments and NGOs. To further upscale accommodating practices to a long-term response cycle, all levels of actor involvement are required and it is necessary to foster knowledge transfer and learning capacities which prepare local people for the future. Hence, additional top-down and multi-level stakeholder engagement is needed. By this engagement, knowledge transfers can be introduced to respond not only to current, but to expected future impacts, and the required funding could be provided for additional structural protection and accommodating options, such as formal insurances and early warning systems. Especially the empowerment of local community leaders is key. These people can work as gatekeepers and well-connected leaders could strengthen bridging and linking from and towards their communities (cf. Marfai et al. 2015).

A potential risk for downgrading from long-term response cycles lies in maladaptation practices. In our case study of Semarang Bay, an example of this would be the further expansion of urbanized and industrialized areas into heavily subsidence-prone coastal zones, such as in peri-urban areas of Kendal. Accelerating land subsidence is the biggest barrier for any response to coastal hazards in the Semarang Bay area and might even reach a tipping point after which living with coastal hazards would no longer be a feasible option.

Downgrading on the community levels from accommodating to a short-term response cycle can happen by destroying or eroding the social capital and participatory capacity of hazard-affected communities. Therefore, top-down coastal management approaches have to keep social cohesion in mind, e.g. in regard to relocation plans.

4.8 Conclusion

Using the example of the Semarang Bay area, we have shown how communities are able to collectively accommodate coastal hazards. Our empirical findings have verified that community-based collective accommodating can be a successful approach to deal with ever present, but usually low intensity coastal hazards. So far, local households and communities in our study areas do not retreat, but are able to protect themselves from coastal hazards with small-scale options and, more importantly, their ability to accommodate their multi-risk environment.

Greater recognition of accommodating is important because top-down policy-making has tendencies to overlook the daily practices of communities and instead prioritize big picture forms of adaptation associated with retreat and protect. However, for affected communities, accommodating is typically the unsung, dominant bottom-up practice that leaves the most tangible mark in terms of ongoing community life. Thus, if coastal risk management is going to be effective, it needs not only to include, but to put an emphasis on accommodating, as the most practiced bottom-up response.

Evidently, as threat horizons intensify because of climate change, strategies of accommodation may be insufficient. The new framework presented here, however, indicates they are not irrelevant. It is important to appreciate their role within cycles of upgrading

and downgrading community responses to coastal hazards. This draws attention to the pathways of collective action and into bringing top-down and bottom-up strategies together, one of the biggest challenges for costal risk management.

In the case of Semarang Bay, this framework offers critical insights for policy futures. In order to respond to expected and uncertain future developments, accommodating, as a habit of living with water, needs to be recognized as the foundation upon which upgrading response options are built from. Accommodating could be enhanced by municipal and NGO engagement. In addition, more technologically advanced accommodate and protection options such as early warning systems or even submersible infrastructure and floating buildings could further improve the ability to live with floods in the Semarang Bay area, but are very cost-intensive. Integrating accommodating into the city's resilient strategy would be a first step. Such a city adaptation plan, focusing on accommodating would probably be adapted very well by the local people as it fits into their social habits, daily practices and attachments to their place of residence. So far, our research shows no evidence of successful alignment of top-down and community-based accommodating measures in Semarang Bay.

These observations are relevant not only in the Indonesian context, but provide insights and starting points for integrated coastal urban planning across the world. Participatory capacity and collective action are basic attributes of local communities worldwide, and especially in the Global South. Further research might apply our proposed framework to focus on accommodating practices and collective bottom-up strategies in different spatial and social contexts. This would be an important contribution to the development of coastal risk management plans which go align with and make use of community capacities for accommodating. Planning 'with' and not 'for' the people is key.

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Adaptive neighborhoods: The interrelation of urban form, social capital, and responses to coastal hazards in Jakarta

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5 Adaptive neighborhoods: The interrelation of urban form, social capital, and responses to coastal hazards in Jakarta

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Abstract

This paper analyzes the relationship between the urban form of neighborhoods and collective bottom-up adaptation processes. The adaptive capacity of urban populations in marginal settlements of the Global South is critically related to social capital, as manifested through social networks, self-organization, and collective action. We analyze these responses and hypothesize that they are significantly shaped by the specific spatial forms of neighborhoods, particularly in the presence and form of places to meet. Drawing on mix-method research, we investigate socio-spatial practices and collective responses to hazards in coastal neighborhoods of Jakarta, including a standardized household survey (n=300) and cultural mapping. Our findings demonstrate that social capital is key to community-based hazard responses. Importantly, the presence of different types of public meeting places enhances different forms of social networks due to highly diversified locations and user groups. We found that North Jakarta's urban form facilitates bonding social capital, which enables the formation of 'responsive neighborhoods' capable of responding on mid-term scales. Meeting places in neighborhood centers foster bonding ties, which, together with attachment to place and social belonging, appear to be key local assets for dealing with natural hazards e.g. by creating informal 'insurance systems'. However, there is insufficient evidence to suggest that the current urban form of North Jakarta supports the formation of 'adaptive neighborhoods' in the long-term, which would require bridging and linking ties to the outside world. Our findings suggest that a spatial perspective on collective hazard response action is important for urban planning strategies to empower local communities.

Keywords: Social capital, attachment to place, neighborhood, natural hazards, adaptive capacity, Indonesia

5.1 Introduction

Responding adequately to natural hazards is one of the biggest challenges for vulnerable populations, many of whom are living in urban areas of the Global South. In megacities, such as Jakarta, settlement structures are diverse and disparities among populations are high. Poor urban dwellers are often forced to live in contested areas that are highly exposed to natural hazards (Leitner and Sheppard, 2018; Aßheuer et al., 2013). However, from their perspective, these settlement sites are also fertile grounds for the generation of bottom-up response capacities (Bonaiuto et al., 2016; Braun and Aßheuer, 2011; Clarke et al., 2018).

In dealing with multi-risk environments, social capital is crucial for response capacities and community self-organization. Especially in the Global South, social networks take on roles that would otherwise be responsibilities of government hazard management agencies (Adger et al., 2003; Chan et al., 2018). Social capital describes how, through networks of trust and reciprocity, network members have access to mutual support, loans, and information – resources that are key to community disaster response capacities (Braun and Aßheuer, 2011; Kerr, 2018; Petzold and Ratter, 2015).

This study applies the concept of social capital from a spatial perspective, using the example of community-based adaptation in urban neighborhoods of North Jakarta. We hypothesize that urban structures are decisive for the probability of social interaction (chances for people to meet) and learning (based on social interaction), and thus critical for stimulating the formation of social capital that is crucial for local community response capacities. Adger et al. (2003) claim that social capital can, indeed, be framed as ‘a geographical concept’, since the reality of living social interactions is strongly shaped by their situation in time and place. Moreover, the impacts of natural hazards, such as storm surges or floods, are experienced at specific locations, and local human responses are inevitably place-specific (cf. Adger et al., 2011; Karlsson and Hovelsrud, 2015).

Our paper draws attention to the importance of understanding how community-based adaptation and the urban form of neighborhoods are interlinked. Such knowledge and urban planning are vital to promote efficient, long-term adaptation under uncertainty.

For example, while top-down hazard management often requires urban dwellers to be relocated, many people living in marginalized neighborhoods have strong attachments to place and social belonging. This mismatch of interests can lead to social conflicts and maladaptation (cf. Schaer, 2015).

While socio-spatial practices have been discussed in the social sciences, including economic geography since the seminal work by Jane Jacobs (1961, see also, e.g., Acedo et al., 2017; Adger et al., 2011; Bathelt and Glückler, 2018; Bærenholdt and Arsæther, 2002; Boschma and Frenken, 2006; Lin and Lockwood, 2014; Scott, 2010; Spencer, 2015), the underlying socio-spatial structures are still under-emphasized in hazard research (cf. Acedo et al., 2017; Adger et al., 2011; Marshall et al., 2012).

This study starts to address this lacuna, and introduces the concept of 'adaptive neighborhoods' to debate on hazards and socio-spatial practices. We define an adaptive neighborhood as a socio-spatial fabric that enables knowledge exchange through social encounters between individuals and groups with both similar and diverse socio-economic backgrounds. Ideally, the emerging social networks foster the generation of social capital through bonding, bridging, and linking ties, which become resources for long-term adaptation.

Working from these conceptual considerations, this paper addresses two central research questions: What role does social capital play for the collective hazard response capacities of coastal neighborhoods? What linkages exist between urban forms of coastal neighborhoods, and the formation of social capital as an adaptive resource? First, we examine quantitative data collected through a standardized household survey in order to uncover the role of social capital in collective hazard response actions. Second, mapping and observational data are applied to identify the specific urban form of coastal neighborhoods, and interlinkages with the formation of social capital.

Before characterizing our study area and research methods, we first describe the theoretical framework for spatializing social capital as a resource for collective hazard response action. We then proceed to present our empirical findings on social capital as a resource for collective action, before considering their spatial dimensions. The discussion deepens our analysis of these results that lead to some concluding observations.

5.2 Literature review and hypotheses

Following Gallopín (2006), we understand *responses to natural hazards* as an umbrella term for both long-term and innovative adaptation as well as short-term and reactive coping (fig 1). Response capacities involve human abilities to adjust to current and expected changes in the environment, to reduce disaster risks, and to learn from previous events (Folke, 2006; Klein et al., 2007).

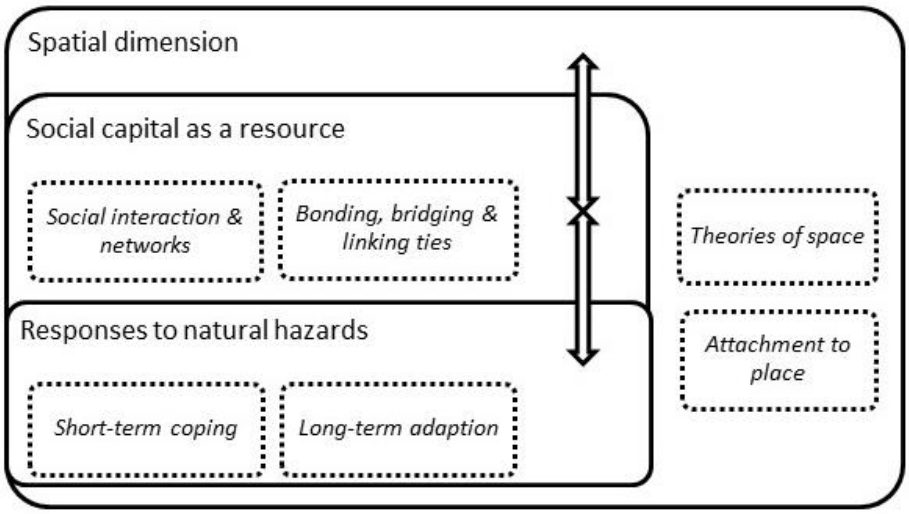

Figure 1: Conceptual outline for the spatial dimensions of social capital as a resource for responses to natural hazards

Coastal hazards such as flooding and land subsidence cannot be tackled by individuals alone, but rather require collective action to address not only technical tasks but social and political challenges, as well (cf. Marfai et al., 2015; Petzold and Ratter, 2015). Applying a bottom-up perspective avoids depicting coastal dwellers as passive victims, and focuses on their active agency in dealing with natural hazards (Waters and Adger, 2017). *Social capital is a resource* for collective hazards responses (fig 1). Through reciprocity, trust, and social control, communities are able to self-organize in response to natural hazards. Thus, we formulate the following hypothesis:

> **H1:** *Social capital has a positive impact on collective community hazard responses.*

Empirical research suggests that social capital is crucial when other forms of capital, such as financial, physical, human, and symbolic, are limited or constrained (Braun and Aßheuer, 2011). Financial capital is the most flexible form of capital, consisting of monetary assets together with physical capital, such as house ownership and other material possessions (Serrat, 2017). Human capital consists of a person's education, knowledge, and learning capacities, as well as constraining factors such as sickness or disability. Symbolic capital pertains to prestige and other endowments of power (Bubandt, 2014). Based on these insights, we derive a second hypothesis:

> **H2:** *For many communities and households in the Global South, social capital tends to be more relevant than other forms of capital for collective bottom-up hazard responses.*

Social capital consists of several structural, cognitive, and behavioral elements that are co-constituted by social practices (cf. Petzold and Ratter, 2015; Wickes et al., 2015). Structural elements include the composition of social network members, including their social homogeneity or heterogeneity, in terms of ethnicity, age, years of residence, migration background, and so forth. Cognitive elements encompass norms of reciprocity, trust, and social control, with the latter assuming the form of reward and punishment.

Based on structural and cognitive features, social bonds can be distinguished into bonding, bridging, and linking ties (cf. Lin, 2008; Portes, 1998). *Bonding ties* emerge in dense, and rather homogeneous, networks in which trust and social control are high (Agurto Adrianzén, 2014). These networks are assumed to foster immediate support and coping capacities, as network members share similar livelihoods and experiences (Chan et al., 2018; Kerr, 2018). Yet, strong bonding ties can also produce what are called lock-ins, by excluding outsiders from the network and by constraining innovation. *Bridging ties* are formed between network members with comparable socio-economic status, but different cultural and/or professional backgrounds. *Linking ties*, in turn, connect people across social classes. Translocal networks, typically established through migration relations, tend to facilitate the establishment of bridging and linking ties (Lin, 2008; Zoomers and van Westen, 2011). These ties tend to be looser than bonding ones. However, bridging and linking ties are assumed to be more likely to

foster long-term adaptation and innovation, as social control is weaker and new ideas are more likely to be exchanged through heterogeneous social networks (cf. Aßheuer, 2014; Hawkins and Maurer, 2010). These structural and cognitive features of social networks thus allow for the behavioral organization of social capital, or the self-organization of the neighborhood, through social interaction, learning, collective activities, and face-to-face meetings.

Here, the *spatial dimension* comes into play (fig 1). Social interactions and encounters within urban environments are inextricably rooted in place and time. Social interaction shapes and defines places through the appropriation and (re-)interpretation of public space. In turn, physical spatial characteristics are influential in shaping social networks (Adger et al., 2011). As Adger et al. (2011, 2) emphasize, a focus "on places highlights the local material and symbolic contexts in which people create their lives, and through which those lives derive meaning". Thus, social capital and interaction mutually shape, and are shaped by, urban form and spatial structures – an active relationship between place and society (cf. Houghton, 2005).

The concept of *'attachment to place'* embraces this idea. Following Marshall et al. (2012), such attachment involves peoples' emotional connection to their places of living. This includes strong social networks and friendships that exist in place. Thus, such attachment involves social and physical dimensions (Lin and Lockwood, 2014). Attachment to place, moreover, can motivate communities to work for adaptive in situ solutions, although it may also constrain options such as relocation (Marshall et al., 2012).

Within an urban neighborhood, attachment to place becomes 'attachment to the neighborhood', defined as positive relations that residents have with such place (Lu et al., 2018). Thus, we understand *neighborhoods* as both socially and spatially constructed, both defined by administrative borders and socio-spatial relations, as well as a sense of belonging. This attachment tends to increase with years of residence and by owning property (Lu et al., 2018).

Public open space is crucial for socio-spatial interactions. Here, people can meet and exchange experiences through face-to-face communication. Because this study focuses on mostly unplanned settlements in Jakarta, a megacity of the Global South, we use a

more holistic approach to public open space as a form of urban commons (cf. Leitner and Sheppard, 2018). These spaces are sites of social interaction, which are largely open and publicly accessible, often at a small-scale neighborhood level. Such places within neighborhoods do not necessarily need to be constituted as common property in order to serve as a place in common. According to Leitner and Sheppard (2018), it is rather the form of use and impact on space that differentiates an urban common from more tangible forms of possession.

In unplanned neighborhoods[1], urban 'communing' as a socio-spatial practice often occurs within so-called *'in-between'* spaces, in the streets between houses, offices, stores, cafés, main roads, and along river banks (AbdouMaliq, 2014; Leitner and Sheppard, 2018; Spencer, 2015). In-between spaces are characterized both by the social interaction that occurs within them, and the urban spatial structures that allow for such social interaction. Thus, we focus on public open spaces that are used as urban commons by local population, and in particular on small-scale in-between spaces in local neighborhoods.

We place an emphasis on official and informal *places to meet*, as these places provide opportunities for social encounter and dwelling time, which are key to the formation of social capital within common public open spaces. Empirical research suggests that neighborhood design and meeting opportunities influence the formation of trust and social relationships (Mount and Cabras 2015; Wood and Giles-Corti, 2008). This leads to the following hypothesis:

> **H3:** *The formation of social capital as a resource for hazard responses is influenced by the quality and number of places to meet within neighborhoods.*

Taking these conceptual considerations into account, the ideal of an *'adaptive neighborhood'* means a socio-spatial fabric that encompasses spatial settings in public open space that facilitate face-to-face meetings and knowledge exchanges. Such sites and interactions generate social capital on the basis of bonding, bridging, and linking ties, which become key resources for long-term hazard responses and innovations.

[1] Settlements in non-favored areas, such as low-lying coastal areas and along river banks. These settlements are inhabited by often poor and vulnerable populations.

In what follows, we consider the potential emergence of such adaptive neighborhoods. We analyze the results of a mixed-methods case study conducted in North Jakarta in order to, first, examine the relevance of different elements of social capital for collective hazard response action, and second, to identify the underlying urban form of neighborhoods.

5.3 Study area: North Jakarta

Indonesia's capital, Jakarta, is a megacity with one of the highest flood risks in the world (Hanson et al., 2011). Over the last four decades, urban land-use within the city's administrative area has increased by 276%, sprawling into low-lying coastal zones (Garschagen et al., 2018). Today, fast-onset risks such as flooding from tides, rainfall, and rivers (fig 2), as well as slow-onset risks including gradual subsidence and urban sprawl, create a multi-risk environment. River floods pose the biggest threat during the monsoon season, emerging from nine major rivers. In February 2007, over 60% of the city was flooded from 60 to 120 cm, leading to 56 deaths and the evacuation of 340,000 people (IFRC, 2007; Marfai et al., 2015).

The risk of all types of flooding is aggravated by land subsidence, largely due to excessive groundwater extraction and high urban surface loads. Subsidence reaches average rates of 4 cm/a and maximums up to 26 cm/a (Marfai et al., 2015). While absolute sea level rise shows no significant trends on Java's north coast, subsidence leads to an increase of the relative sea levels, aggravating the risk for tidal floods (Bott et al., 2018). According to our empirical research in Jakarta, it costs a minimum equivalent of $800 USD to elevate a single-family home, which posts a high financial burden for poor households.

The district under study, North Jakarta (Jakarta Utara), consists of six smaller urban sections (Kecamatan), which are further subdivided into urban quarters (Kelurahan or Kampung). One Kelurahan consists of several larger neighborhood associations (Rukun Warga: RW). One RW also encompasses several smaller neighborhood associations, normally around ten. These Rukun Tetangga (RT) usually consist of 30 to 50

households. Kelurahan representatives are appointed governmental officials, whereas representatives for neighborhood RWs and RTs are elected by the residents (Marfai et al., 2015).

Social networks and neighborhood self-organization on Java strongly correlate with the boundaries of RTs and RWs (cf. Okten and Osili, 2004). The highly institutionalized social structure and organization within a Kelurahan, in the form of RT and RW associations, are key resources for livelihood support and mutual aid. Residents share food, collectively raise money, install informal saving systems, organize medical care, or simply share togetherness. These social networks and self-organization structures can also contribute to community-based non-physical disaster risk reduction (cf. Marfai et al., 2015).

Provincial and municipal governmental risk management in Jakarta focuses on hard structural measures, such as dikes, barriers, and embankments. However, the effectiveness of these measures is debatable (van Voorst, 2016). These strategies often go along with resettling dwellers of flood-prone neighborhoods to newly built multi-story housing estates, so-called 'vertical housing'. The normalization of the Ciliwung River alone resulted in the eviction of 4000 households (Garschagen et al., 2018). Vertical houses, while being more flood secure, have bad reputations among local populations as they often lead to the erosion of social networks and traditional ways of 'communing'. Resistance towards resettlement projects is widespread (Leitner and Sheppard, 2018). The mismatch between politically implemented relocation measures and the interests of the local residents highlights the need for analyzing community-based hazard response strategies.

5.4 Methods

This research follows a mixed-methods approach. First, we conducted a standardized household survey in Bahasa Indonesia. In April and May 2017, with the help of field assistants from the University of Indonesia (UI), we surveyed a total of 300 households

in North Jakarta, representing 786 female and 741 male household members. The reference units in the survey are households defined as entities for collective decision-making. We defined household members as all people who sleep and eat under the same roof for a minimum of 180 days per year. Adult respondents were questioned about the household as a whole, with 51% of the respondents being female and 49% male.

We selected seven Kelurahans in the district of North Jakarta as study areas for the survey, basing our selection on on-site inspection and the insights of local experts from UI (fig 2). All study areas are prone to flooding and subsidence due to their proximity to the coastline and/or their location along riverbanks. We included both urban residential areas with formal residential statuses, as well as urban residential areas with unplanned statuses. The interviewed households belong to lower and lower-middle income families. In each Kelurahan, 40 to 50 households were selected randomly.

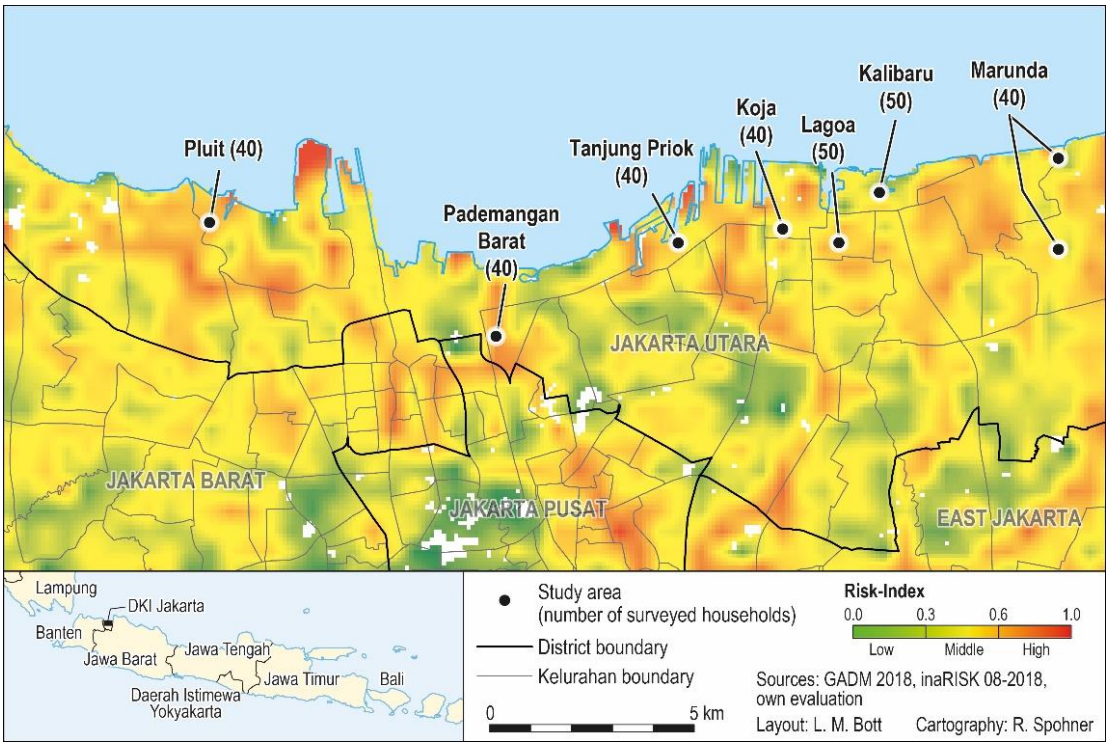

Figure 2: Flooding risks and location of study areas in North Jakarta

In August 2017, we subsequently carried out ground observations and mapping with the help of three local field assistants. We selected ten RWs within the previously surveyed Kelurahan. These included traditional neighborhoods with single-family homes, newer multi-story residential complexes, as well as resettlement areas with vertical houses. Open and semi-structured expert interviews with municipal officials were additionally conducted in order to gain further background information.

Based on the household survey data, we conducted a logistic regression analysis to assess the first and second hypothesis concerning the influence of social capital on collective community hazard response action (fig 3).

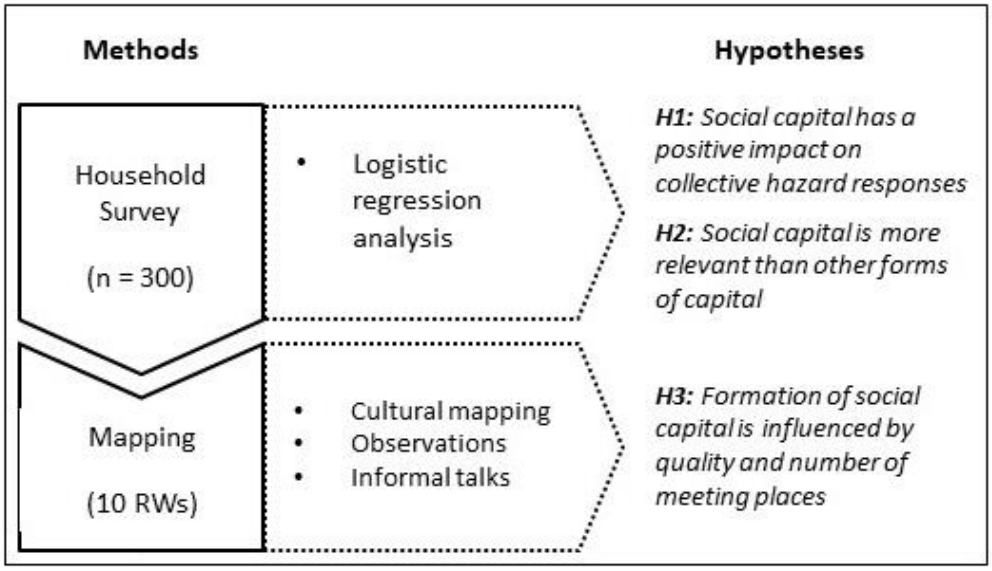

Figure 3: Methodological approach

To assess the third research hypothesis on the interlinkages between the urban form and the formation of social capital, we chose a form of cultural mapping according to Sacco and Vella (2017) (fig 3). This method allows us to explicitly visualize culture-space relationships and to deploy socio-spatial practices. Places to meet were identified and mapped as the most reliable and quantifiable reflection of these socio-spatial practices.

Mapping was combined with field observations concerning how people used places to meet. This method permits insights into residents' meeting behavior and social interaction (Flick, 2007). Observations were conducted in each survey site at least once on a weekday, and once on the weekend, and at different times of day (morning and afternoon/evening). We complemented these observations with informal, open-ended interviews with residents. Interviews conducted in combination with observations aimed to analyze the context of the respondents' lives.

5.5 Results

5.5.1 Social capital and collective hazard response actions

5.5.1.1 Descriptive results

A first descriptive approach to the survey indicators for social capital points to a rather strong bonding structure of social ties in the study areas. This coincides with a predominant short- to mid-term character of response strategies.

Of all households surveyed, 48% participate in one or more collective hazard response actions, such as mangrove replanting, building small embankments, road elevation, establishment of collective community saving funds, and organizing meetings on flood issues. While collectively organized, most of these measures can be categorized as coping rather than adaptation. According to our research, hard structural measures, such as small embankments and pumping systems, only last about 3.5 years. Strategies with a longer perspective include intangible ones, such as collective saving systems.

Social capital as a resource in North Jakarta consists predominantly of bonding ties. The social composition in the neighborhoods studied is rather homogeneous, with 97% of all interviewees following Islam, 75% belonging to a Java-originating ethnicity, and 71% being born in Jakarta. High levels of trust and social control coincide with strong bonding social capital. Some 82% of respondents believe that their neighbors are basically honest and trustworthy. In addition, 81% of respondents assess the rate of participation in their neighborhood collective action as high. Social control in the forms of

reward and punishment are undertaken, such that 22% of respondents think that people who do not join collective actions and meetings should be ignored, while 21% think that those people should lose social status. Social punishment is a strong force in the Javanese neighborhood context. People risk being excluded from social networks, and losing their access to community resources, which in poor neighborhoods are essential for responding to any kind of shock. One punishment reported by 8% of the interviewed households involves formal exclusion from community meetings (RT, RW, PKK[2]) by not being invited. Among rewards, 49% of the surveyed households have access to informal community funds, such as RT/RW/PKK funds, Arisan[3] and Sinoman[4], which work as a co-insurance. In terms of self-organization, 67% of households participate in RT and 54% in RW meetings. Here, collective action (e.g. waste cleaning, embankment building, festivities, funerals, health care) is coordinated (cf. Bott and Braun, 2019). The identified collective actions and the informal system of rewards and punishment are aspects of social capital and self-organization which also contain notions of a 'moral economy'. Neighborhood members engage in a moral economic system, where norms and institutions are established based on peoples' informal rules of reciprocity, fairness, and justice (cf. Götz, 2015; Scott, 1976). These rules then determine important aspects of collective hazard risk reduction such as participation, access to resources, and collective work organization.

Regarding bridging and linking ties, our results show that personal contacts strongly concentrate around living places and administrative boundaries, thus the neighborhood at RT, RW and maximum Kelurahan level. On average, households only have two personal contacts to friends, relatives, or business partners outside Jakarta. Only 28% of households receive remittances.

[2] PKK is the mothers and wives association that corresponds to the respective male RT and RW meetings.
[3] Community money pooling, non-bank savings by social network members.
[4] A form of mutual food pooling, e.g. in the case of receptions and festivities.

5.5.1.2 Regression analysis

Based on the household data and first descriptive results, a logistic regression analysis can be conducted to assess the first and second research hypotheses. The dependent variable 'collective hazard response action' was operationalized as a binary dummy variable for all households who participate in one or more collective response actions (yes=1). These response actions include 'hard' structural measures, such as road elevation, embankments, and pumping systems, as well as 'soft' measures such as mangrove plantation, and non-physical strategies such as holding meetings on flood issues or installing collective saving systems (n=300).

To test the first hypothesis, independent variables were generated for structural, cognitive, and behavioral features of social capital; these include the social composition of neighborhoods, trust, social control, and self-organization (tab 1). Furthermore, we included variables to control for bridging and linking ties. To test the second hypothesis on the relevance of social capital in collective hazard response action compared to the relevance of other forms of capital, we applied control variables for financial, physical, human, and symbolic capital (tab 1). In addition, we controlled for exposure to coastal hazards. The actual exposure is measured by whether or not the home of interviewed households is subsiding (yes=1), and by the frequency of floods each household experiences (at least monthly=1). The perceived household impact is indicated by the perception of how often floods become problematic (at least monthly=1). Furthermore, we controlled for negative impacts of hazard exposure by considering whether or not floods affect the job situation negatively, and whether or not households plan to relocate within the next five years due to exposure.

As binary logistic regression models are linked to less strict assumptions than linear ones, multicollinearity is the only factor necessary to check (Backhaus et al., 2006). The variance inflation factors (VIFs) for the independent variables in our analysis yield a mean VIF of 1.39, thus, multi-collinearity can be ruled out (O'Brien, 2007). Spatial autocorrelation has been controlled for by using robust standard errors.

Table 1: Independent variables

Independent variable	Mean	Std. Dev.	Min	Max
Social capital				
Social Composition				
Ethnicity (Java origin=1)	.75	.43	0	1
Time in neighborhood (years)	34.07	14.61	1	67
Birth place Jakarta (yes=1)	.55	.50	0	1
Family members born outside Jakarta (yes=1)	.18	.39	0	1
Trust				
Perceived trust level (high=1)	.54	.50	0	1
Perceived trustworthiness of neighbors (agree=1)	.79	.41	0	1
Social Control (rewards and punishment)				
In favor of punishment for not attendance (yes=1)	.45	.50	0	1
Excluded from meetings (yes=1)	.08	.27	0	1
Access to community funds (yes=1)	.49	.50	0	1
Self-organization				
Attendance of RT meeting (yes=1)	.67	.47	0	1
Attendance of RW meeting (yes=1)	.54	.50	0	1
Perceived participation level in neighborhood (high=1)	.81	.39	0	1
Bridging and linking ties				
Number of personal contacts outside Jakarta (relatives, friends, business partners)	2.18	1.39	0	6
Receiving remittances (yes=1)	.28	.45	0	1
Financial and physical capital				
Average income (IDR)	2267429	2787563	100000	3.50e+07
Savings > 800 US$ (yes=1)	.13	.34	0	1
House ownership (yes=1)	.83	.38	0	1
Human capital				
Highest education level in household (high school/tertiary education=1)	.87	.34	0	1
Sickness affecting education/employment last 5 years (yes=1)	.77	.42	0	1
Symbolic capital				
Leader position (head of RT, RW, PKK) (yes=1)	.24	.43	0	1
Self-assessment of personal influence (some/a lot=1)	.43	.50	0	1
Exposure to coastal hazards				
Subsidence of residence (yes=1)	.46	.50	0	1
Frequency of floods (at least monthly=1)	.72	.45	0	1
Floods become problematic (at least monthly=1)	.12	.32	0	1
Floods affect jobs (yes=1)	.62	.49	0	1
Relocation plans within next 5 years (yes=1)	.13	.33	0	1

Observations=300

In a first step, we ran a regression model (m1) only considering variables on bonding social capital (tab 2). All variables on social structure and social control, as well as one self-organization variable, show significant results, resulting in a R square of 0.25. Only trust appears to be of no significant influence. Thus, there is a relationship between collective hazard response action and bonding social capital. This relationship remains stable when adding control variables for bridging and linking ties (m2) and on

other forms of capital (financial, physical, human and symbolic; m3). All variables on bridging and linking ties, as well as all other forms of capital are insignificant. Even when adding exposure to hazards as further control variables (m4), which show some significant effects, the significance of the relationship between collective action and bonding social capital persists. Thus, the relationship between collective action and bonding social capital appears to be rather robust in our analysis.

This finding is further supported by applying a Shapley value to the R squared decomposition of the final model (m4). This value shows the relative importance of each group of the explanatory variables to the R squared statistics (Ravazzini and Chávez-Juárez, 2018). The results show that 75% of the explained variance is described by the variables on bonding social capital alone, with control variables on bridging and linking ties adding only 5%, the other forms of capital 7%, and exposure 13%.

In the following, we discuss the estimated effects of the independent variables of the final model (m4) when the margin of error is not significantly higher than 10% (cf. Gelman and Stern, 2006).

With regard to social composition, 'ethnicity from Java' is significantly negatively correlated. Thus, belonging to an ethnic minority originating from outside Java has a positive effect on participating in collective action. Furthermore, households with both family members born outside of Jakarta, and members born in the neighborhood of current residence, are significantly more likely to participate in collective action. These results are explainable by the predominant cause of migration on Java: marriage (cf. Hillmann and Ziegelmayer, 2016). In such cases, family members from outside Jakarta join households that are already established in the neighborhood, and thus become integrated into already established social networks. However, these new members have to prove themselves to the community. As a result, the time the household has been living in the neighborhood is significant as well, although the effect size is small.

Table 2: Binary-logistic regression results for participating in collective hazard response action

	Odds ratio (standard error)	Odds ratio (standard error)	Odds ratio (standard error)	Odds ratio (standard error)
Variables	m1	m2	m3	m4
Social capital				
Social composition				
Ethnicity from Java	**0.359*** ** (0.118)	**0.366*** ** (0.121)	**0.360*** ** (0.125)	**0.354*** ** (0.129)
Time in neighborhood	**0.981*** (0.0115)	**0.981*** (0.0115)	**0.980*** (0.0113)	**0.976** ** (0.0114)
Birth place Jakarta	1.643 (0.515)	**1.766*** (0.552)	**1.920** ** (0.614)	**1.915*** (0.653)
Family members born outside Jakarta	**3.253*** ** (-1.172)	**3.134*** ** (-1.155)	**3.319*** ** (-1.223)	**2.904*** ** (-1.179)
Trust				
Trust level	1.033 (0.323)	0.975 (0.309)	0.968 (0.332)	0.989 (0.342)
Trustworthiness of neighbors	0.981 (0.343)	0.990 (0.350)	1.010 (0.371)	0.868 (0.339)
Social control				
Punishment for not attendance	**2.474*** ** (0.750)	**2.314*** ** (0.746)	**2.233** ** (0.753)	**2.137** ** (0.742)
Excluded from meetings	**0.199** ** (0.135)	**0.200*** ** (0.124)	**0.178*** ** (0.118)	**0.197** ** (0.136)
Access to community funds	**3.205*** ** (0.960)	**3.095*** ** (0.941)	**3.293*** ** (-1.054)	**3.013*** ** (-1.012)
Self-organization				
Attendance of RT meeting	1.676 (0.680)	1.632 (0.662)	1.649 (0.704)	1.532 (0.665)
Attendance of RW meeting	**2.093** ** (0.784)	**2.165** ** (0.820)	**2.387** ** (0.977)	**2.765** ** (-1.159)
Participation level	1.558 (0.648)	1.513 (0.622)	1.494 (0.621)	1.514 (0.697)
Bridging and linking ties				
Number of personal contacts outside Jakarta		1.105 (0.119)	1.129 (0.124)	1.157 (0.130)
Receiving remittances		1.275 (0.426)	1.267 (0.441)	1.149 (0.404)
Financial and physical capital				
Average income			1.000 (3.90e-08)	1.000 (3.96e-08)
Savings > 800 US$			0.827 (0.371)	1.073 (0.531)
House ownership			0.873 (0.369)	0.909 (0.395)
Human capital				
Education			0.867 (0.405)	0.756 (0.355)
Sickness			0.670 (0.237)	0.573 (0.214)
Symbolic capital				
Leader position			0.779 (0.306)	0.707 (0.281)
Self-assessment of personal influence			1.027 (0.385)	1.125 (0.415)
Exposure				
Subsidence				0.733 (0.236)
Frequency of floods				**1.929*** (0.743)
Floods become problematic				**3.399** ** (-1624)
Floods affect job				0.774 (0.255)
Relocation plans				0.920 (0.439)
Constant	0.322* (0.203)	0.255** (0.174)	0.392 (0.348)	0.468 (0.439)
Model fit statistics				
Observations	300	300	300	300
Prob > chi^2	0.0000	0.0000	0.0000	0.0000
Pseudo R^2	0.2448	0.2483	0.2540	0.2814

Robust seeform in parentheses

*** Significant at 1% level (p<0.01), ** significant at 5% level (p<0.05), * significant at 10% level (p<0.1)

In terms of self-organization, participating in RW meetings shows a significant positive effect on collective hazard response actions. This result can be explained by the fact that RW meetings are the highest level of neighborhood-based meetings within the administrative structure of Jakarta. Kelurahans have appointed heads and meetings at this level are neither community-based nor self-organized. RT meetings, in turn, might be too small in member size to tackle issues of coastal hazard response actions.

As expected, flood exposure has a significant effect on collective action. Remarkably though, only actual exposure to floods, and not subsidence, is significant. Subsidence, as a slowly emerging process, tends to become an integral part of the living environment of the exposed people, and thus becomes something 'natural' and no longer perceived as a risk (cf. Bott and Braun, 2019). Moreover, the influence of actual flood exposure is lower than the perceived impact of floods, measured by the perception of how often floods become a problem. This result underlines the assumption that risk perception, and not the actual risk per se, influences the likelihood to take action (cf. Adger, 2003).

In summary, the statistical results show a significant and robust relationship between bonding social capital and collective hazard response actions in the case of North Jakarta. Moreover, bonding social capital is the only capital endowment of coastal dwellers that shows a significant impact in our study areas. Thus, the first and second hypothesis about the influence of social capital on collective hazards responses action, and the higher relevance of social capital over other forms of capital, can be sustained. This leads to the third hypothesis on the spatial basis of bonding social capital as a resource for adaptation.

5.5.2 Social capital and urban form

The formation of social capital requires possibilities and opportunities for encountering and dwelling with network members. According to our household survey, 66% of all neighborhood encounters occur spontaneously and unplanned. Thus, spatial opportunities in public open spaces are critical. Of these spontaneous meetings, 79% occur on neighborhood streets and 13% occur at small street food stands. This means that 92%

of spontaneous, unplanned encounters take place within the in-betweens of common public open space, while others occur at markets (3%) or in houses of prayer (3%).

Based on these results, and previous theoretical considerations of public open space, we develop a classification of public meeting places. This categorization includes the following basic requirements of public open space: They need to allow for face-to-face meetings, be (semi-) publicly accessible, foster social interaction (possibilities for sitting, quietness, shade), be known in the neighborhood, and be used by residents for gatherings. The classification was adjusted after on-site inspections; the final set of classifications includes:

- Nongkrong area (informal meeting places to 'hang out')
- Food Warung (small street food stands)
- Warung (small street shops/kiosks)
- Pos (security posts)
- Religious places (mosques, prayer rooms, etc.)
- Parks
- Playgrounds
- Kelurahan secretariats

These observations allowed for further distinctions among meeting places regarding the purpose of use, and their categorization into informal, formal, and official meeting places. Private meetings among friends and family characterize informal meetings. Residents sit, chat, eat together, drink coffee, or jointly prepare meals. These kinds of meetings are generally the most exclusive ones, because they usually bring people together who share similar characteristics, e.g., family, friends, or colleagues. Formal meetings have a clear purpose, for instance, community work at the RT levels such as collective waste cleaning. Meetings are defined as official when organized by external stakeholders, or used for non-private purposes, e.g., meetings at the Kelurahan level or meetings for vaccinations, elections, or public announcements.

The final mapped numbers of each meeting place classification strongly coincide with household survey findings. Among the in-between spaces of the ten mapped RWs, we identified a total of 265 food Warungs, 127 Warungs, and 120 Nongkrong areas. These

types of places were observed as the most frequented. In addition, 1 park, 50 security post, 23 mosques, 10 playgrounds, and 7 Kelurahan secretariats were also mapped. These latter places served more formal meeting purposes, and were less frequented in consequence. In the following, we describe the different locations and functions of places to meet and assess their influence on social capital (cf. Ankel, 2018).

5.5.2.1 Location, function, and user group of places to meet

Nongkrong areas (informal 'hang out' spots) are the most frequented informal meeting places in North Jakarta. These sites consist of benches or wooden huts. Important features of such places include shad, areas to sit, and (in most cases) a roof for rain protection. Nongkrong areas are located in small lanes and in close proximity to residents' homes. While some locations are deliberately built to serve as Nongkrong areas, other meeting places, such as Warungs or Pos, can also be used for Nongkrong purposes. Nongkrong is a time-consuming activity, and strengthens social ties at a very personal level (AbdouMaliq, 2014). In Nongkrong areas, people predominantly meet with friends and family members to chat, spend time together, and just to 'hang out'. Informal talks with residents revealed that people would not go to Nongkrong areas of other RTs. Thus, Nongkrong areas can be seen as indicators of social networks with closer and stronger bonds among members of one RT than between different RTs. This social differentiation goes even further: Nongkrong areas are often used by different age and gender groups at different times of the day, e.g., by women in the morning, men in the afternoon, and young people in the evening.

Warungs are permanent or semi-permanent kiosk-style street shops that sell warm food or packed snacks and refreshments. Many Warungs provide benches to sit. Warungs located on small streets often have a semi-permanent character. On bigger streets, they take the form of small restaurants. Warungs function as informal meeting places. User groups of Warungs within the mapped areas are clearly distinguished by RT belonging.

Security posts (Pos) serve a more formal function. They are representative buildings for corresponding RTs, which were originally implemented for security functions. They are built from stone or wood, including a roof and benches, and display their respective RW and RT numbers; sometimes they provide electricity and TVs. Pos are

located on bigger streets, usually one in each RT. They are used for official community work, RT meetings, RT leader elections, but also for spontaneous meetings. Thus, Pos are used for both formal and informal meetings. User groups are characterized by a sense of RT membership or belonging, and are differentiated by their ages, genders, and the times of day for their use.

Mosques show a higher diversity in location and user groups. Small mosques are located in narrow lanes of the RTs, and frequented only by RT members. Larger mosques are located on bigger streets and junctions, and are used by all RW residents. Interpreting the role of mosques as places to meet and sites for public social interaction is ambiguous, as they are only partially public open spaces and most social interaction occurs inside. Nevertheless, the areas around the mosques also serve as important meeting places, e.g., for mothers waiting together to take their children home from childcare. Thus, mosques and the spaces around them are used for both formal and informal meetings.

Finally, *Kelurahan* secretariats are representative buildings for the whole Kelurahan, and thus there is only one structure for each. They are located at bigger streets along the outskirts of residential areas. They function only for official purposes, such as official Kelurahan meetings, organizational duties, and medical treatments. They are frequented by all members of the corresponding Kelurahan.

5.5.2.2 Spatial setting of mapped research sites

In order to answer the third hypothesis, we analyze spatial implications for neighborhood social interaction, bearing in mind their different social functions and user groups. In undertaking this analysis, it is important to consider the spatial distribution of meeting places among in-between public open spaces across different survey sites. For this purpose, four of the more exemplary mapped survey sites are discussed in more detail.

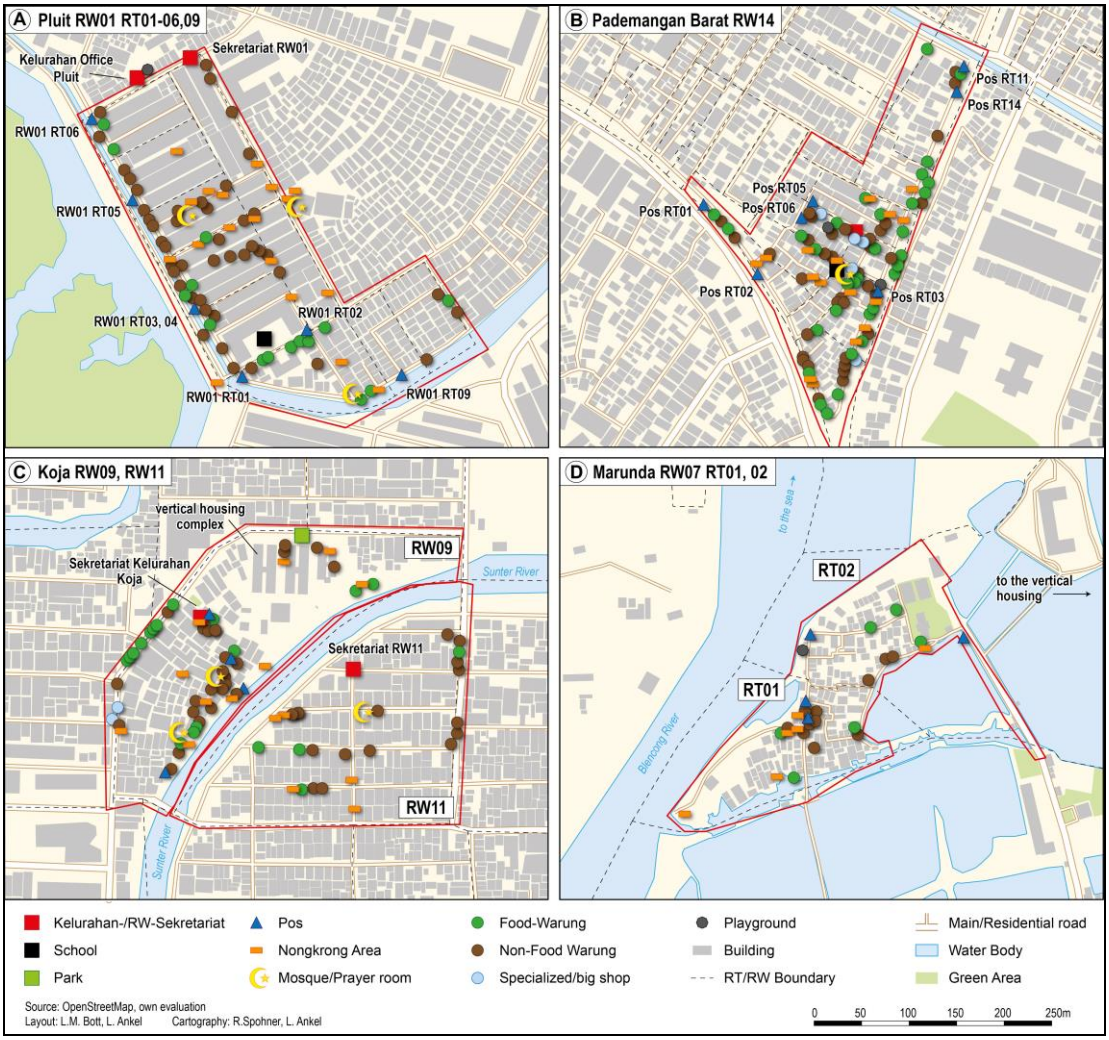

Figure 4: Mapped research sites in North Jakarta

We chose RW01 of Kelurahan, *Pluit*, (fig 4A) as a representative site that presents different meeting places and their distinctive user groups. This RW is highly exposed to river flooding, as the residential area lies below the adjacent river. A concrete wall separates the RW from the flood channel, Banjir Kanal Barat. Pluit is located next to the retention pond, Waduk Pluit, and is a well-known example of forced eviction based on the Public Order Law of 2007 (Leitner and Sheppard, 2018). Some Kampungs were evicted and some residents were resettled to vertical housing apartments. The map presents the distribution of meeting places, with one Pos at the entrance of each RT, larger Warungs situated on bigger streets, and most of the smaller and more informal Warungs and Nongkrong areas located on narrower RT streets that are close to residents' homes.

Pademangan Barat RW14 (fig 4B) depicts the different locations and functions of Pos and Nongkrong areas. This RW has a unique setting within a railway delta that surrounds the eastern and western borders, and makes it only accessible by road from the North. Most of the Nongkrong areas are thus located along smaller streets, whereas most of the Pos are located in the northern parts of the neighborhood that are closer to adjacent RWs. This suggests that these Pos still function as security posts in the neighborhood's entrance areas, whereas the Nongkrong areas constitute more private forms of meeting places.

The two RWs in *Koja* (fig 4C) are specifically selected to highlight differences between old neighborhoods and new housing estates, which incorporate new vertical housing complexes that are inhabited by migrants. RW09 and RW11, despite their geographical closeness, show different attributes according to building structure, population density, and the location of open public spaces and meeting places. The RTs that are furthest east and west in RW09 present the last remaining features of unplanned housing structures. Streets are not accessible by cars.

The RTs in the north have vertical housing complexes built after a fire destroyed the former buildings. The area surrounding the apartment buildings gives an artificial impression. Benches have been installed in a square, and a park was also built. However, local residents do not appear to have adopted this 'engineered' public open space. Public perception of meeting places is important, as they must be seen as open, friendly, and functional before being adopted by user groups (cf. Lager et al., 2015). However, the limited number of in-between spaces between vertical houses, and the smaller number of Nongkrong areas and Warungs, are nonetheless used in similar ways (and by similarly differentiated user groups) as in the old neighborhoods.

The feeling of belonging is an important component of social interaction (cf. Reicher and Haslam, 2009). According to our interviews, the vertical housing apartments are unpopular among residents from old neighborhoods, especially given prejudices against new residents. For Indonesians, moreover, it is culturally important to live on the ground floor, as the space in front of the home is used for hanging-out, cooking together, and informal meetings. Our evidence suggests, moreover, that residents prefer

meeting neighbors with similar status, age, gender, and ethnic background. We conclude that the observable meetings are strongly inward-oriented in relation to neighborhood and tend to co-constitute bonding ties.

Marunda RW07 (fig 4D) is located close to the harbor on reclaimed land, and is a neighborhood that is affected by relocation projects as a result of flood exposure and urban planning transformations. The RW's exposure to tidal floods is omnipresent, as many houses are built on stilts and are connected to each other by wooden bridges. The plotted RTs are located on an island next to a retention pond, and are only accessible via a narrow land bridge. The new apartments are located away from the coastline. However, they could not be mapped in detail due to restricted access. The case of Marunda shows that geographical proximity and strong feelings of belonging are important for the common use of meeting places. The general setting of the old RTs and vertical housing complexes conveyed a different impression from a planning perspective. Apartment buildings are surrounded by a wall with one entrance. Furthermore, there were no shared Nongkrong areas or Pos that were jointly used by new and old residents. Interviews with residents revealed that interactions among residents in vertical housing and the older neighborhoods are scarce, indeed. These results underline the findings that social closeness, and a sense of belonging, are important for frequent and shared use of informal meeting places.

Our empirical findings strongly support hypothesis 3, which suggests that different meeting places foster different forms of social capital due to the location, number, and function of these different places. In summary, meeting places that are highest in number and most frequented are those that are highly informal: Nongkrong areas and small Warungs. The location and function of these meeting places foster strong bonds and high levels of trust among relatively homogeneous user groups. Such meeting places and their emerging social networks are mostly inward-oriented. They are located deep within the RTs, and outsiders are excluded from joining. Thus, these meeting places constantly reproduce bonding social capital among the user groups. More formal meeting places, where people from different RTs, RWs, or even Kelurahan may encounter

one another, are comparatively scarce and less frequented. As a result, spatial and behavioral opportunities to form bridging ties are rather limited, and we found no clear spatial indication of the emergence of linking ties.

5.6 Discussion

Our empirical findings show that places to meet indeed shape the formation of social capital to a considerable degree (verification of hypothesis three), which in turn has a significant impact on the hazard response capacities of local neighborhoods (verification hypothesis one). The extraordinarily strong bonding social capital in the RTs is constantly reinforced by informal meetings in the in-between spaces of the neighborhoods. Accordingly, capacities for immediate support, community self-help, and other coping mechanisms are high. Network members mutually aid and support each other, e.g., through informal saving systems, workforce, and emergency responses, such as self-organized evacuations and emergency kitchens.

However, we found insufficient evidence for long-term 'adaptive neighborhoods,' which would require bridging and linking ties for outside engagement, knowledge transfer, innovations, and social learning. Both survey and mapping suggest that these ties are limited. Nevertheless, a case study by Spencer (2015) on creative industries in the US shows that urban forms can actually facilitate bridging and linking ties. Indeed, our regression analysis revealed that RW meetings have a significant influence on collective action. This means that there are self-organization structures in place at the neighborhood level that can join different RTs to work on issues that are too big for single neighborhoods to deal with, such as flooding and subsidence. Thus, there are first bottom-up neighborhood structures that could give rise to further adaptation initiatives.

The spatially-enforced bonding social capital is a key resource to the response capacity and survival of local neighborhoods in North Jakarta (cf. Chan et al., 2018), thus confirming hypothesis one and two. This means, that bonding ties are so well-established that network members are not only able to get by reactively in the short-term, but to

maintain their livelihoods at least over the mid-term in the case of most coastal hazard incidences (cf. Bott and Braun, 2019). This leads us to conclude that the strong spatially-enforced bonding social capital enables the formation of mid-term 'responsive neighborhoods'.

Adopting a geographical perspective of social capital proves to be highly valuable for understanding the formation of social ties. Our findings clearly indicate that social interactions, and the spaces within which they occur, mutually influence each other. In close relation to Scott's (2010) understanding of the city as a 'canvas' in which social practices are 'inscribed' in the urban landscape, this reading can be extended to an active process of mutually shaping influence. These findings strengthen Adger's (2003) argument that social capital should be considered a geographical concept.

While other studies have shown this socio-spatial relationship, for example, Spencer's (2015) analysis of 'knowledge neighborhoods,' or Scott's (2010) work on the 'urban creative field', our study introduces and develops the concept of 'adaptive neighborhoods' and by highlighting the relevance of socio-spatial relations for hazard response capacities. There are clear links between urban form, social capital, and the hazard response capacities of local neighborhoods.

By analyzing the quality and number of places to meet, we identify clear implications emerging from predominant forms of social capital (hypothesis three), which allow for a better understanding of the formation of social ties, as well as the exclusion or inclusion of certain individuals or groups (cf. Mount and Cabras, 2015). In addition, our findings reveal that even intangible resources in social networks, such as informal insurance systems, have tangible roots, one of them being the spatial setting of places to meet in public open space. These findings help us to better understand the development of bottom-up hazard response capacities.

We argue that attachment to place is an important factor for understanding hazard responses (cf. Bonaiuto et al., 2016; Clarke et al., 2018; Waters and Adger, 2017). Marshall et al. (2012) were the first to show such linkages in the case of Australia's peanut industry. Our study adds a neighborhood perspective from Jakarta, and shows that both community membership and informal meeting places create strong neighborhood attachments. This attachment significantly affects the transformational possibilities of

neighborhoods (cf. Marshall et al., 2012). On the one hand, it explains the intensive usage of in-between spaces as urban commons, and the strong in situ response and self-organizational capacities of the studied neighborhoods. On the other hand, it is an important factor in explaining why residents often oppose relocation, even if new apartments are located on safer grounds. Attachment to place motivates people to find in situ solutions, and helps to explain why people throughout the world tend to stay or even return to places of attachment after severe events (cf. Magee et al., 2016).

5.7 Conclusion

While urban form undoubtedly magnifies social encounters and interactions, it is impossible to disentangle all of the complex socio-spatial interrelations within an urban environment. As it is impossible to empirically grasp all aspects of socio-spatial practices in any given city, smaller and intensive case studies become especially important (cf. Spencer, 2015). This paper approaches complex and co-constituted socio-spatial practices in an urban environment by focusing on meeting places within coastal urban neighborhoods in North Jakarta.

Taking these considerations into account, we have argued for a spatial approach to the formation of social capital as a resource for collective hazard responses. The specific urban form expressed in meeting places shapes the formation of social capital, which in turn shapes the community's response capacities. Both methods employed in this study, including household surveys and the mapping of meeting places, corroborate the conclusion that bonding ties are the predominant form of social capital in North Jakarta's neighborhoods that foster short- and mid-term response capacities. The spatial distribution, quantity, and quality of meeting places influences formal or informal social encounters among user groups that give rise to the cultivated form of social capital.

Our results clearly show that social capital is crucial to collective hazard response actions, and that neighborhood residents in North Jakarta are able to cope with coastal hazards and to maintain their livelihoods. Their attachment to place and strong social networks are critical for 'responsive neighborhoods' that can thrive in the mid-term.

However, the formation of long-term ‘adaptive neighborhoods’ requires not only bonding social capital at the local level, but also bridging and linking ties for which we found only insufficient evidence in North Jakarta. If urban form of public open space would be developed in a way that not only facilitates encounters among people from one neighborhood, but from different places and social strata, this would enable the formation of bonding, bridging, and linking ties that could contribute to long-term adaptive capacities towards natural hazards and truly ‘adaptive neighborhoods’.

The concept of ‘adaptive neighborhoods’ is useful for considering socio-spatial interrelations in the context of urban hazard research. Further case studies should be carried out in different urban settings to investigate the spatial basis for different kinds of social capital as resources for adaptation, and to consider how building design and in-between spaces impacts social relations (cf. Spencer, 2015). In this regard future research should also take the role of digital spaces and the use of information and communication technologies more seriously into account as these technologies can very effectively enable the formation of translocal bridging and linking ties. Measures on the ground helping to facilitate establishing these networks could e.g. be free Wi-Fi zones in public open spaces.

The results of this study contribute to a better understanding of bottom-up hazard response capacities that can be found in urban settings. Such knowledge is vital to planning approaches that seek to promote long-term and innovative adaptation in urban neighborhoods. Interviews with disaster management authorities in Jakarta indicate that within the decentralized political system of Indonesia, there are manifold jurisdictions at national, provincial, municipal and urban district levels. Thus, even developing and coordinating hazard management at higher government and administrative levels can be very challenging, which might be an explaining factor why neighborhoods often have to take on bottom-up initiatives to respond to coastal hazards instead of being able to rely on governmental disaster risk management. However, these jurisdictional difficulties only underline the need for better aligned top-down and bottom-up initiatives. The latter is not only true for Indonesia but for many countries of the Global South – and the Global North.

Urban planning that more thoroughly acknowledges community's attachment to place and social-belonging might yield fewer conflicts. When communities are actively engaged in hazard risk management, their social capital can not only be deployed at a small-scale neighborhood level, but integrated in top-down planning projects. If relocation is unavoidable due to serious exposure, keeping communities intact could at least preserve their bonding social capital and therefore their response capacities. Moreover, if the spatial basis for social capital as a resource for hazard responses is recognized, then spatial opportunities can be provided that not only enable bonding social capital but also foster the emergence of bridging and linking ties. When urban planners actively engage local communities by acknowledging neighborhoods' social capital and attachment to place as resources for hazard responses, then, planning can actively contribute to the emergence of long-term 'adaptive neighborhoods'.

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Translocal social capital as a resource for community-based responses to coastal flooding – Evidence from urban and rural areas on Java, Indonesia

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6 Translocal social capital as a resource for community-based responses to coastal flooding – Evidence from urban and rural areas on Java, Indonesia

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Abstract

Social capital is used widely by households in the Global South as a collective response mechanism to natural hazards. It is argued that these processes serve as substitutes for scarce financial and human capital in poor communities. To date, the majority of studies on social capital in the Global South has framed these processes in place-based ways, assuming that they are developed and deployed within local spaces. However, in an increasingly globalized world, people's social networks increasingly transcend the local, and social capital is therefore manifested in multi-scalar geographies. The aim of this study is to assess the significance of this translocality for the use of social capital in responding to natural hazards. Using evidence from communities under threat of sea-water inundation in rural and urban areas in North Java, we focus on both the outcomes of translocal social capital for hazard adaptation and the origins of these social ties. Our results show that households with a higher number of translocal contacts are more likely to take proactive measures against flooding and subsidence. Furthermore, we found that the conditions for establishing translocal social capital differ between rural and urban areas, and we show that the propensity for translocal social capital is stratified along economic lines. Poorer households have fewer translocal social ties, which impairs their ability to adapt to environmental threats. Thus, our results contest former assumptions about (translocal) social capital being a prime resource for the poor. The paper concludes that interventions in poor communities designed to enhance translocal social capital may offer answers to this problem.

Keywords: Translocality, social capital, adaptation, sea level rise, Jakarta, Semarang

6.1 Introduction

Urban and rural settlements are increasingly subject to territorial influences that subvert their borders such as global environmental change and globalization processes (cf. Oosterveer, 2018). Contemporary and future challenges of responding to coastal hazards and environmental change are not only faced locally but call for translocal networking and collaboration.

Many empirical studies have shown the relevance of social networks in the adaptation processes of local communities and households (e.g. Aldrich, 2011; Braun & Aßheuer, 2011; Chatterjee, 2010; Murphy, 2007; Portes, 1998). Especially in the Global South, people respond to hazards collectively using their social capital. Social capital thus takes on roles in responding to hazards that would otherwise be the responsibilities of the state and its hazard management agencies (Adger et al., 2003). Through networks of trust, individuals are able to organize access to loans, remittances, mutual help, information, and knowledge that have the potential to become valuable resources for disaster recovery and bottom-up adaptation (Aßheuer et al., 2013).

However, in a globalized world, social capital is increasingly organized across local and national boundaries (cf. Andersson et al., 2018; Boas, 2017; Rockenbauch & Sakdapolrak, 2017). Despite this fact, most of the existing studies in the field of hazard research have a strong local or regional focus and tend to ignore the manifold strong and weak social ties that can extend over a larger geographical scale, across different regions, or even transnationally.

This study aims to overcome this limited view of social capital in hazard and climate change research by conceptualizing social capital as a translocal phenomenon. This can be achieved by relating the concept of social capital to work that has been done on translocality and translocal spaces. Translocality in this sense refers to the emergence of boundary-crossing social networks that enable people to circulate, to exchange ideas and resources, and to share common practices (Greiner & Sakdapolrak, 2013a). Translocal networks are complex as they are multidirectional and overlapping thereby challenging traditional dichotomies of ‘here’ and ‘there’ (Daskalaki et al., 2016; Greiner & Sakdapolrak, 2013a).

By applying this focus, our study adds an important bottom-up dimension to social science hazard research. Results on how translocal social capital enables (or hampers) the endowed people to cope with fast-onset natural hazards and to adapt to slow-onset events such as sea level rise lead to improved knowledge about socio-ecological interactivity and vulnerability. To achieve this aim, this paper looks at hazard response actions and social networking, both in rural and urban settings. Thus, the first central research question focusses on the outcomes of translocal social capital: Do translocal social contacts have a positive influence on the coastal hazard response capacities of households?

Existing literature has hypothesized that social capital works as a substitute for lacking financial and human capital (e.g. Li et al., 2017; Nasution et al., 2015; Rustiadi & Nasution, 2017). Thus, social capital is framed as a resource for hazard responses, especially of poor communities. Other literature on translocality has pointed to the important role of financial assets and knowledge in building translocal networks, which are strongly related to practices such as migration, tourism, using information and communication technologies (ICTs), and producing for global value chains (Etzold, 2016; Freitag & Oppen, 2010; Zoomers & van Westen, 2011). Thus, it can be assumed that a certain amount of financial and human capital is in fact required to establish translocal ties. This assumption leads to the second main research question on the origin of translocal social capital: Which factors enable local urban and rural households to establish translocal networks that are relevant for responding to natural hazards?

To answer the two research questions, we apply a multi-place-based approach and study human-environment interaction, social relations, and hazard responses in rural and urban areas of different scales on the north coast of Java. In particular, we focus on highly hazard-prone coastal communities in the megacity Jakarta, in the regional urban center Semarang, and in adjacent peri-urban areas of Kendal and in rural areas of Demak. Through the use of qualitative focus group discussions and a quantitative household survey, social ties and collective actions are analyzed to identify hazard responses, learning processes, and hazard perceptions, with obvious implications for hazard and climate change actions (cf. Gioli et al., 2014; Tschakert, 2007).

The next section outlines and combines social capital approaches and the idea of translocality in the Global South to formulate a general framework for studying bottom-up adaptation to natural hazards and environmental change. In a second step, the study areas and methods are described. The result section analyzes the findings with regard to urban-rural differences. Based on our empirical findings, the relevance of the translocal social capital approach for geographical and hazard research are discussed, before concluding the paper.

6.2 Translocal social capital

Since the 1990s, social capital has become an established concept in social and political sciences (e.g. Castiglione et al., 2008; Lin, 2008; Portes, 1998; Putnam, 1993), human geography (e.g. Adger, 2003; Mohan & Mohan, 2002), and economics (e.g. Claus et al., 2015), and has been applied successfully in hazard research (e.g. Aldrich, 2011; Braun & Aßheuer, 2011; Murphy, 2007). An important contribution of the social capital approach in hazard research is that it emphasizes the active role of individuals and local communities in dealing with environmental change, rather than portraying them as helpless victims. Moreover, it contributes to a meaningful bottom-up perspective which contrasts to the often top-down dominated approaches on hazard and emergency management (Murphy, 2007; Nakagawa & Shaw, 2004). Thus, local social networks and mutual help are highly relevant for disaster recovery (Braun & Aßheuer, 2011; Hossain & Ahmed, 2015; Portes, 1998). However, a deeper understanding is needed of the pathways that determine the outcomes and origin of social networks on different spatial scales.

In a globalized world, social networks increasingly stretch across regional boundaries of all scales. Nonetheless, most empirical research in the field of social capital and hazard response studies still has a strong local or regional focus. Yet, based on insights from translocality approaches in development studies it becomes evident that development outcomes cannot be explained by analyzing only one place (Zoomers et al., 2016). Changes in one location can have a significant impact on processes elsewhere (cf.

Zoomers, 2018). Places are being transformed and shaped by processes of connectedness such as migrant social networks, municipal partnerships, global value chains and production networks (cf. Etzold, 2016). Applying a translocal approach to hazard response studies can overcome a too narrow spatial bias while still recognizing the importance of specific places. Interlinked localities thereby appear as nodes in translocal social networks (Zoomers & van Westen, 2011; fig 1). The translocality approach combines notions of locality and mobility, takes into account geographies of inter- and intra-regional interrelations, and allows thus for a better understanding of socio-spatial dynamics.

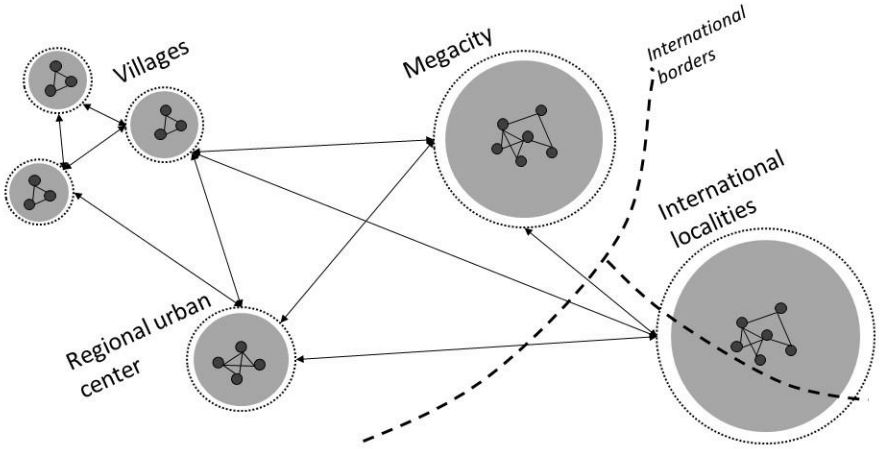

Figure 1: Schematic of translocal social networks

Translocality studies have been applied by human geographers (e.g. Brickell & Datta, 2011; Steinbrink, 2009; Verne, 2012; Zoomers & van Westen, 2011), by anthropologists (e.g. Gottowik, 2010; Greiner, 2010; Greiner & Sakdapolrak, 2013b; Núñez-Madrazo, 2007), in cultural studies (e.g. Bennett & Peterson, 2004; Ma, 2002), in history and area studies (Freitag & Oppen, 2010; Oakes & Schein, 2006), and in development studies (e.g. Grillo & Riccio, 2004; Zoomers & van Westen, 2011). However, while the translocality approach offers specific advantages for adaptation and hazard research, it has only recently been applied in this field (e.g. Rockenbach & Sakdapolrak, 2017).

The integration of the translocality approach in social capital research allows the development of a holistic conceptual framework to analyze and categorize resources and dynamics in social rural-urban networks of communities and households, and their role

in adaptation processes towards climate and environmental change. Focusing on social capital enables researchers to analyze the structure, quality, and resources of social networks (cf. Adger, 2003), while translocality studies allow for analyzing the spatial nature of social networks and their geographical localizations (cf. Greiner & Sakapolrak, 2013b; Zoomers, 2018). The combination of both concepts, therefore, offers a new analytical perspective and contributes to knowledge about highly dynamic human-environment interactions and complex adaptation processes. Both concepts describe social phenomena which are not static but constantly changing and thus are complex in nature. While in the literature, disaster resilience is often regarded as a range of network capacities (cf. Norris et al., 2008; Wilkin et al., 2019) or as range of distinct capitals such as social and financial ones (cf. Aldrich, 2011; Aßheuer et al., 2013) our framework combines both concepts.

Figure 2 illustrates the framework of translocal social capital as a resource for responding to natural hazards and environmental change. Local social networks within one closely connected homogeneous community at a certain place generate bonding social capital. These ties are associated with immediate support and mutual help. However, strong bonding ties can also lead to the exclusion of certain people and restrain innovative ideas (Agurto Adrianzén, 2014). Translocal social capital is formed within the translocal space between inter-connected communities located at different places. The networking social capital (bridging and linking ties) which emerges from these connections is characterized as looser (weaker) than bonding social capital but is assumed to offer promising pathways for innovations and new ideas, knowledge, and resources (Cofré-Bravo et al., 2019). Bridging and linking ties tend to have a different quality as they are more heterogeneous and include members of different ethnic, cultural, and occupational backgrounds (bridging ties) as well as connections over hierarchical stratums (linking ties) (Aßheuer, 2014; Hawkins & Maurer, 2010). Based on the structure and quality of the networks, it can be assumed that local bonding social capital is more likely to contribute to short-term coping activities whereas translocal networking social capital can be assumed as being more prone to trigger and enable long-term adaptation processes. To build up adaptive capacities, households and communities learn from

previous events, develop innovative ideas, and overcome resource constraints. Therefore, the building of adaptive capacities can be enhanced by engaging in translocal social networks, creating external linkages, and boosting mutual support to develop the required flexibility to plan under uncertainties (cf. Cope et al., 2018; Norris et al., 2008). Based on these considerations, we assume that in contrast to local bonding social capital, translocal social capital allows for more innovative and long-term adaptation. Thus, we formulate the following hypothesis on the outcomes of translocal social capital for adaptation:

> **H1:** *Households with more translocal contacts are more likely to undertake proactive measures against coastal hazards.*

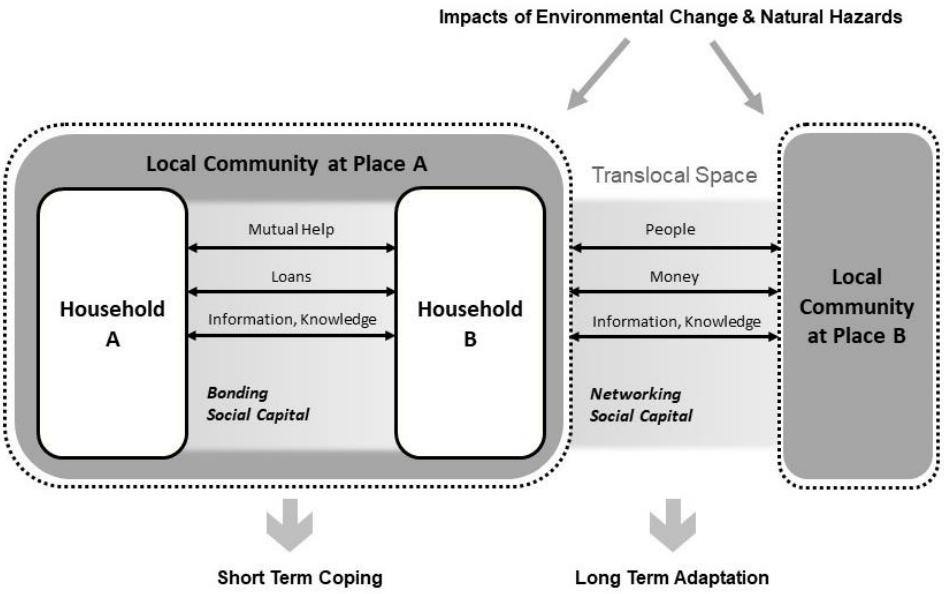

Figure 2: Schematic framework of translocal social capital and responses to environmental change

Empirical research further suggests that strong bonding and weaker bridging ties are more likely to be found in rural communities, whereas urban communities tend to have relatively stronger bridging and linking ties (Pelling & High, 2005; Sørensen, 2016). This assumption is related to an important practice in establishing translocal contacts: migration (cf. Etzold, 2016). Translocality and migration research has shown that migration as a livelihood strategy is usually not undertaken by the poorest members of a society but requires a certain amount of education and financial assets, meaning human

and financial capital (Bernzen et al., 2019; Codjoe et al., 2017; de Haas, 2005; Foresight, 2011).

Research on the outcomes of migration for adaptation practices in the regions of origin has pointed out that translocal networks are often established independent of hazard exposures but rather as general livelihood support strategies (Bott, 2016; Romankiewicz et al., 2016). With regard to hazard research, there is a tendency to focus only on the positive effects of already established social networks. However, we argue that examining the formation of translocal ties should be considered in hazards research as well, and not only in migration-related studies. This widened perspective allows to better understand the preconditions of this important resource for adaptation and to steer interventions in poor communities aiming at enhancing community response capacities. Thus, we formulate the second hypothesis on the origin of translocal social capital:

> **H2:** *In contrast to local social capital, translocal one requires a significant amount of financial and human capital to be established.*

We argue that to capture the different relevant forms of social capital a translocal perspective is required. Only by applying a translocal approach is it possible to adequately cover the specific roles of bonding, bridging, and linking ties. In the following, we analyze the outcomes and origin of translocal social contacts with regard to responding to coastal hazards in four different urban and rural study areas on Java.

6.3 Study areas in North Java

The large cities on Java's northern coast are highly exposed multi-risk environments (Suroso & Firman, 2018). Jakarta is among the megacities with the highest flood risk worldwide and the regional urban center of Semarang likewise shows extremely high exposure (Abidin et al., 2013; Hanson et al., 2011). Over the last decade, both cities have gained population, reaching 10 mill and 1.5 mill inhabitants respectively in the municipal areas. As a result, they sprawled into sensitive low-lying coastal zones (Esteban et al., 2017; Garschagen et al., 2018; Marfai & King, 2008). As a consequence of the increased surface load and the excessive groundwater extraction, land subsidence

of the alluvial soils has increased dramatically, reaching maximum rates of 26 cm/a in Jakarta and 19 cm/a in Semarang (Abidin et al., 2013; Marfai et al., 2015).

While absolute sea level rise shows no significant trend at the north coast of Java, subsidence leads to a measured increase of the relative sea level by about 10 cm/a (Bott et al., 2018). Consequently, flood frequencies have risen. Low-lying areas in Semarang (22 % of the city) are frequently inundated up to 40 to 60 cm by tidal floods (Marfai & King, 2008; Nugraha et al., 2015;). The situation is further aggravated by rain and river floods. In Jakarta, nine major rivers cause flood levels up to 120 cm (Marfai et al., 2015). Even rural and peri-urban areas in Demak and Kendal, to the West and East of Semarang City, are facing frequent flooding (fig 3).

Responding to coastal hazards is a major challenge for poor households and neighborhoods. People are forced to settle in highly flood-prone areas along channels and river banks and on low-lying flood plains (Leitner & Sheppard, 2018). The human and financial capital of these populations is typically insufficient to protect themselves against flooding and subsidence on a long-term scale (cf. Hillmann & Ziegelmayer, 2016).

Against this background, social capital has become a major asset to allow neighborhoods to accommodate coastal hazards (Bott & Braun, 2019). On Java, self-organization at village (Desa) and urban quarter (Kelurahan) levels is highly institutionalized. One Kelurahan or Desa is divided into several larger neighborhood associations, so-called Rukun Warga (RWs) and further subdivided into around 10 smaller neighborhood associations called Rukun Tetangga (RTs). One RT consist of about 30 to 50 households. The heads of RWs and RTs are elected by the local community whereas the head of Kelurahan/Desa is appointed by the government (Marfai et al., 2015). These RT and RW structures are the backbone of community self-organization on Java (Okten & Osili, 2004). People meet regularly in RT and RW meetings. Here important community matters are discussed and organized such as health care, community flood protection, waste cleaning, emergency kitchens, and legal issues (Bott & Braun 2019).

6.4 Research methods

This research follows a mixed-methods approach. In a first research phase (August and September 2016), we conducted eight focus group discussions (FGD) with community members in seven hazard-prone coastal urban quarters of Semarang with the help of three Indonesian student assistants from the Gadjah Mada University (UGM). This method was used to gain first qualitative information and to analyze the interactions and communication patterns between participants.

Based on the qualitative findings, we developed a standardized household survey, which was conducted in Indonesian with the help of field assistants from the Diponegoro University (UNDIP) and the University of Indonesia (UI). Between March and May 2017, we surveyed a total of 950 households (300 in North Jakarta, 330 in Semarang, 160 in Kendal, and 160 in Demak), representing 2,248 female and 2,122 male household members. The reference units in the survey are households defined as entities for collective decision-making. Adult respondents were surveyed about all household members. 50 % of the respondents were female and 50 % male. Additional open and semi-structured key informant interviews with local leaders and municipal officials were conducted throughout both research phases to gain additional background information.

We selected 14 urban Kelurahan in the district of North Jakarta and in Semarang, and eleven villages (Desa) in Demak and Kendal as study areas for the survey based on on-site inspections and with the help of local experts from UGM, UNDIP, and UI (fig 3). In each urban Kelurahan 40 to 50 households were selected for the interviews during random walks; in each rural Desa 13 to 40 households. All study areas are prone to flooding and/or subsidence due to their proximity to the coastline and/or their location along riverbanks (fig 3). We included both urban residential areas with formal residential status as well as unplanned settlements. The interviewed households belong to the low and lower-middle income classes. The urban study areas include fishing communities and industrial worker areas as well as settlements of the lower urban middle class. The peri-urban study areas located in the district of Kendal are facing significant in-

dustrial suburbanization. Major roads and the railway connect the coastal areas of Kendal to Semarang, allowing daily commuting between the two. The rural villages in Demak, in contrast, are still largely based on local aqua- and agriculture and are not accessible by the railway or major roads.

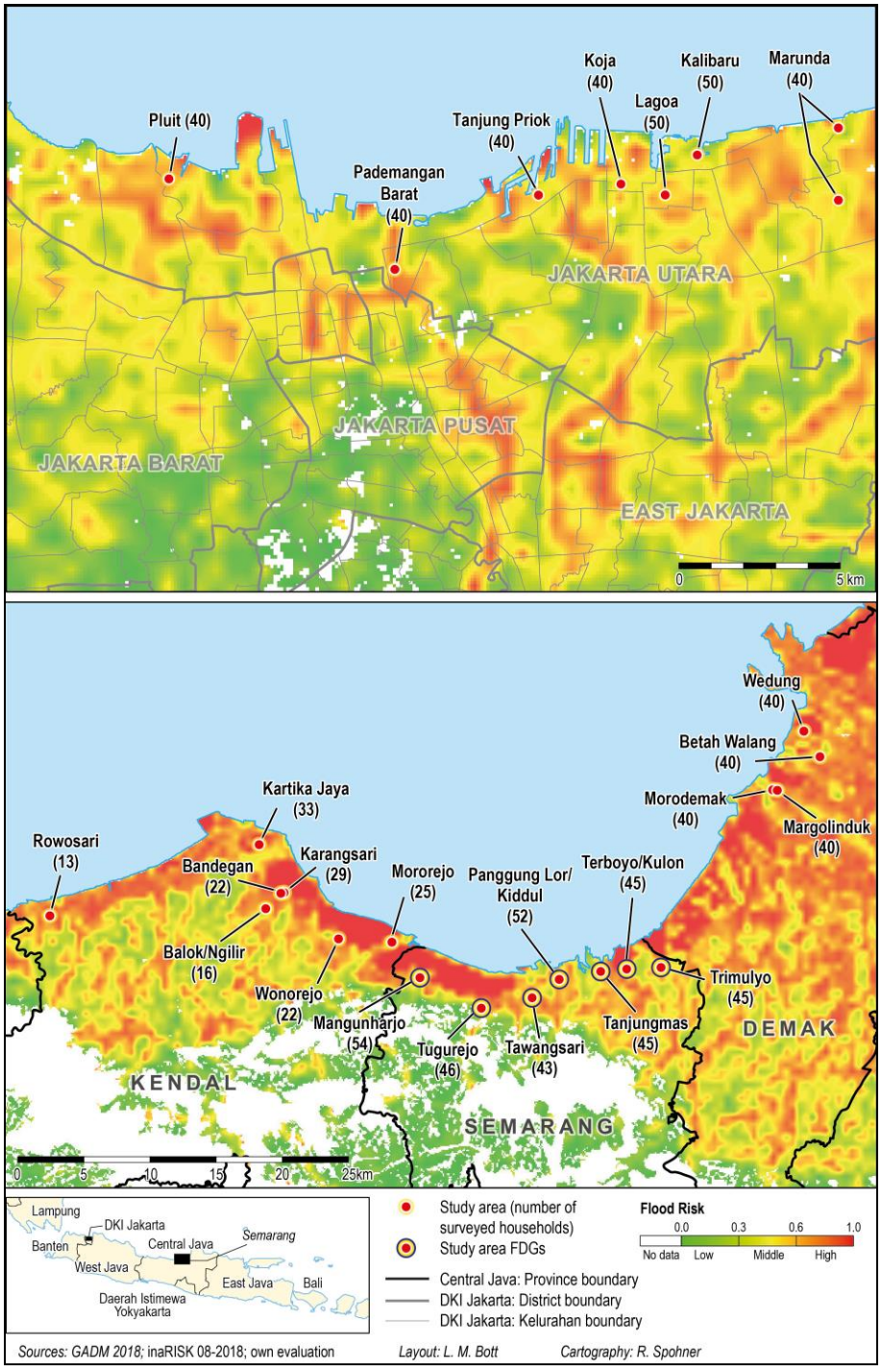

Figure 3: Study areas and risk towards tidal and river flooding

Based on the household survey data, we conducted Chi-squared tests to answer the first research question concerning the role of translocal social capital for proactive hazard response action. To uncover the origin of such translocal social capital (research question 2), we applied a regression analysis, where we operated the number of translocal contracts of a household as the dependent variable. Because this variable is based on count data with non-normally distributed residuals, a Poisson regression was applied instead of an ordinary least square regression. Following Coxe et al. (2009), count variables with a low arithmetic mean (< 10) can produce biased results in standard ordinary squares regressions. Poisson regressions are generalized linear models. Counts are the observed scores and the predicted scores are calculated as the natural logarithms of these counts. That way generalized linear models are flexible in errors structure and "a potentially nonlinear relationship between the dependent variable and the predictors" (Coxe et al., 2009: 122) can be linearized.

6.5 Results

6.5.1 Descriptive results on social capital and translocal social networks

Descriptive analysis of the survey indicators for social capital points to a rather strong bonding structure of social ties in all study areas, based on social composition, trust levels, and social control (cf. Bott & Braun, 2019). The social composition in the neighborhoods studied is rather homogeneous, with 94 % of all interviewees following Islam, 89 % belonging to a Java-originating ethnicity, and 60 % being born in their current place of residence. However, the heterogeneity of social composition is significantly higher in urban than in rural study areas.

Identified high levels of trust and social control tend to coincide with strong bonding social capital. Some 83 % of the respondents trust their neighbors. Social control is executed by means of rewards and punishment: 40 % of respondents agree that neighbors should be ignored by the community or lose their social status if they do not participate in neighborhood meetings and collective actions. Results from FGDs show that in the Javanese neighborhood context, socially punished people risk the exclusion from

social networks and thereby from community resources, which are important means of non-physical disaster risk reduction.

Regarding bridging and linking ties, descriptive results indicate that personal contacts strongly concentrate around the living places. On average, households have 1.5 personal contacts to friends, relatives, or business partners outside their place of residence. Remittances are received by 20 % of households.

The reason for these results can be found in the strong sedentary culture on Java (cf. Hillmann & Ziegelmayer, 2016). In contrast to other Global South countries highly exposed to coastal hazards, such as Bangladesh (Bernzen et al., 2019) or Ghana (Codjoe et al., 2017; Hillmann & Ziegelmayer, 2016), migration of household members is not a common livelihood strategy. Instead of migrating, households engage in tight neighborhood networks as informal social insurances (Bott & Braun, 2019). For this reason, migration is not a much-considered adaptation strategy towards coastal hazards. Only 7 % of the interviewed households stated that they would consider relocating within the next five years because of flooding and subsidence. Therefore, the number of translocal contacts and thus the impact of translocal social capital on adaptation outcomes can be assumed to be much smaller on Java compared to regions with well-established migration patterns. However, the question remains whether, even within such a rather sedentary culture, translocal social capital still benefits the proactive hazard responses of endowed people.

6.5.2 The effects of translocal social contacts on adaptation to coastal hazards

To test the first hypothesis on the outcomes of translocal social capital for proactive hazard responses, we run two Chi-squared tests to analyze whether households with a high number of translocal contacts are more likely to undertake proactive measures against coastal hazards. A contact is classified as translocal if the contact person is living in another district, province, or country than the surveyed household. We used the dummy variable ‘high number of translocal contacts’ (> 2 translocal contacts = 1) as the dependent variable. 18 % of households have more than two of these contacts. To control for proactive response actions, we used concrete measures taken against floods and subsidence. The first variable is whether households undertake proactive

measures preceding a flood. We created a binary dummy variable for proactive measures (proactive measures are taken = 1, n = 950). This dummy variable includes measures such as rebuilding of houses on piers, pillars or columns, installing private pumping systems, sleeping in raised beds instead of on the floor, storing possessions in higher places, building elevated shelves, increasing house thresholds, covering the house with ceramic tiles, building drainage channels or foundation vents, and building concrete walls around the house.[1] For measures against subsidence, we analyzed whether households exposed to subsidence elevate their houses (yes = 1; n = 521[2]).

The results show that households with an above average number of translocal contacts are significantly more likely to engage in proactive actions against coastal hazards (tab 1). This finding applies for measures against subsidence and even more so for flood responses.

Table 1: Bivariate relationships of proactive measure against flooding/house elevation and a high number of translocal contacts

	Proactive measures against flooding			**House elevation**		
High translocal capital	**No**	**Yes**	**Total**	**No**	**Yes**	**Total**
No	234	546	780	149	283	432
%	30	70	100	34.5	65.5	100
Yes	25	145	170	19	70	89
%	14.7	***85.3***	100	21.3	***78.7***	100
Total	259	691	950	168	353	521
%	27.3	72.7	100	32.2	67.8	100
Pearson Chi² (1)		**16.4641**			**5.8342**	
Pr		**0.000**			**0.016**	

Based on the Chi-squared tests, the first hypothesis that households with more translocal contacts more likely to undertake proactive measures could be validated. Thus, even within a highly sedentary culture with relatively low numbers of translocal ties in international comparison, translocal social networks have a positive influence on adaptation.

[1] Seven of the nine variables included in this dummy show significant positive results in separate Chi-squared analyses, the other two variable show positive but non-significant effects.

[2] The sample size is reduced because only households that reported being exposed to subsidence are included.

6.5.3 The origin of translocal social contacts in urban and rural areas on Java

Based on the descriptive results of the household survey, a Poisson regression analysis can be conducted to examine the second hypothesis on the origin of translocal social contacts. The dependent count variable 'number of translocal social contacts of a household' was used to investigate how translocal social capital is established.

To test for the second hypothesis, independent variables were generated for financial, physical, human, and symbolic capital, including variables on income, education, and leadership (tab 2). In addition, we used variables on ICTs under financial and physical capital (material possession), as access to ICTs is vital for establishing and maintaining translocal contacts (Boas, 2017). Furthermore, we used variables for the different study areas (Jakarta, Semarang, Demak, and Kendal) to test for regional rural-urban differences. In addition, we controlled for the migration history of the households. These control variables are used as migration is assumed to be the most influential practice in establishing translocal ties, and thus necessary to control for (cf. Brickell & Datta, 2011; Etzold, 2016; Freitag & Oppen, 2010). To test for hazard influences, we, furthermore, controlled for flood and subsidence exposure.

Poisson regressions are bound to less strict assumptions than ordinary square ones. The required issue to check is whether there is a zero-inflated model, which is not the case in neither of our six models (cf. Coxe et al., 2009). Furthermore, multicollinearity can be ruled out, as the variance inflation factors (VIFs) for the independent variables in all models yield mean VIFs no higher than 1.49 (cf. O'Brien, 2007; tab 3).[3]

[3] In contrast to linear least squares regressions where the R^2 represents the proportion of variance accounted for by the model, the pseudo-R^2 in Poisson regressions is based on the deviance, which is a measure for the badness of fit (Coxe et al. 2009). The value of the pseudo-R^2 in Poisson regressions is used to compare different versions of a model but does not allow to assess the general model's fitness. In our analysis the final model (all 2) shows the highest pseudo-R^2 and is therefore the closest to a perfect model.

Table 2: Definitions of dependent & independent variables

	All		Urban		Rural			
Variables	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Min**	**Max**
Number of translocal contacts	1.5	1.26	1.7	1.37	1.1	0.88	0	6
Financial & physical capital								
Savings (yes=1)	.40	.49	.50	.50	.20	.40	0	1
Non-farm self-employment (yes=1)	.18	.38	.19	.39	.16	.37	0	1
Internet communication (yes=1)	.35	.48	.43	.50	.18	.38	0	1
Days per month of mobile data access (no. of days)	19.41	11.49	20.7	11.77	16.86	10.50	0	30
Human capital								
Tertiary education (yes=1)	.23	.42	.28	.45	.13	.34	0	1
Secondary education (yes=1)	.54	.50	.55	.50	.53	.50	0	1
Symbolic capital								
Leader position (yes=1)	.16	.36	.18	.39	.11	.31	0	1
Public engagement (yes=1)	.53	.50	.59	.49	.40	.49	0	1
Migration								
Born in place of residence (yes=1)	.59	.49	.52	.50	.75	.44	0	1
Migration of family members (yes=1)	.36	.48	.30	.46	.47	.50	0	1
Exposure								
Flood exposure (yes=1)	.68	.47	.61	.49	.81	.39	0	1
Subsidence (yes=1)	.55	.50	.55	.50	.54	.50	0	1
Observations	**950**		**630**		**320**			

In a first step, we run a Poisson regression model including all study areas (all 1; n = 950) only considering independent variables on the different study areas and other forms of capital (tab 3). We repeated the same model for urban areas only (urban 1; n = 630) and for rural/peri-urban areas only (rural 1, n = 320). That way, regional differences between all study areas, as well as rural-urban divides and their influence on translocal ties, can be seen in more detail.

The results show a highly significant correlation between having a higher number of translocal contacts and living in Jakarta, where the number of contacts is higher than in all other study areas. Furthermore, all variables on financial and physical capital, on human capital, and one on symbolic capital show significant results in the models ‘all 1’ and ‘urban 1’. Thus, there is a significant relationship between the other forms of capital and the number of translocal contacts in the general model and in urban areas.

This relationship largely remains stable when adding control variables for migration and exposure (all 2 and urban 2), with migration showing significant effects and exposure being only of minor influence. Only ‘savings’ loses its significant influence in the final urban model (urban 2). Thus, the relationship between financial, physical, and human capital with the number of translocal contacts appears to be robust in the general and the urban models (all 2 and urban 2).

In the rural models, the relationship between other forms of capital and the number of translocal contacts is less significant with only the variables on ICTs and public engagement showing significant results in the final model (rural 2).

We now discuss the differences between the three final models (all 2, urban 2 and rural 2) focusing on the estimated effects of those independent variables with margins of errors not significantly higher than 10 % (cf. Gelman & Stern, 2006).

Living in the capital and megacity Jakarta has a highly significant positive influence on establishing translocal contacts, both in the general and in the urban model (all 2 and urban 2). Thus, it is more likely to have a higher number of translocal contacts in urban areas than in rural ones and it is even more likely the larger the urban center is. This result supports other empirical findings, showing that urban areas have stronger networking ties, whereas rural areas are more likely to develop dense bonding social networks (cf. Pelling & High, 2005; Sørensen, 2016). In general, households have a much higher number of translocal contacts in our urban study areas compared to our rural ones (tab 2), the maximal amount of translocal contacts in rural areas is four compared to six in urban ones.

Table 3: Poisson regression results for the number of translocal contacts per household

	IRR (standard error)	IRR (standard error)	IRR (standard error)	IRR (standard error)	IRR (standard error)	IRR (standard error)
VARIABLES	all 1	urban 1	rural 1	all 2	urban 2	rural 2
Districts						
Jakarta	**1.555*** **	**1.593*** **		**1.422*** **	**1.623*** **	
	(0.143)	(0.106)		(0.136)	(0.115)	
Semarang	0.988			0.893		
	(0.0936)			(0.0919)		
Kendal	0.970		0.789	0.882		0.822
	(0.108)		(0.102)	(0.101)		(0.120)
Financial & physical capital						
Savings	**1.154** **	**1.139***	**1.264***	**1.122***	1.115	1.204
	(0.0744)	(0.0830)	(0.178)	(0.0724)	(0.0815)	(0.175)
Non-farm self-employment	**1.135***	**1.207** **	0.942	**1.121***	**1.184** **	0.974
	(0.0747)	(0.0897)	(0.145)	(0.0741)	(0.0885)	(0.152)
Internet communication	**1.267*** **	**1.272*** **	1.225	**1.283*** **	**1.282*** **	**1.296***
	(0.0848)	(0.0961)	(0.178)	(0.0864)	(0.0972)	(0.189)
Days per month of mobile data access	**0.994** **	**0.989*** **	**1.014** **	**0.995***	**0.990*** **	**1.014** **
	(0.00278)	(0.00305)	(0.00661)	(0.00280)	(0.00309)	(0.00670)
Human capital						
Tertiary education	**1.481*** **	**1.721*** **	1.174	**1.413*** **	**1.640*** **	0.924
	(0.137)	(0.201)	(0.208)	(0.132)	(0.194)	(0.169)
Secondary education	**1.296*** **	**1.456*** **	1.134	**1.274*** **	**1.413*** **	1.015
	(0.102)	(0.152)	(0.145)	(0.101)	(0.149)	(0.132)
Symbolic capital						
Leader position	0.952	0.900	1.164	0.980	0.935	1.233
	(0.0677)	(0.0714)	(0.185)	(0.0700)	(0.0751)	(0.197)
Public engagement	**1.374*** **	**1.412*** **	**1.250***	**1.344*** **	**1.377*** **	**1.273** **
	(0.0829)	(0.101)	(0.144)	(0.0811)	(0.0993)	(0.149)
Migration						
Born in place of residence				**0.733*** **	**0.742*** **	**0.766***
				(0.0418)	(0.0473)	(0.107)
Migration of family members				1.054	0.930	**1.629*****
				(0.0603)	(0.0631)	(0.195)
Exposure						
Flood exposure				1.067	1.097	0.869
				(0.0662)	(0.0759)	(0.123)
Subsidence				1.063	1.044	1.112
				(0.0600)	(0.0686)	(0.131)
Constant	0.785**	0.746**	0.704**	0.933	0.823	0.731
	(0.0799)	(0.0863)	(0.100)	(0.122)	(0.110)	(0.171)
Model fit statistics						
Observations	950	630	320	950	630	320
Mean VIF	1.37	1.49	1.20	1.29	1.38	1.21

*** p<0.01, ** p<0.05, * p<0.1

IRR = Incidence rate ratio

Regarding financial capital, savings have a significant positive impact on having a higher number of translocal contacts. This result is explicable by the fact that translocal practices such as migrating or establishing translocal business relations require financial means (cf. Etzold, 2016; Foresight, 2011; de Haas, 2005). Households that are able to save money on top of their monthly expenditures are more likely to have the required financial assets to invest in translocal networking. This effect is significant in all first models and remains significant in the second general model (all 2). Savings have an obvious effect on the number of translocal contacts in all study areas. Furthermore, non-farm self-employment shows a significant positive effect in the general and even more significantly in the urban model (all 2 and urban 2). This result is explicable as people who are self-employed are more likely to engage in translocal business relations. The reason why this effect was not found in the rural model might be due to lower level non-farming self-employment activities in Kendal and Demak than compared to Semarang and especially Jakarta.

Investing in ICT (an asset belonging to physical capital), shows significant results in all final models. Using internet communication platforms, such as WhatsApp, Skype, and Facebook, allows people to stay in touch over larger distances and thus facilitates establishing and maintaining translocal contacts. The positive effect is thereby stronger in urban areas due to a higher share of people using internet communication. The number of days per month a person has mobile data shows significant results as well, although the effect size is relatively small.

Regarding human capital, a higher level of education both secondary and tertiary shows highly significant results in the general and urban model (all 2 and urban 2). A higher level of education allows the endowed people to access universities, higher level occupations, etc.; thus, opportunities to engage translocally. The reason that education is not significant in the rural models might be due to a combination of fewer people with higher education and less financial assets e.g. to study at other places.

Public engagement, as an indicator for symbolic capital, becomes significant in all models because it allows people to interact with persons from other districts and villages (cf. Etzold, 2016). Not surprisingly, the control variables on migration show sig-

nificant effects on the number of translocal contacts. People who were born at the current place of residence are less likely to have a higher number of translocal contacts. In rural areas, immigration of family members also becomes highly significant. The higher importance of migration in rural areas might be due to the fact that urban areas offer a large range of opportunities to encounter and get to know people from other places. In rural areas, in contrast, especially in very remote ones in Demak, migration is the dominating translocal practice (cf. Rockenbauch & Sakdapolrak, 2017).

Exposure to coastal hazards has no significant effect on translocal contacts. This result is explicable, as households in our study areas are not willing to migrate due to flooding and subsidence. Thus, exposure is no push for migration, which would foster translocal contacts. However, independent of the influence of hazard exposure on the formation of translocal ties, the established translocal contacts are able to function as a resource for proactive hazard responses in the study areas (see tab 1). Thus, translocal networks established by households without hazard exposure can still benefit connected households in other places which are highly prone to natural hazards and thus function as an informal co-insurance (Adger, 2003).

In summary, there is a significant and robust relationship between the number of translocal contacts a household has and financial/physical and human capital in the general model (all 2) and the urban model (urban 2). Thus, the second hypothesis on the correlation between human and financial capital with translocal social networks could be validated in our analysis for the urban study areas. This correlation was found to be less significant in rural areas, which might be due to the lower amount of translocal contacts.

In general, there is a significant difference between the formation of translocal social contacts in urban and rural areas. The larger and better connected the whole area the more likely is the emergence of translocal contacts on the household level (highest in Jakarta). This result coincides with the correlation between translocal social capital and financial and human capital. On average, households in urban areas have higher financial and human capitals than rural households, and the larger the urban center is the better developed are those assets.

6.6 Discussion

We found that translocal social capital has a positive influence on proactive responses to coastal hazards. This is a significant finding because it was validated in the relatively sedentary context on Java. The positive impacts of translocal social capital on long-term and innovative adaptation of communities and households can thus be expected to be even much larger in communities with long standing migration pathways and translocal livelihoods. Several findings from migration studies support this assumption (cf. Bernzen et al., 2019; Bott, 2016). Suleri and Savage (2006), for example, found that households in Pakistan that receive remittances are much faster in recuperating from natural hazards. A study by Romankiewicz et al. (2016) on Nguith, Senegal, shows how long standing migration histories and translocal networks lead to increased independence from agriculture and climate variability, even if environmental change plays no part in the original migration decision making. Scheffran et al. (2012) show how migration networks increase social resilience in Western Sahel communities through processes of co-development between regions of origin and host regions.

Despite the recognition of positive impacts of migration on community-based adaptation on the one hand and the knowledge about the crucial role of social capital for hazard responses on the other, a conceptual linkage between translocally and social capital with regard to hazard research had been missing so far. This might be due to the fact that hazard exposure tends to play no major role in establishing translocal ties (Bernzen et al., 2019; Bott, 2016; Codjoe et al., 2017; Romankiewicz et al., 2016). Accordingly, insights from translocality studies and social capital hazard research have previously not been combined. This gap has led to partly inaccurate assumptions of social capital being a prime resource for the poor.

Our results show that endowments which facilitate migration, such as financial and human capital, are important factors in establishing translocal ties, in other words networking social capital. Consequently, previous assumption on social capital working as a substitute for lacking financial and human capital need to be reconsidered. According to our research findings, this substituting characteristic only holds true for local

bonding social capital. Translocal social capital, in contrast, strongly correlates with the financial and human capital.

This finding is relevant for social science hazard research. In the context of hazards research in the Global South, more innovative and long-term responses to natural hazards are more likely to be accessible for better off households. Poorer households and communities have weaker translocal social capital and have to rely almost exclusively on local bonding social capital, which impairs their abilities to adapt to environmental threats in a long-term and proactive manner.

This leads to specific implications for hazard management. Interventions in poor communities designed to enhance translocal social capital may offer solutions to lacking translocal ties and reduced adaptive capacities (cf. Cope et al., 2018). Top-down support by governmental agencies and NGOs is important to improve knowledge transfer and translocal networking (cf. Bott & Braun, 2019). In general, there is an urgent requirement to better coordinate top-down hazard management planning and community-based responses (cf. Koerth et al., 2014). Interventions designed to enhance education levels and student exchange programs could be one approach to increase translocal social capital. Our FGDs revealed that on Java universities already oblige their students to conduct social work in other communities. The students tend to stay in the houses of local people, and about 50 % stay in touch after the social work is completed. This could be a structure were further exchange programs could be built upon. Another approach would be to empower local community leaders. These people often work as gatekeepers for their communities, especially RW and RT leaders play important roles in this regard. Well-connected leaders are in the position to strengthen or inhibit translocal social networking from and towards their communities (cf. Marfai et al., 2015).

Our results also confirm another important fact: Poverty is a huge barrier for people adapting to natural hazards and environmental change. This holds true not only for economic development and social mobility but also for spatial mobility and disaster preparedness. Thus, interventions designed to reduce poverty might be the most important instruments to increase adaptive capacities.

6.7 Conclusion

This paper has established the conceptual framework of translocal social capital as a novel approach to investigate community-based hazard responses. We applied this framework to a multi-place based case study in coastal hazard-prone rural and urban areas on Java, Indonesia. Our results show that even within a relatively sedentary culture, translocal contacts have a significant positive influence on proactive measures of households against coastal hazards. Furthermore, we are able to show that translocal social capital requires financial and human capital to be established. This finding partly contradicts general assumptions of social capital functioning as a prime resource for poor communities. The combination of the concepts of social capital and translocality thus offers important new insights for research on community-based adaptation.

Based on our empirical findings on Java it becomes clear that interventions in poor communities designed to enhance translocal social capital may offer promising pathways towards long-term adaptation. Especially in rural areas, governmental and NGO support are required to enhance networking possibilities for local households. Poverty reduction is one of the most relevant parameters in enhancing community-based disaster response capacities. In this regard, it is crucial to plan together with the affected communities instead of just for them.

While the proposed framework partially stems from development studies, it is in no way limited to research in the Global South. Processes such as globalization (as a functional and border crossing integration) and global environmental change are translocal by nature. Research applying our translocal social capital framework follows a relational geographic approach, which at its core includes places and regions of all scales and networks between them; and can be applied in different contexts. Further research should look at the different ends of translocal social networks to analyze exchanged resources and social relations in more detail. Comparative studies of translocal social capital in communities with long established migration patterns and translocal livelihoods could reveal further details about the direct and indirect effects on community-based adaptation.

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Concluding discussion

7 Concluding discussion

The aim of this thesis is to generate new insights and knowledge contributing to the broader discussion of community-based adaptation processes towards coastal hazards. In particular, the findings demonstrate how households and communities respond to coastal flooding and sea level change and which resources enable them to self-organize and to act collectively. The analyses shed new light on how bottom-up hazard response capacities develop and on which timescale they are effective. In doing so, this thesis offers new contributions first of all on theoretical and empirical levels, but also provides political implementations and methodological value. Insights of this thesis provide guidance for future social science research as well as for policy makers in how to better align top-down disaster risk reduction with community-based responses.

7.1 Empirical contributions

The results of this thesis add an important dimension to the theorization of adequate responses to coastal hazards. This research proves that small-scale *accommodating* strategies, such as the establishment of informal loan systems, self-organization in regular meetings, and collective work-organization such as waste cleaning, can be very effective means to maintain livelihoods in hazard-prone coastal areas. Furthermore, social capital has been analyzed as a key asset for accommodating and self-organization in detail both with a spatial and a translocal perspective, adding the concepts of *adaptive neighborhoods* and *translocal social capital* to the debates about coastal risk reduction and community-based adaptation.

Regarding RQ 1, the findings of this thesis show that household and community-based accommodating strategies contribute significantly to non-physical risk reduction. Engaging in accommodating strategies usually happens less intentionally with regards to hazard risk reduction and has the character of an autonomous and continuous habit, one which is deeply embedded in daily practices of hazard-affected people. As such, one of the biggest advantages of accommodating strategies are their flexibility. Flexibility

that is required to deal with an unforeseen future and changing threat horizons. The results highlight how accommodating can work as a bridge between short-term coping and long-term adaptation as well as a link between community-based and top-down initiatives.

In the *Semarang Bay* area, results show that participatory capacity and self-organization are key factors in enabling communities to continue to reside in unstable environments (RQ 2). Coastal floods have become an accepted element of life and are not perceived as severe 'risks' by the local population. Rather than retreating or gaining permanent protection, people have found ways to accommodate to and hence to live with floods. However, while local people are able to survive in spite of their continuous exposure to coastal hazards, the knowledge about (future) sea level rise is limited. Half of the surveyed respondents have never heard about the term 'sea level rise'. This leads to the question how long staying in the hazard-prone areas along Semarang Bay will remain socially and economically feasible. Research from cooperation partners at the GFZ Potsdam shows that land subsidence is indeed increasing in and around Semarang, and thus flood risk will be further aggravated in the future.

Key findings clearly demonstrate that, so far, coastal dwellers along Semarang Bay have developed local strategies to successfully respond to the changing environmental conditions. All studied neighborhoods show strong bonding social capital with dense linkages between largely homogeneous groups. Social capital is highly institutionalized in neighborhood associations with elected leaders (higher ranking RWs and lower ranking RTs) and collective activities are often organized in different gender-separated village meetings. Collective activities such as 'gotong-royong' are deeply rooted in cultural traditions. The applied bottom-up response strategies are soft protection options such as small-scale reforestation, sand sack walls, house elevations, or simple pumping systems. Apart from these small-scale protection measures, people have learned to live with floods and hence to accommodate to their changing environment. Because tidal floods occur almost on a daily basis but are usually relatively shallow and short-time, small-scale protection measures proved to be sufficient during most flood incidents.

With special regards to *Jakarta*, this thesis adds a decidedly spatial perspective to the concept of social capital as a resource for adaptation. The Jakarta findings – as the ones from Semarang Bay – strongly support the hypothesis that social capital is the key capital resource for community-based hazard response (RQ 3). In fact, it is the only capital endowment to yield significant results in the logistic regression analysis for the case study sites in Jakarta. Moreover, the results indicate a clear spatial basis of social capital (RQ 4). Different types of meeting places within the public space of urban neighborhoods enhance different forms of social networks due to variations of location, function, and user groups. Meeting places located in narrow streets and lanes of small neighborhoods strongly foster bonding ties and high levels of trust and social control. Bonding social capital, a strong attachment to place, and a sense of social belonging appear to be key assets for in-situ responses to natural hazards and allow local people to establish a mid-term 'responsive neighborhood'. Recognizing these assets is important to work for, not against community empowerment in urban hazard management. However, the establishment of long-term adaptive neighborhoods requires also bridging and linking ties to the outside world. Social interaction between different neighborhoods and different social strata are required to enhance long-term adaptation and to improve the assimilation of top-down and bottom-up strategies.

This leads to the empirical results on translocal social capital (RQ 5), analyzed in all rural and urban study areas (Jakarta and the Semarang Bay area). The findings show that translocal networks have a significant positive influence on taking proactive measures against coastal hazards at household levels. Thus, in addition to local bonding social capital, which is key to self-organization and collective action, translocal ties add proactive and more innovative response options. This finding is further relevant in the context of the identified strong sedentary traditions on Java, thus, translocal networking can be assumed to be much stronger in communities where migration is an established livelihood strategy, e.g. in Ghana or Bangladesh (cf. Bernzen et al. 2019, Codjoe et al. 2017, Hillmann & Ziegelmayer 2016).

Regarding the origin of translocal social capital, the applied Poisson regression shows that financial and human capital significantly contribute to the number of translocal contacts possessed by a household. Thus, insights from migration studies about how

migrant networks are formed over larger distances apply to establishing translocal social capital as well but have previously not been combined with social capital hazard research. A resulting key finding is that former assumptions need to be revised about social capital being a prime resource for the poor and being able to work as substitute for lacking education and financial assets. While this substituting character might stand for bonding social capital, translocal networking strongly correlates with other capital endowments. Poorer households are likely to be excluded from translocal ties, which impairs their abilities for long-term adaptation. These findings underline that poverty is a huge barrier to adaptive capacities. Poverty reduction thus needs to be a key target to improve response capacities of local households.

This result is further supported by the finding that rural households have significant lesser translocal contacts than urban ones and Jakarta as the capital and megacity is the most favorable place for establishing translocal ties. Thus, interventions in rural and smaller city communities are also required to support the formation of translocal networks.

Finally, the final experts' and practitioners' workshop revealed that all participants agreed with the findings of this study on social capital and its capacity to foster self-organization and local hazard responses. However, with regard to top-down support, it became also clear that the implementation of strategies based on scientific findings is often hampered by multi-jurisdictional layers and conflicting interest, e.g. between different state agencies and/or between municipality and province governments.

In this regard, the workshop results support former assumptions that no fundamental transformational change is visible in the Indonesian disaster risk management (Garschagen et al. 2018). Results of the workshop, shed light on why the current infrastructure-focused, flood-protection paradigm is still dominating. The discussion revealed that university scholars in Indonesia are well aware of the interplay of anthropogenic and natural hazards in their coastal zones and clearly emphasize land subsidence as the key target for disaster risk reduction. However, in the workshop it became also appartent that they are hardly listed to by both provincial and municipal authorities and NGOs. Results showed that politicians tend to focus on large-scale hard flood protection structures because those are highly visible and do not cause conflicts with local

enterprises. Furthermore, blaming global warming for rising sea levels instead of subsidence shifts the responsibility for coastal flooding to the global community, whereas admitting the underlying processes for land subsidence would place the responsibility on local governmental authorities. Acting on this responsibility and implementing the required mitigation strategies, such as providing drinking water from surface sources, is a cost-intensive but non-prestigious project which would potentially cause conflicts with local enterprises due to strictly enforced groundwater regulations. Conflicts with marginalized local neighborhoods, due to relocation programs, instead seem to be acceptable in the name of flood risk reduction. NGOs also strongly opposed recognizing subsidence as the major cause behind coastal flooding. The reason for this might be that they obtain international funding based on climate change narratives. There is a fear that they would lose funding without the absolute sea level rise argument. Thus, based on the elaborated reasons, the room for a timely transformation of coastal risk reduction pathways seems to be highly constrained. Therefore, it can be assumed that households and communities on Java have to further strongly rely on their own self-organization abilities and bottom-up response capacities.

Beyond the Indonesian case studies, these key findings contribute to the general investigation of which socio-institutional factors enable or hinder coastal societies to respond to changing sea levels. This thesis contributes to this debate with the findings on self-organization within coastal communities in urban and rural settings. The results show how local decision-making regarding coping, accommodating, and adaptation is organized in local communities and which role social networks play in this context. These insights contribute to a deeper understanding of bottom-up responses and their respective timescales and allow researchers and policy-makers to better assess how bottom-up community-based adaptation could be more systematically assimilated with top-down approaches.

Furthermore, this study adds to determining the natural and social coastal systems responses to future sea level change. Analyzing case study areas which experience frequent flooding already today allows to assess how communities might be able to respond to future sea level changes. People on Java rather tend to stay than to migrate

even when confronted with frequent flooding and high rates of land subsidence. Accommodating and soft protection options are preferred, and living with floods becomes a part of daily practices. Strategies of hard protection or retreat are more difficult to access by local communities but are also less favored options. This finding is supported by the results from the Jakarta case study, showing how strong social belonging and attachment to place enable in-situ responses and why migration is not a favored option. In addition, this thesis enhances the assessment of response strategies to sea level change under given technical, economic, cultural, social, and political constraints. People on Java tend to be highly sedentary which constrains their options to retreat. Social and cultural factors play a strong role in this respect. Another decisive factor for not migrating is proximity to the work place. So far, subsidence and coastal hazards in general tend to be ignored in spatial planning and thus for the location of industrial firms. These continue to concentrate in flood-prone low-lying coastal zones (Neise et al. 2018). From a socio-economic perspective, the findings show that people rely on bonding social capital as an opportunity which allows them to maintain their livelihood on a mid-term cycle. However, they do this out of necessity, too. Both financial and human capital are constrained which also reduces local households' abilities to establish translocal networks. In the highly institutionalized administrative order on Java, local community leaders and stakeholders can become gatekeepers in social networks with the potential to translocally link their neighborhoods to other communities and external agencies. Moreover, the potential of community-based adaptation and bottom-up approaches needs to be considered more thoroughly in disaster risk management and spatial planning strategies. However, so far, this is difficult to achieve within the multi-layered governmental jurisdictions within the decentralized Indonesian system. Crude relocation programs, for instance, often lead to maladaptation as communities become spatially scattered, which erodes their social capital and hazard response capacities (cf. Chapter 5).

7.2 Theoretical contributions

This thesis makes vital, new conceptual advances. First, Chapter 4 introduces a new conceptual framework for *accommodating* change. This conceptualization offers new understanding of processes and options of responses to coastal hazards in general and offers insights into how people are able to live with flooding environments and how they do so by slowly changing day to day practices. Although the IPCC (Wong et al. 2014) acknowledges *accommodating* as one form of adaptation alongside *retreating* and *protecting*, accommodating still tends to be overlooked as a response strategy because it is often seen as only temporary or insubstantial compared with the two response options of retreat and protect. Thus, my research contributes to the debate about coastal adaptation and bottom-up processes. I argue that accommodating deserves deeper consideration by researchers examining hazard response modes among coastal populations. Moreover, the findings offer new insights into how to better align bottom-up with top-down disaster risk reduction, especially with the 'response cycles of accommodating coastal hazards' (Chapter 4, fig 3) by highlighting up- and downscaling pathways.

Second, Chapter 5 adds the concept of *adaptive neighborhoods*. Here, social capital as a key resource in collective community responses is analyzed as a geographical and thus a spatial one, contributing to debates on socio-spatial practices. The adaptive neighborhood concept allows to analyze local community-based response capacities based on the urban form of the neighborhood and resulting social capital structures. This concept offers new understanding on how the urban form and urban spatial planning influence the adaptive capacities of local communities. Both maladaptive pathways as well as effective adaptation pathways are highlighted.

Third, Chapter 6 extends the local perspective on social capital as a resource for hazard responses by adding a translocal perspective and introducing the concept of *translocal social capital*. This approach allows to analyze social networks and their contribution to adaptation across spatial boundaries. By combining formerly separated debates and insights from social capital hazards research and translocality studies, this thesis proves that the establishment of translocal networks requires a significant amount of financial

and human capital. Thus, former assumptions about social capital being a prime resource for the poor do not apply for translocal ties. This finding is highly relevant in guiding sustainable interventions in local communities to increase response capacities. In the following two subchapters, I discuss in more detail the concepts of adaptive neighborhoods and social networks in hazard research.

7.2.1 Adaptive neighborhoods

This thesis has established the term *adaptive neighborhood* as resembling the ideal situation where the socio-spatial fabric of a neighborhood allows the respective community to establish bonding, bridging, and linking ties which, in turn, become a resource for long-term adaptive capacities. However, in practice, there is a variety of different socio-spatially structured neighborhoods which results in a continuum of response capacities from reactive and short-term to adaptive and long-term.

By combining the results of this thesis – the response cycles of accommodating coastal hazards, the spatial basis of social capital as well as insights from local and translocal social networks – I am able to derive a new categorization of socio-spatial neighborhoods which distinguish four different types of neighborhoods in the context of hazard responses (fig 1).

A: The first type, the *reactive neighborhood*, describes a largely isolated neighborhood. Social encounters are constrained to the specific urban form of the neighborhood and ties to the outside world are very limited. This socio-spatial fabric fosters short-term coping and reactive measures that allow people to recover and to ‘get by’.

B: The second type, the *responsive neighborhood*, resembles the situation found in Jakarta and the Semarang Bay area. People are connected at least between adjacent neighborhoods and some spatial opportunities and meeting places for social encounters with people from other RTs and RWs are established. The higher self-organization abilities of these neighborhoods result in mid-term accommodative cycles and allow people to ‘maintain their livelihoods’ (see Chapter 4, fig 3: the response cycles of accommodating coastal hazards).

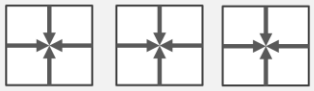
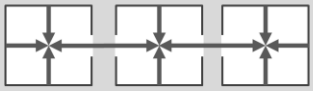
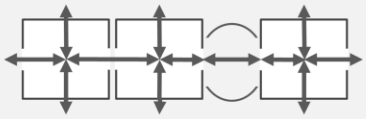
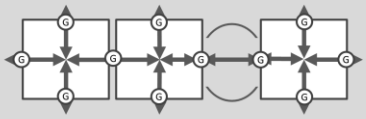
Type of neighborhood	Social capital & attachment to place	Hazard response
A: Reactive neighborhood 	• Isolated local communities • Inward-oriented networks • Bonding ties • High attachment to place • Highly informal places to meet	• Short-term coping • Reactive hazard responses
B: Responsive neighborhood 	• Connected neighboring communities • Inward-oriented networks and some networks to neighboring communities • Bonding and some bridging ties • High attachment to place • Informal and formal places to meet	• Mid-term accommodating • Intensive collective action
C: Adaptive neighborhood 	• Locally and translocally connected communities • Bonding, bridging, and linking ties • Weaker attachment to place • Translocal social fields	• Long-term adaptation • Innovative hazard responses
C: Gatekeeper-driven adaptive neighborhood* 	• *Locally and translocally connected gatekeepers* • *Bonding, bridging and linking ties established by gatekeepers*	• *Long-term adaptation and innovative hazard responses initiated and guided by gatekeepers*

Figure 1: Types of neighborhoods in the context of hazard responses

C: The third type, the *adaptive neighborhood*, refers to the ideal situation. In this case, community members themselves are well-connected with the outside world, even over translocal spaces, thus, both local and translocal social capital are strong.

C*: Finally, the fourth type is a subcategory of an adaptive neighborhood, a *gatekeeper-driven adaptive neighborhood*. In contrast to type C, this case is mainly driven by a few key actors. Bridging and linking ties and especially translocal social capital are established not by the majority of community members themselves but by engaged and well-connected local leaders. These people function as gatekeepers (or brokers) in translocal exchanges of resources and knowledge flows. Thus, they are the 'bridges' that connect different spatially separated neighborhoods and communities to each other (Arena & Uhl-Bien 2016). These gatekeepers possess disproportionate participatory capacities, symbolic capital, and communication power, which enable them to exercise

control over networks (Lee 2017). As Chapter 4 indicates, local stakeholders can play a central role in the highly institutionalized social order in Javanese neighborhoods. Furthermore, the results from the Jakarta case study show that there is a strong need to improve institutional linkages between municipal stakeholders and local communities. In this regard, local leaders could be the bridge to access know-how and funding that is needed to unlock communities' response capacities and to 'scale-up' existing bottom-up response strategies (cf. Béné et al. 2016, Marfai et al. 2015). They can become *'agents for adaptation'*.

An example of a gatekeeper-driven soft protection project in a local neighborhood is the mangrove reforestation in Mangunharjo, West Semarang. The reforestation started in 1999 with the agency of a local community member, but is now supported by the Diponegoro University, CSR funding from a local entrepreneur, and national and international NGOs. The positive effects of the project are increased coastal protection but also higher social cohesion and environmental awareness because the community learned to work together in the project (FGD and key informant interview, Mangunharjo, cf. also Lange 2019).

Based on the results of this thesis that show the importance of household and community-based hazard responses, an important question arises: Are local and translocal social networks and the emerging social capital *the* solution for disaster risk reduction in the Global South?

7.2.2 Social capital and translocal networks: The key to hazard risk reduction?

The findings and conceptual contributions of this thesis show that community-based accommodating practices are essential in dealing with coastal hazards and changing threat horizons. The results demonstrate how households and communities are able to accommodate coastal risk and how they are able to self-organize and to maintain their livelihood on mid-term cycles. Social capital on local and translocal scales provides the basic structures and resources to enable responses to coastal hazards. In addition, these measures often have to take over for lacking municipal hazard management. Nev-

ertheless, in isolation bottom-up and community-based hazard responses are no panaceas to overcome larger-scale resource and knowledge constraints and administrative mismanagement.

This thesis does not argue for shifting the responsibility of disaster risk reduction away from the state to households and small communities. I rather argue that community-based response capacities and strategies need to be recognized and integrated into top-down disaster risk management to achieve sustainable and long-term risk reduction. What is required is not only top-down support but an effective and coherent alignment of top-down and bottom-up responses. Translocal networking and the establishment of truly adaptive neighborhoods can hardly be achieved by the communities alone. A sustainable aligning with top-down initiatives is required as the response cycles of accommodating risk show (Chapter 4).

While social capital is more relevant for collective hazard responses than other forms of capital (Chapter 5), the development of social capital cannot be seen as completely independent of other capitals. Chapter 6 shows that especially translocal social capital requires financial and human capital to be established. The results highlight that poverty is a substantial barrier to establishing translocal ties and therefore adaptive neighborhoods and long-term adaptive cycles.

Furthermore, the access to social capital is not equally distributed within communities but depends on power relations, symbolic capital, and participatory capacities (cf. Pelling & High 2005). Thus, top-down interventions might also be required to ensure that especially the poorest members of a neighborhood are not excluded from social networks and that newcomers to a community, such as rural-urban migrants, are not marginalized. Here, spatial opportunities for encounters between new and old community members could be a beneficial approach. In the following, policy implications of the results of this thesis are discussed in more detail.

7.3 Policy implications

This thesis contributes to improving approaches to better align top-down with bottom-up coastal risk reduction. The cycles of accommodating coastal risks show that community-based response capacities are significantly improved by abilities to act collectively and by participatory capacities. However, the empirical results reveal that top-down support and scientific knowledge transfer are required to move to a long-term adaptive cycle. The same applies to up-scale a responsive to an adaptive neighborhood and to establish translocal social networks. Such support needs to be effectively combined with community-based strategies and has to recognize communities' response capacities, otherwise these interventions might lead to conflicts or even cause adverse effects of maladaptation. This alignment of top-down and bottom-up strategies might in fact be the key challenge in responding to environmental changes and natural hazards of all kinds and in all regional and local contexts worldwide (cf. Koerth et al. 2014). The following advices can be given to improve this linkage:

First, for coastal risk management to be effective, it should not simply include but emphasize community-based accommodating strategies. These strategies tend to be overlooked by top-down policy making. However, accommodating is the most essential and a vastly practiced response of hazard-affected communities and needs to be finally recognized as such. Accommodating is the key to bridging top-down and bottom-up strategies and the foundation to upgrade mid-term to long-term response cycles. Integrating it into national and municipal resilient strategies and disaster risk reduction planning, not only in Indonesia, is a major advice from this thesis.

In doing so, bottom-up accommodating strategies and the habit of 'living with floods' could be supported by additional structural and technical accommodating options, such as submergible infrastructure, early warning systems, or formal insurances. Soft adaptation options such as floating houses and submergible buildings should be considered by municipal authorities (cf. English et al. 2017). In Louisiana and Vietnam, there are already projects developing and testing options for amphibious retrofitting of small single family homes with low financial costs (BFP 2018). Finding solutions to spare

local households the huge financial burden of repetitive elevation could offer solutions out of poverty and increase adaptive capacities.

Second, to not just support but to actively integrate community-based strategies, strengthening households' and communities' participatory capacities should be a key priority for top-down disaster risk reduction initiatives. The results of this thesis emphasize that participatory capacities are crucial to empower hazard-affected communities to enact their response capacities. To achieve this, strategies are required to foster knowledge transfer and learning capacities to prepare local people for uncertain future threat horizons (cf. Cinner et al. 2018). Initiatives should include clearly identifying contact persons, simplified communication channels, listening to local communities' concerns, planning together with local neighborhoods, e.g. by holding workshops, collaborations with local universities and research institutes, and empowering and training of local leaders. By supporting participatory capacities of local communities and trust-building in municipal authorities, short-term and reactive coping capacities can be up-scaled to mid-term or even long-term cycles.

In addition, the findings of this thesis have important implications for urban spatial planning. Urban risk management needs to improve worldwide in the next years due to urban transformations and environmental changes (cf. WBGU 2016). With regards to local neighborhoods and relocation programs, top-down hazard management is explicitly spatial and therefore place shaping. Urban politics needs to account not only for risks to certain places but also for the attached cultural and social meanings. Failing this goal can cause conflicts between urban hazard management and local communities. Resettlement, as an option of retreat, can be a constructive response to natural hazards. However, it is questionable whether it can be considered as successful if social networks, attachment to place, and sense of belonging are being eroded (Adger et al. 2011). A recent study by Garschagen et al. (2018), indeed shows that social ties and adaptive capacities of households in Jakarta had been reduced after relocation. The current procedure with forced clearance of unplanned neighborhoods and constant threats of eviction only deepen the communities' distrust in municipal authorities, which impairs a sustainable alignment of top-down and bottom-up initiatives.

Thus, *third,* keep communities intact if resettlement is indeed unavoidable in reducing coastal risks. That means relocating existent neighborhoods together and communicating the process in a transparent manner to the affected households. In this way, bonding social capital and thereby the communities' response capacities can be maintained. Disturbance of place inevitable has a psychological impact on people (Adger et al. 2011). Yet, emotional disorder can be reduced by maintaining social belonging and by integrating communities into planning procedures.

Fourth, recognize the spatial basis for the formation of social capital. With regards to bonding social capital, this means acknowledging mainly the (informal) meeting places. Spatial opportunities should be provided for people to appropriate public open space as urban commons. Rather than a social engineering of meeting places, it is important to allow the formation of bottom-up structures and natural growing development, e.g. by permitting the establishment of informal Warungs and Nongkrong areas. Residents' perceptions of a place as point to meet and interact is key to its success. Meeting places have to be perceived as friendly, welcoming, and functional before being taken on (cf. Lager et al. 2015). Furthermore, provide opportunity spaces for the formation of bridging and linking ties (cf. Cinner et al. 2018). The results show that personal contacts and therefore meeting places are important for bottom-up hazards responses. Thus, further research should focus on how bridging and linking ties can be enhanced also by spatial planning. Initiatives could be to provide opportunity spaces, e.g. Pos, to be used by members of several RTs and especially to be jointly used by old and new residents. In this regard, ICT can play an important role, as it provides opportunities to stay connected translocally. Internet cafes and free wife zones could provide digital spaces to link different communities.

Fifth, more bridging and linking ties allow for a better assimilation of top-down and bottom-up responses. Increasing the exchange and knowledge transfers between residents of local neighborhoods and the municipality is an important step towards achieving more adaptive neighborhoods (cf. Marfai et al. 2015). In this regard, local leaders can become brokers in social networks and can strengthen the bridging and linking ties of their neighborhoods. Thus, local leaders could be first target persons for top-down empowerment. One possibility to initiate this process could be to organize specific

training programs or workshops on disaster risk management, where an open dialog can be established between local leaders and municipal agencies. If trainings were to be held for local leaders from different neighborhoods together, these events could further work as networking opportunities. Such 'peer-to-peer' networks can not only empower local people but contribute to facilitate learning and ultimately lead to developing innovative response strategies (cf. Cinner et al. 2018).

Sixth, results on translocal social capital show that poor households have difficulties to participate in translocal networks. This might impair their long-term adaptive capacities. Thus, addressing the root causes of poverty and increasing human capital are key factors for top-down initiatives in empowering local households and communities (cf. Cinner et al. 2018). Support, e.g. in the form of scholarships, could be helpful in reducing poverty and increasing translocal social networks. Results from FGDs in lower middle class neighborhoods (Panggung Lor & Tawangsari) show that universities are important locations to meet with people from different neighborhoods.

Seventh, providing governmental incentives for local entrepreneurs to engage in public disaster risk reduction could support communication processes between governmental agencies and local neighborhoods. To achieve long-term, innovative, and sustainable adaptation processes the need for a better coordination is not limited to actions by governmental agencies. Other actors should be engaged as well such as NGOs, universities and the private sector. In the Global South, especially small and medium-sized enterprises are often strongly embedded in the local neighborhoods with close employer-employees' relationships. In Indonesia, those relationships are a reason for companies and local people to persist at their current location (Chapter 4, Neise 2019).

Finally, the *eighth* advice is to situate hazard responses within broader socio-economic and political processes. Urbanized coastal zones are characterized by large-scale, coupled, and complex socio-ecological changes, including urbanization, land use-changes, climatic change, changes in consumption, technological innovation, political changes etc. (cf. Chapter 3). Thus, it is almost impossible to disentangle the effects of environmental change from anthropogenic processes and to separate hazard responses from other livelihood strategies and daily live risk reductions (cf. Conway et al. 2019). Planning under uncertainty ultimately means to prepare for events that might or might not

happen. Thus, other reasons for taking action or at best additional benefits of the taken measures need to be communicated. This means that instead of only focusing on hazard risk reduction, key assets should be prioritized such as poverty reduction, increasing education levels and participatory capacities, and empowering local communities (cf. Cinner et al. 2018, Conway et al. 2019). That way, the general livelihood of local households and communities is supported, and under these favorable conditions, adaptation to coastal hazards can happen autonomously as a by-product of enhanced socio-economic and participatory capacities (cf. Romankiewicz et al. 2016).

In summary, an effective integration of community-based hazard responses into top-down coastal risk reduction might be the most important task for national and municipal governments worldwide to engage in long-term and sustainable adaptation pathways. Ultimately, disaster risk reduction policies need to be questioned as to whether they reinforce the marginalization of vulnerable communities or whether they empower local people and enforce communities' response capacities.

7.4 Limitations and outlook for further research

This study confirms that a consequently applied mixed-methods approach offers significant advantages in proceeding when studying collective hazard responses and translocal social networks. Moreover, this thesis contributes to connecting conceptual frameworks of community-based adaptation with quantitative indicators (cf. Cutter et al. 2014). This is especially relevant for concepts measured by indirect and disaggregated indicators. Thereby, this thesis further adds to established indicators for social capital and tests new indicators for translocal networks and hazards responses, such as proactive flood responses or collective actions. These composite quantitative indicators are needed to compare different study areas. Especially with the translocal social capital approach, indicators are generated that are useful to explain differences in disaster risk reduction between and within different places (cf. Annex A). Nevertheless, some limitations of the chosen methods and the resulting data set have to be mentioned and the room for further research needs to be laid out:

First, even though the interviewers for the household survey were trained during intensive kick-off workshops, the data sampling was supervised, and the final data were cleaned during an extensive and precise cleaning process, it is impossible to entirely rule out that some errors might remain. Although all questions were discussed with the interviewers in detail, some differing understanding cannot be completely precluded. In this regard, the advantages of a mixed-methods approach lie in cross-checking and triangulating of quantitative with qualitative results.

Second, social expectancy is an issue which can never be ruled out completely in household surveys. The survey was conducted during the governor's elections in Jakarta. The highly sensitive issue of relocation played a major role in the candidates' campaigns. To preclude that questions might not be answered honestly, politically highly sensitive questions were avoided in the questionnaire. Furthermore, it is possible that some questions might not have been answered correctly due to a lack of scientific knowledge. Knowledge about the processes relating to subsidence was not entirely clear to all respondents. In this regard, the answers were analyzed as perceptions of the respondents. For the actual exposure, the results were cross-checked with physical science data from cooperation partners at the GFZ Potsdam.

Third, the quantitative and qualitative data for this study were gathered each in one year. Therefore, it is not possible to detect variations and changes over time. For further research, especially on translocal social networks, adding a panel design would be a valuable extension to analyze temporal aspects of evolving and changing translocal networks (cf. Kallis et al. 2018, Schapendonk 2015). This would enable researchers to address questions regarding potential spatial shifts and dynamics in social networks e.g. due to technological innovations, social media, or political changes.

Fourth, this thesis focusses specifically on sea level changes and coastal flooding. Thus, the results have to be understood in relation to the specific hazard constellation which is characterized by a high frequency but a generally low intensity. Accommodating is a successful and highly adapted strategy in responding to these hazard constellations, but might not be the answer to fast-onset and high impact disasters such as tsunamis, tropical cyclones, or volcanic eruptions.

Fifth, this thesis uses a case study approach focusing on four rural and urban sites on Java. Thus, the empirical results of this study first of all represent the explicit Northern Javanese context. Nevertheless, the results generate insights into bottom-up approaches to adaptation pathways that – despite their culture-specific character – might also work in other spatial contexts. Social capital and translocal practices are basic attributes of local communities worldwide. Regardless of the specific geographical and political contexts, network dynamics and most practices within networks are to some extent universal in nature (cf. Nakagawa & Shaw 2004). Moreover, the methodological approach and the applied conceptual frameworks of this thesis lay a foundation for prospective comparative studies. While this study focusses on case studies in the Global South, the theoretical assumptions are not primarily based upon debates from development studies, but on current paradigms of social transitions and environmental change (cf. Müller-Mahn & Verne 2010). Thus, both empirical results and conceptual advances of this study are not limited to the Global South context, but can be applied in research in contexts of the Global North as well.

Sixth, the study areas of this thesis are characterized by a largely sedentary culture with implications especially with regards to the development of translocal social networks. Further research in communities with long standing migration patterns could further advance hazard research on translocal social capital. Different forms of socio-cultural structures, habits, and routines (e.g. networks that are based on family belonging versus ones based on neighborhoods, patriarchal versus matriarchal systems, and sedentary versus migratory cultures) lead to different configurations of social networks (cf. Entwisle et al. 2007, Pachucki & Breiger 2010). A subsequent research project at the University of Cologne will further investigate social networks in different socio cultural settings throughout the Indonesian archipelago.

Seventh, to expand on research on adaptive neighborhoods, future case studies in different Global North and Global South settings should investigate how the built environment of public open space and building designs influence socio-spatial relations and interactions. Moreover, future surveys on social capital as a resource for hazard responses could include more questions and indicators for place attachment and gate-

keepers in social networks. This study indicates that both are important for the development of social capital and hazard response capacities. In doing so, researchers need to consider both positive impacts that gatekeepers offer in social networks and negative effects such as bottlenecks in knowledge exchange and the potential exclusion of certain groups or individuals.

Eighth, further research should look into the decision making to relocate or to stay at local neighborhood levels by taking into account employer-employees relations. This thesis has shown that people tend to stay in flood-prone areas because of their spatial closeness to their work place. Conducting such an extensive analysis of exposed and vulnerable urban neighborhoods, including key functions of residing and working, would be a relevant contribution to the discourse about bottom-up risk reduction.

Altogether, this thesis has provided new empirical evidence and theoretical approaches that advance social science hazard research. These frameworks as well as the applied methods can be used in comparative studies, not only in the Global South, but worldwide. The overall aim is to enhance urgently required understandings about household- and community-based responses towards socio-environmental changes and uncertainties. Better aligning bottom-up responses with top-down planning enables comprehensive disaster risk reduction, empowers local communities, and meets place-specific adaptation needs. Planning together with the hazard affected community instead of just for them is the best way to sustainable adaptation pathways and long-term coastal risk reduction.

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Appendix A: Supplementary material

Questionnaire for the FGDs

1. ***RT/RW and social structure*** 10 – 15 Minutes *(What is the social structure of the community? How do people perceive their community? Consensus about geographical and social boundaries, consensus about what is the 'RT/RW')*

We want to know about your RT/RW. Can you tell us how big it is? What is an example of general activities?

- What do you like most about your RT/RW?
- Is there anything that is not so positive in your RT/RW?
- If you could change just one thing about this RT/RW what would it be? Please agree on one thing.
- Do people generally know each other in your street/RT/RW?
- Do most people own or rent their house?

How has your RT/RW changed over the last five years? In the last five years, have a lot of people moved to your RT/RW or migrated to other places?

- Why do people move to your RT or why do people leave? *(age, social status, education)*

2. ***Perception about floods and subsidence, description of the livelihood situation*** 10 – 15 Minutes *(How do participants perceive the situation they live in with regard to floods and subsidence?)*

Can you tell us about floods in your RT/RW?

  - What kind of floods do you have? *(tidal, rain, river)*
  - How often do you experience floods?
  - How long do floods usually last?
  - How deep is the water?
  - Is the water running into your house?
- Has there been a change in how often floods occur and how long they last over the last five years?
- What was the strongest flood you ever experienced? Please tell us about it. *(How much damage? What did people do?)*

- Are floods a problem for your daily live? Please explain…
- What causes floods?
    - Does subsidence aggravate the situation?

How does subsidence affect your RT/RW? Please tell us about it… *(house, infrastructure, streets, more floods, etc.)*

- How high are subsidence rates in your RT/RW?
- What percentage of houses is affected in your RT/RW?
- Has there been a change in the subsidence rates over the last five years?
- Is subsidence a problem for people in your RT/RW? Please explain…
- What do you think causes subsidence?

Can you tell us about coastal erosion? Does coastal erosion affect your RT or your economic activity?

- Experts are discussing whether there is a rise of the global sea level. Do you think that will happen in Semarang? Do you think that a higher sea level will be a problem in the future?

3. ***Coping/Adaptation:*** *(What do people do to respond to floods and subsidence?)*

What do you and the people in your RT/RW do to deal with floods and subsidence?

    - What works best/helps the most/is most practiced?
    - What goes wrong?
- Did protection improve in the last five years? Please explain why or why not.
- Have new technologies and methods been used in the last five years to deal with floods and subsidence and where did these new ideas come from (outside of the RT?)?
- Are the things you do permanent/long-lasting or do you have to do it again and again? (e.g.: How often do people have to rebuild/elevate their houses because of floods and/or subsidence?)
- How do people help each other to protect their individual houses? What are other kinds of help/mutual assistance that you can expect when your family is affected by floods and subsidence? *(e.g.: cleaning together, giving people shelter, lending money)*

    - What do women do? What do men do?
    - Can you explain how you actually elevate a house and how people of the RT/RW help?

Do people in your RT/RW work together to improve the protection against floods and to minimize subsidence?

- Can you describe one example in detail?
  - What kind of obstacles did you have to deal with?
  - Who participated and helped?
  - What was the result of this collective work?
- What does the local government/authorities do? *(Is it helpful? What more would you expect?)*
- If these floods and subsidence keep on happening would you move to another place?
  - Is it expensive to deal with floods and subsidence?

4. ***Social capital*** *(How do people work together as a group, how do they help each other, and whom do they trust?)*

We already discussed whether people in your RT/RW work together to deal with floods and subsidence, are there other issues that affect the RT/RW that are addressed together? *(Mangrove plantation, school funding, funeral funding, etc.)*

- In some places when people want to work together, there is a lot of talking and discussing but not much action that happens afterwards. How is it in your RT?
- Did solidarity and generosity decrease/increase over the last five to ten years in your RT/RW?

From where/whom do people get assistance in a crisis? *(Family, neighbors, friends, government, employers, landlords, social foundation, ulama, etc.)*

- Mutual help only works when people not only take but also give. What happens to people that exploit/take advantage of the help and trust of others? *(social control)*

Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people in your RT? Can you explain… *(Childcare, money, secret, leave house unlocked)*

How are decisions made in your RT that concern all people? Do you hold meetings?

- What kind or meetings do you have?
- What is discussed in male meetings and what is discussed in female meetings?
- What is the role of the head of the RT/RW in decision making?
- Who are the important people in your RT/RW? *(their function)*

Can you name groups or organizations that are active in your RT/RW? Which groups play the most important role in helping to improve the wellbeing of people in your RT/RW? *(It could be religious, social, political organizations, worker unions, companies, NGOs, etc. Whatever is important for the community/for many people.)*

5. ***Translocal social networks*** *(Do people have social networks to places outside of Semarang and, if yes, do they also get help from them?)*

Obliviously, contacts in your RT/RW are important to deal with floods and subsidence. But how about contacts to people outside of Semarang? Please explain…

- Family and close friends, but how about other people outside of Semarang? *(People who lived here, people who visit, business contacts, community service students, …)*
- What kind of help and from whom? Please explain and use examples.
- Do many people of your RT/RW marry people from outside?
    - How do they get to know each other?

Which kind of assistance or advice do people usually get from people within your RT/RW and which kind of assistance or advice do people usually get from outside your RT/RW in time of crisis?

- Is it more helpful to have family members living in the same RT/RW, or to have family members living in other places when dealing with floods and subsidence?
- Do many people in your RT/RW receive remittances?
    - Are households in your RT/RW that receive remittances better off than other households that do not?
- Did families and households that left the RT/RW stay in contact with their friends in their former RT/RW? How often are you in contact?

People like to stay in contact with friends, family and other people that live in other places. What are important tools to communicate? *(WhatsApp, SMS, phone call, Facebook, e-mail, letters, skype, etc.)*

- Do most people in your RT have a smartphone?
- How important are social media for staying in contact?
- Do many people have internet access?
- People use different mediums of communication for different purpose.
    - What are Facebook/WhatsApp/phone calls typically used for?

Household survey questionnaire

Introduction

Introductory statement
I am [name], I am a student at the [name of University]. I would like to ask you some questions about your village and natural hazards. Do you live at least 5 years in this village? 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 ... minutes. All comments and responses are anonymous and will be treated confidentially. The purpose is purely academic. If you don't feel fine with 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. May I proceed with the questionnaire?

Just observations, **not** to be asked!
Please fill out all the questions.

1.1.1 Interviewer ID:

1.1.2 Nr. of Interview:

1.1.3 GPS:

1.1.4 ID Photo of the house:

1.1.5 Village, RW, RT:

1.1.6 Adress/Location description:

1.1.7 Date of interview (dd/mm/yyyy):

1.1.8 Time started (hh:mm):

1.1.9 Time finished (hh:mm):

1.1.10 Name of interviewer:

1.1.11 Name of respondent:

1.1.12 Sex of respondent:
- ○ 1=male
- ○ 2=female

1.1.13 What are the house walls made of?
- ○ 1=wood
- ○ 2=stone, bricks, cement
- ○ 3=Adobe, wattle, daub
- ○ 4=metal
- ○ 5=straw, sticks

When doing Section 3:
Please list all the Translocal contacts here to have an overview and check during the interview.

TRL contact ID	First/Nickname
I	
II	
III	
IV	
V	
VI	

(Household members = People that sleep and eat minimum of 180 days per years in one house)
Start the interview here!

2.1.1 How many female members live in this household?

2.1.2 How many male members live in this household?

2.1.3 How many are children? (under 18 years old)

2.1.4 Are the following generations living in your household?

	0=No	1=Yes
Children	○	○
Parents	○	○
Grandparents	○	○

2.1.5 How old are you? *(years)*

2.1.6 How long does your household live in this village? *(years)*

2.1.7 What is your place of birth?
- ○ 1=this village
- ○ 2=this city
- ○ 3=other city/village on Java, please specify
- ○ 4=other province outside Java, please specify (province, island)
- ○ 5=other city in another country, please specify (city, country)

2.1.8 *If you were not born here,* why did you move here?
- ○ 1=family reunification/marriage
- ○ 2=better opportunities to work
- ○ 3=education reasons
- ○ 90=other, please specify

2.1.9 Have some from today's household members come to live in your household from other places? *If no, go to 2.1.14.*
- ○ 0=No
- ○ 1=Yes

2.1.10 *If yes:* How many new members?

2.1.11 Are the new members male, female, or both?

	male	female
New members of household	☐	☐

2.1.12 *If they were not born as members of your household,* why did they join?
- ○ 1=marriage
- ○ 2=better opportunities to work
- ○ 3=education reasons
- ○ 90=other, please specify

2.1.13 Where were they born?
- ○ 1=this city
- ○ 2=other city/village on Java, please specify
- ○ 3=other province outside Java, please specify (province, island)
- ○ 4=other city in another country, please specify (city, country)

2.1.14 What is your highest level of formal education?
- ○ 1=Never attended school
- ○ 2=Preschool
- ○ 3=Primary school incomplete
- ○ 4=Primary school completed
- ○ 5=Middle school
- ○ 6=High school
- ○ 7=Tertiary education (College or University)

2.1.15 What is the highest level of formal education in your household?
- ○ 1=Never attended school
- ○ 2=Preschool
- ○ 3=Primary school incomplete
- ○ 4=Primary school completed
- ○ 5=Middle school
- ○ 6=High school
- ○ 7=Tertiary education (College or University)

2.1.16 Who has the highest level of formal education in your household?

	0=No	1=Yes
Generation of grandparents	○	○
Generation of father/mother	○	○
Generation of son/daughter	○	○

2.1.17 What is your religion?
- ○ 1=Islam
- ○ 2=Catholicism
- ○ 3=Protestantism
- ○ 4=Hinduism
- ○ 5=Buddhism
- ○ 6=Confucianism

2.1.18 What is your ethnic group?

- ☐ Javanese
- ☐ Sundanese/Bantenese
- ☐ Batak
- ☐ Betawi
- ☐ Minangkabau/Malay/Acehnese
- ☐ Buginese/Makassarese/Moluccans
- ☐ Banjarese
- ☐ Balinese Sasak
- ☐ Chinese
- ☐ Other

2.1.19 Do household members belong to another ethnic group than yours, which?

- ☐ 77=No
- ☐ Javanese
- ☐ Sundanese/Bantenese
- ☐ Batak
- ☐ Betawi
- ☐ Minangkabau/Malay/Acehnese
- ☐ Buginese/Makassarese/Moluccans
- ☐ Benjarese
- ☐ Balinese Sasak
- ☐ Chinese
- ☐ Other

2.1.20 Which languages do you speak?

	1. Language	2. Language	3. Language	4. Language
1=Bahasa	○	○	○	○
2=Javanese	○	○	○	○
3=Chinese	○	○	○	○
4=Hindu	○	○	○	○
5=Malaysian	○	○	○	○
6=Arab	○	○	○	○
7=English	○	○	○	○
90=Other	○	○	○	○

2.1.21 What is your occupational form? *If 1 or 4 go to 2.1.24 / if 2 or 3 go to 2.1.23.*

- ○ 1=No work
- ○ 2=Homemaker
- ○ 3=Student
- ○ 4=Retired
- ○ 5=Daily labourer
- ○ 6=Employed
- ○ 7=Self-employed
- ○ 90=Other, please specify

2.1.22 What is your sector of occupation?
- ○ 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 (restaurant, store, etc.)
- ○ 9=factory worker
- ○ 10=security services
- ○ 11=other services
- ○ 12=employed by/working for government
- ○ 13=head of village/politician
- ○ 90=other, please specify

2.1.23 Where is your location of employment/education?
- ○ 1=same village
- ○ 2=same district
- ○ 3=same city
- ○ 90=other place, please specify (city and province)

2.1.24 Are you the main earner? *If yes, go to question 2.1.28.*
- ○ 0=No
- ○ 1=Yes

2.1.25 *If respondent is **not** the main earner*: What is the occupational form of the main earner?
- ○ 5=Daily labourer
- ○ 6=Employed
- ○ 7=Self-employed
- ○ 90=Other please specify

2.1.26 *If respondent is not the main earner*: What is the 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 (restaurant, store, etc.)
- ○ 9=factory worker
- ○ 10=security services
- ○ 11=other services
- ○ 12=employed by/working for government
- ○ 13=head of village/politician
- ○ 90=other, please specify

2.1.27 *If the respondent is not the main earner:* Where is the location of employment/education of the main earner?
- ○ 1=same village
- ○ 2=same district
- ○ 3=same city
- ○ 90=other place, please specify (city and province)

2.1.28 How many household members contribute regularly to the household income?

2.1.29 Do members of your household hold the following positions:

	0=No	1=Yes
Head of RT/RW	○	○
Head of PKK	○	○
Leader of association/community (fisher/farmer/factory)	○	○
Project leader (e.g. mangrove or hazard management)	○	○
Other, please specify	○	○

2.1.30 How many members of your household have a health insurance?

2.2.1 What is your household's average monthly income? *(IDR per month)*

2.2.2 Does your household have financial savings?
- ○ 0=No
- ○ 1=Yes

2.2.3 *If yes:* I apologize for the possible inconvenience caused by the question - do you have more than IDR 11 000 000 in savings?
- ○ 0=No
- ○ 1=Yes

2.2.4 Do you have a bank account?
- ○ 0=No
- ○ 1=Yes

2.2.5 The ownership status of your house is...
- ○ 1=owned and completely paid for
- ○ 2=owned with a mortgage
- ○ 3=rented
- ○ 4=given in exchange for services
- ○ 5=squatter
- ○ 90=other, please specify

2.2.6 How many levels does your house have? *(including ground floor)*

2.2.7 How many rooms does your house have? *(all except kitchen and bathrooms)*

2.2.8 What is the primary source of drinking water for your household?
- ○ 1=from water state company (piped water system)
- ○ 2=communal well
- ○ 3=private well
- ○ 4=natural body of water (river/stream)
- ○ 5=water truck
- ○ 6=bottled water
- ○ 90=other, please specify

2.2.9 Where does your household dispose most of its garbage?
- ○ 1=river/ocean
- ○ 2=communal garbage bin
- ○ 3=it is burned
- ○ 4=land filling/bury
- ○ 5=collected by private/public garbage truck
- ○ 6=communal collective system
- ○ 90=other, please specify

3.1.1 Under which circumstances do you mostly meet with people from your village?
- ○ 1=randomly
- ○ 2=at work
- ○ 3=meetings (RT/RW, PKK, etc.)
- ○ 4=activities (Tahlilan, sports, etc.)
- ○ 5=family gatherings
- ○ 6=business meetings
- ○ 7=political events
- ○ 90=other, please specify

3.1.2 Besides formal meetings, where do you mostly meet people from your village spontaneously?
- ○ 1=on the streets of your village
- ○ 2=small warong in your village
- ○ 3=Koperasi in your village
- ○ 4=farmers/traditional market
- ○ 5=sport field
- ○ 6=aula
- ○ 7=mosque/church/house of prayer
- ○ 90=other, please specify

3.1.3 Do any household members attend these meetings?

	0=No	1=Yes
RT (meeting)	○	○
RW (meeting)	○	○
PKK (meeting)	○	○
Arisan meeting	○	○
Fisher community	○	○
Fish farmer community	○	○
Farmer community	○	○
Factory community	○	○
KNN (youth organization)	○	○
Political group	○	○
Sports group	○	○

3.1.4 Who attends the meeting: women, men, or both?

	Men	Women
RT (meeting)	☐	☐
RW (meeting)	☐	☐
PKK (meeting)	☐	☐
Arisan meeting	☐	☐
Fisher community	☐	☐
Fish farmer community	☐	☐
Farmer community	☐	☐
Factory community	☐	☐
KNN (youth organization)	☐	☐
Political group	☐	☐
Sports group	☐	☐

3.1.5 Are there meetings you would like to attend, but are not invited to?
- ○ 0=No
- ○ 1=Yes

3.1.6 *If yes*: Which one?
- ○ 1=RT (meeting)
- ○ 2=RW (meeting)
- ○ 3=PKK (meeting)
- ○ 4=Arisan meeting
- ○ 5=Fisher community
- ○ 6=Fish farmer community
- ○ 7=Farmer community
- ○ 8=Factory community
- ○ 9=KNN (youth organization)
- ○ 10=Political group
- ○ 11=Sports group

3.1.7 Which meetings are the most important to your household? *Please use the numbers from 3.1.6 (e.g. 3 for PKK)*

First meeting	
Second Meeting	
Third Meeting	

3.1.8 Do members of these meetings have the same political viewpoint?

	0=No	1=Yes
First meeting	○	○
Second meeting	○	○
Third meeting	○	○

3.1.9 Do the members mostly have the same occupation?

	0=No	1=Yes
First meeting	○	○
Second meeting	○	○
Third meeting	○	○

3.1.10 Are the members mostly from the same age group?

	0=No	1=Yes
First meeting	○	○
Second meeting	○	○
Third meeting	○	○

3.1.11 Do the members mostly have the same level of education?

	0=No	1=Yes
First meeting	○	○
Second meeting	○	○
Third meeting	○	○

3.1.12 How does the group usually make decisions?

	1=The leader decides and informs the other group members	2=The leader asks group members what they think and then decides	3=The group members hold a discussion and decide together	4=we vote	90=other, please specify
First meeting	○	○	○	○	○
Second meeting	○	○	○	○	○
Third meeting	○	○	○	○	○

Other

3.1.13 Have you or your household acquired new skills or learned something valuable on these meetings?

	0=No	1=Yes
First meeting	○	○
Second meeting	○	○
Third meeting	○	○

If yes, which new skill?

3.1.14 What are important topics at RT/RW and PKK meetings?

	0=No	1=Yes
Health issues	○	○
Cleaning the village	○	○
Legal issues	○	○
Flood protection	○	○
Elevation/Subsidence	○	○
Community members in need	○	○
Business opportunities	○	○
Other topics, please specify	○	○

3.1.15 What do you thing about the following statement?
People who never want to give money in meetings for other people should not receive communal funds.

○ 0=Disagree
○ 1=Agree

3.1.16 Does your household have access to the following communal funds?

	0=No	1=Yes
RW/RT meeting savings	○	○
PKK funds	○	○
Arisan	○	○
Sinoman	○	○
Other, please specify	○	○

3.1.17 Do any of your household member participate in these activities?

	0=No	1=Yes
Pengajian	○	○
Tahlilan	○	○
Communal night watch	○	○
Karong Taruna	○	○
Doing sports together	○	○
Gotong royong	○	○
Organized collective construction work	○	○
Cook for construction worker	○	○
Waste cleaning	○	○
Posyandu	○	○
Planting mangroves	○	○

3.1.18 Who participates: women, men, or both?

	men	women
Pengajian	☐	☐
Tahlilan	☐	☐
Communal night watch	☐	☐
Karong Taruna	☐	☐
Doing sports together	☐	☐
Gotong royong	☐	☐
Organized collective construction work	☐	☐
Cook for construction worker	☐	☐
Waste cleaning	☐	☐
Posyandu	☐	☐
Planting mangroves	☐	☐

3.1.20 If a problem affected the entire village, for instance crop disease or violence, who would deal with the situation?

	0=No	1=Yes
Each household/person would deal with it individually	○	○
Neighbours among themselves	○	○
Local government/municipal political leaders	○	○
Heads of RW/RT	○	○
The entire village	○	○
Other, please specify	○	○

3.1.21 What happens to people who do not attend and participate in meetings and community activities?

○ 1=Nothing
○ 2=Lose status/respect
○ 3=Do not get help when they are in need
○ 4=Are not considered as members of the community
○ 5=They are ignored

3.1.22 Do you agree or disagree with the following statement:
A woman who never visits sick neighbors should not be visited when she is sick.

○ 0=Disagree
○ 1=Agree

3.1.23 Differences often exist between people living in the same village/neighborhood. Do differences such as the following tend to divide people in your village?

	0=No	1=Yes
Differences in education levels	○	○
Differences in wealth/material possession	○	○
Differences in landholdings	○	○
Differences in social status	○	○
Differences between men and women	○	○
Differences between younger and older generations	○	○
Differences between long-time inhabitants and new settlers	○	○
Differences between political party affiliations	○	○
Differences in religious beliefs	○	○
Differences in ethnic background	○	○

Other, please specify:

3.1.24 If these differences cause problems, how are they usually handled?

	0=No	1=Yes
People work it out between themselves	○	○
Family/household members intervene	○	○
Neighbours intervene	○	○
Heads of RT/RW mediate	○	○
Religious leaders mediate	○	○
Judicial leaders mediate	○	○

3.1.25 In the last 5 years, have you been involved in the following things:

	0=No	1=Yes
Voted in the elections	○	○
Made a personal contact with an influential person	○	○
Made the media interested in a problem	○	○
Actively participated in an information campaign	○	○
Actively participated in an election campaign	○	○
Contacted your elected representative	○	○
Notified the court or police about a problem	○	○
Made a monetary or in-kind donation	○	○
Volunteered for a charitable organization	○	○

3.1.26 Overall, how would you rate the degree of participation in this village?

○ 1=Verly low
○ 2=Low
○ 3=High
○ 4=Very high

3.1.27 How much influence do people like yourself have to make this village a better place?

○ 1=No influence
○ 2=Not very much
○ 3=Some
○ 4=A lot

3.1.28 Suppose you suffered an economic loss. Who would assist you financially?

	0=No	1=Yes
No one would help	○	○
Family	○	○
Neighbours/Friends	○	○
Religious leader/group	○	○
Head of RT/RW	○	○
Patron/Employer/Benefactor	○	○
Political leader	○	○
Mutual support group to which you belong	○	○
Other, please specify	○	○

3.1.29 How is the level of trust in your village?

○ 1=low
○ 2=mediate
○ 3=high

Suppose your household had to go away for a while. In whose charge could you leave your house/your fields?

	0=No	1=Yes
No one	○	○
Other family member	○	○
Neighbour	○	○
Anyone from the RT/RW for this purpose	○	○
Other, please specify	○	○

3.1.31 If you suddenly had to go away for a day or two, who would take care of your children?

	0=No	1=Yes
No one	○	○
Other family member	○	○
Neighbour	○	○
Anyone from the RT/RW for this purpose	○	○
Other, please specify	○	○

3.1.32 Are you afraid that your motorcycle might get stolen in this village?

○ 0=No
○ 1=Yes
○ 77=I don't own one

3.1.33 If a community project does not directly benefit your neighbour but has benefits for others, do you think your neighbour would contribute time or money?

○ 1=Will not contribute
○ 2=Will contribute time
○ 3=Will contribute money
○ 4=Will contribute time and money

3.1.34 Do you agree or disagree with the following statements?

	0=Disagree	1=Agree
Most people in this RW are basically honest and can be trusted.	○	○
Members of this RW are more trustworthy than people in other places.	○	○
In this RW, one has to be careful that others do not take advantage of them.	○	○
Most people in this RW are willing to help if you need it.	○	○
This RW has become safer in the last five years.	○	○
I feel accepted as a member of this RW.	○	○
The environmental awareness of the people in this RW is high.	○	○

3.2.1 Where does the largest number of your relatives live?

○ 1=In the same village
○ 2=in the same city
○ 3=In another city/village, please specify

3.2.2 Please list the most important contact people of your household who live outside your city like relatives and acquaintances.
List the first name or nickname and their estimated age.
Also list them in the ID overview on page 2, you will need them later!

Contact I (name)	
Age of contact I	
Contact II (name)	
Age of contact II	
Contact III (name)	
Age of contact III	
Contact IV (name)	
Age of contact IV	
Contact V (name)	
Age of contact V	
Contact VI (name)	
Age of contact VI	

3.2.3 What is the gender of your contact person?

	1=male	2=female
Contact I	○	○
Contact II	○	○
Contact III	○	○
Contact IV	○	○
Contact V	○	○
Contact VI	○	○

3.2.4 What is the place of residence of your contacts? *(City and province in Indonesia or city and foreign country)*

Contact I	
Contact II	
Contact III	
Contact IV	
Contact V	
Contact VI	

3.2.5 What is the persons connection to your household?

	Contact I	Contact II	Contact III	Contact IV	Contact V	Contact VI
1=Relative	○	○	○	○	○	○
2=In-Law	○	○	○	○	○	○
3= Friend	○	○	○	○	○	○
4=Business	○	○	○	○	○	○
5=Religious community	○	○	○	○	○	○
6=Co-worker/fellow student	○	○	○	○	○	○
7=NGO/volunteer	○	○	○	○	○	○
8=Political party	○	○	○	○	○	○
9=Patronage	○	○	○	○	○	○
90=Other, please specify	○	○	○	○	○	○

3.2.6 How would you discribe your relationship?

	1=loose	2=friendly	3=very tight
Contact I	○	○	○
Contact II	○	○	○
Contact III	○	○	○
Contact IV	○	○	○
Contact V	○	○	○
Contact VI	○	○	○

3.2.7 What is his/her level of eduction?

	1=Lower than mine	2=Same as mine	3=Higher than mine
Contact I	○	○	○
Contact II	○	○	○
Contact III	○	○	○
Contact IV	○	○	○
Contact V	○	○	○
Contact VI	○	○	○

3.2.8 What is his/her social status?

	1=Lower than mine	2=Same as mine	3=Higher than mine
Contact I	○	○	○
Contact II	○	○	○
Contact III	○	○	○
Contact IV	○	○	○
Contact V	○	○	○
Contact VI	○	○	○

3.3.1 Do you own a…

	0=No	1=Yes
Basic mobile phone	○	○
Smartphone/Blackberry	○	○
Landline telephone	○	○
Tablet computer	○	○
Personal computer (PC)	○	○

3.3.2 Do you have…

	0=No	1=Yes
Acess to the Internet	○	○
Skype	○	○
Facebook	○	○
Whatsapp/BBM	○	○

3.3.3 How many days per month do you usually have deposit to use your mobile phone for communication? *(days per month)*

3.3.4 Per year, how often do you averagely go to family gatherings outside your village? *(times per year)*

3.3.5.How do you mainly communicate with the floowing people?

	1=face to face	2=phone calls	3=SMS	4=WhatsApp/ BBM	5=Facebook	6=E-Mail	7=Video chat e.g. Skype
Relatives in your village	○	○	○	○	○	○	○
Neighbours/ friends in your village	○	○	○	○	○	○	○
Head of RT/RW	○	○	○	○	○	○	○
Contact I	○	○	○	○	○	○	○
Contact II	○	○	○	○	○	○	○
Contact III	○	○	○	○	○	○	○
Contact IV	○	○	○	○	○	○	○
Contact V	○	○	○	○	○	○	○
Contact VI	○	○	○	○	○	○	○

3.3.6 How often are you in contact with the following people?

	1= every day	2= every week	3= several times a month	4= monthly	5=a few times per year	6= once a year	7= less than once a year
Relatives in your village	○	○	○	○	○	○	○
Neighbours/ friends in your village	○	○	○	○	○	○	○
Head of RT/RW	○	○	○	○	○	○	○
Contact I	○	○	○	○	○	○	○
Contact II	○	○	○	○	○	○	○
Contact III	○	○	○	○	○	○	○
Contact IV	○	○	○	○	○	○	○
Contact V	○	○	○	○	○	○	○
Contact VI	○	○	○	○	○	○	○

3.3.7 For what reason or occasion do you meet with people from outside your village?

	1= Business meeting	2= Family gathering	3= Friendly visit	4= Religious meeting	5= Political meeting	90= Other, please specify
Contact I	○	○	○	○	○	○
Contact II	○	○	○	○	○	○
Contact III	○	○	○	○	○	○
Contact IV	○	○	○	○	○	○
Contact V	○	○	○	○	○	○
Contact VI	○	○	○	○	○	○

3.3.8 Do you receive money from people from outside your village?

○ 0=No
○ 1=Only in times of crisis as remittances
○ 2=Only in times of crisis as loan
○ 3=Occasionally remittances
○ 4=Regularly as remittances
○ 5=As loans

If yes: From whom? (Contact IDs)

3.3.9 Do you send money to people from outside your village?

○ 0=No
○ 1=Only in times of crisis as remittances
○ 2=Only in times of crisis as loans
○ 3=Occasionally as remittances
○ 4=Regularly as remittances
○ 5=As loans

If yes: To whom? (Contact IDs)

3.3.10 Do you send or receive food from people from outside your village?

○ 0=No
○ 1=Provide in times of crisis
○ 2=Regularly provide
○ 3=Get in times of crisis
○ 4=Regularly get
○ 5=Provide and get equally

If yes: With whom? (Contact IDs)

4.1.1 Which events affected your household negatively in the last 5 years *(Natural hazards, family matters, job related events…)*?

Answer 1
Answer 2
Answer 3
Answer 4

4.1.2 Is your house subsiding? *If no, go to question 4.1.8.*

○ 0=No
○ 1=Yes

4.1.3 Do you elevate your house? *If no, go to question 4.1.6.*
- ○ 0=No
- ○ 1=Yes

4.1.4 *If yes:* How often do you have to elevate your house? Every... years:

4.1.5 *If yes:* How much did you elevate it the last time?
- ○ 1=less than 50cm
- ○ 2=between 50cm and 1m
- ○ 3=more than 1m

4.1.6 *If no:* Why not?
- ○ 1=Too expensive
- ○ 2=It's ineffective (the rates are too high)
- ○ 3=We're planning to relocate

4.1.7 What are the consequences of subsidence of your house?

	0=No	1=Yes
Floods enter house more easily	○	○
Cannot fit properties inside of the house	○	○
Financial problems due to elevation need	○	○
The house collapsed	○	○

4.1.8 In the last 5 years, how often did the different floods inundate the road in front of your house?

	1=nearly constantly through high tides	2=nearly constantly through Monsoon season	3= monthly	4=a couple time a year	5=once a year	6= every 2-3 years	7=not anymore	8= never
Tidal floods	○	○	○	○	○	○	○	○
River floods	○	○	○	○	○	○	○	○
Rain floods	○	○	○	○	○	○	○	○

4.1.9 When does your house get flooded?
- ○ 1=every time the road in front in flooded
- ○ 2=if the road in front is flooded more than ankle deep
- ○ 3=if the road in front is flooded hip high deep
- ○ 4=only in case of extrem high flood
- ○ 5=never

4.1.10 How many hours do floods generally last? *(hours)*

4.1.11 In the last 5 years, how high did the water averagely 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 a chest high

4.1.12 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 a chest high

4.1.13 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 a chest high

4.1.14 At which water level do floods become a problem?
- ○ 2=Ankle high
- ○ 3=Knee high
- ○ 4=Hip high
- ○ 5=Chest high
- ○ 6=Higher than chest high
- ○ 7=Never

4.1.15 How often did flood become a problem in the last 5 years?
- ○ 1=Never
- ○ 2=Once
- ○ 3=every few years
- ○ 4=yearly
- ○ 5=every few months
- ○ 6=monthly
- ○ 7=constantly

4.1.16 Have you ever not been able to cook in your house during floods?
- ○ 1=Never
- ○ 2=Once
- ○ 3=every few years
- ○ 4=yearly
- ○ 5=every few months
- ○ 6=monthly
- ○ 7=weekly
- ○ 8=constantly

4.1.17 Have floods ever led to blackouts in your house?
- ○ 1=Never
- ○ 2=Yes, once
- ○ 3=Yes, every few years
- ○ 4=Yes, yearly
- ○ 5=Yes, every few months
- ○ 6=Yes, monthly
- ○ 7=Yes, weekly
- ○ 8=Yes, constantly

4.1.18 Have important facilities like schools and medical centres been closed due to floods or subsidence?
- ○ 1=Never
- ○ 2=Once
- ○ 3=every few years
- ○ 4=yearly
- ○ 5=every few months
- ○ 6=monthly
- ○ 7=weekly
- ○ 8=constantly

4.1.19 Did you ever have to evacuate because of floods?
- ○ 1=Never
- ○ 2=Once
- ○ 3=every few years
- ○ 4=yearly
- ○ 5=every few months
- ○ 6=monthly
- ○ 7=weekly
- ○ 8=constantly

4.1.20 *If yes:* When was the last time? *(year)*

4.1.21 Did floods and subsidence affect the income/job situation of the household?
- ○ 0=No
- ○ 1=Yes

4.1.22 If yes: What affected the job situation?

	0=No	1=Yes, minor impact	2=Yes, endangering livelihood
Fish ponds/rice fields were flooded	○	○	○
Fish ponds/rice fields poisoned because of waste	○	○	○
Factories were flooded	○	○	○
Factories under too much subsidence	○	○	○
Could not reach working place because of flooded roads	○	○	○
Could not open my store/business/restaurant because of floods	○	○	○
Had to stay at home to clean or do construction work on your house	○	○	○
Employer relocated factory	○	○	○
Became unemployed	○	○	○
Illness	○	○	○

4.1.23 Does your household own any rice fields/fishponds?
- ○ 0=No
- ○ 1=Yes

4.1.24 Who owns most of the rice fields and fish ponds in this area
- ○ 1=privately owned by the farmers
- ○ 2=government
- ○ 3=developer
- ○ 4=private companies

4.1.25 How much money do you save per month to afford private flood protection and elevation of your house? *(IDR per month)*

4.1.26 Has it become more difficult for you to pay for flood protection and elevation during the last 5 years?
- ○ 0=No
- ○ 1=Yes, a little bit
- ○ 2=Yes, very much

4.1.27 Did any of these assets get lost or were damaged due to floods, abrasion or waste pollution?

	0=No	1=Yes
Clothes	○	○
Food	○	○
Furniture	○	○
Papers/documents	○	○
Electronic devices (TV etc.)	○	○
Motor bike	○	○
Farm land/Fish ponds	○	○
Fish/Crop harvest	○	○

4.1.28 Did you replace it?

	0=No	1=Part of it	2=By something similar	3=Yes	4=By something better/more valuable
Clothes	○	○	○	○	○
Food	○	○	○	○	○
Furniture	○	○	○	○	○
Papers/documents	○	○	○	○	○
Electronic devices (TV etc.)	○	○	○	○	○
Motir bike	○	○	○	○	○
Farm land/Fish ponds	○	○	○	○	○
Fish/Crop harvest	○	○	○	○	○

4.1.29 Have any household member been affected by the following diseases (last year)?

	0=No	1=Yes
Gastro-Intestinal disease (e.g. diarrhoea)	○	○
Febrile Illness (e.g. from mosquito bite)	○	○
Lung disease	○	○
Skin infections/Allergies (e.g. itchy skin)	○	○
Food intoxication	○	○

4.1.30 Have people, that suffer from these diseases, usually still been able to work/attend school?
○ 0=No
○ 1=Yes

4.1.31 Do you think that these diseases are caused by floods?
○ 0=No
○ 1=Yes

We obviously don't want anything bad happened in the future. But if we can "forecast" what may happen in the future from what you've learned and experienced so far, I (interviewer) would be very happy to know what you think about future floods and subsidence.

4.2.1 What do you think, how often will river floods happen in the future?
○ 1=less often
○ 2=same frequency
○ 3=more often

4.2.2 What do you think, how strong will river floods be in the future?
○ 1=less flood water
○ 2=same amount of water
○ 3=more flood water

4.2.3 What do you think, how much will it be raining in the future?
- ○ 1=less rain
- ○ 2=same
- ○ 3=more rain

4.2.4 What do you think, how strong will tides be in the future?
- ○ 1=lower tides
- ○ 2=same height of tides
- ○ 3=higher tides

4.2.5 What do you think high subsidence rates will be in the future?
- ○ 1=lower rates
- ○ 2=same rates
- ○ 3=higher rates

4.2.6 Have you heard of the term "sea level rise"? *If no, proceed with Question 4.2.9.*
- ○ 0=No
- ○ 1=Yes

4.2.7 If yes, where did you hear it?

	0=No	1=Yes
Media (Radio, Internet etc.)	○	○
Relatives from the same village	○	○
Friends from the same village	○	○
Other people from the same village	○	○
Head of RT/RW	○	○
People from another residence place	○	○
NGOs	○	○
University researcher	○	○
Politicians	○	○
Government Agencies	○	○
If people from other place of residence, name Contact ID	○	○

4.2.8 What do you think about sea level rise?

	1=Agree	0=Disagree
It won't affect us.	○	○
It's a big threat for my family.	○	○
We are prepared for it.	○	○
The government has to protect us.	○	○
We have to help ourselves.	○	○
As a community we are able to deal with it.	○	○

4.2.9 Have you heard of the term "climate change"?
- ○ 0=No
- ○ 1=Yes

4.2.10 Is the environmental awareness in your village increasing?
- ○ 0=No
- ○ 1=Yes

4.2.11 If yes: Who is helping to increase the awareness?

	0=No	1=Yes
People in the village in general	○	○
(Head of) RT/RW or PKK meeting	○	○
People who moved to the village	○	○
Acquaintances from other places	○	○
Government Agencies	○	○
NGOs	○	○
Universities/Researchers/Student groups	○	○
Politicians	○	○
Companies/CSR	○	○
Media	○	○

5.1.1 Which statement does apply to your household in the last 5 years?

	0=No	1=Yes
At least one member migrated to another place to look for a job	○	○
At least one member migrated to be able to send remittances	○	○
At least one member migrated to another place to study	○	○
At least one member migrated to another place to marry	○	○
Household moved here from another city or region	○	○

5.1.2 What are the reasons that you household has not migrated to another village/city to be safe from floods and subsidence?

	0=No	1=Yes
Cannot afford it	○	○
Don't want to lose social community	○	○
Need to be close to working place	○	○
Other, please specify	○	○

5.1.3 Is your household planning to relocate in the next 5 years because of floods and subsidence?

○ 0=No

○ 1=Yes

If yes, where would you go? (City and Kelurahan)

5.2.1 What of the following things does your household do during strong (hip-high) floods?

	0=No	1=Yes
Eat/cook at an emergency kitchen	○	○
Receive rice as food aid	○	○
Take shelter at the house of friends/family members	○	○
Provide shelter for friends/family members	○	○

5.2.2 What do you buy or do to be prepared for strong floods?

	0=No	1=Yes
Store food, drinking water	○	○
Stock medicine	○	○
Preventive medical treatment (vaccination)	○	○
Store fuel for pumping system	○	○
Invest in social contacts (networks, associations, reciprocal gifts, etc.) so you give and receive help	○	○
Store sandbags	○	○
Store construction materials like bricks, stones, cement	○	○

5.2.3 What do you do to maintain and protect your house and belongings?

	0=No	1=Yes
Clean house after floods	○	○
Repair house	○	○
Rebuild house on piers, pillars or columns	○	○
Sleep on bed instead of floor	○	○
Store things in higher places	○	○
Build elevated shelves etc. to store things	○	○
Build higher house thresholds	○	○
Cover house floor with ceramic tiles	○	○
Built drainage channels or foundation vents	○	○
Built small concrete wall around the house	○	○
Use black fishing nets instead of embankments	○	○
Install a private pumping system	○	○

5.2.4 For which communal measures for your RT/RW did member of your household spend time or money in the last 5 years?

	0=No	1=Yes
Build permanent embankments	○	○
Improve permanent embankments	○	○
Build pumping system for the village	○	○
Improve/repair pumping system	○	○
Build retention basins	○	○
Install collective savings system for emergency situations	○	○
Send a petition to the local government for funding and support	○	○
Elevate the road	○	○
Elevate important facilities e g. schools	○	○
Plant mangroves	○	○
Hold special meetings for dealing with floods and subsidence	○	○
Other, please specify	○	○

5.2.5 How long do they usually last?

	1=Just for one event	2=Under one year	3=1 year	4=up to 5 years	5=5 to 15 years	6=More than 15 years
Permanent embankments	○	○	○	○	○	○
Pumping system for the village	○	○	○	○	○	○
Retention basins	○	○	○	○	○	○
Collective savings system for emergency situations	○	○	○	○	○	○
Elevation of the road	○	○	○	○	○	○
Elevation of important facilities e g. schools	○	○	○	○	○	○
Plantation of mangroves	○	○	○	○	○	○

5.2.6 In the last 5 years, did you do anything new against floods and subsidence? *(new method, material, etc.. If no, go to question 5.2.10)*

○ 0=No
○ 1=Yes

5.2.7 *If yes,* please specify:

New measure 1 ☐

New measure 2 ☐

New measure 3 ☐

5.2.8 *If there are new measures,* are they more efficient / do they last longer than older measures?

	0=No	1=Yes
New measure 1	○	○
New measure 2	○	○
New measure 3	○	○

5.2.9 *If there are new measures,* where did you get the idea from?

	New measure 1	New measure 2	New measure 3
1=Own idea	○	○	○
2=Relatives/friends of your village	○	○	○
3=Other people of your village	○	○	○
4=RT/RW or PKK meeting	○	○	○
5=People who moved to the village	○	○	○
6=Acquaintances from other places (please name Contact ID)	○	○	○
7=Employer	○	○	○
8=Landlord	○	○	○
9=Government agencies	○	○	○
10=NGO/volunteers	○	○	○
11=Universities/Researchers/Student groups	○	○	○
12=Patronage/Politician	○	○	○
13=Companies, CSR	○	○	○
14=Media	○	○	○

Contact IDs:

5.2.10 How long in advance do you usually know that a flood will come?

- ○ 1=I don't know in advance
- ○ 2=only minutes before
- ○ 3=1 hour before
- ○ 4=1 to 5 hours before
- ○ 5=more than 5 hours before

5.2.11 If yes, how do you know that floods will come?

	0=No	1=Yes
Using tide-tables	○	○
Weather forecasts in the media	○	○
Rapid alert system/Early warning system	○	○
Through the head of RT/RW	○	○
Through people from my village	○	○
Other, please specify	○	○

5.2.12 If you had to decide on just one thing you could change in your RT/RW, what would it be?

- ○ 1=More awareness about the environment (e.g. waste)
- ○ 2=More social closeness and solidarity in this RT/RW
- ○ 3=Better flood protection (e.g. pumping systems and permanent embankments)
- ○ 4=No more waste in this village, the rice fields and fish ponds
- ○ 5=Construction techniques that would protect the house from subsidence
- ○ 6=Better job opportunities
- ○ 7=Better facilities (e.g. medical facilities, schools, etc.)
- ○ 8=No more land reclamation and coastal development
- ○ 9=Getting a legal land ownership certificate

5.3.1 Who would you ask for advice in personal matters/personal crisis e.g. illness, comforting advice?

	0=No	1=Yes
People of your village	○	○
Head of RW/RT	○	○
RT/RW or PKK meeting	○	○
Acquaintances from other villages (please name Contact ID below)	○	○
Employer/Landlord	○	○
Patron	○	○

Contact IDs

5.3.2 Who would you ask for advice on work and business opportunities/financial matters?

	0=No	1=Yes
People of your village	○	○
Head of RW/RT	○	○
RT/RW or PKK meeting	○	○
Acquaintances from other villages (please name Contact ID below)	○	○
Employer/Landlord	○	○
Patron	○	○
Universities/Researchers/Students	○	○
NGOs	○	○
Government organization	○	○

Contact IDs

5.3.3 Who would you ask for advice on flood and subsidence/protection and elevation?

	0=No	1=Yes
People of your village	○	○
Head of RW/RT	○	○
RT/RW or PKK meeting	○	○
Acquaintances from other villages (please name Contact ID below)	○	○
Employer/Landlord	○	○
Patron	○	○
Universities/Researchers/Students	○	○
NGOs	○	○
Government agencies	○	○

Contact IDs

5.3.4 Do members of your household do any of the following activities?

	0=No	1=Yes
Repairing the house of someone else	○	○
Elevating the house of someone else	○	○
Working in emergency kitchen	○	○
Supply others with food, drinking water, etc.	○	○

5.3.5 Whom do you help in times of crisis?

	0=No	1=Yes
Relatives/friends in the same village	○	○
New people who moved to the village	○	○
Other people in the same village	○	○
Relatives/friends who live at other places, please name Contact ID	○	○
Other people who live at other places, please name Contact ID	○	○

Contact IDs

Thank you very much for your answers and your time. We are now finished with the questionnaire. Do you have any questions you would like to ask me? Or is there anything else you would like to tell me about? I wish you a pleasant day.

Not applicable: -77 No answer/refused: -88 Answer: I don't know: -99

List of key informant and expert interviews

Type of organization	Institution	Location	Date
Scientific institute	Universitas Diponegoro – Department of Geological Engineering	Semarang	28/07/2016
Scientific institute	Universitas Diponegoro – Department of Oceanography	Semarang	03/08/2016
RW administration	RW leader	Semarang	09/09/2016
Mangrove farmers	Mangrove community	Semarang	16/09/2016
Scientific institute	Universitas Diponegoro – Department of Urban and Regional Planning	Semarang	14/03/2017
Scientific institute	Universitas Diponegoro – Department of Oceanography	Semarang	15/03/2017
Governmental authority	BPBD DKI Jakarta	Jakarta	04/04/2017
Governmental authority	BBWSC Ciliwung Cisdane	Jakarta	06/04/2017
Governmental authority	Public Works DKI Jakarta	Jakarta	08/04/2017
Governmental authority	Bappeda Kota Semarang	Semarang	13/04/2017
Governmental authority	Bappeda Kota Semarang	Semarang	13/04/2017

Appendix B: Own contribution

Article 1 (Chapter 4) was co-authored by Boris Braun (University of Cologne). Article 2 (Chapter 5) was co-authored by Leda Ankel (University of Cologne) and Boris Braun. Article 3 (Chapter 6) was co-authored by Bill Pritchard (The Sydney University) and Boris Braun.

All three articles are research papers based on empirical data that has been collected during three field research trips to Indonesia between July 2016 and March 2018. 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 1678/14-1).

My contributions to the three papers are the following:

- Review of relevant literature
- Development of the theoretical frameworks
- Development of research questions and hypotheses
- Assistance in writing the corresponding research proposal for the DFG
- Organization of field research phases and coordination with local partner institutions (UGM, UI, UNDIP)
- Selection and on-site inspection of the case study areas in collaboration with local research institutions
- Selection of research methods
- Development of all qualitative and quantitative questionnaires
- Conduction of all FGDs and key-informant and expert interviews
- Training and supervision of research assistants during kick-off workshops and during conducting the quantitative household survey
- Guidance of Leda Ankel during the development and field research for her Master´s thesis, especially selection of relevant literature, development of the research idea and hypothesis, selection of study areas and methods

- Cleaning and crosschecking of qualitative and quantitative research data
- Independent content analysis of qualitative results, using MAXQDA
- Independent statistical analysis of qualitative results, using STATA
- Independent writing of all manuscripts
- Revision of all manuscripts under the supervision of Boris Braun (all articles) and Bill Pritchard (third article)

Appendix C: Eigenständigkeitserklärung

Ich versichere, dass ich die von mir vorgelegte Dissertation mit dem Titel:

„Living with sea level change and coastal flooding –
Collective responses of households and communities in Indonesia"

selbständig angefertigt, die benutzten Quellen und Hilfsmittel vollständig angegeben und die Stellen der Arbeit − einschließlich Tabellen, Karten und Abbildungen −, die anderen Werken im Wortlaut oder dem Sinn nach entnommen sind, in jedem Einzelfall als Entlehnung kenntlich gemacht habe; dass diese Dissertation noch keiner anderen Fakultät oder Universität zur Prüfung vorgelegen hat; dass sie − abgesehen von unten angegebenen Teilpublikationen − noch nicht veröffentlicht worden ist, sowie, dass ich eine solche Veröffentlichung vor Abschluss des Promotionsverfahrens nicht vornehmen werde. Die Bestimmungen der Promotionsordnung sind mir bekannt. Die von mir vorgelegte Dissertation ist von Prof. Dr. Boris Braun betreut worden.

Teilpublikationen:

- Bott, L.M., Braun, B. (2019). How do households respond to coastal hazards? A framework for accommodating strategies using the example of Semarang Bay, Indonesia. International Journal of Disaster Risk Reduction, 37. 101177. DOI: 10.1016/j.ijdrr.2019.101177.
- Bott, L.M., Ankel, L., Braun, B. (2019). Adaptive neighborhoods: The interrelation of urban form, social capital, and responses to coastal hazards in Jakarta. Geoforum, 106, 202-213. DOI: 10.1016/j.geoforum.2019.08.016.
- Bott, L.M., Pritchard, B., Braun, B. (under review). Translocal social capital as a resource for community-based responses to coastal flooding – Evidence from urban and rural areas on Java, Indonesia.

_____ _____

Datum, Ort Lisa-Michéle Bott

Responding to flooding and sea level change is a daily challenge for coastal populations worldwide. Filling knowledge gaps on how households and communities respond to these hazards is crucial to recognize the adaptation needs and capacities of exposed communities. This thesis presents the results of original, mixed-methods research (focus group discussions and a standardized household survey) collected in Jakarta and the Semarang Bay area on Java, Indonesia. This study analyses the main question: How do households and communities respond to coastal hazards and what are their resources to self-organize and to act collectively? The adaptive capacity of communities, especially in the Global South, is critically related to social capital, as manifested through social networks, self-organization, and collective action. This thesis applies social capital first from a spatial perspective, focusing on local socio-spatial structures, and second, from a translocal perspective, analyzing boundary-crossing social networks.

The results add an important dimension to the contemporary theorization of responding to coastal hazards. Accommodating strategies, such as informal non-bank saving systems, are crucial for people to maintain their livelihoods on a more substantial basis than recognized in much of the literature. Furthermore, the findings demonstrate that social capital is significantly shaped by the specific spatial forms of neighborhoods, particularly in the presence and form of places to meet. However, there is insufficient evidence to suggest that the current urban form of North Jakarta supports the formation of adaptive neighborhoods in the long-term, which would require social ties to the outside world. In this regard, the results on translocal social capital show that households with a higher number of translocal contacts are more likely to act proactively against coastal hazards.

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